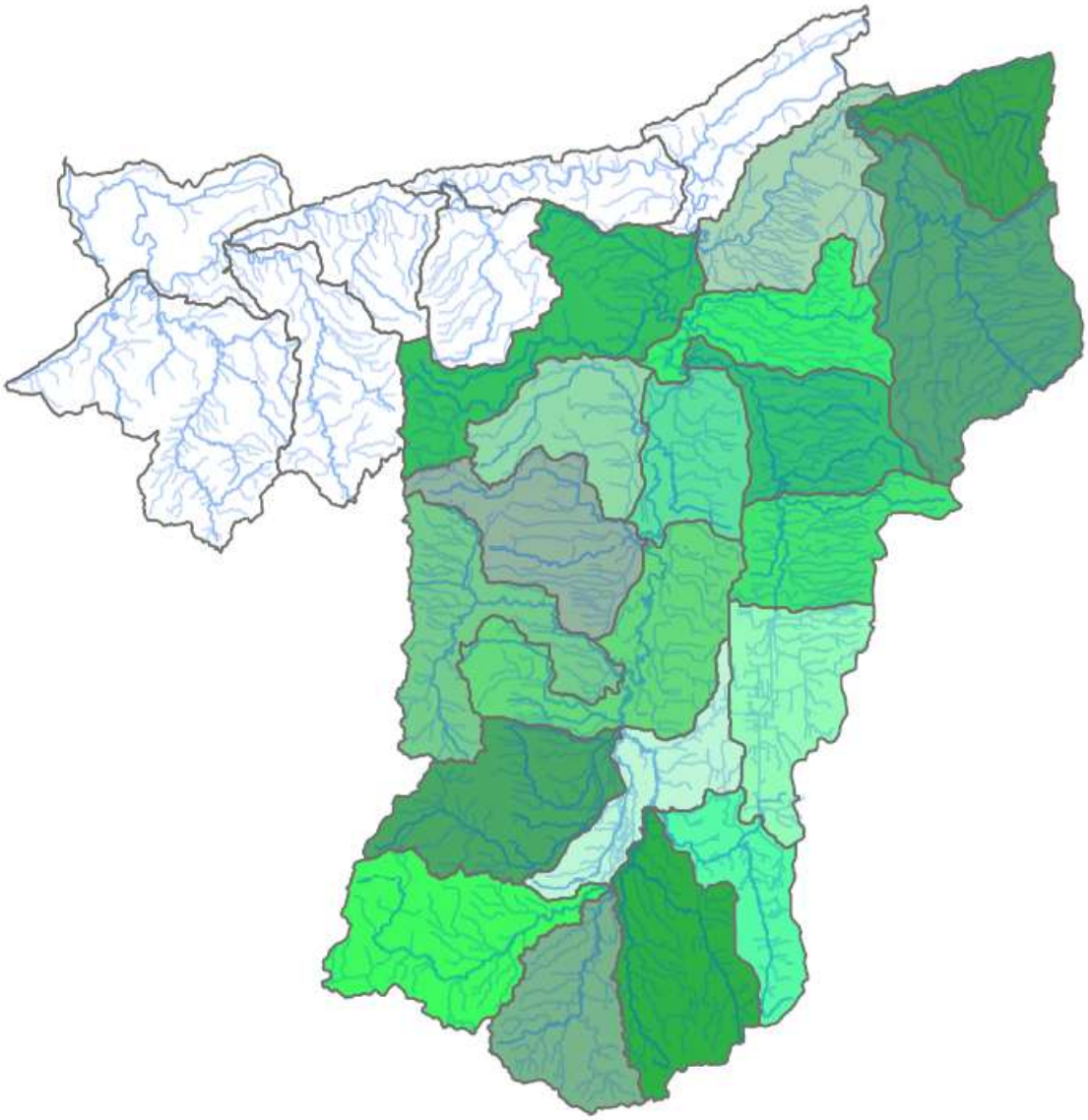
Upper Grand River Watershed Action Plan



Western Reserve Land Conservancy
3850 Chagrin River Road, Moreland Hills, Ohio 44022
(440) 528-4150 (Phone)
www.wrlandconservancy.org
Contact: George Warnock
gwarnock@wrlandconservancy.org

Final version - December 13, 2012

Village of Jefferson
Judy Maloney, Mayor

_____

Village of Middlefield
William Poole, Jr., Mayor

_____

Village of Orwell
Lawrence E. Bottoms, Mayor

_____

Village of Roaming Shores
John L. Ball, Mayor

_____

Village of Rock Creek
Robert Schultz, Mayor

_____

Village of West Farmington
Allen Patchin, Mayor

_____

Austinburg Township
Gerald Burke, Council Chairperson

_____

Bazetta Township
Paul Hovis, Council Chairperson

_____

Bloomfield Township
Roger Peterson, Jr., Council Chairperson

_____

Bristol Township
Andrew Holko, III, Council Chairperson

_____

Champion Township
Jefferey S Hovanic, Council Chairperson

_____

Cherry Valley Township
John T Polchin, Council Chairperson

_____

Colebrook Township
Edward A Benton, Council Chairperson

_____

Denmark Township
Charles J Frye, Council Chairperson

_____

Dorset Township
Herbert J Dean, Council Chairperson

_____

Farmington Township
Wesley Largin, Council Chairperson

_____

Greene Township
Roy B Gregory, Council Chairperson

_____

Harpersfield Township
James Pristov, Trustee

_____

Hartsgrove Township
Bruce G Gottron, Council Chairperson

_____

Hiram Township
Kathy Schulda, Council Chairperson

_____

Huntsburg Township
Jerry M Rose, Jr., Council Chairperson

_____

Jefferson Township
Charlene A Kusar, Council Chairperson

_____

Lenox Township
John A Maylish III, Trustee

_____

Mecca Township
William Harrison, Council Chairperson

_____

Mesopotamia Township
Lester Vargo, Council Chairperson

_____

Middlefield Township
Robert J Troyer, Council Chairperson

_____

Montville Township
Alexa Holbert, Trustee

_____

Morgan Township
Bret Bellas, Trustee

_____

Nelson Township
Roger K Dott, Trustee

_____

New Lyme Township
Brian Edelman, Trustee

_____

Orwell Township
Mark C Hart, Trustee

_____

Parkman Township
Kevin O'Reilly, Council Chairperson

_____

Plymouth Township
Debbie Friendstrom, Trustee

_____

Richmond Township
Allen Slater, Council Chairperson

_____

Rome Township
Gary Hunter, Council Chairperson

_____

Sheffield Township
Alan Kohta, Trustee

_____

Southington Township
Michael C Biery, Trustee

_____

Thompson Township
Erwin Leffel, Council Chairperson

_____

Troy Township
Gerald Mitchell, Council Chairperson

_____

Trumbull Township
Ron Tamburrino, Council Chairperson

_____

Windsor Township
James Plizga, Council Chairperson

_____

Ashtabula County Health District

_____

Ashtabula County Metroparks

_____

Ashtabula Soil & Water Conservation District

_____

Ashtabula Soil & Water Conservation District

_____

Cleveland Museum of Natural History

_____

Ducks Unlimited

_____

The Farmland Center

_____

Geauga Park District

_____

Geauga County Planning Commission

_____

Geauga Soil & Water Conservation District

_____

Hiram College

_____

Kent State University

_____

Lake County Planning Commission

_____

Lake County Health District

_____

Lake Soil & Water Conservation District

_____

Lake County Stormwater Management Dept.

_____

Lake Metroparks

_____

The Land Trust Alliance

_____

The Nature Conservancy

_____

Ohio EPA

_____

ODNR- Division of Forestry

_____

ODNR- Watercraft - Scenic Rivers Program

_____

ODNR- Soil and Water Resources

_____

ODNR- Wildlife

_____

OSU Extension/Sea Grant

_____

Ohio Wetlands Foundation

_____

Portage Park District

_____

Trumbull County Health Department

_____

Trumbull Soil & Water Conservation District

_____

Trust for Public Land

_____

U.S. Army Corps of Engineers

_____

U.S.F.W.S.– Partners of Fish & Wildlife

_____

USDA Farm Service Agency

_____

USDA Natural Resources Conservation Service

_____

Western Reserve Resource Conservation & Development

_____

Western Reserve Land Conservancy

_____

This Page Intentionally left blank

Table of Contents

Table of Contents ix
I. INTRODUCTION, Defining the Upper Grand River Watershed 1
A. Defining the Watershed 6
- Counties 6
- Incorporated Areas 7
- Unincorporated Areas 8
- Special districts (park, school, conservancy, sewer, soil and water, agriculture, regional planning orgs.) 10
- Special designations (National and state wild & scenic rivers) 12
- Phase 2 stormwater communities 12

B. Demographics (Population, ages, education and income levels, locations of growth and economic patterns.) 14
- Population, ages education levels 14
- Income levels 28
- Economic patterns (Source: Driving the Recovery Home – What Matters Most to Northeast Ohio's Economy) 32

C. Geographic locators 40
- USGS HUC 40
- State 305(b) identification numbers 49
- Other (e.g., GIS, long-lat, etc.) 50

D. General Watershed Information 51
- Background/historic information on previous and/or current watershed protection and management activities, including previous planning documents 51

II. WATERSHED PLAN DEVELOPMENT 54
Watershed partners 56
- Watershed residents, landowners 56
- Local businesses/industries, regulated community 56
- Local and state governments 56
- Non governmental organizations 57
- Community organizations 57
- Educational institutions or educators 57

E. Mission Statement 58
- Mission statement of Grand River Partnership 58
- Problems in mission statement 58

Discover level of participation by partnership members in planning and implementation of WAP. 58
F. Structure, organization, administration 58
- Legal status 58
- Partner roles and responsibilities 58
- Operational procedures and bylaws 58

- Group decision-making process 58
- Basic contact information 58

G. General Plan Content 58

- Outline of the plan's content 58
- Endorsement of plan by key watershed partners 58
- Adoption of the plan by local units of government. 58
- Information/education component for public understanding of the project 59

III. WATERSHED INVENTORY 62

A. Description of the watershed 64

- Geology 64
- Biological Features 88
- Water resources 94
- Land Use including land cover description (with percentages by subwatershed) 124

B. Cultural Resources 141

- Sites of historical, cultural or recreational significance 141

C. Previous and Complementary Efforts 142

- History of previous water quality efforts in the watershed 142
- A listing of current efforts that will help to meet water quality standards that are occurring in the watershed. 142

D. Physical attributes of streams and floodplain areas that support habitat, recreation, water quality, etc. 143

- Early settlement conditions 143
- Channel and floodplain condition. 147
- Forested riparian corridor assessment 147
- Number of miles with forested natural riparian buffer 147
- Number of miles with permanent protection 147
- Miles of natural channel 148
- Miles & location of modified channel 148
- Dams 148
- Channelization 148
- Streams with unrestricted livestock access 148
- Eroding banks (number and severity of sediment produced) 148
- Floodplain connectivity 148
- Riparian levees 148
- Entrenched miles 148
- Status and Trends 148

E. Water Resource Quality (to meet the requirements of the Clean Water Act, lakes, streams and wetland must be included in this assessment) 149

- Locationally-referenced use designations/use attainment 149
- Causes and sources of impairment or threats as presented in the 305(b) 303 (d) integrated water quality report 151

- Status and trends (areas where water quality is in attainment, but local information indicates that the current situation, if unchanged, will likely result in water quality degradation.) 184

IV. Watershed Impairments, Restoration And Protection Goals, and Implementation/Action Plan 186

A. Dead Branch Subwatershed 188

- 12-digit HUC 041100040101 – Dead Branch Subwatershed Problem Statements, Goals, objectives and Action 195

B. Headwaters Subwatershed 198

- 12-digit HUC 041100040102 Headwaters Subwatershed Problem Statements, Goals, objectives and Action 205

C. Baughman Creek Subwatershed 210

- 12-digit HUC 041100040103 – Baughman Creek Subwatershed Problem Statements, Goals, objectives and Action 218

D. Center Creek Subwatershed 222

- 12-digit HUC 041100040104 – Center Creek Problem Statements, Goals, objectives and Action 228

E. Coffee Creek Subwatershed 234

- 12-digit HUC 041100040105 – Coffee Creek Subwatershed Problem Statements, Goals, objectives and Action 240

F. Swine Creek Subwatershed 244

- 12-digit HUC 041100040105 – Swine Creek Subwatershed Problem Statements, Goals, objectives and Action 251

G. Upper Rock Creek Subwatershed 256

- 12-digit HUC 041100040201 – Upper Rock Creek Subwatershed Problem Statements, Goals, objectives and Action 262

H. Middle Rock Creek Subwatershed 266

- 12-digit HUC 041100040202 – Middle Rock Creek Subwatershed Problem Statements, Goals, objectives and Action 273

I. Lower Rock Creek Subwatershed 278

- 12-digit HUC 041100040203 – Lower Rock Creek Subwatershed Problem Statements, Goals, objectives and Action 285

J. Phelps Creek Subwatershed 290

- 12-digit HUC 041100040301 – Phelps Creek Subwatershed Problem Statements, Goals, objectives and Action 298

K. Hoskins Creek Subwatershed 302

- 12-digit HUC 041100040302 – Hoskins Creek Subwatershed Problem Statements, Goals, objectives and Action 309

L. Mill Creek (1)-Grand River Subwatershed 316

- 12-digit HUC 041100040303 – Mill Creek (1)-Grand River Subwatershed Problem Statements, Goals, objectives and Action 323

M. Mud Creek Subwatershed 332

- 12-digit HUC 041100040304 – Mud Creek Subwatershed Problem Statements, Goals, objectives and Action 340

N. Plumb Creek - Grand River Subwatershed 346

- 12-digit HUC 041100040305 – Plumb Creek - Grand River Subwatershed Problem Statements, Goals, objectives and Action 353

O. Griggs Creek Subwatershed 358
- 12-digit HUC 041100040401 – Griggs Creek Subwatershed Problem Statements, Goals, objectives and Action 364

P. Peters Creek - Mill Creek Subwatershed 368
- 12-digit HUC 041100040402 – Peters Creek-Mill Creek Subwatershed Problem Statements, Goals, objectives and Action 375

Q. Village of Jefferson – Mill Creek Subwatershed 380
- 12-digit HUC 041100040403 – Village of Jefferson-Mill Creek (2) Subwatershed Problem Statements, Goals, objectives and Action 387

R. Three Brothers Creek-Grand River Subwatershed 394
- 12-digit HUC 041100040501 – Three Brothers Creek-Grand River Subwatershed Problem Statements, Goals, objectives and Action 401

S. Bronson Creek-Grand River Subwatershed 406
- 12-digit HUC 041100040502 – Bronson Creek-Grand River Subwatershed Problem Statements, Goals, objectives and Action 414

V. Implementation of Ohio Coastal Nonpoint Pollution Control Program Management Measures 446
- Introduction 448
- Program Specifics 448
- Management Measures for Urban Areas 448
- Management Measures for Hydromodification 449
- Urban Areas: 449
- Hydromodification Activities that Impact Coastal Waters 451
- Dams 453
- Streambank and Shoreline Erosion 454

VI. EVALUATION 456

VII. APPENDICES 458

APPENDIX A – Table of Tables 462

APPENDIX B – Table of Maps 470

APPENDIX C - Table of Photos 473

Part I.
INTRODUCTION,
Defining the Upper Grand River Watershed

I. INTRODUCTION, Defining the Upper Grand River Watershed

Photo 1. Grand River at Mechanicsville Road – view south *(Source: GRPI)*

The Grand River - which was originally named the "Geauga" after the Native American word for "raccoon"- incorporates portions of Ashtabula, Geauga, Lake, Portage, and Trumbull Counties in Northeast Ohio.

The Grand River has two distinct reaches. The Upper reach flows slowly through the broad valley of an ancient glacial lake, past some of the state's largest wetlands, floodplain forests, marshes, wet meadows, and swamps. The lower reach, west of Harpersfield, has cut a steep shale gorge notable for its cold, fast flow, spectacular sedge meadows, glacial slumps, and deep ravines. The lowest reaches of the river created sand dunes and palustrine sand plains; and aquatic beds and emergent marshes were once plentiful. Lake effect precipitation in Ohio's "snow belt" increases the biological diversity of the watershed. Hemlock/white-pine/northern hardwood forests in steep ravines and rare hemlock swamp forests provide habitats for plant and animal species usually found in colder, mountainous climates.

Rich in forested communities, the watershed supports beech-maple, oak-hickory, and hemlock-northern hardwood forests. Riparian and floodplain areas are often dominated by trees that tolerate frequent flooding, such as eastern cottonwood, sycamore, black willow, and black walnut. These streamside forests are critical to the health of the river. They minimize streambank erosion and filter out pollutants from agricultural and urban runoff. Forest canopies lower water temperature and allow the river to support a diversity of aquatic life such as river redhorse, rainbow trout, eastern sand darter, and northern brook lamprey. The Grand provides habitat for Ohio's smallest salamander, the rare four-toed salamander, and the elusive spotted turtle. Beavers frequent the riverbanks, and thanks to the Ohio Division of Wildlife's reintroduction program, river otters once again seen flourishing along the banks of the Grand.

I. INTRODUCTION, Defining the Upper Grand River Watershed

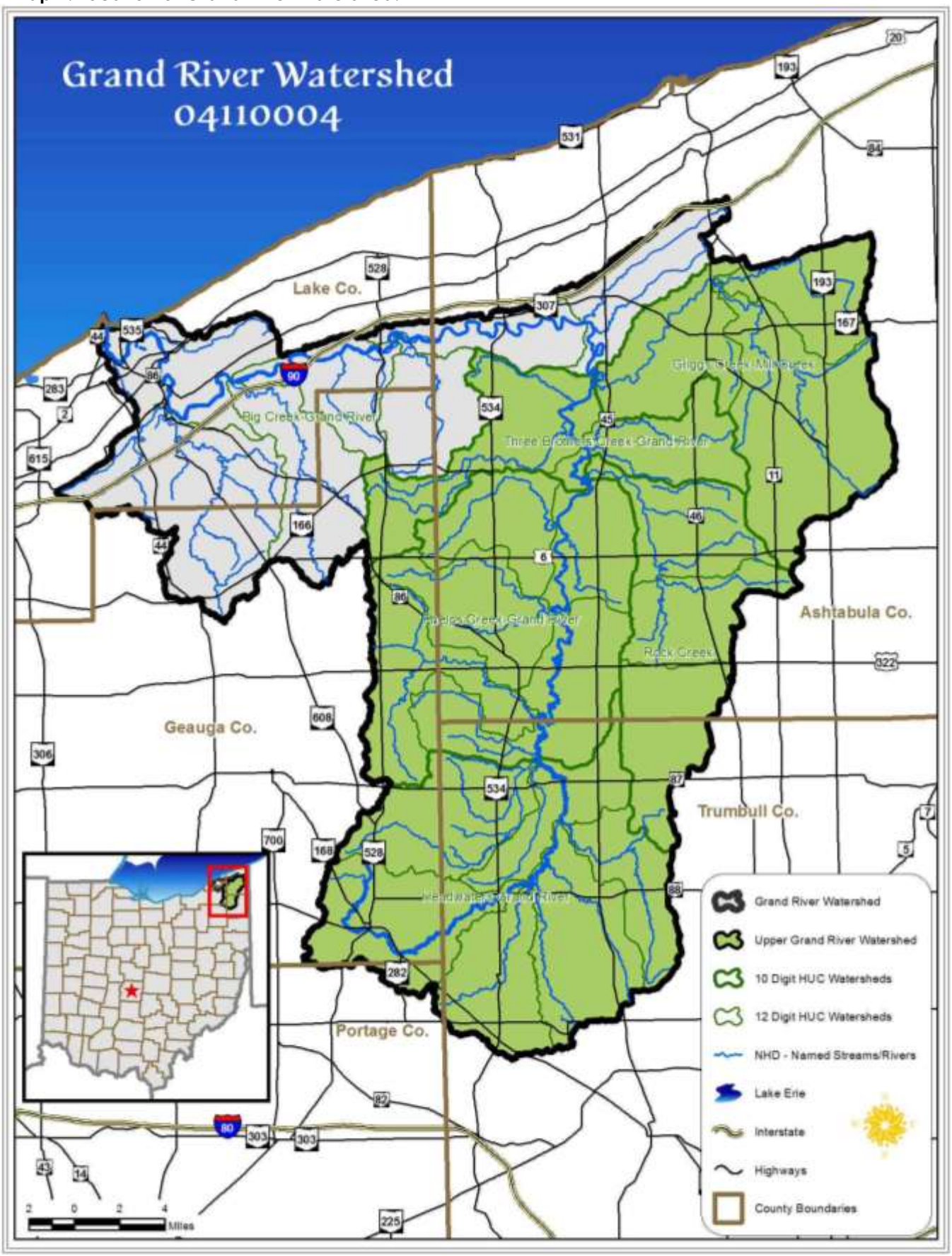
Diverse wetlands along the Grand River protect the quality of the stream's water from degradation. Many of these remaining wetlands support rare plant species, such as painted trillium and bunchberry. The forests along the river shelter nesting and migratory bird populations, including yellow-bellied sapsuckers and cerulean warblers. The Eastern Massasauga rattlesnake, a very rare inhabitant of the watershed, has suffered dramatic population declines in recent years. The watershed may provide one of the best areas for recovery of this secretive reptile in coming years.

The principal streams located within the watershed include: the Grand River (102.7 miles), Mill Creek (28.8 miles), Rock Creek (18.4 miles), and Big Creek (15.6 miles). In total, there are 53 named streams in the Grand River Watershed.

Photo 2. Grand River Headwaters *(Source: GRPI)*

I. INTRODUCTION, Defining the Upper Grand River Watershed

Map 1. Location of Grand River Watershed.



I. INTRODUCTION, Defining the Upper Grand River Watershed

This page left intentionally blank

I. INTRODUCTION, Defining the Upper Grand River Watershed

A. Defining the Watershed

- **Counties**

The Grand River and its tributaries flows through five counties and sixty communities, detailed below. Additional information included below for each county includes square miles of land in the Grand, Upper Grand, and Lower Grand River Watershed (Table 1), the percentage of land in the Grand, Upper Grand, and Lower Grand River Watershed (Table 2), and the percentage of each county in the Grand, Upper Grand, and Lower Grand River Watershed (Table 3).

Note: Lake County is not represented in the Upper Grand River Watershed.

Table 1. Square Miles of Land in the Grand River Watershed and subwatersheds.

County Name	Abbr.	miles² Total Grand River Watershed	miles² Upper Grand River Watershed	miles² Lower Grand River Watershed
Ashtabula	ATB	341.4	296.3	45.1
Geauga	GEA	131.1	78.6	52.6
Lake	LAK	86.5	0	86.5
Portage	POR	3.9	3.9	0
Trumbull	TRU	142.6	142.6	0

Table 2. Percentage of Land in the Grand River Watershed and subwatersheds.

County Name	Abbr.	% Total Grand River Watershed	% Upper Grand River Watershed	% Lower Grand River Watershed
Ashtabula	ATB	48.4%	56.8%	24.5%
Geauga	GEA	18.6%	15.1%	28.6%
Lake	LAK	12.3%	0	47.0%
Portage	POR	0.6%	0.7%	0
Trumbull	TRU	20.2%	27.3%	0

Table 3. Percentage of County in the Grand River Watershed.

County Name	Abbr.	% of County in GR Watershed	% of County in Upper GR Watershed	% of County in Lower GR Watershed
Ashtabula	ATB	48.1%	41.7%	6.4%
Geauga	GEA	32.1%	19.2%	12.9%
Lake	LAK	37.4%	0	37.4%
Portage	POR	0.8%	0.8%	0
Trumbull	TRU	22.4%	22.4%	0

I. INTRODUCTION, Defining the Upper Grand River Watershed

- **Incorporated Areas**

The Grand River and its tributaries flows through sixty communities, detailed below. Additional information included below for each community includes square miles of land in the Grand, Upper Grand, and Lower Grand River Watershed, and whether the entity is designated under NPDES Phase II.

Note: There are no NPDES Phase II communities in the Upper Grand River Watershed.

Table 4. Incorporated areas of the Grand River Watershed.

Municipality	Abbr.	mi^2 Total GR Watershed	mi^2 Upper GR Watershed	mi^2 Lower GR Watershed	Phase II
Village of Roaming Shores	ATB	2.7	2.7	0	NO
Village of Jefferson	ATB	2.5	2.5	0	NO
Village of Orwell	ATB	2.1	2.1	0	NO
Village of Rock Creek	ATB	1.0	1.0	0	NO
Village of West Farmington	TRU	0.9	0.9	0	NO
Village of Middlefield	GEA	0.4	0.4	0	NO
City of Chardon	GEA	2.4	0	2.4	NO
City of Kirtland Hills	LAK	0.5	0	0.5	NO
City of Mentor	LAK	0.8	0	0.8	YES
City of Painesville	LAK	5.5	0	5.5	NO
Perry Village	LAK	0.6	0	0.6	NO
Village of Fairport Harbor	LAK	1.0	0	1.0	NO
Village of Grand River	TRU	0.3	0	0.3	NO
Village of Madison	LAK	0.02	0	0.02	YES

I. INTRODUCTION, Defining the Upper Grand River Watershed

- **Unincorporated Areas**

Note: There are no NPDES Phase II communities in the Upper Grand River Watershed.

Table 5. Unincorporated areas of the Grand River Watershed.

Township	Abbr.	miles² Total GR Watershed	miles² Upper GR Watershed	miles² Lower GR Watershed	Phase II
Austinburg	ATB	23.4	7.6	15.8	No
Cherry Valley	ATB	6.9	6.9	0	No
Colebrook	ATB	14.2	14.2	0	No
Denmark	ATB	22.3	22.3	0	No
Dorset	ATB	22.5	22.5	0	No
Harpersfield	ATB	16.7	4.0	12.7	No
Hartsgrove	ATB	24.9	24.9	0	No
Jefferson	ATB	23.4	21.8	1.6	No
Lenox	ATB	24.4	24.4	0	No
Morgan	ATB	22.0	22.0	0	No
New Lyme	ATB	23.9	23.9	0	No
Orwell	ATB	21.7	21.7	0	No
Plymouth	ATB	7.0	0.6	6.4	No
Richmond	ATB	1.3	1.3	0	No
Rome	ATB	22.5	22.5	0	No
Sheffield	ATB	3.4	3.4	0	No
Trumbull	ATB	25.6	19.2	6.6	No
Windsor	ATB	24.7	24.7	0	No
Huntsburg	GEA	14.2	14.2	0	No
Middlefield	GEA	16.3	16.3	0	No
Montville	GEA	19.7	14.6	5.1	No
Parkman	GEA	26.4	26.4	0	No
Thompson	GEA	25.8	4.5	21.3	No
Troy	GEA	2.2	2.2	0	No
Hiram	POR	0.07	0.07	0	No
Nelson	POR	4.01	4.01	0	No
Bazetta	TRU	0.2	0.2	0	Yes
Bloomfield	TRU	25.5	25.5	0	No
Bristol	TRU	26.0	26.0	0	No
Champion	TRU	11.6	11.6	0	Yes
Farmington	TRU	26.3	26.3	0	No
Greene	TRU	5.2	5.2	0	No
Mecca	TRU	1.3	1.3	0	No
Mesopotamia	TRU	26.7	26.7	0	No
Southington	TRU	18.9	18.9	0	No
Saybrook	ATB	2.2	0	2.2	No
Chardon	GEA	8.1	0	8.1	No
Claridon	GEA	0.03	0	0.03	No
Hambden	GEA	15.8	0	15.8	No
Concord	LAK	22.0	0	22	No
Kirtland	LAK	0	0	0	No
Leroy	LAK	25.4	0	25.4	No
Madison	LAK	13.5	0	13.5	No
Mentor	LAK	0	0	0	Yes
Painesville	LAK	9.3	0	9.3	No
Perry	LAK	7.5	0	7.5	Yes

I. INTRODUCTION, Defining the Upper Grand River Watershed

Map 2. Communities of the Grand River Watershed.

I. INTRODUCTION, Defining the Upper Grand River Watershed

- **Special districts (park, school, conservancy, sewer, soil and water, agriculture, regional planning orgs.)**

1. Park:

Ashtabula County Metroparks- Ashtabula County land preservation, public parks and greenspace, Western Reserve Greenway Trail – **Grand River Partnership members**

Geauga Park District- Geauga County land preservation, educational programs, nature centers, nature events, public greenspace and parks, shelters and meeting spaces – **Grand River Partnership members**

Lake Metroparks- Lake County land preservation, educational programs, bike trails, public parks and open space, recreational rentals (boat rentals, cross country skiing), summer camps, shelters and meeting space, wildlife center and programs – **Grand River Partnership members**

Portage Park District- land preservation, educational programs, bike trails, public parks and open space – **Grand River Partnership members**

Trumbull County MetroParks- land preservation, educational programs, bike trails, public parks and open space – **Grand River Partnership members**

2. Health:

Ashtabula County Health District- home sewage and septic system information – **Grand River Partnership members**

Geauga County Combined Health District- home sewage, septic system and water supply information

Lake County Health District- air pollution information, sewage/septic and water information, mosquito control, beach information – **Grand River Partnership members**

Portage County Combined General Health District- home sewage, septic system and water supply information

Trumbull County Health Department- home sewage/septic information, well information, water testing – **Grand River Partnership members**

3. School Districts

Ashtabula County
- Ashtabula County Educational Service Center
- Ashtabula Area City Schools
- Buckeye Local Schools
- Geneva Area City Schools
- Grand Valley Local Schools
- Jefferson Area Local Schools
- Pymatuning Valley Local Schools

Geauga County
- Berkshire Local Schools
- Cardinal Local Schools
- Chardon Local Schools
- Ledgemont Local Schools

Lake County
- Fairport Harbor Exempted Village Schools
- Kirtland Local Schools
- Madison Local Schools
- Mentor Public Schools
- Painesville City Local Schools
- Painesville Township Local Schools
- Perry Public Schools

Portage County
- James A. Garfield Schools

Trumbull County
- Bloomfield-Mespo Local Schools
- Bristol Local Schools
- Champion Local Schools
- Lakeview Local Schools
- Maplewood Local Schools
- Southington Local Schools

I. INTRODUCTION, Defining the Upper Grand River Watershed

4. Soil and Water:

Ashtabula Soil & Water Conservation District- education, technical assistance, erosion/ drainage issues, pond construction, soils information, fish and tree sales, Ashtabula land preservation – **Grand River Partnership members**

Geauga County Soil and Water Conservation District- education (adult and children), technical assistance, erosion/ drainage issues, soils information, construction and subdivision information, stormwater information, NPDES Phase II information, fish and tree sales, Geauga County land protection – **Grand River Partnership members**

Lake County Soil and Water Conservation District- education, stormwater information, subdivision regulations and information, erosion/drainage issues, soil information, HHEI assessments, stream sign project, fish and tree sales – **Grand River Partnership members**

Portage County Soil and Water Conservation District- Conservation Easements, Conservation Planning, Cost Share Programs, Drainage Issues, Education Programs, Engineering Services, Farmland Preservation, Maps & Resources, Sediment & Erosion Control, Soils Information, Storm Water Management, Stream Monitoring, Urban Program, Volunteer Program, Wetland Information

Trumbull Soil and Water Conservation District- information on flood prevention, land protection, erosion, land use planning, conservation education for children and adults – **Grand River Partnership members**

5. Regional Planning Organizations:

Ashtabula County Planning Commission- County Subdivision Regulations, lot splits, Census data and information, land use planning, zoning issues – **Grand River Partnership members**

Eastgate Regional Council of Governments- promotes cooperative regional efforts in the planning, programming, and implementation of public sector activities.

Geauga County Planning Commission- land preservation, land use, zoning issues and advice, Census data, subdivision review – **Grand River Partnership members**

Lake County Planning Commission- topographical maps, Census data, land use data, zoning information, aerial photographs, subdivision and lot splits, coastal erosion maps, building permit data – **Grand River Partnership members**

Northeast Ohio Areawide Coordinating Agency- responsible for, among other things, the region's Long Range Transportation Plan, the Transportation Improvement Program (TIP), the region's water quality plan and an Overall Work Program (OWP) which carries out national planning guidance, air quality conformity, watershed planning, and special studies. – **Grand River Partnership members**

Portage County Regional Planning Commission- provides a wide range of planning services, including acting on subdivisions, zoning regulations, zoning amendments, administering and writing grants, creating plans and digital maps, advising residents on land splits, and providing data.

Trumbull County Planning Commission- provides land-use and infrastructure planning, economic development, affordable housing, zoning and subdivision reviews, floodplain administration, mapping, and information services.

Western Reserve Resource Conservation & Development (RC&D)- To plan, promote, and implement conservation and sustainable use of natural resources in both rural and urban areas. Serves Ashtabula, Cuyahoga, Geauga, Lake, Lorain, Medina, Portage, Summit, and Trumbull counties. – **Grand River Partnership members**

I. INTRODUCTION, Defining the Upper Grand River Watershed

Photo 3. Grand Wild & Scenic River *(Source: Grand River Partners, Inc.)*

- **Special designations (National and state wild & scenic rivers)**

  Ohio passed the nation's first scenic river protection legislation in 1968. About 800 river miles are designated along these 14 streams and some of their tributaries with the majority of these river corridors being privately owned. The role of Ohio's Wild, Scenic and Recreational Act is to identify and protect those rivers and streams possessing characteristics of state significance. Designation as a wild, scenic or recreational river is not a river restoration tool designed to restore a degraded stream; rather it is a means of publicly recognizing and retaining conservation support for Ohio's high quality waterways.

  On January 17, 1974, the Grand River became Ohio's second wild and scenic river. Designated sections include: from Harpersfield covered bridge downstream to the Norfolk and Western Railroad trestle south of Painesville (wild, 23 miles) and from US 322 bridge in Ashtabula County downstream to Harpersfield covered bridge (scenic, 33 miles). The Upper Grand River Watershed encompasses most of the Scenic Designation segment of the Grand River.

  The Ohio EPA lists all designated Superior and Outstanding State Waters in OAC Section 3745-1-05:

  - Superior High Quality Waters are water systems having exceptional ecological values. Ecological values are based upon the combination of the presence of federal and/or state threatened or endangered species and a high level of biological integrity.
  - Outstanding State Waters are water systems having special significance to the state due to exceptional ecological and/or recreational values.

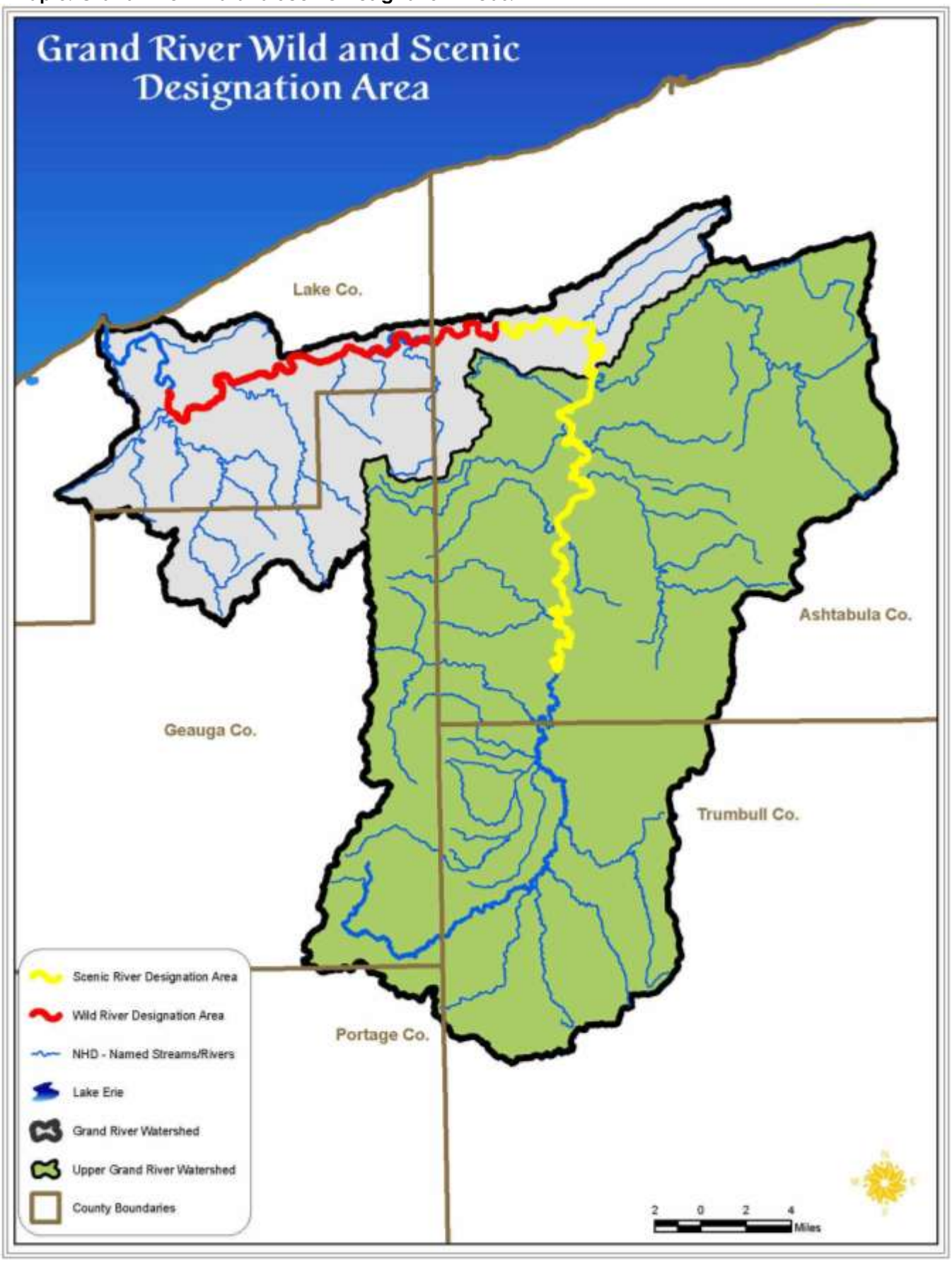
  According to OAC Section 3745-1-05 - Table 5-4, Baughman Creek, a tributary to the Grand River in Trumbull County, is listed as a Superior High Quality Water. A portion of the Grand River in Ashtabula County is designated as an Outstanding State Water based on exceptional ecological value (OAC Section 3745-1-05 - Table 5-5).

- **Phase 2 stormwater communities**

  There are no Phase II Stormwater Communities in the Upper Grand River Watershed.

I. INTRODUCTION, Defining the Upper Grand River Watershed

Map 3. Grand River Wild and Scenic Designation Areas.



I. INTRODUCTION, Defining the Upper Grand River Watershed

B. Demographics (Population, ages, education and income levels, locations of growth and economic patterns.)

- **Population, ages education levels**

This section deals with the analysis of the economic, political, and social aspects of the Grand River Watershed area. The state of the population is thoroughly examined. Additionally, other important data such as socioeconomic patterns and housing is also included.

1. Population and Population Trends

The population density for the State of Ohio in 2000 was 277 people per square mile. In the highly developed Lower Grand River Watershed, population density of 352 people per square mile exceeds the population density for Ohio by 27 percent. Population density for the Upper Grand River Watershed ranges from 127 people per square mile (46 percent of population density for Ohio) to 61 people per square mile (22 percent of population density for Ohio)(Table 6). The lack of development and high level of agriculture may account for the lower levels of population density.

Table 6. Population Density in the Grand River Watershed.
(Source: 2000 Census – U.S. Census Bureau Data Download Center)

HUC 10	HUC 10 Name	Total Adjusted Population (2000)	Total Miles^2	People/ Miles^2 (2000)
0411000401	Headwaters Grand River	19967	157	127
0411000402	Rock Creek	4705	71	66
0411000403	Phelps Creek-Grand River	10972	132	83
0411000404	Griggs Creek-Mill Creek	8737	104	84
0411000405	Three Brothers Creek-Grand River	3558	58	61
0411000406	Big Creek-Grand River (Lower Grand)	64826	184	352

The level of development and population density may contribute to the level of racial and ethnic diversity in the Lower Grand River Watershed. Though the extent of racial and ethnic diversity trail levels for the State of Ohio, the population of the Lower Grand River Watershed is far more diverse than the Upper Grand River Watershed. In fact, the Hispanic or Latino population of the Lower Grand River Watershed is nearly 20 percent higher than the state Hispanic or Latino population, though these levels are almost 500 percent below the national level (Table 7).

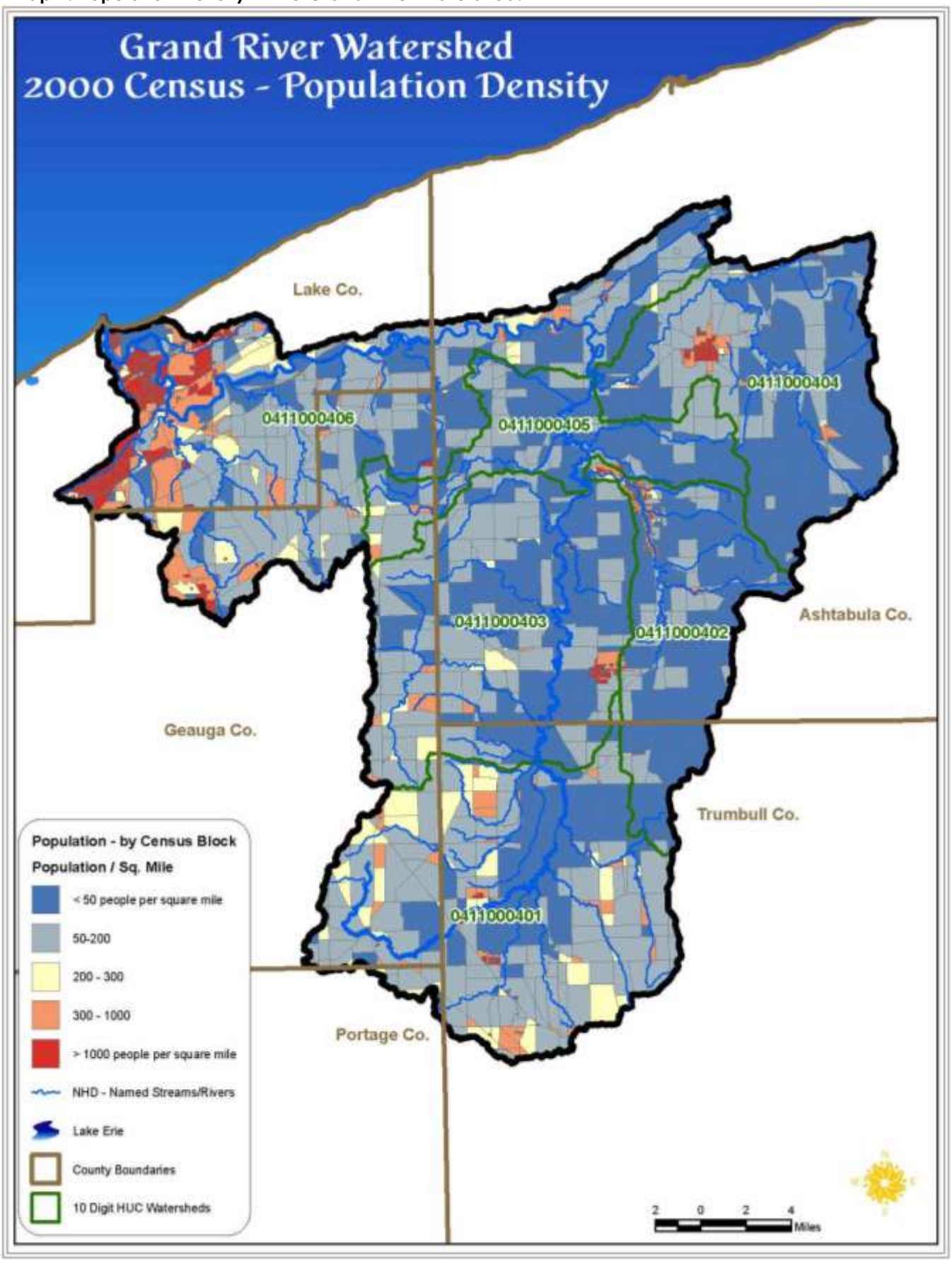
Table 7. Racial Diversity in the Grand River Watershed.
(Source: 2000 Census – U.S. Census Bureau Data Download Center

HUC 10	Total Adjusted Population (2000)	% White	% Black	% American Indian	% Asian	% Hawaiian/ Pacific Islander	% Hispanic or Latino	% Other	% Multi-race
0411000401	19967	97.7	0.8	0.1	0.1	0.0	0.5	0.1	0.7
0411000402	4705	96.8	1.5	0.1	0.1	0.0	0.6	0.1	0.8
0411000403	10972	95.8	1.9	0.1	0.2	0.0	0.6	0.3	1.1
0411000404	8737	95.9	1.9	0.2	0.3	0.0	0.6	0.2	0.9
0411000405	3558	96.6	1.2	0.1	0.3	0.0	0.8	0.2	0.8
0411000406	64826	89.0	3.6	0.1	0.5	0.0	3.7	1.8	1.2

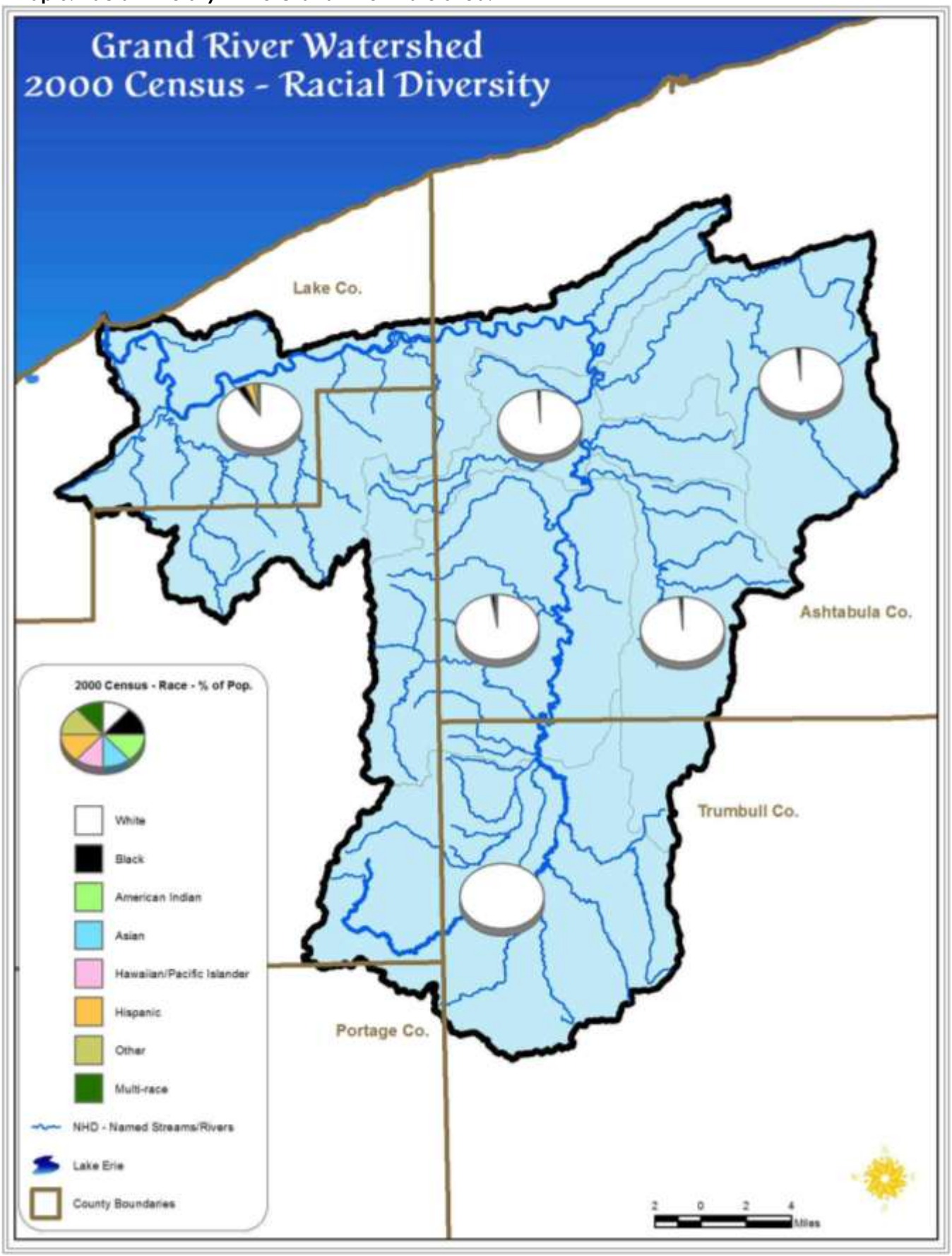
Table 8. Median Age of Population in the Grand River Watershed.
(Source: 2000 Census – U.S. Census Bureau Data Download Center)

HUC 10	HUC 10 Name	Median Age
0411000401	Headwaters Grand River	29.82
0411000402	Rock Creek	30.82
0411000403	Phelps Creek-Grand River	30.53
0411000404	Griggs Creek-Mill Creek	30.72
0411000405	Three Brothers Creek-Grand River	33.32
0411000406	Big Creek-Grand River (Lower Grand)	30.68

Map 4. Population Density in the Grand River Watershed.

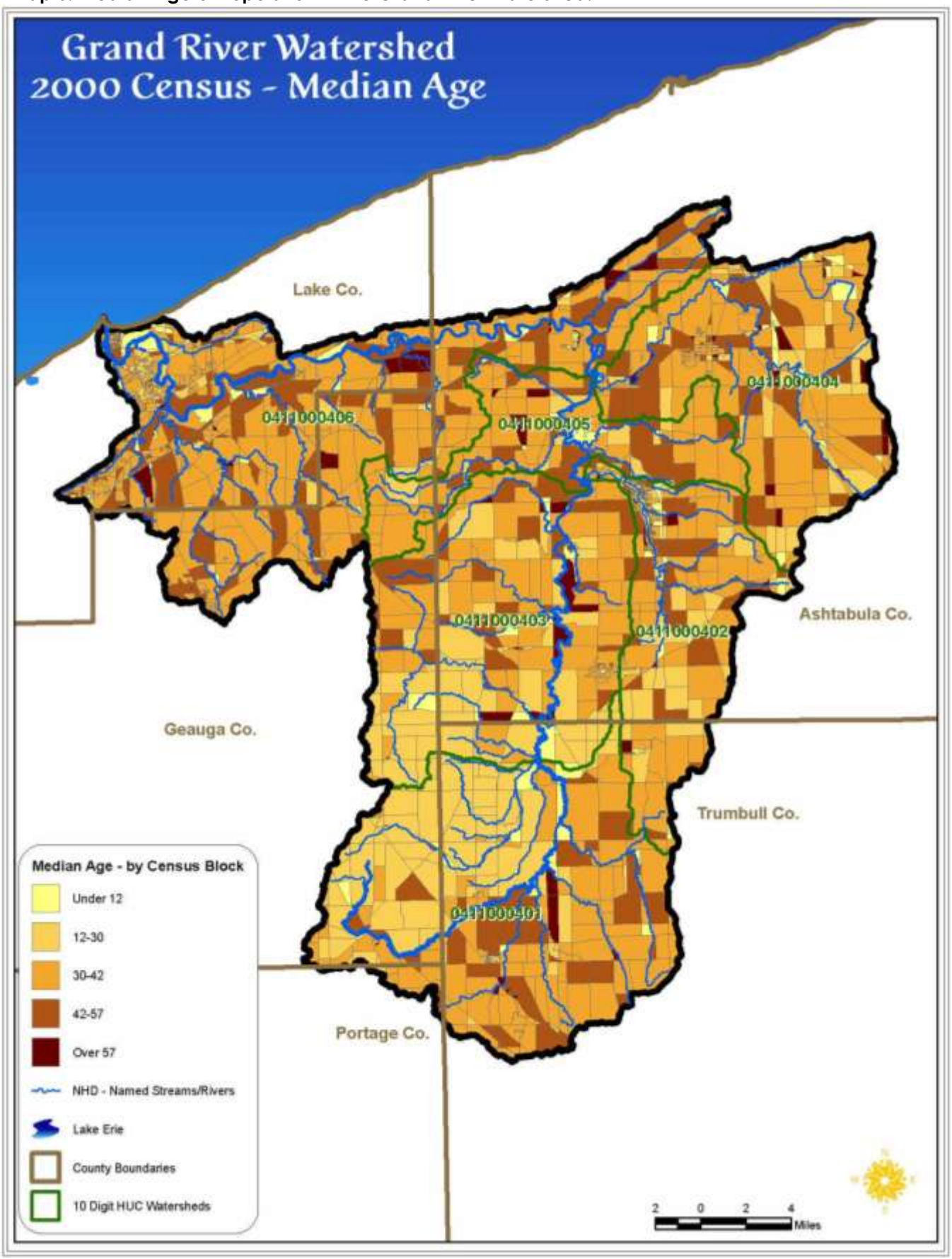


Map 5. Racial Diversity in the Grand River Watershed.



I. INTRODUCTION, Defining the Upper Grand River Watershed

Map 6. Median Age of Population in the Grand River Watershed.



2. Housing

The housing market in the Grand River Watershed Basin has seen steady rises in building permits in the last few decades, especially in the mid to late l990s. Although most experienced slight growth, a few notable townships have seen a higher and more sustained level of growth. In Ashtabula County, townships such as Denmark, Hartsgrove, and Windsor have all seen gains in population of over 20% from 1990 to 2000. Only Jefferson Township lost population in the county. A large reason for the consistent gains is that the housing stock continues to increase. Table 9 shows the number of housing units for each township in both 1990 and 2000 and the amount of change. Also included is the percentage of occupied units in both years. Townships with the most overall housing growth include Middlefield Township (including Middlefield Village) at 324 and Hambden Township at 292 in Geauga County and Orwell Township at 211 in Ashtabula County. All other townships grew in housing units by less than 200 units. In addition to the growth of housing units in all of the townships, 72% of townships also saw an increase in the percentage of occupied units. Most of these increases occurred in Ashtabula and Geauga Counties. Only Farmington Township in Trumbull County increased the percentage of occupied units from 1990 to 2000 and that growth was a mere 0.4%.
Table 10 displays the amount of current housing in the primary townships that was built before 1950. Analyzing this data is of importance because it provides several direct and indirect sources of information.

For instance, higher percentages of housing built before 1950 can indicate certain trends. Higher percentages indicate a possible need for more rehabilitation of the current housing stock. They may also indicate either an older population or perhaps a low amount of new housing construction. Dorset Township in Ashtabula County has a very high number of its homes built prior to 1950. In fact at 66.2%, the next highest percentage is nearly 20 points lower. Colebrook Township, also in Ashtabula County, has 46.3% of its housing stock built prior to 1950. Other townships with noticeable percentages of older housing include Austinburg at 43.7%, Bloomfield at 40%, and Cherry Valley and Denmark, both with 39.8%. Interestingly enough, not a single Geauga County township had a high percentage of homes built before 1950. To the contrary, some of the smallest percentages such as Hambden's 12.2% and Middlefield Township's 24.5% are found within the county.

Table 9. Change in Housing Levels 1990 to 2000 in the Primary Townships of Grand River Watershed.

Ashtabula County Housing Units

Township	1990	% Occupied 1990	2000	% Occupied 2000	Change 1990 - 2000
Austinburg	761	84.9%	903	90.9%	142
Cherry Valley	291	82.8%	339	85.5%	48
Colebrook	280	88.6%	319	92.8%	39
Denmark	274	88.0%	335	91.6%	61
Dorset	311	88.1%	335	91.9%	24
Harpersfield	936	91.7%	1,036	93.6%	100
Hartsgrove	409	94.1%	510	94.7%	101
Jefferson	1,983	95.2%	2,159	95,4%	176
Lenox	477	91.0%	524	94.8%	47
Morgan	659	82.7%	812	86.2%	153
New Lyme	361	90.9%	420	91.9%	59
Orwell	908	95.5%	1,119	94.2%	211
Plymouth	728	96.8%	812	96.2%	84
Rome	569	76.3%	731	81.3%	162
Trumbull	477	91.4%	542	95.4%	65
Windsor	505	92.3%	579	91.7%	74

Geauga County Housing Units

Township	1990	% Occupied 1990	2000	% Occupied 2000	Change 1990 - 2000
Hambden	1,214	96.0%	1,506	96.3%	292
Huntsburg	706	96.7%	876	97.9%	170
Middlefield	1,919	95.2%	2,243	n/a	324
Montville	593	94.8%	737	94.6%	144
Parkman	823	93.8%	994	96.0%	171
Thompson	794	94.6%	900	96.2%	106

Trumbull County Housing Units

Township	1990	% Occupied 1990	2000	% Occupied 2000	Change 1990 - 2000
Bloomfield	385	95.3%	400	93.3%	15
Bristol	1,055	97.3%	1,164	94.0%	147
Farmington	639	93.6%	786	96.2%	109
Mesopotamia	620	93.7%	729	93.6%	109

Table 10. Percentage of Housing Built Prior to 1950 in the Primary Townships of Grand River Watershed.
USA Average: 22.3% - State of Ohio Average: 31.4% - Watershed Average: 31.4%

Ashtabula County Average: 35.2%		Geauga County Average 24.7%		Trumbull County Average 33.4%	
Township	Prior to 1950	Township	Prior to 1950	Township	Prior to 1950
Austinburg	43.70%	Hambden	12.20%	Bloomfield	40.00%
Cherry Valley	39.80%	Huntsburg	28.80%	Bristol	29.70%
Colebrook	46.30%	Middlefield	24.50%	Farmington	35.10%
Denmark	39.80%	Middlefield V.	29.70%	Mesopotamia	33.90%
Dorset	66.20%	Montville	27.50%		
Harpersfield	26.50%	Parkman	32.30%		
Hartsgrove	42.40%	Thompson	25.80%		
Jefferson	36.10%				
Lenox	25.70%				
Morgan	31.00%				
New Lyme	32.50%				
Orwell	35.90%				
Plymouth	27.10%				
Rome	26.10%				
Trumbull	31.80%				
Windsor	38.00%				

An important indicator of such factors as the economic climate and housing market of an area can be supported by viewing VMT (vehicle miles traveled) data and daily commute times. As Table 11 indicates, the primary townships in each county overall average a daily commute time of just over one half hour. However, within these overall averages lie significant differences. In Ashtabula County, Cherry Valley Township averages a daily commute of4l minutes. By comparison, Jefferson Townships only averages 22.8. Simply put, Jefferson Township has a higher number of residents who live closer to their work. A similar circumstance exists in Geauga County. Middlefield Village also has significant industrial activity. As a result, the average commute time is only 22.6 minutes. Conversely, Parkman Township averages a lengthy 36.8 commute per day.

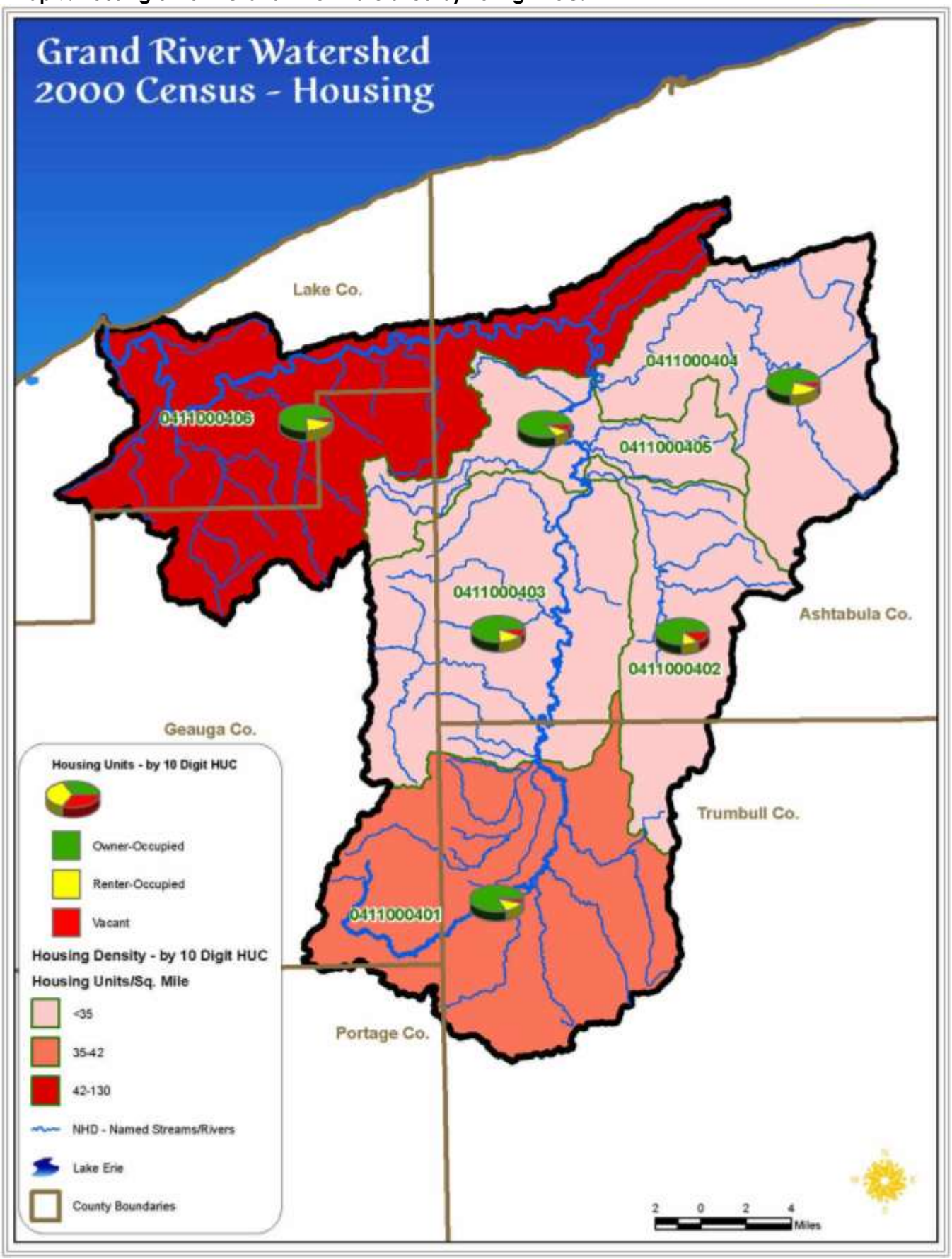
Table 11. Average daily commute (in minutes) for residents in the Grand River Watershed.

Ashtabula County Average: 30.3		Geauga County Average 31.7		Trumbull County Average 30.8	
Township	Minutes	Township	Minutes	Township	Minutes
Austinburg	25.2	Hambden	31.7	Bloomfield	26.3
Cherry Valley	41	Huntsburg	34.6	Bristol	26
Colebrook	38.4	Middlefield	29	Farmington	34.4
Denmark	35.6	Middlefield V.	22.6	Mesopotamia	36.6
Dorset	32.8	Montville	33.7		
Harpersfield	29	Parkman	36.8		
Hartsgrove	38.4	Thompson	33.9		
Jefferson	22.8				
Lenox	24.8				
Morgan	34.4				
New Lyme	34.6				
Orwell	31.2				
Plymouth	24.7				
Rome	39.3				
Trumbull	32.5				
Windsor	38.2				

Table 12. Housing Units in the Grand River Watershed by 10-digit HUC.
(Source: 2000 Census – U.S. Census Bureau Data Download Center)

HUC 10	HUC 10 Name	House Units/ miles^2	% Occupied	% Owner Occupied	% Renter Occupied	% Vacant	% Seasonally Occupied
0411000401	Headwaters Grand River	41.68	95.98	82.80	13.18	4.02	0.76
0411000402	Rock Creek	26.89	87.72	74.61	13.11	12.28	7.40
0411000403	Phelps Creek-Grand River	27.52	93.29	76.22	17.07	6.71	2.46
0411000404	Griggs Creek-Mill Creek	32.32	94.61	72.44	22.18	5.39	1.16
0411000405	Three Brothers Creek-Grand River	22.71	93.96	84.10	9.86	6.04	1.82
0411000406	Big Creek-Grand River (Lower Grand)	129.73	95.46	75.55	19.91	4.54	0.41

Map 7. Housing Units in Grand River Watershed by 10 Digit HUC.



This page left intentionally blank

3. Education

Table 13. Education Attainment of Adult Population in the Grand River Watershed.
(Source: 2000 Census – U.S. Census Bureau Data Download Center)

Population 25 years and over	Total	Less than 9th grade	9th to 12th grade; no diploma	High school graduate (includes equivalency)	Some college; no degree	Associate degree	Bachelor's degree	Graduate or professional degree
White – Male	46706	2793	4961	16966	10041	2314	6396	3235
White – Female	49986	2678	5078	18796	10825	3451	6437	2721
Black or African American - Male	975	85	214	363	208	32	50	23
Black or African American - Female	1150	73	207	466	234	39	87	44
American Indian and Alaska Native - Male	75	16	13	22	16	0	8	0
American Indian and Alaska Native - Female	53	0	22	26	5	0	0	0
Asian – Male	176	0	9	25	17	4	37	84
Asian – Female	273	19	11	32	45	27	58	81
Native Hawaiian and Other Pacific Islander - Male	7	0	0	7	0	0	0	0
Native Hawaiian and Other Pacific Islander - Female	0	0	0	0	0	0	0	0
Some other race - Male	448	257	112	44	27	6	2	0
Some other race - Female	197	77	41	46	17	8	8	0
Two or more races - Male	383	55	43	152	54	37	23	19
Two or more races – Female	443	23	46	110	136	55	55	18
Hispanic or Latino - Male	821	377	212	88	89	23	30	2
Hispanic or Latino – Female	674	186	130	162	98	19	48	31

Table 14. Education Attainment of Adult Population in the Upper Grand River Watershed.
(Source: 2000 Census – U.S. Census Bureau Data Download Center)

Population 25 years and over	Total	Less than 9th grade	9th to 12th grade; no diploma	High school graduate (includes equivalency)	Some college; no degree	Associate degree	Bachelor's degree	Graduate or professional degree
White – Male	19785	2074	2470	8283	3647	834	1710	767
White – Female	20799	1873	2261	9114	3570	1204	2062	715
Black or African American - Male	281	24	64	119	47	27	0	0
Black or African American - Female	367	9	57	188	67	16	18	12
American Indian and Alaska Native - Male	12	0	12	0	0	0	0	0
American Indian and Alaska Native - Female	30	0	10	18	2	0	0	0
Asian – Male	23	0	0	0	8	4	7	4
Asian – Female	50	0	0	13	19	2	0	16
Native Hawaiian and Other Pacific Islander - Male	7	0	0	7	0	0	0	0
Native Hawaiian and Other Pacific Islander - Female	0	0	0	0	0	0	0	0
Some other race - Male	23	0	5	2	14	0	2	0
Some other race - Female	26	0	0	19	7	0	0	0
Two or more races - Male	125	20	15	66	11	7	6	0
Two or more races - Female	166	7	7	53	55	14	21	9
Hispanic or Latino - Male	66	0	5	21	22	12	6	0
Hispanic or Latino - Female	98	0	5	57	16	8	12	0

Table 15. Education Attainment of Adult Population in the Lower Grand River Watershed.
(Source: 2000 Census – U.S. Census Bureau Data Download Center)

Population 25 years and over	Total	Less than 9th grade	9th to 12th grade; no diploma	High school graduate (includes equivalency)	Some college; no degree	Associate degree	Bachelor's degree	Graduate or professional degree
White – Male	26921	719	2491	8683	6394	1480	4686	2468
White – Female	29187	805	2817	9682	7255	2247	4375	2006
Black or African American - Male	694	61	150	244	161	5	50	23
Black or African American - Female	783	64	150	278	167	23	69	32
American Indian and Alaska Native – Male	63	16	1	22	16	0	8	0
American Indian and Alaska Native - Female	23	0	12	8	3	0	0	0
Asian – Male	153	0	9	25	9	0	30	80
Asian – Female	223	19	11	19	26	25	58	65
Native Hawaiian and Other Pacific Islander - Male	0	0	0	0	0	0	0	0
Native Hawaiian and Other Pacific Islander - Female	0	0	0	0	0	0	0	0
Some other race - Male	425	257	107	42	13	6	0	0
Some other race - Female	171	77	41	27	10	8	8	0
Two or more races - Male	258	35	28	86	43	30	17	19
Two or more races - Female	277	16	39	57	81	41	34	9
Hispanic or Latino - Male	755	377	207	67	67	11	24	2
Hispanic or Latino - Female	576	186	125	105	82	11	36	31

This page left intentionally blank

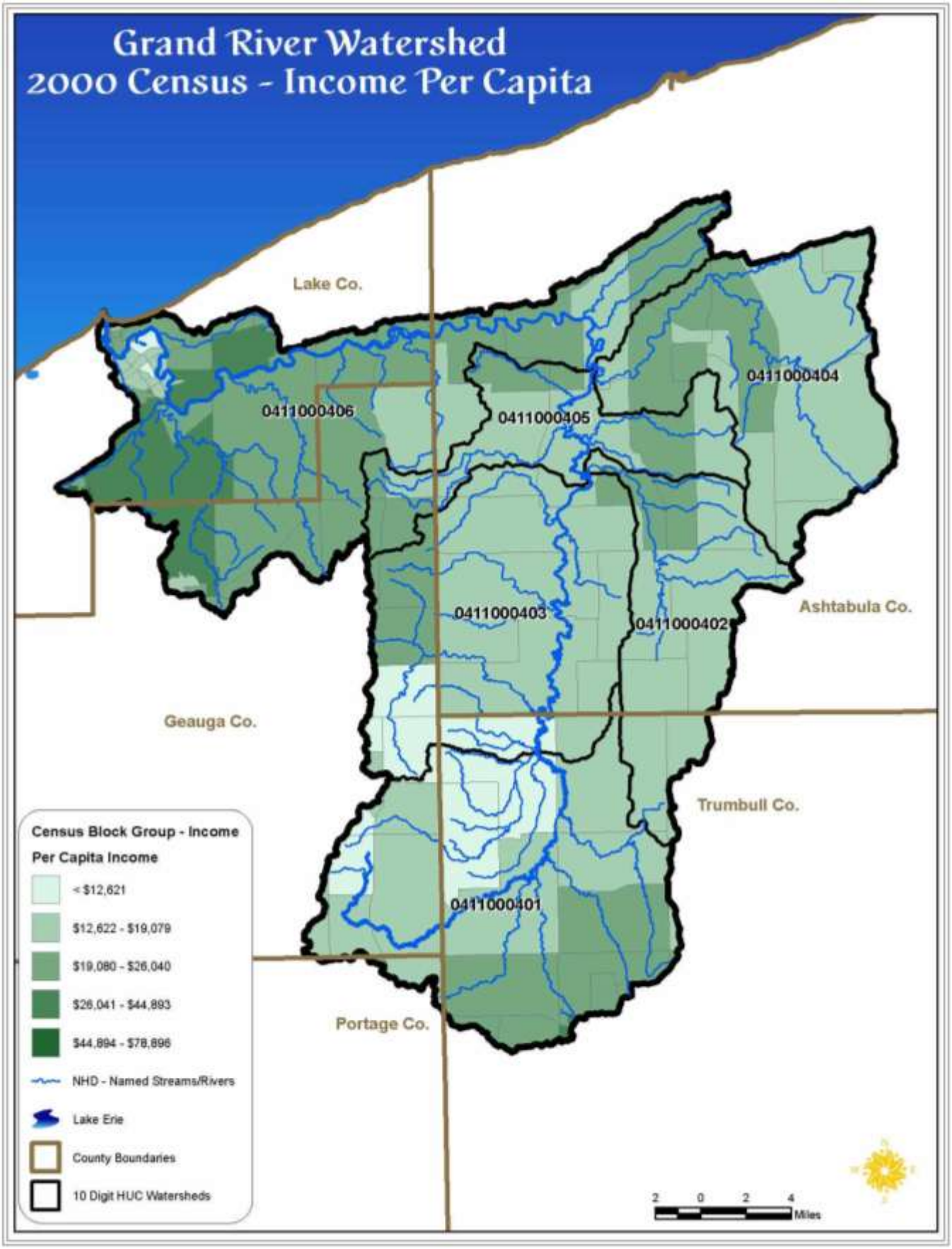
- **Income levels**

According to U.S. Census 2000 data, the national Average Per Capita Income in 1999 dollars is 21,587. All Upper Grand River subwatersheds report Average Per Capita Income from 6% to 22% below the national average. The Lower Grand River Watershed reports Average Per Capita Income nearly 3% above the national average. (Table 16)

Table 16. Average per Capita Income in the Grand River Watershed by 10-digit HUC
(Source: 2000 Census – U.S. Census Bureau Data Download Center)

HUC 10	HUC 10 Name	Average Per Capita Income
0411000401	Headwaters Grand River	$17,126.54
0411000402	Rock Creek	$17,354.46
0411000403	Phelps Creek-Grand River	$16,763.47
0411000404	Griggs Creek-Mill Creek	$17,635.00
0411000405	Three Brothers Creek-Grand River	$20,259.57
0411000406	Big Creek-Grand River (Lower Grand)	$22,177.17

Map 8. Income per Capita in Grand River Watershed.



I. INTRODUCTION, Defining the Upper Grand River Watershed

1. Comparing Educational Attainment to Levels of Income

Table 17. Earnings by Educational Attainment in the Counties of the Grand River Watershed.
(Source: 2000 Census – U.S. Census Bureau Data Download Center)

Population 25 years and over	Earnings by County				
	Ashtabula County	Geauga County	Lake County*	Portage County†	Trumbull County†
Average	$25,318	$36,461	$34,615	$31,903	$28,265
Male	$31,777	$48,799	$40,374	$40,132	$33,691
Female	$21,133	$25,306	$28,591	$24,439	$22,938
Less than high school graduate	$16,576	$19,820	$15,419	$16,809	$16,494
Male	$18,482	$28,803	$26,224	$23,482	$29,675
Female	$12,333	$9,926	$13,297	$15,166	$7,296
High school graduate (includes equivalency)	$22,996	$27,080	$28,510	$28,040	$24,698
Male	$28,698	$32,064	$34,281	$37,728	$30,206
Female	$18,338	$21,761	$23,298	$18,706	$20,052
Some college or associate's degree	$28,787	$32,555	$35,247	$30,059	$28,661
Male	$39,404	$47,362	$40,213	$38,750	$33,958
Female	$23,835	$24,651	$29,828	$23,098	$24,763
Bachelor's degree	$49,718	$52,271	$45,490	$42,472	$39,785
Male	$73,261	$71,296	$57,372	$49,115	$49,785
Female	$39,386	$40,007	$36,342	$30,035	$33,706
Graduate or professional degree	$55,092	$78,786	$58,688	$47,588	$48,312
Male	$57,412	$100,394	$73,952	$51,113	$52,635
Female	$50,659	$47,662	$50,759	$44,567	$42,405

***Note: No part of Lake County is located in the Upper Grand River Watershed**

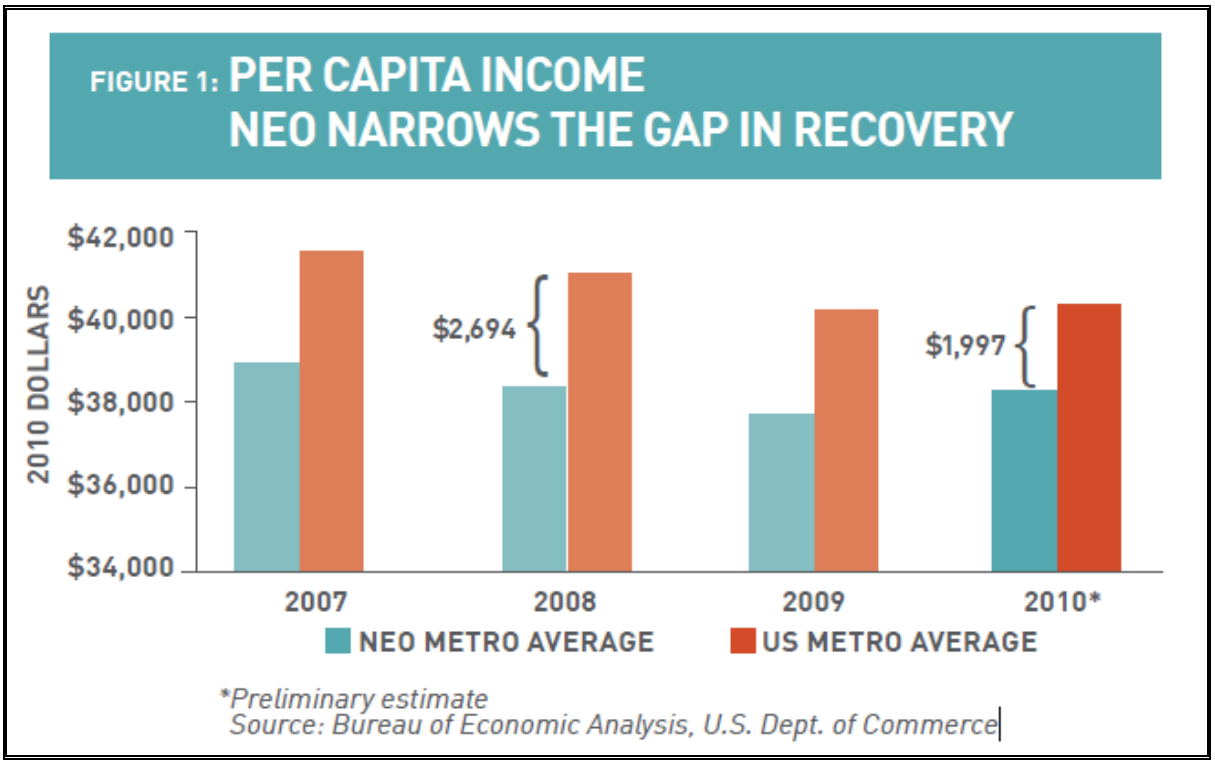
This page left intentionally blank

I. INTRODUCTION, Defining the Upper Grand River Watershed

- **Economic patterns** (Source: Driving the Recovery Home – What Matters Most to Northeast Ohio's Economy)

By some measures, Northeast Ohio is outpacing other metro areas in its recovery from the Great Recession, but it still has considerable ground to make up for the severe losses incurred since 2007. Setbacks, such as income and job loss, may have looked and felt like just another hard, long bump in the road for Northeast Ohio, but in fact – and as suggested throughout – they are likely indicators of a shifting socioeconomic landscape. Regional economic growth is measured here by changes in four leading indicators: per capita income, employment, gross metropolitan product (GMP) and productivity. Between 2007 and 2010, the analysis finds that:

Per Capita Income not only declined less than other metro areas during the recession, but it is also rebounding faster. The average income for Northeast Ohioans increased 1.5 percent between 2009 and 2010, far exceeding the 0.2 percent income growth in the average U.S. metro. This was not a just contribution of one or two places in the region; Akron, Canton, Cleveland and Youngstown metro areas each posted a higher per capita income in 2010 than in 2009. And although per capita income in Northeast Ohio is still lower than other metro areas ($38,293 versus $40,290), the gap has narrowed since 2008 (see Figure 1).

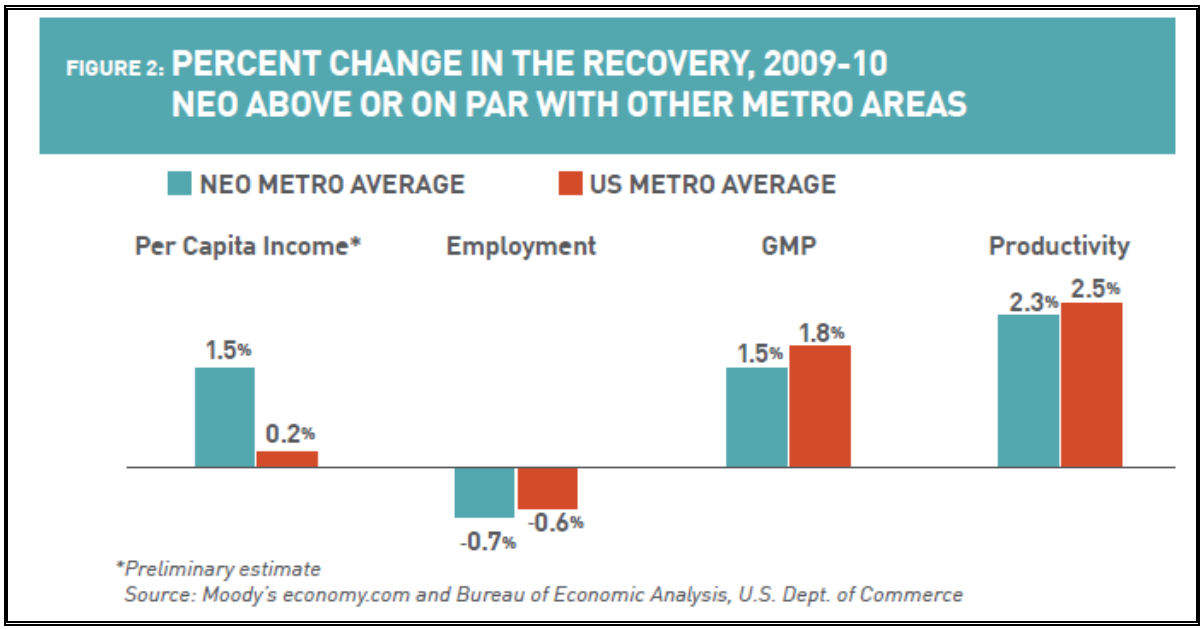


Employment Northeast Ohio's recovery remains jobless. Even while regional output continues to grow, jobs remain scarce. Between 2007 and 2010, employment has declined 8 percent, a pace 1.5 times that of the average metro. The bulk of these losses occurred between 2008 and 2009, when the region shed more than 100,000 jobs -- a result of weak consumer confidence, population loss, low employer demand and delayed hiring. As is usually the case coming out of recession (and more so in recent ones), a full jobs recovery occurs years after the official recovery has begun. Only one metro area in Northeast Ohio, Youngstown, posted modest employment gains between 2009 and 2010. Importantly by 2010, the region's rate of employment change was back in line with other metro areas in the nation: -0.7 and -0.6 respectively (see Figure 2).

I. INTRODUCTION, Defining the Upper Grand River Watershed

Gross Metropolitan Product The region's economic output shrank a dramatic 4.5 percent between 2007 and 2010, compared to less than 1 percent in all U.S. metro areas studied. Nevertheless, Northeast Ohio is gaining traction in the recovery. Between 2009 and 2010, output increased 1.5 percent in Northeast Ohio compared to 1.8 percent in the average metro area (see Figure 2). And of the $10 billion in output lost over the four-year period, the region had recaptured about a quarter of the dollars lost ($2.4 billion) by 2010. In order to compete nationally and globally, however, the region will need to continue to improve its pace of production– be it in auto or electronics manufacturing, health service provision or education. Output is increasing modestly in other metro areas around the country as well, and at a slightly faster pace.

Productivity Regional productivity increased the second year in a row, and is generally on par with other metro areas in the recovery: 2.3 percent in Northeast Ohio versus 2.5 percent in other metro areas (see Figure 2). However, productivity gains do not always translate into shared prosperity. Businesses tend to operate more efficiently in a downturn, but these adjustments may or may not lead to increased investment, sustained employment or better wages for the majority of workers.



I. INTRODUCTION, Defining the Upper Grand River Watershed

1. Government

Table 18. Contact List for Townships of the Upper Grand River Watershed.

County	Township	Mailing Address	Phone
Ashtabula	Austinburg	P O Box 134, Austinburg OH 44010	440-275-1378
Ashtabula	Trumbull	2730 Mechanicsville Rd, Rock Creek 44084	440-474-6500
Ashtabula	Cherry Valley	4045 Russell Rd, Dorset OH 44032	440-293-9987
Ashtabula	Colebrook	7569 St Rte 46, Orwell 44076	440-422-3322
Ashtabula	Denmark	1909 St Rte 193 North, Jefferson 44047	440-858-2655
Ashtabula	Dorset	2561 St Rte 193, Dorset 44302	440-858-2325
Ashtabula	Harpersfield	4858 Cork-Cold Springs Rd, Geneva 44041	440-466-2242
Ashtabula	Hartsgrove	5321 St Rte 534 South, Rome 44085	440-474-4114
Ashtabula	Jefferson	1313 Perry Rd, Jefferson 44047	440-576-2430
Ashtabula	Lenox	P O Box 423, Jefferson 44047	440-576-7130
Ashtabula	Morgan	2139 Forman Rd, Jefferson 44047	440-563-3475
Ashtabula	New Lyme	4627 Lenox-New Lyme Rd, Jefferson 44047	440-294-2811
Ashtabula	Orwell	P O Box 672, Orwell 44076	440-437-5553
Ashtabula	Plymouth	4350 Runkle Ave Extension, Ashtabula 44004	440-992-7484
Ashtabula	Richmond	6489 Footville-Richmond Rd, Andover 44003	440-293-7229
Ashtabula	Rome	P O Box 5057, Rome 44085	440-563-3445
Ashtabula	Saybrook	7247 Center Rd, Ashtabula 44004	440-969-1106
Ashtabula	Sheffield	4233 Forest Ridge Dr, Ashtabula 44004	440-224-1811
Ashtabula	Windsor	P O Box 223, Windsor 44099	440-272-5795
Portage	Nelson	PO Box 377, Garrettsville 44231	330-527-4985
Portage	Hiram	PO Box 1827, Hiram 44234	330-569-7724
Trumbull	Bazetta	3372 SR 5 Northeast, Cortland 44410	330-637-8816
Trumbull	Bloomfield	PO Box 34, North Bloomfield 44450	440-685-4646
Trumbull	Bristol	5617 North Park Ave, Bristolville 44402	330-889-2575
Trumbull	Farmington	PO Box 81, West Farmington 44491	330-889-3024
Trumbull	Southington	PO Box 266, Southington 44470	330-889-2551
Trumbull	Champion	149 Center St East, Warren 44481	330-847-7083
Trumbull	Green	2880 Gardner-Barclay, North Bloomfield 44450	330-583-2024
Trumbull	Mecca	PO Box 567, Cortland 44410	330-638-0363
Trumbull	Mesopotamia	PO Box 104, Mesopotamia 44439	440-693-4325
Geauga	Chardon	9949 Mentor Rd, Chardon 44024	440-286-3711
Geauga	Claridon	PO Box 66, East Claridon 44033	440-635-0648
Geauga	Hamden	13887 GAR Highway, Chardon 44024	440-286-4364
Geauga	Huntsburg	PO Box 280, Huntsburg 44046	440-636-5486
Geauga	Middlefield	PO Box 384, Middlefield 44062	440-632-5095
Geauga	Montville	PO Box 116, Montville 44064	440-968-3784
Geauga	Parkman	PO Box 688, Parkman OH 44080	440-548-5292
Geauga	Thompson	PO Box 204, Thompson 44086	440-298-9813
Geauga	Troy	13950 Main Market Rd, Burton 44021	440-834-8614

Table 19. Contact List for Villages of the Upper Grand River Watershed.

County	Village	Mailing Address	Phone
Ashtabula	Jefferson	27 East Jefferson Street, Jefferson, OH 44047	440-576-3941
Ashtabula	Orwell	PO Box 56, Orwell 44076	440-437-6459
Ashtabula	Roaming Shores	PO Box 237, Roaming Shores 44084	440-563-3132
Ashtabula	Rock Creek	PO Box 92, Rock Creek 44084	440-563-3992
Trumbull	West Farmington	PO Box 81, W Farmington OH 44491	330-889-2558
Trumbull	West Farmington	PO Box 215, W Farmington OH 44491	330-889-2558
Geauga	Middlefield Village	PO Box 1019, Middlefield 44062	440-632-5248

Table 20. Contact List for County Seats of the Upper Grand River Watershed.

County	County Seat	Phone
Ashtabula	25 W. Jefferson St, Jefferson, OH 44047	440-576-3750
Geauga	470 Center Street, Chardon, Ohio 44024-1068	440-279-1660
Portage	449 S. Meridian Street, Ravenna, Ohio 44266	330-297-3600
Trumbull	160 High St NW, Warren, OH 44481-1093	330-675-2451

I. INTRODUCTION, Defining the Upper Grand River Watershed

2. Regulated community

The following tables list the NPDES Permits for discharges into the Upper Grand River (Table 21) and Lower Grand River. Links are provided for Ohio EPA permits in the Upper Grand River. Visit the Ohio EPA's Division of Surface Water Individual NPDES Permits (Industrial and Municipal Discharges) for more information on Ohio's Individual NPDES Permits (Industrial and Municipal Discharges). (http://www.epa.ohio.gov/dsw/permits/individuals.aspx)

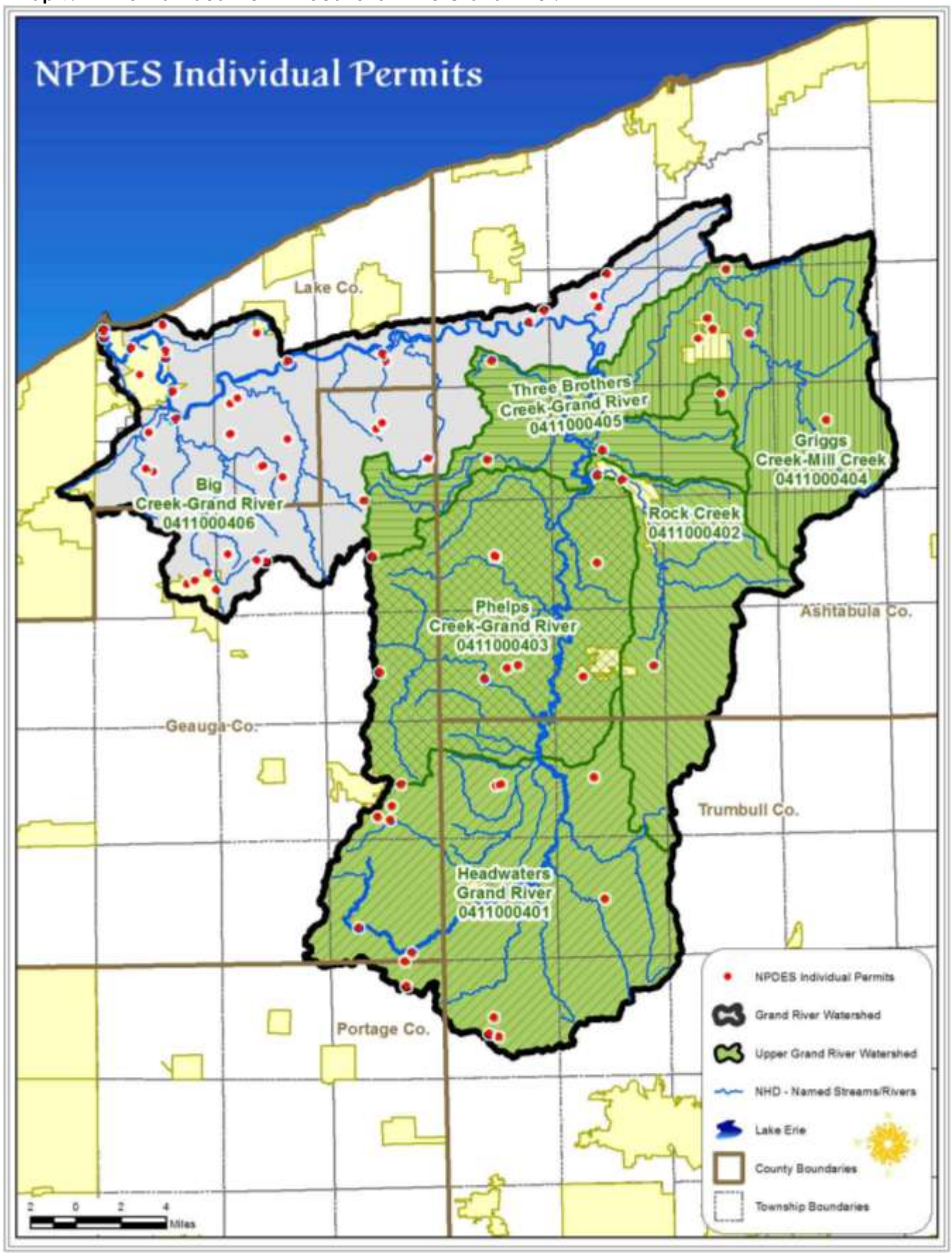
Table 21. NPDES Permits in the Upper Grand River Watershed.

12-Digit HUC	OEPA Permit	USEPA Permit	FACILITY	COUNTY
041100040101	3PR00227	OH0128473	Halfway Restaurant	Trumbull
041100040101	3PV00066	OH0107514	Southington Estates LLC	Trumbull
041100040101	3PT00067	OH0126187	Southington Local Schools	Trumbull
041100040102	3PV00009	OH0044334	Nelson Ledges Estate MHP	Portage
041100040102	3PR00274	OH0129569	Kool Lakes Family Campground - Clubhouse	Portage
041100040102	3PR00135	OH0098396	Rigsby Ranch FKA River Pines	Geauga
041100040102	3PG00160	OH0134279	Geauga Co Parkman WWTP	Geauga
041100040104	3PT00065	OH0126012	Bristol Local School	Trumbull
041100040105	3PT00128	OH0139238	Bloomfield High School	Trumbull
041100040106	3PV00053	OH0098507	Middlefield MHP	Geauga
041100040106	3IQ00027	OH0063908	Mercury Plastics Inc Fabrication	Geauga
041100040106	3PW00029	OH0129411	Bridge Lake Farm WWTP	Geauga
041100040106	3PR00465	OH0140333	End of Commons General Store	Trumbull
041100040106	3IH00076	OH0129526	Middlefield Orig Cheese Coop	Geauga
041100040106	3IN00300	OH0123692	Shively Land Co LLC	Trumbull
041100040201	3IY00160	OH0123480	Orwell WTP	Ashtabula
041100040203	3PB00068	OH0045659	Roaming Shores WWTP	Ashtabula
041100040203	3PA00029	OH0107204	Rock Creek STP	Ashtabula
041100040301	3PR00424	OH0137243	Camp Whitewood	Ashtabula
041100040301	3PT00137	OH0143065	Cardinal Local Sch Dist	Geauga
041100040302	3PT00074	OH0126357	Windsor Community Center	Ashtabula
041100040302	3PR00232	OH0128589	Grand Valley Country Manor	Ashtabula
041100040302	3PR00214	OH0126314	Hartsgrove BP Convenient Station	Ashtabula
041100040302	3PR00270	OH0129470	Hartsgrove General Store	Ashtabula
041100040303	3PB00041	OH0026913	Orwell WWTP	Ashtabula
041100040305	3PP00044	OH0129984	ODOT Rome Maintenance Outpost	Ashtabula
041100040402	3PP00041	OH0128449	ODOT Dorset Outpost Garage	Ashtabula
041100040402	3PT00029	OH0044920	Ashtabula County JVS	Ashtabula
041100040403	3PV00081	OH0121614	DFC MHP	Ashtabula
041100040403	3PC00021	OH0025887	Jefferson WWTP	Ashtabula
041100040403	3PR00438	OH0139301	Harassment's Bar	Ashtabula
041100040403	3PR00324	OH0133027	King Luminaire Co Inc	Ashtabula
041100040403	3IS00121	OH0131296	Ken Forging Inc	Ashtabula
041100040501	3PT00116	OH0134473	Glenbeigh Hospital	Ashtabula
041100040502	3PR00192	OH0125865	Plank Road Tavern	Geauga
041100040502	3PR00457	OH0139629	Great Lake Medieval Faire	Ashtabula
041100040502	3PT00136	OH0142999	Cork Elem	Ashtabula

Table 22. NPDES Permits in the Lower Grand River Watershed.

12-Digit HUC	OEPA Permit	USEPA Permit	FACILITY	COUNTY
041100040601	3PG00145	OH0098469	Coffee Crk WWTP	Ashtabula
041100040601	3PT00115	OH0134457	Grand River Academy	Ashtabula
041100040601	3IG00089	OH0129186	Pilot Travel Center No 2	Ashtabula
041100040602	3PV00076	OH0112135	Rustic Pines MHP WWTP	Geauga
041100040602	3PT00141	OH0143189	Ledgemont High School	Geauga
041100040603	3PR00391	OH0136719	Kenisee Grand River Campground	Ashtabula
041100040603	3PV00084	OH0123421	Whispering Willow MHP	Ashtabula
041100040604	3PT00142	OH0143197	Ledgemont Elementary School	Geauga
041100040604	3PR00372	OH0134601	Camp Lejnar	Lake
041100040604	3PR00178	OH0123641	Cedar Hills Conference Center	Lake
041100040605	3PR00333	OH0133159	Thompson United Methodist Church	Geauga
041100040605	3PR00379	OH0134686	Young Men's Christian Assoc (YMCA) Outdoor	Lake
041100040605	3PR00143	OH0101583	Thunder Hill Golf Course	Lake
041100040605	3PR00357	OH0134244	Little Thunder Kids Golf Course	Lake
041100040606	3PB00010	OH0022659	Chardon WWTP	Geauga
041100040606	3IE00058	OH0051551	Structural North America	Geauga
041100040606	3PR00179	OH0123650	Chardon United Methodist Church	Geauga
041100040606	3PG00055	OH0028908	Wintergreen WWTP	Geauga
041100040606	3PR00430	OH0139131	Hambden Grange Hall No 2482	Geauga
041100040606	3PR00156	OH0112291	Terrace Glen Estates MHP	Geauga
041100040606	3PV00077	OH0117129	Maple Ridge MHC	Geauga
041100040606	3PG00063	OH0039021	Sunshine Acres STP	Lake
041100040606	3PR00383	OH0134759	Concord Tavern	Lake
041100040606	3IE00004	OH0037982	Ricerca Biosciences LLC	Lake
041100040606	3PR00380	OH0134708	Grumpy Bear LLC dba Bunky's Pub	Lake
041100040606	3PT00055	OH0103021	Leroy Elem Sch	Lake
041100040606	3PR00382	OH0134732	Capps Tavern	Lake
041100040606	3PR00478	OH0140571	Junior Properties LTD	Lake
041100040606	3PT00120	OH0134716	Henry F LaMuth Middle Sch	Lake
041100040606	3PG00130	OH0092096	Rio Grand WWTP	Lake
041100040607	3PR00398	OH0136841	Frary's Restaurant	Lake
041100040607	3PH00054	OH0091952	Heatherstone WWTP	Lake
041100040607	3IB00015	OH0039357	Painesville Municipal Electric Plant	Lake
041100040607	3II00071	OH0114511	Eckart America LP	Lake
041100040607	3PV00120	OH0134694	Spring Lake MHP	Lake
041100040607	3PD00029	OH0026948	Painesville WPC Plt	Lake
041100040607	3IJ00021	OH0001317	Carmeuse Lime Inc Grand River Ops	Lake
041100040607	3PR00377	OH0134660	Mid-West Materials Inc	Lake
041100040607	3IE00030	OH0000515	Morton Salt	Lake
041100040607	3IF00007	OH0000299	Hardy Industrial Technologies LLC *	Lake

Map 9. NPDES Individual Permit Locations in the Grand River.



This page left intentionally blank

I. INTRODUCTION, Defining the Upper Grand River Watershed

C. Geographic locators

- **USGS HUC**

Watersheds in the United States were delineated into hydrologic units by the U.S. Geological Survey using a national standard hierarchical system based on surface hydrologic features. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to twelve digits based on the six levels of classification: 2-digit HUC – region, 4-digit HUC – subregion, 6-digit HUC – accounting unit, 8-digit HUC - cataloguing unit, 10-digit HUC – watershed & 12-digit HUC – subwatershed.

The 8-digit HUC for the Grand River Watershed is 04110004. (See Map 9)

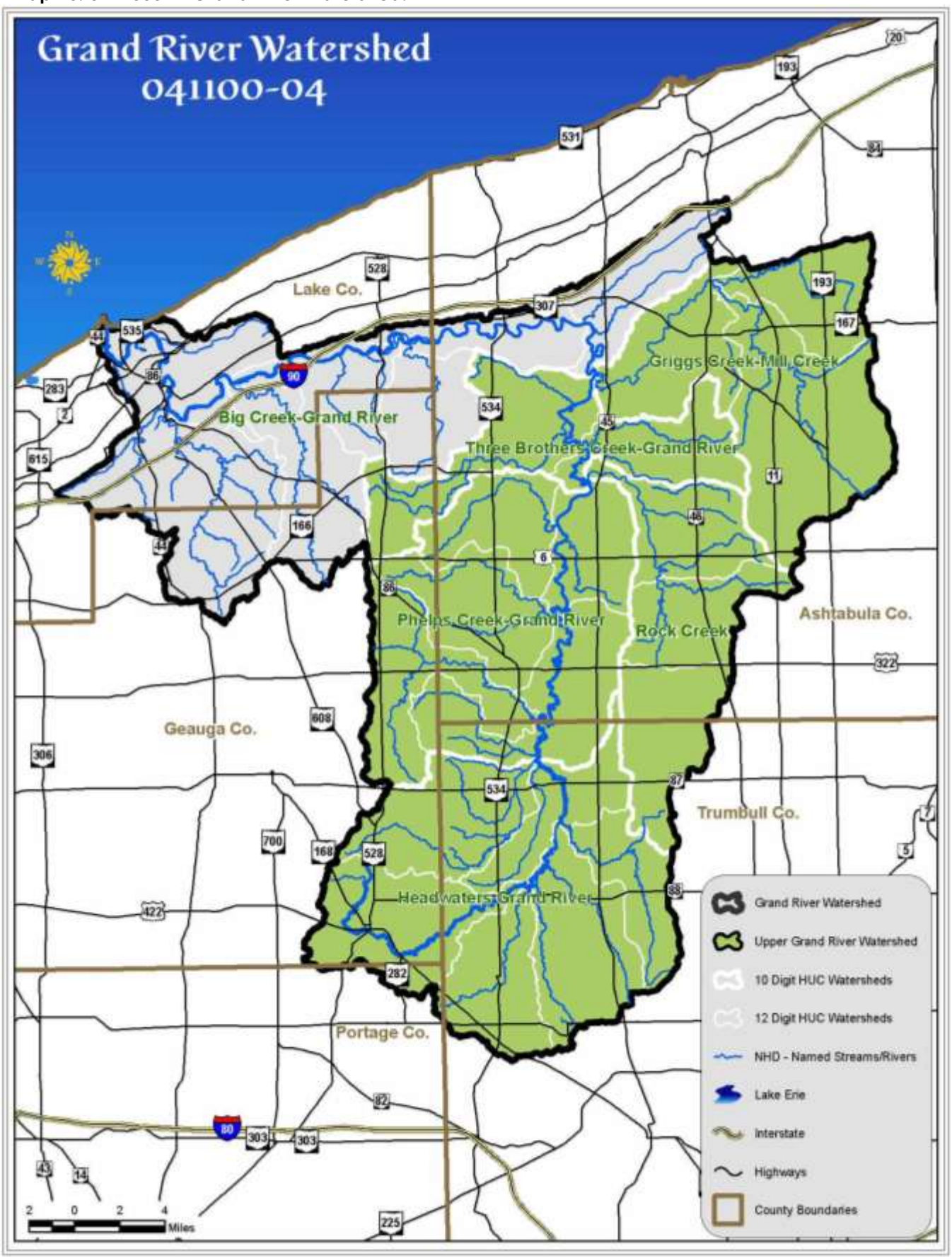
Table 23. The 10-digit HUC's for The Grand River subwatersheds.

HUC 10	HUC 10 Name	ACRES
0411000401	Headwaters Grand River	100,542
0411000402	Rock Creek	45,349
0411000403	Phelps Creek-Grand River	84,594
0411000404	Griggs Creek-Mill Creek	66,238
0411000405	Three Brothers Creek-Grand River	36,950
0411000406	Big Creek-Grand River (Lower Grand)	117,894

(See Maps 10 - 15)

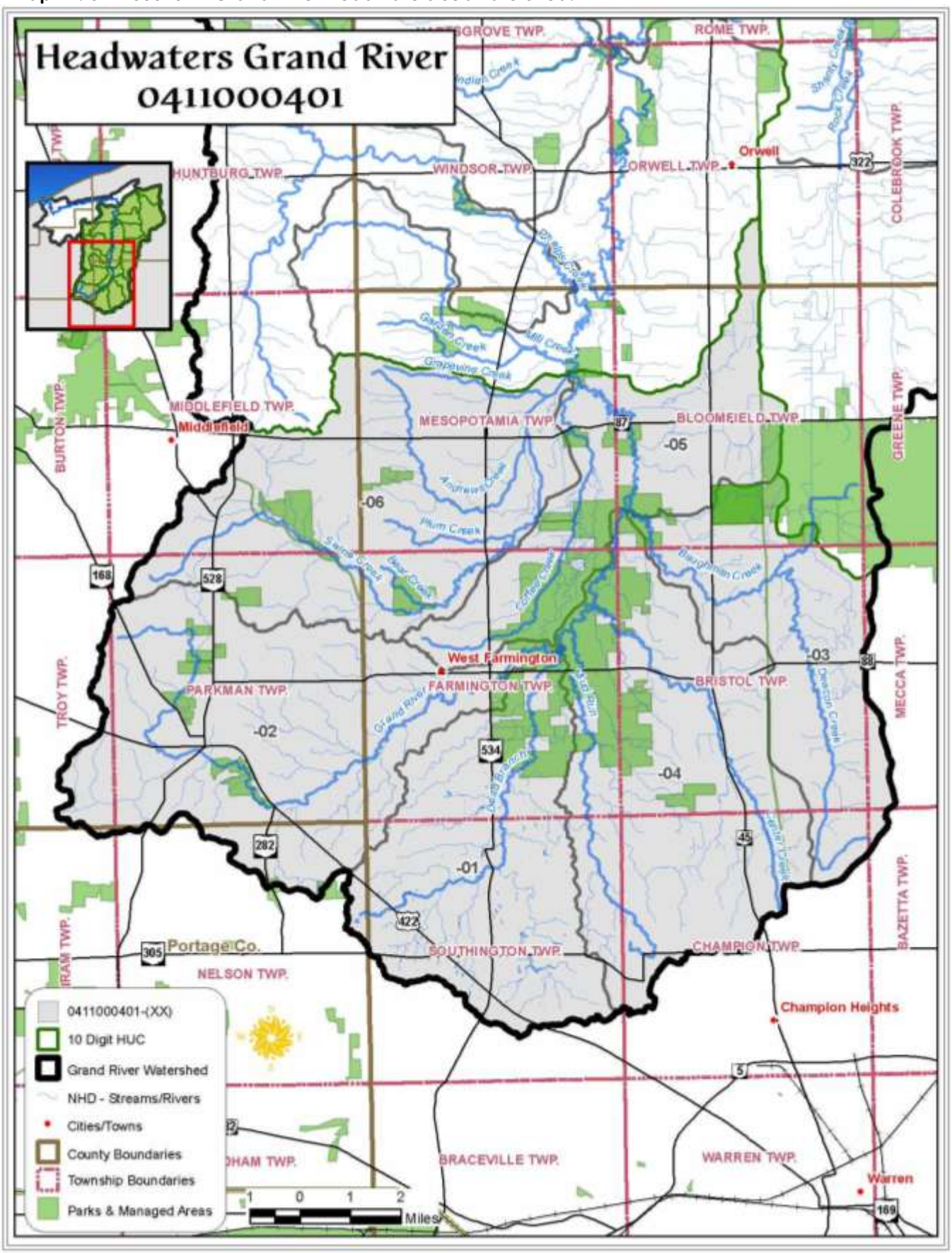
I. INTRODUCTION, Defining the Upper Grand River Watershed

Map 10. 04110004 - Grand River Watershed.



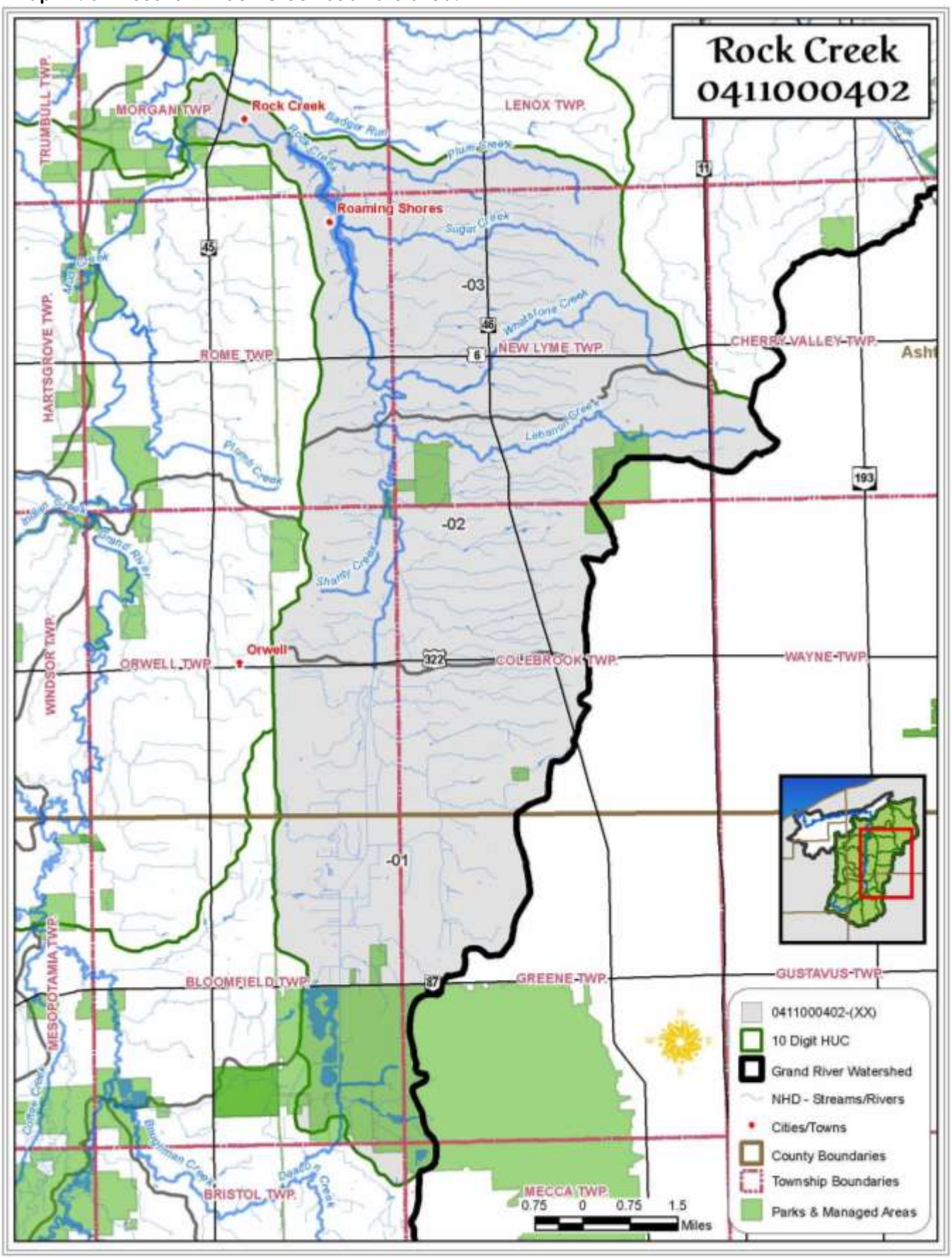
I. INTRODUCTION, Defining the Upper Grand River Watershed

Map 11. 0411000401 - Grand River Headwaters Subwatershed.

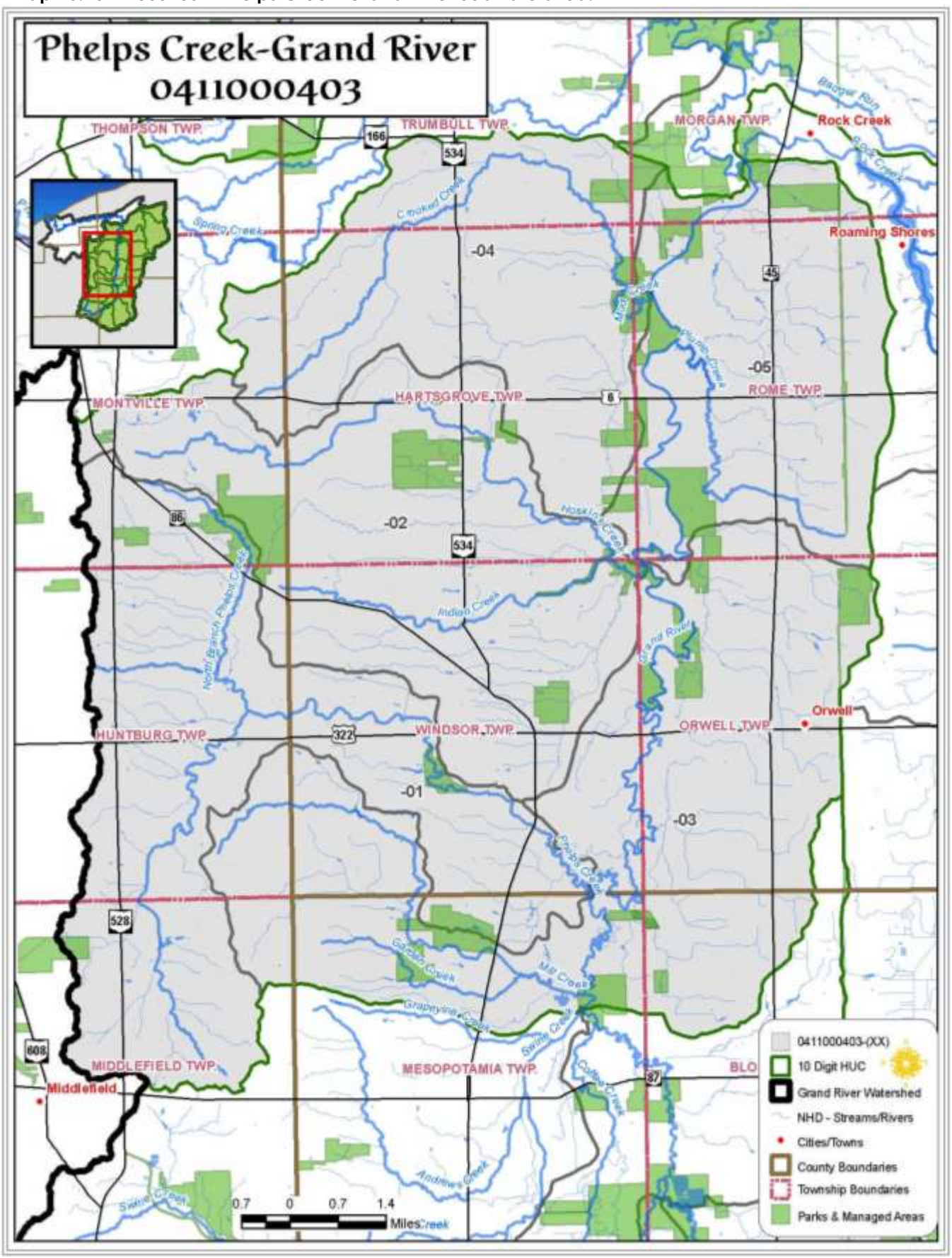


I. INTRODUCTION, Defining the Upper Grand River Watershed

Map 12. 0411000402 - Rock Creek Subwatershed.

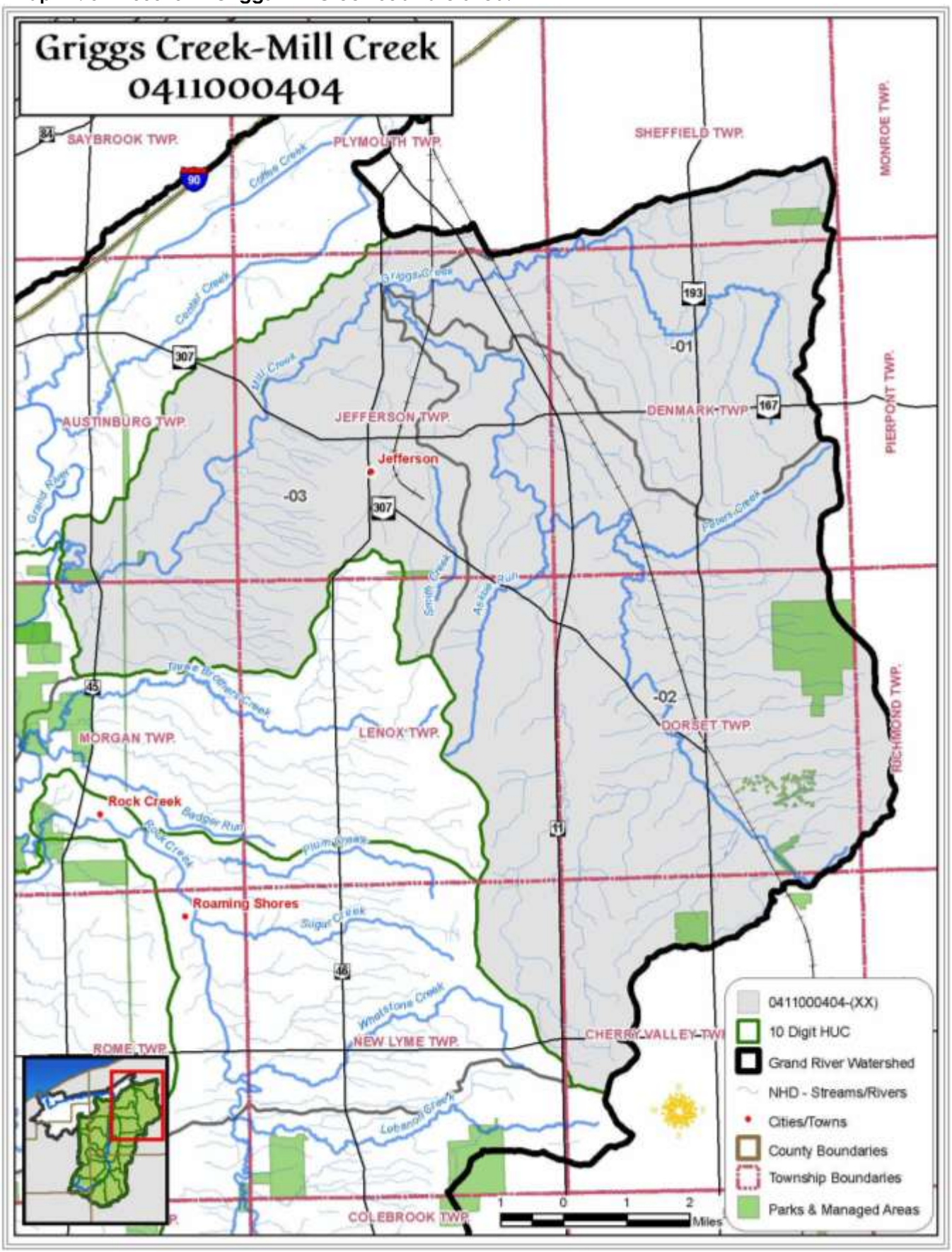


Map 13. 0411000403 - Phelps Creek-Grand River Subwatershed.



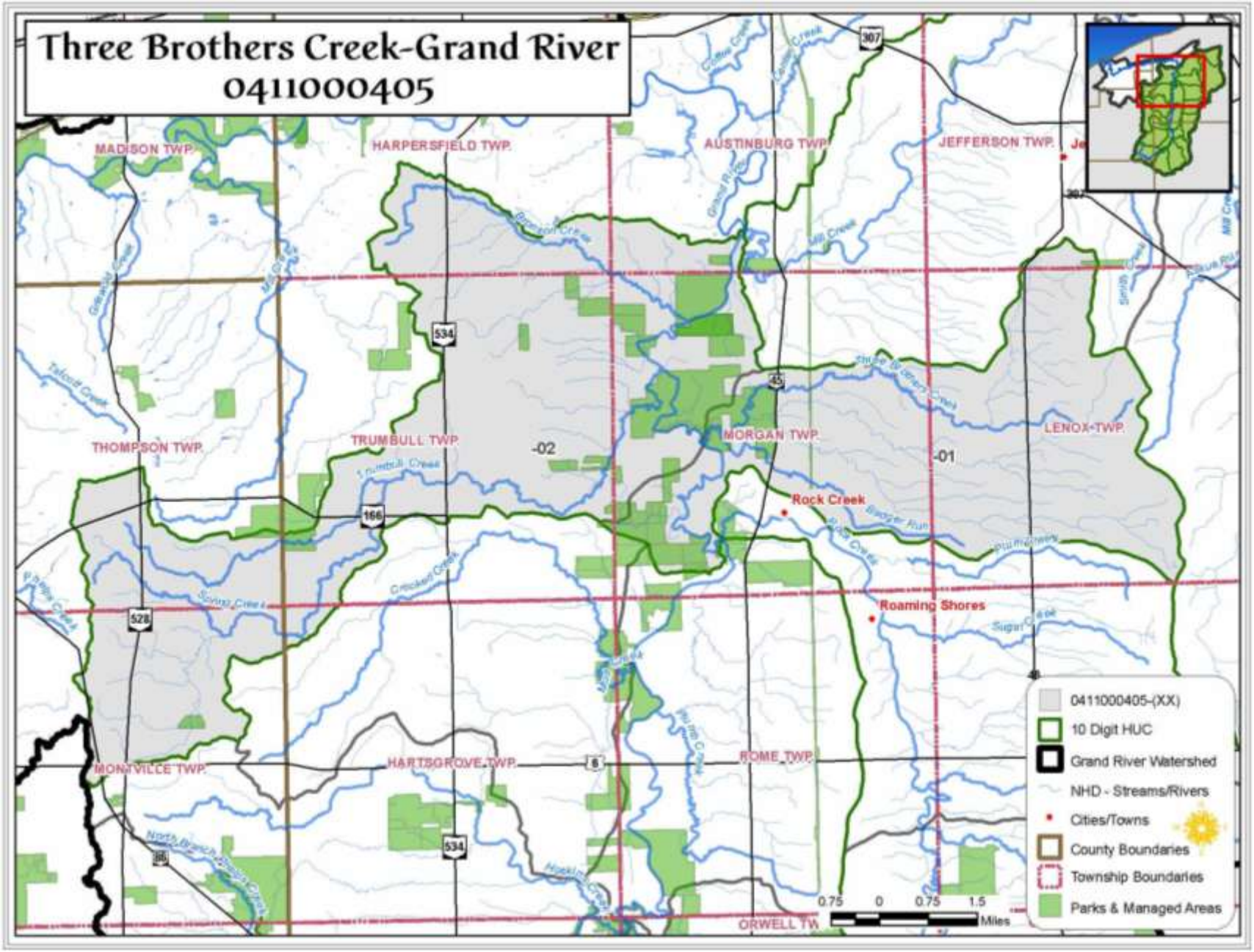
I. INTRODUCTION, Defining the Upper Grand River Watershed

Map 14. 0411000404 - Griggs-Mill Creek Subwatershed.



I. INTRODUCTION, Defining the Upper Grand River Watershed

Map 15. 0411000405 - Brothers Creek - Grand River Subwatershed.



I. INTRODUCTION, Defining the Upper Grand River Watershed

Map 16. 0411000406 - Big Creek - Grand River Subwatershed.

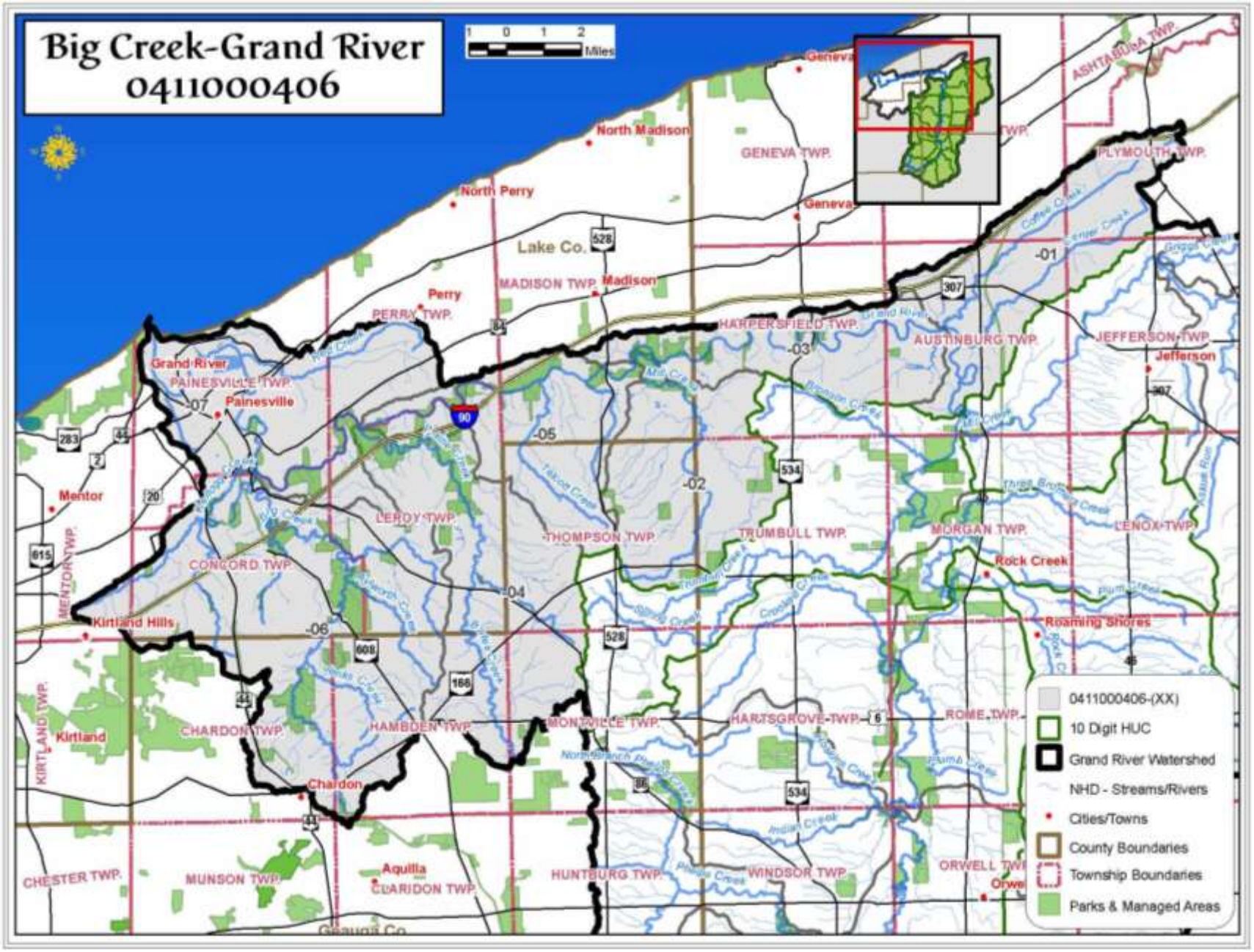


Table 24. The 12-digit HUC's for The Grand River subwatersheds.

HUC 12	HUC 12 Description	ACRES
041100040101	Dead Branch	15,452
041100040102	Headwaters Grand River *(Grand River headwaters to above Dead Branch)*	21,228
041100040103	Baughman Creek	11,790
041100040104	Center Creek-Grand River *(Grand River below Dead Branch to above Baughman Creek)*	20,093
041100040105	Coffee Creek-Grand River *(Grand River below Baughman Creek to above Swine Creek)*	12,163
041100040106	Swine Creek	19,816
041100040201	Upper Rock Creek *[Snyder Ditch to U.S. Rt. 224 (Rock Creek headwaters)]*	16,635
041100040202	Middle Rock Creek *(Rock Creek below U.S. Rt. 224 to below of Lebanon Creek)*	13,658
041100040203	Lower Rock Creek *(Rock Creek below Lebanon Creek to mouth)*	15,056
041100040301	Phelps Creek	18,765
041100040302	Hoskins Creek	17,175
041100040303	Mill Creek (1)-Grand River *[Grand River below Swine Creek to above Hoskins Creek (except Phelps Creek)]*	22,888
041100040304	Mud Creek	13,467
041100040305	Plumb Creek-Grand River *[Grand River below Hoskins Creek to above Rock Creek (except Mud Creek)]*	12,299
041100040401	Griggs Creek	13,216
041100040402	Peters Creek-Mill Creek *(Mill Creek (2) headwaters to above Griggs Creek)*	35,025
041100040403	Town of Jefferson-Mill Creek *(Mill Creek (2) below Griggs Creek to Grand R.)*	17,997
041100040501	Three Brothers Creek-Grand River *(Grand River below Rock Creek to below Three Brothers Creek)*	13,875
041100040502	Bronson Creek-Grand River *[Grand River below Three Brothers Creek to above Mill Creek (2)]*	23,075
041100040601	Coffee Creek-Grand River *[Grand River below Mill Creek (2) to below Coffee Creek (Lower Grand)]*	14,063
041100040602	Mill Creek (3) (Lower Grand)	13,415
041100040603	Village of Mechanicsville-Grand River *[Grand River below Coffee Creek to above Mill Creek (3) (Lower Grand)]*	10,617
041100040604	Paine Creek (Lower Grand)	18,424
041100040605	Talcott Creek-Grand River *[Grand River below Mill Creek (3) to above Paine Creek (Lower Grand)]*	12,346
041100040606	Big Creek (Lower Grand)	32,224
041100040607	Red Creek-Grand River [Grand River below Paine Creek to Lake Erie [except Big Creek] (Lower Grand)]	16,805

- **State 305(b) identification numbers**

Table 25. State 305(b) Identification Number for Grand River Watershed

305(b) ID	Stream Name
03-001	Grand River
03-002	Black Brook (Lower Grand)
03-003	Pebble Branch (Lower Grand)
03-004	Red Creek (Lower Grand)
03-005	Kellogg Creek (Lower Grand)
03-006	Ellison Creek (Lower Grand)
03-007	Talcott Creek (Lower Grand)
03-008	Griswold Creek (Lower Grand)
03-009	Mill Creek (Grand R. RM 23.58) (Lower Grand)
03-010	Coffee Creek (Lower Grand)
03-011	Center Creek (Lower Grand)
03-012	Bronson Creek (Lower Grand)
03-013	Trumbull Creek (Lower Grand)
03-014	Spring Creek (Lower Grand)
03-015	Three Brothers Creek (Lower Grand)
03-016	Badger Run (Lower Grand)
03-017	Crooked Creek (Lower Grand)
03-018	Mud Creek (Lower Grand)
03-019	Mill Creek (Grand R. RM 75.17)
03-020	Garden Creek
03-021	Coffee Creek
03-022	Baughman Creek
03-023	Center Creek
03-024	Mud Run
03-025	Dead Branch
03-026	Marsh Creek
03-027	Heisley Creek
03-028	McKinley Creek
03-030	Mentor Creek
03-031	Trib. to Grand River (RM 11.05)
03-032	Trib. to Grand River (RM 19.28)
03-033	Trib. to Grand River (RM 21.22)
03-100	Big Creek
03-101	Gordon Creek
03-102	East Creek
03-103	Aylworth Creek
03-104	Jenks Creek
03-105	Cutts Creek
03-110	Paine Creek
03-111	Bates Creek
03-112	Phelps Creek
03-120	Mill Creek (Grand R. RM 41.28)
03-121	Griggs Creek
03-122	Askue Run
03-123	Peters Creek
03-124	Cemetery Creek
03-130	Rock Creek
03-131	Plum Creek
03-132	Sugar Creek
03-133	Whetstone Creek
03-134	Lebanon Creek
03-135	Shanty Creek
03-140	Hoskins Creek
03-141	Indian Creek
03-142	Montville Ditch
03-150	Phelps Creek
03-151	North Branch Phelps Creek
03-152	South Branch Phelps Creek
03-160	Swine Creek
03-161	Grapevine Creek
03-162	Andrews Creek
03-163	Plum Creek

- **Other (e.g., GIS, long-lat, etc.)**

Table 26. Latitude, Longitude & Elevations of Key Features of the Grand River Watershed.

Feature	Latitude	Longitude	Elevation (ft)
Grand River Headwaters (Parkman)	041° 24' 39.00" N	-081° 04' 0.30" W	1180
Grand River Mouth (@ Lake Erie)	041° 45' 37.83" N	-081° 16' 49.90" W	571
Scenic Section (Beginning)	041° 32' 4.72" N	-080° 54' 5.24" W	786
Scenic Section (End) (Lower Grand)	041° 45' 22.42" N	-080° 56' 28.47" W	728
Wild Section (Beginning) (Lower Grand)	041° 45' 22.42" N	-080° 56' 28.47" W	728
Wild Section (End) (Lower Grand)	041° 42' 58.67" N	-081° 13' 42.24" W	607
Gauging Station (Painesville) (Lower Grand)	041° 44' 26.51" N	-081° 02' 47.91" W	677
Confluence of Red Creek & Grand River (Lower Grand)	041° 44' 57.87" N	-081° 14' 9.95" W	580
Confluence of Big Creek & Grand River (Lower Grand)	041° 42' 25.83" N	-081° 13' 47.01" W	611
Confluence of Paine Creek & Grand River (Lower Grand)	041° 43' 19.49" N	-081° 10' 33.84" W	636
Confluence of Talcott Creek & Grand River (Lower Grand)	041° 44' 15.34" N	-081° 04" 52.27" W	664
Confluence of Griswold Creek & Grand River (Lower Grand)	041° 44' 15.34" N	-081° 03' 33.17" W	677
Confluence of Mill Creek (3) & Grand River (Lower Grand)	041° 44' 42.15" N	-081° 02' 0.51" W	682
Confluence of Coffee Creek & Grand River (Lower Grand)	041° 45' 20.87" N	-080° 52' 22.59" W	755
Confluence of Center (2) Creek & Grand River (Lower Grand)	041° 45' 6.98" N	-080° 51' 57.02" W	757
Confluence of Mill Creek (2) & Grand River	041° 43' 24.54" N	-080° 51' 50.05" W	758
Confluence of Bronson Creek & Grand River	041° 42' 13.29" N	-080° 52' 53.84" W	758
Confluence of Trumbull Creek & Grand River	041° 41' 37.18" N	-080° 53' 22.27" W	759
Confluence of Three Brothers Creek & Grand River	041° 40' 33.81" N	-080° 52' 37.39" W	765
Confluence of Rock Creek & Grand River	041° 39' 17.73" N	-080° 52' 20.40" W	768
Confluence of Mud Creek & Grand River	041° 37' 39.77" N	-080° 53' 56.97" W	768
Confluence of Plumb Creek (Lake Cardinal) & Grand River	041° 38' 43.79" N	-080° 52' 35.39" W	769
Confluence of Hoskins Creek & Grand River	041° 34' 14.64" N	-080° 54' 10.40" W	778
Confluence of Phelps Creek & Grand River	041° 30' 01.85" N	-080° 55' 07.55" W	791
Confluence of Mill Creek (1) & Grand River	041° 28' 48.50" N	-080° 55' 18.05" W	796
Confluence of Swine Creek & Grand River	041° 28' 37.36" N	-080° 55' 18.40" W	799
Confluence of Coffee Creek & Grand River	041° 28' 25.33" N	-080° 55' 07.43" W	800
Confluence of Baughman Creek & Grand River	041° 26' 10.66" N	-080° 54' 03.47" W	808
Confluence of Center (1) Creek & Grand River	041° 24' 32.54" N	-080° 54' 49.82" W	818
Confluence of Mud Run & Grand River	041° 24' 09.36" N	-080° 55' 22.88" W	821
Confluence of Dead Branch & Grand River	041° 23' 46.30" N	-080° 55' 37.40" W	823

I. INTRODUCTION, Defining the Upper Grand River Watershed

D. General Watershed Information

- **Background/historic information on previous and/or current watershed protection and management activities, including previous planning documents**

Lower Grand River Watershed Action Plan - Prepared by: Vicki Domonkos, Watershed Coordinator, Grand River Partners, Inc. – Conditionally endorsed by the State of Ohio, pending Ohio EPA TMDL

In 2000, Grand River Partners, Inc. was awarded a Watershed Coordinator Grant, which provided the organization the ability to hire a Watershed Coordinator to develop a comprehensive plan for the Lower Grand River and its surrounding watershed. Knowing the size and the number of different ecological areas of the watershed, it was decided to break the watershed into two separate sections for the planning process; the Upper and Lower Grand River Watersheds.

The goal of the Lower Grand River Watershed Plan is to address causes and sources of water quality impairments and habitat degradation within the watershed, and to recommend restoration and protection goals. The outcome of the Lower Grand River Watershed Plan is an itemization of problems, priorities, and action items identified and supported by local Grand River Watershed communities.

The purpose of this plan is to reduce water resource impairment in all water bodies within the Lower Grand River Watershed that do not currently meet water quality standards. It is also to identify areas that are meeting standards, and protect these areas. However, the main goal of the Lower Grand River Watershed Plan is to restore and maintain the chemical, physical, and biological integrity of water bodies within the watershed. Lakes, ponds, wetlands, are all covered under state and federal law.

Grand River Riparian Corridor Protection Plan – March 1998 - Prepared by Davey Resource Group

The Grand River Watershed Protection Project's goal is to protect the water quality and aquatic habitat, wetlands, and associated forest communities of the 705-sqaure-mile (approximately 455,680 acres) Grand River Watershed.

The first objective is to protect the riparian corridor of the Grand River and major tributaries through acquisition of conservation easements and land use controls. Criteria for prioritization of conservation easements have been created and land use controls that local jurisdictions can use have been identified based on public health and safety.

The second objective is to provide education for landowners on the ecological and economic benefits of riparian buffers, wetlands, floodplains, and steep slopes. The Grand River Riparian Corridor Protection Manual being developed in conjunction with this report will assist elected officials, public servants, decision makers, and concerned citizens in making the right choices for watershed protection.

The Grand River Riparian Corridor Protection Plan was adopted by the Grand River Partnership in March of 1998. To date, the Grand River Partnership has permanently protected approximately 50 miles of Streambank of the Grand River Proper.

Upper Grand River Watershed Plan; "A Watershed Management Plan for the Grand River Watershed"

This plan was written by a group of partnering agencies including: the Ashtabula Soil and Water Conservation District, Eastgate Regional Council of Governments, Geauga County Health Department, Geauga Soil and Water Conservation District, Grand River Partners, Inc., Kent State University, Lake Erie College, ODRN Division of Natural Areas and Preserves, ODNR Division of Soil and Water, ODNR Division of Wildlife, Ohio EPA Northeast District, Portage County Soil and Water Conservation District, Trumbull County Planning Commission, Trumbull County Soil and Water Conservation District, and the Trumbull Health Department.

The purpose of this plan is to reduce water resource impairment in all waterbodies within the Grand River Watershed that do not currently meet water quality standards. It is also to identify areas that are meeting standards, and protect these areas. The goal of the plan is to restore and maintain the chemical, physical, and biological integrity of waterbodies within the watershed. Lakes, ponds, wetlands are all covered under state and federal law.

I. INTRODUCTION, Defining the Upper Grand River Watershed

Grand River Watershed Conservation Area Plan – July 2005 – Prepared by the Nature Conservancy, Ohio Chapter

The Ohio Chapter of The Nature Conservancy has developed a conservation plan for the Grand River as a guide for focusing its activities on the highest conservation priorities in the watershed over the next five years. Most of these activities will require working cooperatively with local partners to achieve conservation success. This plan will be coordinated with the planning efforts of Grand River Partners, Inc., as well as other organizations working in the area.

The conservation targets, threats, and overall conservation goals are summarized below. The full document, including conservation strategies, is presented on the pages that follow.

Table 27. Conservation Targets for the Grand River Watershed.

(Source: Table from Grand River Watershed Conservation Area Plan – July 2005 – Prepared by the Nature Conservancy, Ohio Chapter)

Target #1	Medium Shale Run River and Associated Riparian and Tributary Communities ("Gorge" Area)
Target #2	Medium to Large River and Associated Lowland Floodplain and Tributary Communities ("Lowlands" Area)
Target #3	Primary Headwater Streams and Associated Wetland Communities
Target #4	Upland Forest Mosaic (Dry-Mesic Mixed Forest with Hemlock (White Pine) Northern Hardwood Forest as a nested target)
Target #5	Northern (Great Lakes) Flatwoods (Hemlock-Yellow Birch Swamp Forest and Wet (Sedge-Grass) Meadow as nested targets)
Target #6	Eastern Massasauga Rattlesnake
Target #7	Glacial Slump (Calcareous Cliff Communities)

Threats to Conservation Targets in the Grand River Watershed

Incompatible residential development

Development of roads or utilities

Incompatible forestry practices

Invasive species

Incompatible agricultural practices

Oil or gas drilling

Altered drainage patterns or diversions of water

Clearing of riparian buffers

Wastewater treatment

Disruption of natural disturbance regime (flooding, fire)

Lampricide application

Priority Conservation Goals for the Grand River Watershed

Overall: Improve viability ranking of each target in the watershed.

Maintain at least 50% forest cover throughout entire watershed.

Ensure that at least 10 occurrences of each forest type greater than 100 acres within the watershed are protected by conservation ownership or management.

Increase size of each protected core forest area to at least 225 acres.

Maintain at least 75% forest cover within 100 feet buffer around Class III primary headwater streams.

I. INTRODUCTION, Defining the Upper Grand River Watershed

Grand River Headwater Prioritization / Coldwater Stream Study

This project will initiate development of headwater stream conservation priorities for the western rim of the Grand River watershed which occurs in Lake, Geauga and Ashtabula counties, Ohio. Conservation priorities for these streams will be developed through a combination of analyses using patterns of baseflow discharge to identify areas of high groundwater contribution, determining what landscape features these areas are associated with using a Geographic Information System (GIS), and field surveys to identify important local freshwater biodiversity features found within identified areas. It is hoped that results from initial analyses in select subwatersheds can be used to develop models to identify priority areas in adjacent subwatersheds, and possibly develop ordinances to help protect these important resources. This will be of major benefit to the Lower Grand River Watershed in maintaining its high water quality.

Lake Soil and Water Conservation District, Headwater Habitat Evaluation Study

Lake County Soil and Water Conservation District have been working on gathering data and information on all of the Headwater streams in the county. The ultimate goal of this study is to illustrate the importance and the direct impacts that Headwater Streams have on the overall health of the river system as a whole, and eventually generate regulations that protect these headwater streams. To date, all of the Headwater Streams in the Lower Grand River Watershed, located within Lake County, have been evaluated.

Comprehensive Wildlife Conservation Strategy; Streams and Watersheds Tactical Plan 2005-2010

The Ohio Department of Natural Resources, Division of Wildlife developed a tactical plan to ensure that the quality and health of Ohio's most biologically diverse and pristine habitats remain in tact. The main goal of this plan is to use a watershed approach in protecting and managing riparian habitats to enhance aquatic wildlife abundance and diversity, and increase recreational opportunities in Ohio's Focus Watersheds.

Focus Watersheds were drawn from the ODNR Candidate Streams for Protection and Restoration. This rates Ohio watersheds by integrating measures of physical and biological integrity, biodiversity, and recreational opportunity. All watersheds received a prioritization score which ranks their relative importance for protection and restoration activities. The DOW has identified eleven Focus Watersheds to concentrate efforts related to aquatic portion of its CWCS. These include the highest scoring watersheds in Ohio. Watersheds in both the Lake Erie and Ohio River drainages representing all of Ohio's major ecoregions have been included. All have diverse habitat types with high use designations and excellent biodiversity, and most are Ohio Scenic Rivers. The Grand River was given a score of 11, the second highest score in the state of Ohio.

The key strategies outlined in the plan include; dam removal and fish passage, habitat protection and restoration on private lands, habitat restoration and protection on public lands, biological habitat assessment and monitoring, restoration and maintenance of hydrological functions, educating Ohio's citizens regarding the value of streams and watersheds, and to provide funding for stream and watershed programs.

Part II.
WATERSHED PLAN DEVELOPMENT

This Page Intentionally left blank

II. WATERSHED PLAN DEVELOPMENT

Watershed partners

Grand River Partnership - In the early 1990s, several conservation agencies operating within the watershed recognized a number of threats to the river's quality and moved to develop ways to maintain the pristine conditions of the Grand River Watershed. This loose coalition of public and private agencies has come to be known as the Grand River Partnership.

The Grand River Partnership (Partnership), is made of many different agencies, organizations, and businesses. These entities decided there was a need for a member driven group solely focused and dedicated to specific projects and areas within the Grand River Watershed. These partners offer invaluable information and expertise to the residents and landowners in the Grand River Watershed. This group meets quarterly, and maintains a healthy working relationship to assure that the high quality of the Grand River and its surrounding watershed is well maintained. Below is a complete list of members of the Partnership and the information, expertise, and knowledge that they provide.

Western Reserve Land Conservancy facilitates the Grand River Partnership by conducting meetings, forming project collaborations and directing partnership relations and activities. The Grand River Watershed coordinator acts as the facilitator for the partnership and coordinates meetings, and communications.

- **Watershed residents, landowners**

  Western Reserve Land Conservancy membership of over 1700 includes members from all parts of the Western Reserve region of Northeast Ohio. The Grand River Chapter of the Land Conservancy has specific focus on the Grand River Watershed and the five counties associated with the watershed. Members of the Grand River Chapter participate in the watershed action plan process, education and outreach, fundraising and volunteer efforts such as restoration and clean-up projects. The most current list of members can be found in the Land Conservancy's annual report. (http://www.wrlandconservancy.org/news-publications.htm)

- **Local businesses/industries, regulated community**

  Western Reserve Land Conservancy donor base of foundations and corporations consists of a diverse group of organizations partnering with the Land Conservancy for a variety of reasons. Some donors provide the land conservancy with general financial support, while others provide funding for specific projects. The most current listing of corporate and foundation support can be found in the Land Conservancy's annual report. (http://www.wrlandconservancy.org/news-publications.htm)

- **Local and state governments**

  Lake County Stormwater Management Department- stormwater infrastructure pertaining to quality and quantity, Phase II implementation, public information on Stormwater – **Member of Grand River Partnership**

  Ohio EPA- water quality data, watershed plan guidance and information, attainment status and information, TMDL status and information, NPDES permits, emergency spill response – **Member of Grand River Partnership**

  ODNR- Division of Forestry- Forest Management Plans, forest information, timber harvest information, emerald ash borer, techniques on management of forests – **Member of Grand River Partnership**

  ODNR- Division of Natural Areas and Preserves- Scenic Rivers Program, rare species information, invasive species information, natural resources preservation/nature preserves, canoe clean-ups, water quality information – **Member of Grand River Partnership**

  ODNR- Division of Soil and Water Conservation- estimating load reductions for agricultural and urban land, soil publications, watershed planning information and assistance, grants, trainings – **Member of Grand River Partnership**

  ODNR- Division of Wildlife- hunting regulations, wildlife data and information, Lake Erie fisheries status, fish stocking schedules, wildlife population stats, land protection, wildlife diversity, project funding – **Member of Grand River Partnership**

II. WATERSHED PLAN DEVELOPMENT

U.S. Army Corps of Engineers- protection of the nation's aquatic resources, permitting information, wetland information, wetland mitigation expertise – **Member of Grand River Partnership**

U.S. Fish and Wildlife Service- wetland restoration and planning assistance, invasive species control – **Member of Grand River Partnership**

USDA Natural Resources Conservation Service- soils information, conservation assistance and planning, cost share programs and funding for agricultural BMPs, WRP assistance – **Member of Grand River Partnership**

Western Reserve Resource Conservation & Development- WRP funding, Countryside Program (conservation development), riparian area protection, WREP funding, agricultural BMPs – **Member of Grand River Partnership**

- **Non governmental organizations**

Cleveland Museum of Natural History- plant species identification and information, invasive plant species information, rare habitat preservation, biodiversity, natural community preservation – **Member of Grand River Partnership**

Ducks Unlimited- NAWCA funding, waterfowl information, migratory bird information, wetland construction – **Member of Grand River Partnership**

The Farmland Center- Farmland protection in the Western Reserve, technical assistance to local communities, resources for farmers and communities, outreach programs – **Member of Grand River Partnership**

The Land Trust Alliance – latest information and regulations regarding land protection, professional trainings and conferences, land protection policy and guidance – **Member of Grand River Partnership**

The Nature Conservancy- land preservation, GIS mapping and printing, land protection prioritization, conservation easements, land stewardship – **Member of Grand River Partnership**

Ohio Wetlands Foundation- wetland information, mitigation resources, stream mitigation – **Member of Grand River Partnership**

Trust for Public Land- greenprinting work, conservation of public lands, local funding for conservation – **Member of Grand River Partnership**

Western Reserve Land Conservancy - land protection/conservation easements, conservation buyer program, works with landowners in a 14-county region – **Member of Grand River Partnership**

- **Community organizations**

LEADERship Ashtabula County- encourage, educate, and stimulate individuals to become familiar with, interested in, and engaged in all facets of civic endeavor.

- **Educational institutions or educators**

Kent State University- (Trumbull & Ashtabula) provides GIS and information, research, student internships – **Member of Grand River Partnership**

Lake Erie College- provides GIS and information, research, student internships – **Member of Grand River Partnership**

Hiram College- provides GIS and information, research, student internships – **Member of Grand River Partnership**

OSU Extension/Sea Grant - livestock and crop information, forestry information, land use information, groundwater resources, water resource protection and management, Ohio Watersheds Network, Ohio Woodland Stewards Program, Lake Erie information – **Member of Grand River Partnership**

II. WATERSHED PLAN DEVELOPMENT

E. Mission Statement

- **Mission statement of Grand River Partnership**

  Grand River Partnership is a taskforce devoted to improving the water quality of the Grand River. Federal, state and local conservation agencies, farmers, businesses, foundations and citizens work together by helping landowners comply with regulations and maximize the responsible use of their property and resources. The partnership provides stewardship for the natural resources making our region a productive, healthy and beautiful place to live.

- **Problems in mission statement**

  Discover level of participation by partnership members in planning and implementation of WAP.

F. Structure, organization, administration

Grand River Partnership is a loose confederation of agencies, private organizations, businesses and individuals working together to bring preservation, protection and restoration to the Grand River watershed.

- **Legal status**

  The Grand River Partnership has no legal status.

- **Partner roles and responsibilities**

  The Grand River Partnership is facilitated by the watershed coordinator and the sponsor organization, currently Western Reserve Land Conservancy. The watershed coordinator sets quarterly meeting dates, arranges for the quarterly meeting venue and prepares the quarterly meeting agenda. There are no other formal roles or responsibilities within the Grand River Partnership.

- **Operational procedures and bylaws**

  The Grand River Partnership has no operational procedures or bylaws.

- **Group decision-making process**

  The Grand River Partnership makes decisions through discussion and general consensus.

- **Basic contact information**

  The basic contact information for the participating members of the Grand River Partnership is available upon request from the watershed coordinator.

G. General Plan Content

- **Outline of the plan's content**

  The plan is set up to follow the Appendix 8 format. It begins with an introduction to the watershed followed by discussion of the plans development before inventorying the key components of the Upper Grand River. This is followed with a discussion of the impairments in the stream before proceeding to tables that include the problem statements, action items, and how they will be implemented. The evaluation process describes how the plan will be updated and revised.

- **Endorsement of plan by key watershed partners**

  A draft copy of the watershed action plan will be submitted to the Area Assistance Team for review. After corrections and additional information is added to the plan per the recommendations of the Area Assistance Team, the plan will be submitted for state endorsement. After the plan is endorsed by the state, local stakeholders, agencies and governments will be approached for endorsement.

- **Adoption of the plan by local units of government.**

  The planning team will be seeking endorsement of the watershed action plan by the governing bodies of all partner jurisdictions. A statement of endorsement to be added later, will be found in the table at the beginning of the plan.) after submission of the plan for state endorsement. Following state endorsement we will be seeking additional support and endorsement from those jurisdictions not participating in the plan development as well as any other interested parties. We will work with local

units of government to seek adoption of the plan. A signed table of endorsers will appear at the beginning of the final plan.

- **Information/education component for public understanding of the project**

Communication and Education Outreach will be an ongoing action throughout the planning and implementation process. As part of the final portion of the inventory phase of planning, a fact sheet will be created to share with our elected officials as well as the general public the current status of the Grand River Watershed. This fact sheet will provide a general overview of the Grand River Watershed and will include causes of impairments along with their sources and outlines our next steps in planning.

Local primary and secondary (K-12 & colleges & universities) will be approached and asked to participate in the education and outreach efforts within the watershed.

As the team develops a menu of possible action items for restoring and protecting the creek we will be inviting members of the community review and provide feedback. Some of the meetings will be focused on specific stakeholder groups including the development community, business community, agricultural community, as well as the general public.

Following the completion of the planning process, the Grand River Partnership will be kept apprised of new developments in the watershed. They will also be invited to activities focused on the watershed, such as creek clean-ups and festivals. An annual forum on the watershed will be held to bring together all those interested in the watershed, including these stakeholders, and will provide an opportunity to invite new partners into the partnership. Participants in the event will also be asked to provide suggestions and observations, regarding the future state of the river and any particular problems needing to be addressed.

a. Public Meetings

Stakeholder meetings will be held by a combination of 10 digit Hydrologic Unit Codes.

0411000404 – Griggs – Mill Creek (2) & 0411000405 – Three Brothers Creek – Grand River
0411000403 - Phelps Creek-Grand River & 0411000402 – Rock Creek
0411000401 - Headwaters Grand River

Elected Officials – Initial meetings – Watershed Planning 101 - Introduction to Watershed Planning

August 25, 2011 - 0411000404 & 0411000405 – held at Ashtabula County Soil & Water Conservation District, 39 Wall Street, Jefferson, OH 44047-1137

September 8, 2011 - 0411000403 & 0411000402 – held at The Nature Conservancy - Northeast Ohio Project Office, Gregory Building, 3973 Callender Rd, Rome Township, OH 44084

September 21, 2011 – 0411000401 – held at Geauga Park District, Swine Creek Reservation, Swine Creek Lodge, 16004 Hayes Road, Middlefield Township, OH 44062

General Public – Initial meeting – Watershed Planning 101 - Introduction to Watershed Planning

September 1, 2011 - 0411000404 & 0411000405 – held at Ashtabula County Soil & Water Conservation District, 39 Wall Street, Jefferson, OH 44047-1137

September 15, 2011 - 0411000403 & 0411000402 – held at The Nature Conservancy - Northeast Ohio Project Office, Gregory Building, 3973 Callender Rd, Rome Township, OH 44084

September 29, 2011– 0411000401 – held at Geauga Park District, Swine Creek Reservation, Swine Creek Lodge, 16004 Hayes Road, Middlefield Township, OH 44062

Elected Officials – Subsequent meetings – Update on Planning Progress - TBA

General Public – Subsequent meetings – Update on Planning Progress - TBA

b. School/Public Presentations

Meetings for school and the general public are conducted on a request basis. The presentation is tailored to fit the audience. Please contact the Grand River Watershed Coordinator to arrange for a watershed presentation.

II. WATERSHED PLAN DEVELOPMENT

c. Survey of Watershed Residents

Survey of Residents of the Upper Grand River Watershed by Grand River Partners, Inc., Trumbull County Health Department and Ohio State University Extension to determine residents' attitudes toward protecting water quality and preserving sensitive lands in the watershed, particularly those lands adjacent to the river itself or to tributaries that lead to the river. An article titled "From Water Quality to Riparian Corridors: Assessing Willingness to Pay for Conservation Easements Using the Contingent Valuation Method" reports the outcome of the survey to elicit public response to a proposal to fund a purchase of a conservation easements program to protect an environmentally sensitive riparian corridor. The results from two versions of the contingent valuation method (CVM)--a payment card and a referendum--reveal that mean household willingness to pay (WTP) is $16.80 and $29.16, respectively. Factors influencing WTP include proposed cost, age of respondent, and individual sense of local environmental priorities. This type of study represents an important opportunity for Extension educators to assist local officials as they struggle to make policy decisions regarding a variety of public projects.

An additional survey may be conducted to determined local awareness of watershed action planning and implementation activities and efforts.

This Page Intentionally left blank

PART III.
WATERSHED INVENTORY

This Page Intentionally left blank

III. WATERSHED INVENTORY

A. Description of the watershed

- **Geology**

1. Topography

The Grand River is very unique, and its varying topography has created a wide variety of habitats. The Grand River watershed (elevation: highest – 1384 feet above sea level; lowest – 569 feet above sea level; total change in elevation – 815 feet) can be broken into five very different topographical sections: the headwaters, the lowlands, the gorge area, tributaries, and the estuarine area. The sections of the Grand River that lie within the Upper Grand River Watershed include the Headwaters Area, the Lowlands area, and the Tributaries area.

Pre-Glacial and Inter-Glacial Drainage and Topography

Stout and Lamborn (1924), Stephenson (1933), Stout et al. (1943), Cummins (1950), and Totten and White (1987) provide accounts of the pre-glacial and inter-glacial drainage and drainage changes in Mahoning County and adjacent areas. Drainage changes occurring over time in Mahoning County are numerous and complex and are still not totally understood. It is important to note that entire drainage systems, including tributaries, have changed and these various systems have been superimposed (overlapped) over time.

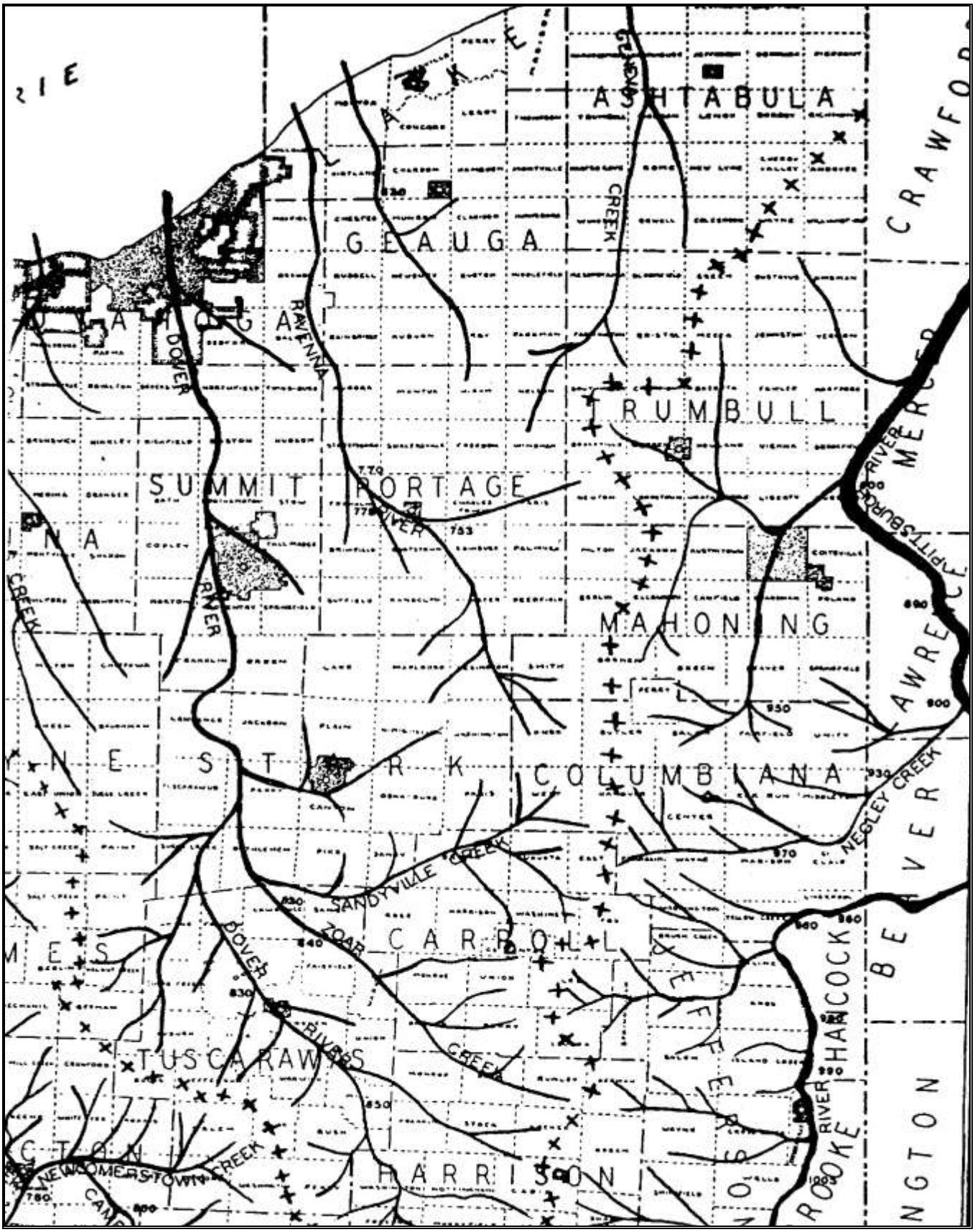
Stout et al. (1943) proposed that a northeasterly-flowing tributary of the Pittsburgh River drained the majority of Mahoning County (Figure 5). The Pittsburgh River flowed roughly northward from Pittsburgh and was the master stream draining this area (Stout et al., 1943 and Totten and White, 1987). Stout et al. (1943) also proposed that the Ravenna River drained the western margin of Mahoning County. The Ravenna River flowed northwestward through Portage County and Geauga County. Stout et al. (1943) speculated that these drainages, although not physically connected, were roughly time equivalent of the Teays River drainage system in south-central and western Ohio.

Previously, Stout and Lamborn (1924) and Stephenson (1933) had provided an alternative interpretation of the pre-glacial drainage of the area. These reports referred to the master stream draining this region as the ancestral Monongahela River. The ancestral Monongahela River flowed northward, approximately followed the course of the present Beaver River and Shenango River through western Pennsylvania (Stephenson, 1933). At Sharon Pennsylvania, the ancestral Monongahela River turned sharply to the southwest, flowing towards Hubbard. This stream cut the broad valley presently occupied by Crab Creek (Stephenson, 1933). Where modern Crab Creek valley joins the Mahoning River valley, the ancestral Monongahela River turned to the northwest, roughly following the course of the present Mahoning River (Stout and Lamborn, 1924 and Stephenson, 1933).

(source: Ground Water Pollution Potential Of Mahoning County, Ohio By Michael P. Angle, Ohio Department Of Natural Resources, Division Of Water Resources Section. 2003)

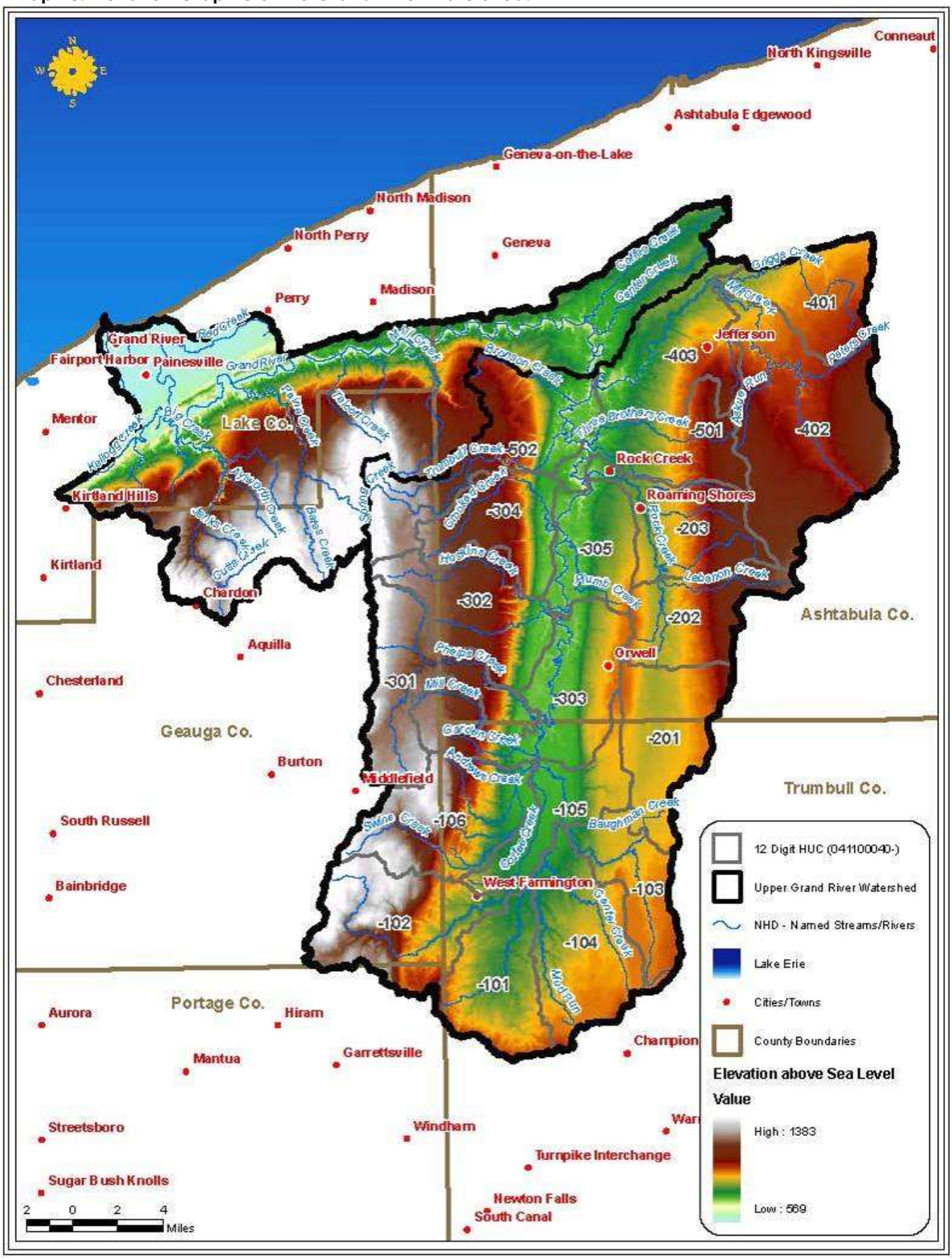
III. WATERSHED INVENTORY

Map 17. Pre-glacial (Teays Stage) drainage in Northeast Ohio (after Stout et al., 1943). The line of x's indicate the drainage divide.

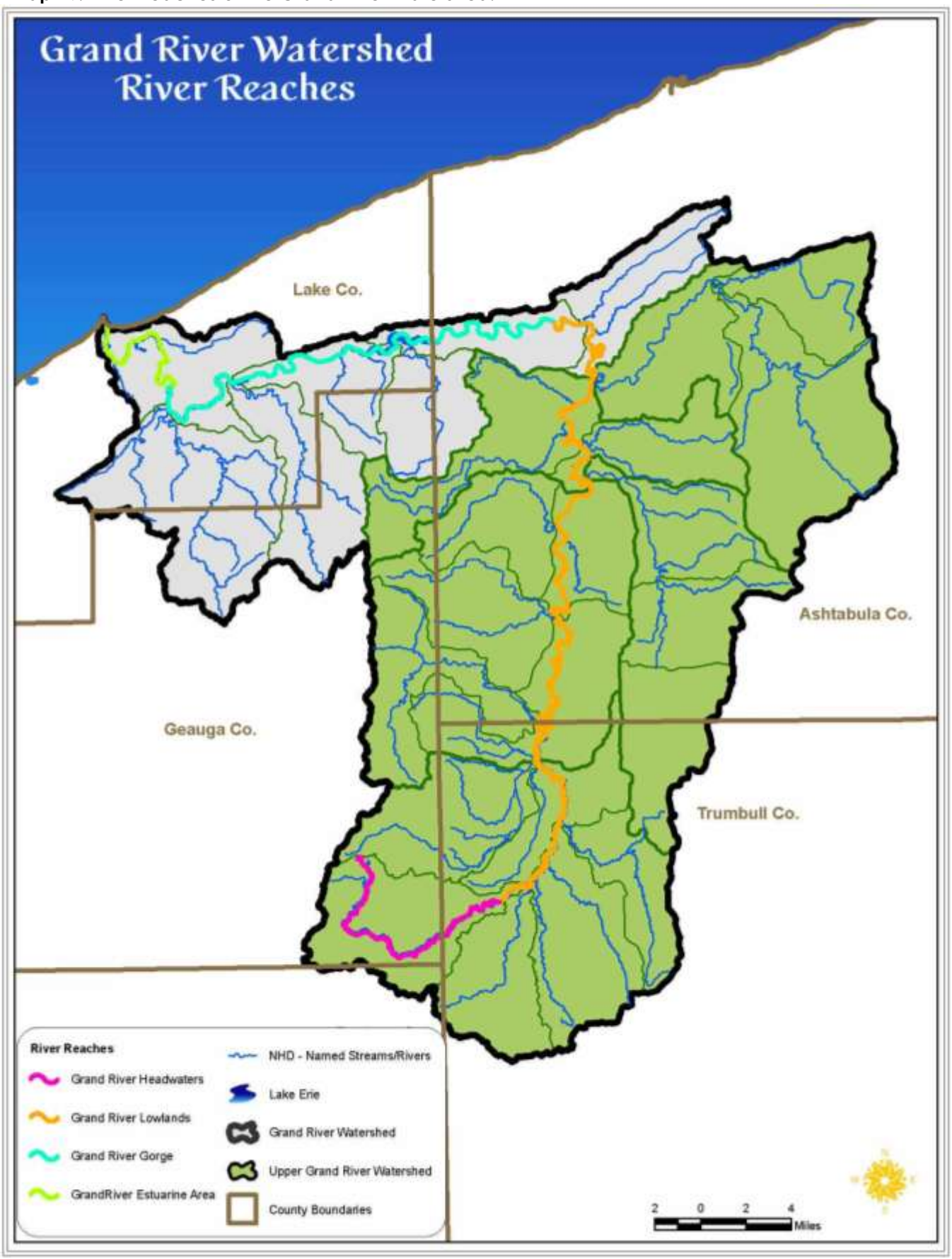


III. WATERSHED INVENTORY

Map 18. Elevation Graphic of the Grand River Watershed.



Map 19. River Reaches of the Grand River Watershed.



III. WATERSHED INVENTORY

Major Regions of the Upper Grand River Watershed

The Headwaters Area

Photo 4. Grand River Headwaters *(Source: GRPI)*

This 15.5 mile reach of the Grand River begins in Parkman Township, Geauga County from the headwaters downstream to State Route 88. Channel substrates through this portion of the river have very little diversity. The headwaters drain areas of the Grand River underlain predominately by sandstone bedrock, with very few riffle, run, pool complexes that are typically associated with streams. Where bedrock is very close to the surface, flow is not sustained through the summer because the shallow soil horizon does not store water (Map 20).

Major Regions of the Upper Grand River Watershed (cont'd)

The Lowlands Area

Photo 5. Grand River Lowlands *(Source: GRPI)*

Located between State Route 88 and Cork Cold Springs Road, the lowlands lay where the Grand River cut a channel through what once was an ancient lake bed. The lake bed is approximately 2 miles wide and has a profound influence on the rivers morphology. Here the Grand River flows through an entrenched channel that meanders wildly and has a very low gradient with a predominance of pool areas. Riffles in this reach of the Grand River are very few. Extensive terraces and wetlands can be found adjacent to the river. In this reach of the Grand River the floodplain is very narrow as a result of the entrenched channel. Soft sediments and woody debris dominate the substrate types in this reach of the river. The presence of fine sediments in combination with the narrow floodplain cause the fine material to remain suspended in the water column. The Grand River takes on a stained appearance that is simply the nature of the river. The water color only typically clears up each fall. The stained appearance of the water is for the most part natural, and not caused by land use practices (Map 20).

Major Regions of the Upper Grand River Watershed (cont'd)

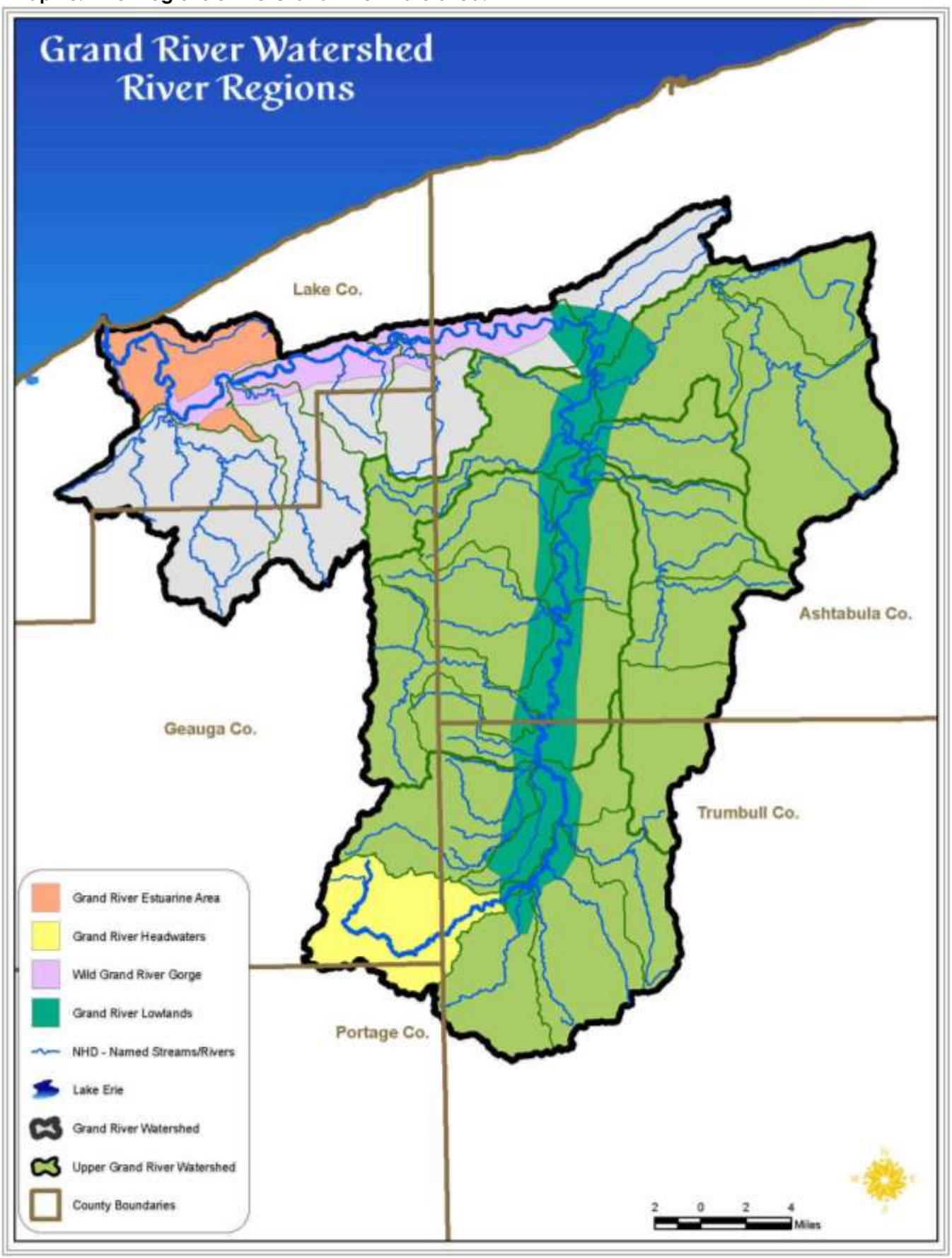
The Tributaries Area

Photo 6. Grand River Tributaries - Phelps Creek *(Source: GRPI)*

Comprised of the high quality tributaries, the tributaries area helps maintain the Grand River's pristine water quality. A number of these tributaries have been studied and monitored by the EPA and have been found to be some of the highest quality streams. Some of these tributaries to the Grand River have been found to be very rare, Cold Water Streams based on their biology.

III. WATERSHED INVENTORY

Map 20. River Regions of the Grand River Watershed.



III. WATERSHED INVENTORY

2. Geology

a. Bedrock Geology: Most of the bedrock in the Grand River Watershed is Mississippian and Pennsylvanian in age. The Mississippian rocks are generally fine-grained siltstones and sandstones, while the Pennsylvanian rocks are mostly conglomerates, sandstones, shales, limestone, and coal. The strata dip gently to the south and southeast at about 30 feet per mile.

b. Surficial Geology: The glacial and immediate postglacial history of the region is mostly responsible for surficial deposits in the Upper Grand River Watershed. The watershed is dominated by three major types of deposits:

i. Silty tills dominate the uplands of the Glaciated Plateau;

ii. Sorted sands and gravels from glacial outwash are present mostly along the western boundary of the watershed;

iii. Fine silts and clays dominate the Grand River Lowland that had been occupied by proglacial lakes;

3. Soils

Soil in Ohio depends on the interrelationships of five soil-forming factors physical and mineralogical composition of the parent material, climate under which the material has accumulated and existed since accumulation, the plant and animal life in and on the soil, relief or topography; and the length of time weathering has acted on the soil matter. During the last glaciation, debris carried along by the glaciers was deposited either directly by the ice or by meltwater from the glacier. The material left by glacial ice sheets was in the form of silty glacial tills and ground moraine across the uplands, sorted outwash along the ice margins and clayey lake plains in the Grand River Lowland.

Soils are here discussed by county. In Trumbull County they can be divided into several broad categories. The first category occurs on modern floodplains and on the former glacial lake surfaces. These are level to gently sloping areas that vary from very poorly drained to well drained in a few locations. In general these soils suffer from flooding and seasonal wetness and ponding, and have moderately slow to very slow permeability. Typically they have high seasonable water tables. Three soil associations are present in these poorly drained areas:

A - The Fitchville-Haskins-Sebring Association

B - The Caneadea-Canadice Association

C - Holly-Orrville-Tioga Association

All three associations consist of soils formed from fine texture lacustrine material, glacial outwash, or glacial till. The Holly-Orrville-Tioga Association is solely associated with flat flood plains and it is common to find it on valley floors associated with the basins of former glacial lakes.

In Ashtabula County the Caneadea-Canadice Association is present and has the same characteristics as in Trumbull County. In addition there are also the Platea-Pierpont Association, and the Platea-Sheffield Association. These are characterized by deep, nearly level to gently sloping soils that very from somewhat poorly drained to poorly drained silty soils situated on glaciated uplands. The Platea-Pierpont Association occurs in the northern part of the county on hummocky morainal deposits.

In northern Portage and Geauga Counties the soils associations are different. The Mahoning Ellsworth and the Remsen-Geeburg- Trumbull associations are formed on the glaciated uplands in fine to moderately fine textured glacial till. These are distinguished by somewhat poorly drained to moderately drained soils that are fairly deep to the bedrock. Overall these soils have slow to very slow permeability and are nearly flat to gently sloping. The Remsen-Geeburg- Trumbull association tends to be found on steeper areas along major drainage areas. The Sebring-Holly-Caneadea Association is in low lying basins mainly in the southern portion of Geauga County and in northern Portage County. Its main characteristics are poorly drained soils which are mainly silty or clayey. Most are level to gently sloping and were formed from either lacustrine material in former glacial lake basins, or from alluvial material on flood plains. Streams that form in these soils are typically slow, contain ponded areas and have a low gradient.

Hydric Soils These are soils that exhibit evidence that they have been saturated, flooded or ponded long enough annually to develop anaerobic conditions in the upper part. They make up part of the criteria for the identification of wetlands. Since areas within all soil map units delineated in soil survey publications include soils that vary from the soil series used in the map unit name, hydric soils constitute 100 percent of only the wettest of map units. Conversely, map units identified with moderately well drained soils in the map unit name may include relatively small areas in depressions or seeps that meet hydric soil criteria.

The Hydric Soils Map illustrates that a very high percentage of areas in most soil map units in the western coastal counties meets hydric soil criteria. Areas with a very high percentage of hydric soils are also common in Ashtabula County. The percentage of hydric soils is in the range of 45 to 65 percent in some map units near cities where areas of poorly drained and very poorly drained soils have been paved or built on and therefore no longer meet hydric soil criteria (Map 21).

Highly Erodible Lands (HEL) Highly Erodible Lands have been defined in order to identify areas on which erosion control efforts should be concentrated. The Food Security Act of 1985, as amended in subsequent farm bills, includes provisions that remove incentives to produce annually tilled agricultural commodity crops on highly erodible land unless cropland on such land is protected from excessive soil erosion. The definition is based on erosion indices derived from certain variables of the Universal Soil Loss Equation and the Wind Erosion Equation. The indices are the quotient of tons of soil loss by erosion predicted for bare ground divided by the sustainable soil loss, or "T factor."

Some soil map units are clearly defined as having slopes steep enough and long enough to meet highly erodible land criteria. Other soil map units are clearly defined as having so little slope or such short slopes that highly erodible land criteria cannot be met. Thus, they are designated as "Not highly erodible." Soil map units identified as "Potentially highly erodible land" require additional information to determine whether specific areas within delineations meet highly erodible land criteria.

Highly erodible land is rare in the Grand River Watershed. On the other hand, much of the land is potentially highly erodible. Most areas that are definitively highly erodible are narrow and associated with valley slopes that extend above 800 feet in elevation (Map 22).

Prime Farmland Prime Farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber and oilseed crops. It must also be available for these uses. It has the soil quality, growing season and moisture supply needed to produce economically sustained high yields of crops when treated and managed according to acceptable farming methods, including water management. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.

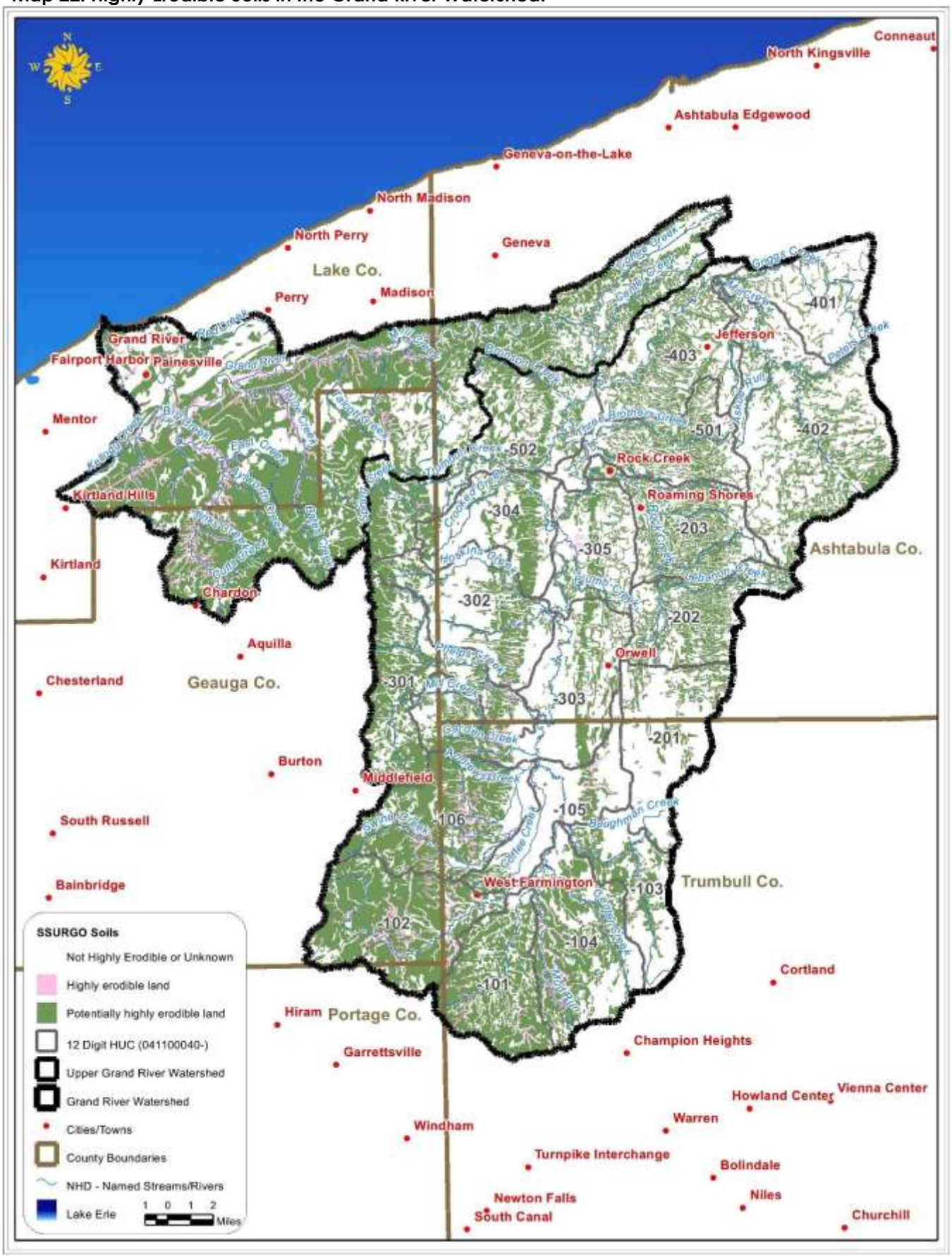
Most areas in the Grand River Watershed cannot meet prime farmland criteria. Soils that do not meet prime farmland include soils that have been converted to urban uses, soils that cannot be drained effectively, soils with insufficient moisture holding capacity, and soils with more than six percent slope (Map 23).

III. WATERSHED INVENTORY

Map 21. Hydric Soils in the Grand River Watershed.

III. WATERSHED INVENTORY

Map 22. Highly Erodible Soils in the Grand River Watershed.



III. WATERSHED INVENTORY

Map 23. Prime Farmland Soils in the Grand River Watershed.

This page left intentionally blank

4. Glacial History and Geology

Ohio is traditionally considered to have been affected by at least 4 glaciations: the Nebraskan, Kansan, Illinoian, and Wisconsinan. However, only traces of the Wisconsinan Stage are evident in the landscape today. Although, there is little or no dating control on the deposits and moraines in the region, White (1982) proposes that during the Wisconsinan Stage the Laurentide Ice Sheet invaded the area approximately 40,000 years ago as a series of ice lobes into the region. Specifically it advanced east-southeastward through the Lake Erie Basin as the Lake Erie Lobe. This lobe further split into sub-lobes that spilled southward onto what is now Ohio. The Grand River Valley held the Grand River Lobe, immediately to the west was the Killbuck lobe, and immediately to the east was another small unnamed lobe. The Grand River Lobe re-advanced several times to deposit at least 4 major tills in the region: the Titusville Till, the Kent Till, the Lavery Till, and the Hiram Till. One of the best exposures in the region is at Swine Creek Reservation where the 4 tills are evident (Figure 3). These tills have characteristically different grain size compositions affecting the soils in the region (Table 28).

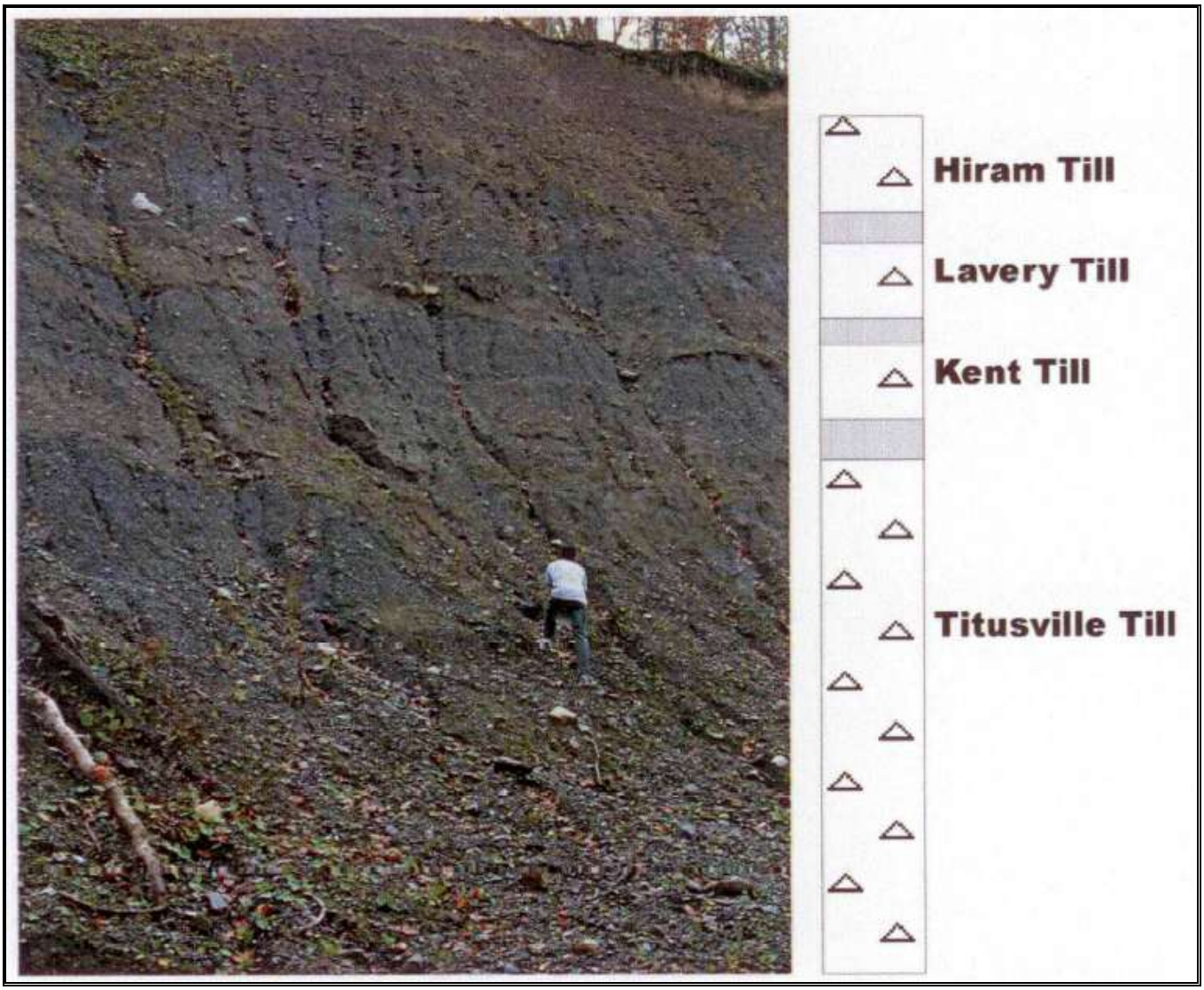
As the ice retreated northwards through the Grand River Lowland 2 separate lakes were trapped in front of the ice in the lowland area (Map 23). The oldest Lake, Rock Creek Lake, had its surface at approximately 900-920ft (White, 1971). Under this surface, lake silts and clays are up to 5ft thick. Rock Creek Lake drained eastward across northern Trumbull County into what is now Mosquito Creek Reservoir. The younger Grand River Lake, reached an elevation of approximately 810ft. At this elevation there is now a flat plain approximately 1-3 miles wide dominated by laminated sands silts and clays (White 1982). The Grand River Lake was likely dammed by ice as it sat at the Painesville Moraine.

The Grand River follows an unusual route that was influenced mostly by deposits and landforms of the last glaciation. The headwaters can be found in northern Portage and southern Geauga counties, and from there, the Grand River flows northeast and then directly north through Trumbull and Ashtabula Counties through the glacial lake dominated Grand River Lowland. At the northern end of the lowland, the river is faced by the Painesville Moraine that acts as a major barrier to its movement. This moraine also marks part of the watershed boundary. The river is forced to turn westward at a sharp 90° angle where it flows in a narrow valley between the Painesville Moraine to the north and the Euclid Moraine to the south (Map 24). The Grand River cuts through the Escarpment through the Chagrin Shale in places along this stretch to form the Grand River Gorge which is up to 250ft deep. This section of the river has been designated as wild. The gorge is dominated by more rugged topography, deep ravines, and faster flowing water. At the western extent of this stretch the river forces its way through the Painesville Moraine at Painesville. Once past the moraine, the Grand River meanders across the lower Lake Plain before entering into Lake Erie. The Lake Plain contains several cut-off meanders and meander scars of the Grand River. One abandoned meander is now Mentor Marsh State Nature Preserve. A glacial moraine also marks the southern margin of the Grand River Watershed. This, the Defiance Moraine, is a large prominent moraine that can be traced across all of Ohio.

Table 28. Composition of tills in the Grand River Watershed (modified from White, 1982)

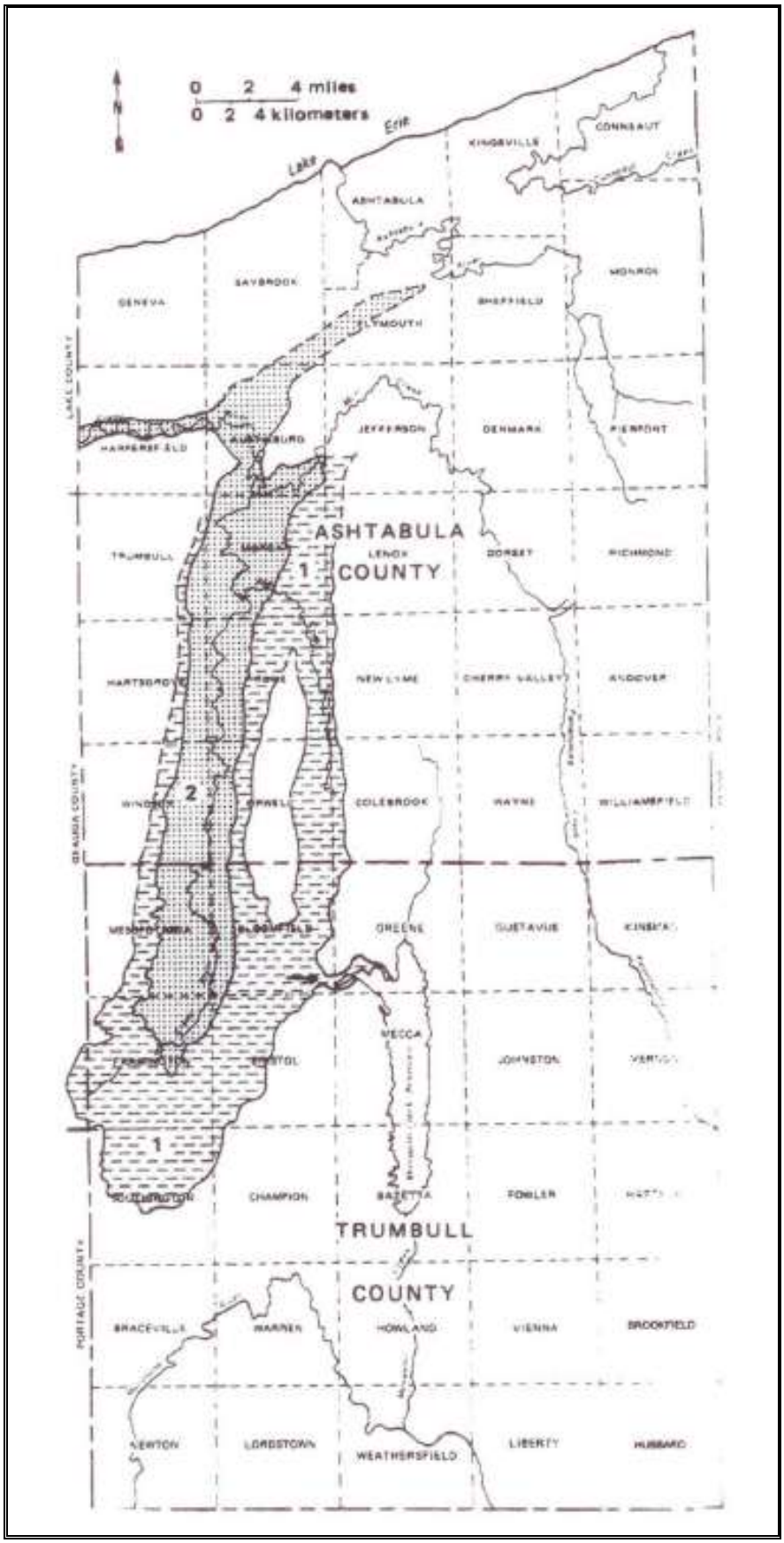
Composition	% sand	% silt	% clay
Hiram Till	20	47	33
Lavery Till	27	48	25
Kent Till	36	45	19
Titusville	43	40	17

Figure 3. Exposure of four (4) till units at Swine Creek Reservation. Silt beds lie between the tills.



III. WATERSHED INVENTORY

Map 24. Glacial lakes in the Grand River Watershed. 1. Rock Creek Lake (elevation 820±ft); 2. Grand River Lake (elevation 820±ft) ***(From White, 1982)***



III. WATERSHED INVENTORY

Map 25. End Moraines in the Grand River Watershed.
Map showing major glacial moraines based on glacial sediment distribution. 9. The Defiance Moraine; 12. The Kent Moraine; 14. The Euclid Moraine; 15. The Painesville Moraine; 16. The Ashtabula Moraine.
(Source: White, 1984)

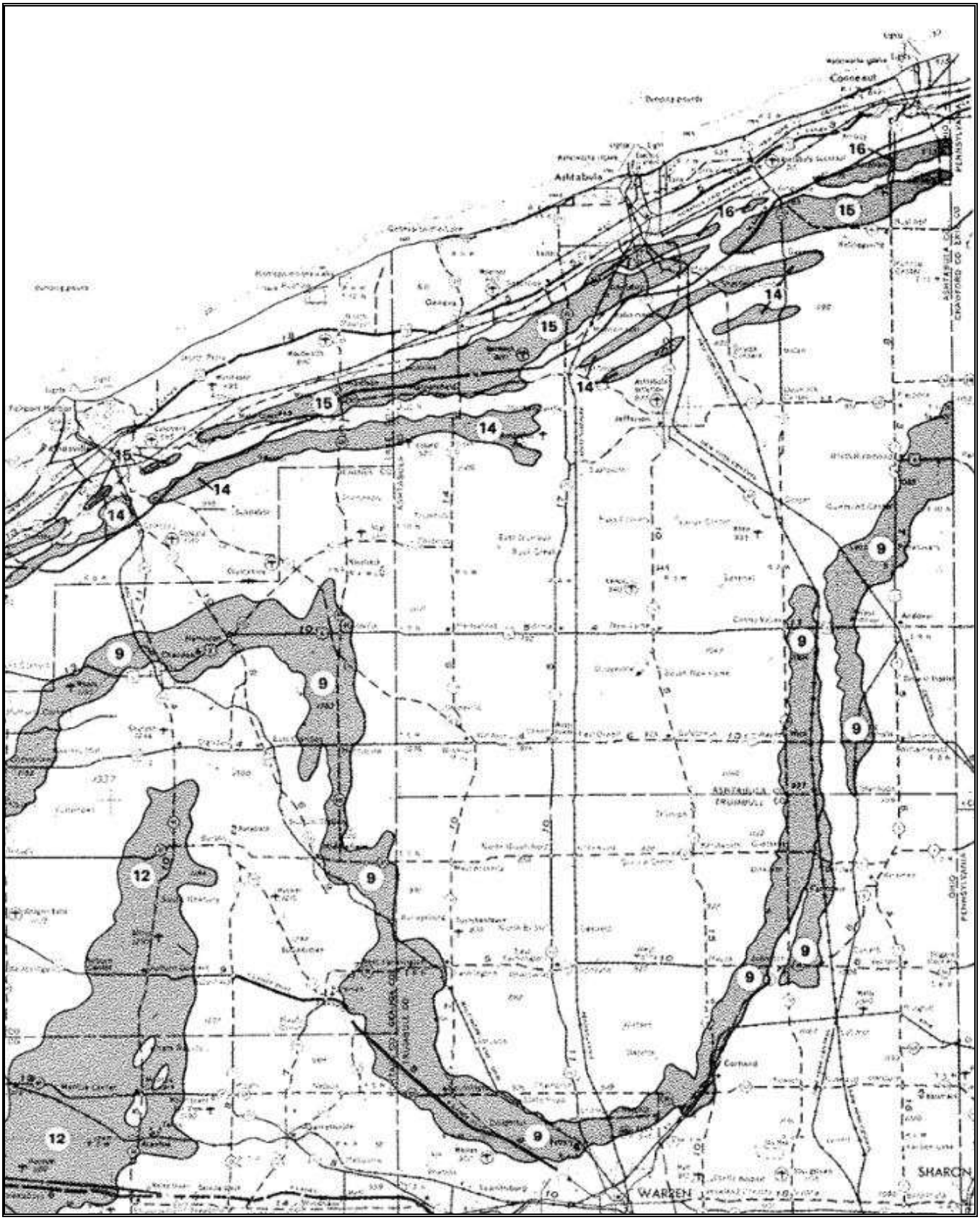


Table 29. Chronology of the glacial history in the Grand River Watershed

Glacial Geological Type	Calculated Acres	Percent
Helocene (Recent) - a	2562.4	0.77%
Helocene (Recent) - b	0.0	0.00%
Helocene (Recent) - p	1178.5	0.35%
Late Wisconsian - B	0.0	0.00%
Late Wisconsinan - LS	1351.3	0.40%
Late Wisconsinan - LL	0.0	0.00%
Late Wisconsinan - LC	71737.1	21.47%
Late Wisconsinan - OU	5230.2	1.57%
Late Wisconsinan - K	2360.9	0.71%
Late Wisconsinan - E	0.0	0.00%
Late Wisconsinan - Late Woodfordian ice deposits - G5	0.0	0.00%
Late Wisconsinan - Late Woodfordian ice deposits - M5	558.2	0.17%
Late Wisconsinan - Late Woodfordian ice deposits - G4	213748.3	63.97%
Late Wisconsinan - Late Woodfordian ice deposits - M4	25590.9	7.66%
Late Wisconsinan - Late Woodfordian ice deposits - L4	0.0	0.00%
Late Wisconsinan - Late Woodfordian ice deposits - U4	1518.8	0.45%
Late Wisconsinan - Late Woodfordian ice deposits - G3	5509.1	1.65%
Late Wisconsinan - Late Woodfordian ice deposits - M3	634.8	0.19%
Late Wisconsinan - Late Woodfordian ice deposits - U3	0.0	0.00%
Late Wisconsinan: Early Woodfordian ice deposits - G1	505.5	0.15%
Late Wisconsinan: Early Woodfordian ice deposits - M1	0.0	0.00%
Late Wisconsinan: Early Woodfordian ice deposits - U1	0.0	0.00%
Late Wisconsinan: Early Woodfordian ice deposits - UX	1634.9	0.49%
Illinoian - Ik	0.0	0.00%
Illinoian - Ig	0.0	0.00%
Illinoian - Id	0.0	0.00%
Illinoian - Iu	0.0	0.00%
Pre-Illinoian - Kl	0.0	0.00%
Cenozoic - Cc	0.0	0.00%

III. WATERSHED INVENTORY

Map 26. Glacial Geology of the Grand River Watershed.

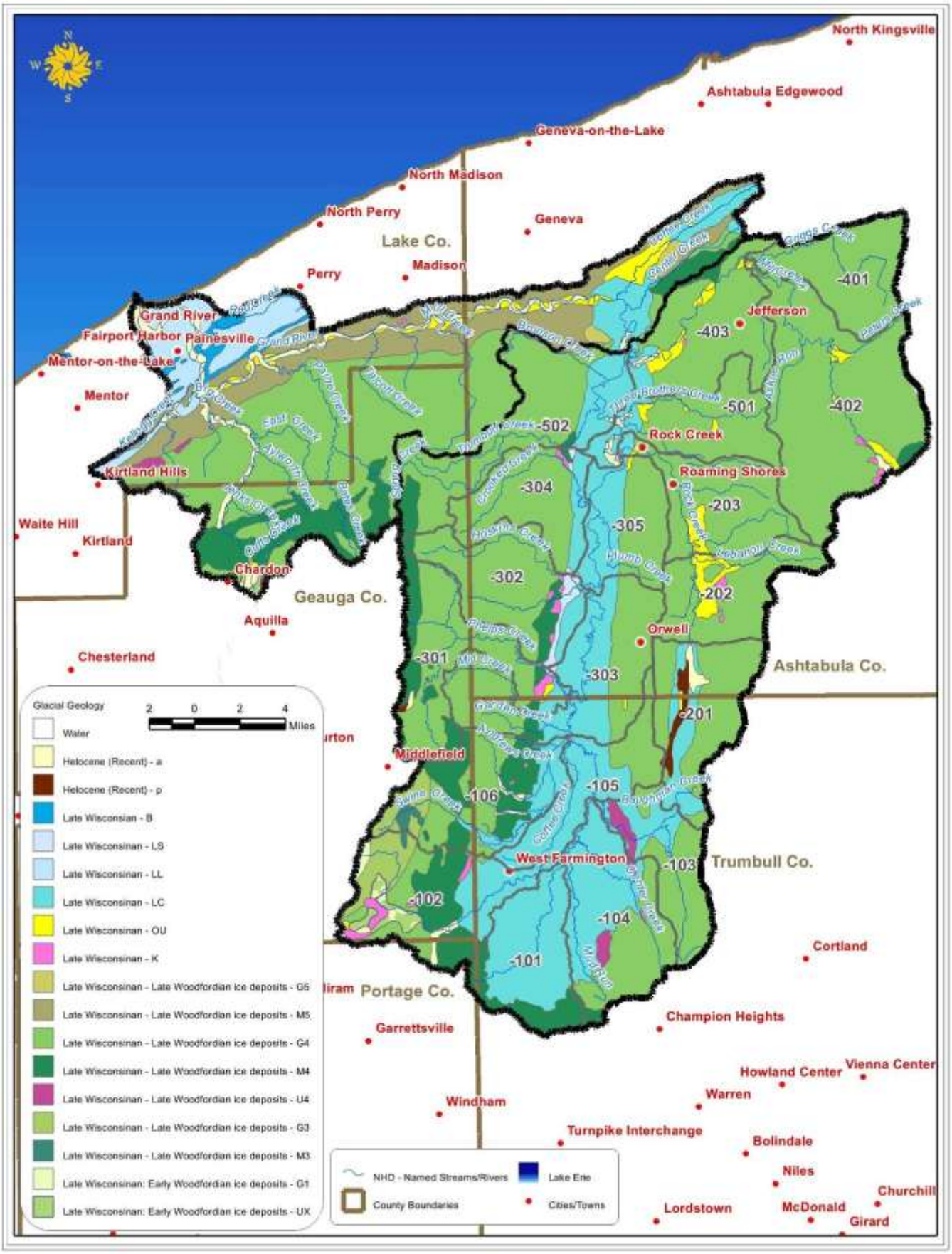


Table 30. Metadata for map of Glacial Geology of the Grand River Watershed.

HOLOCENE (RECENT) - 10kA to present:

Water

a - Alluvium and alluvial terraces, deposited in present and former floodplains; ranges from silty clay in areas of fine-grained deposits to coarse sand, gravel, or cobbles in areas of shallow bedrock.

b - Beach sand, deposited on the Lake Erie shore since 3 kA.

p - Peat, 0.4 m or more thick, with minor amounts of sand, silt, or clay; also contains organic muck or marl in some areas.

LATE WISCONSINAN - 23 to 13 kA; water-deposited units:

B - Beach ridges, along shores of former glacial lakes; fine sand to coarse gravel and cobble deposits; includes small areas of dunes and nearshore sand.

LS - Lacustrine sand, deposited in glacial lakes as shallow-water deltas or nearshore bars and sheets; includes many small areas of dunes.

LL - Lacustrine silt, deposited in low-velocity water of glacial and slackwater lakes; may contain fine sand or clay; well-laminated in distal portions of deltas, poorly laminated elsewhere.

LC - Lacustrine clay, deposited in calm water of glacial lakes; mostly laminated; covered in places with thin organic deposits.

OU - Outwash, undifferentiated, deposited by meltwater in front of glacial ice, occurs as valley terraces or low plains; sand and gravel, well sorted and stratified.

O1 - High-level outwash terraces (Kennard, Mount Vernon, Vanatta levels); formed from 22 to 18 kA; sand and gravel with 10 cm to 1 m of silt or loess cover.

O2 - Intermediate-level outwash terraces (Urbana, Circleville levels); formed from 18 to 15 kA; sand and gravel.

O3 - Low-level valley train outwash (Mad River, Utica, Brinkhaven, Worthington levels); formed from 15 to 14 kA; sand and gravel; contains small areas of peat.

K - Kames and kame terraces, deposited by meltwaters in contact with glacial ice; forms groups of hummocks or high valley-side terraces; sand and gravel, poorly sorted and bedded, contains some boulders and till masses.

E - Eskers, linear ridges deposited in glacial ice tunnels; often in line with kames; sand and gravel, poorly sorted and bedded, contains some boulders and till masses.

LATE WISCONSINAN - Late Woodfordian ice deposits, 18kA to 14kA:

Silty till (Ashtabula Till):

G5 - Ground moraine, flat to gently undulating.

M5 - End moraine, occurs as hummocky ridges higher than adjacent terrain.

Clayey till (Hiram till):

G4 - Ground moraine, flat to gently undulating.

M4 - End moraine, occurs as hummocky ridges higher than adjacent terrain.

L4 - Lake-planed moraine, very flat, planed by waves in glacial lakes; small patches of sand, silt, or clay on the surface in many areas.

U4 - Hummocky moraine, occurs as non-linear hummocky patches higher than surrounding terrain.

Silty clay till (Hayesville, Lavery tills):

G3 - Ground moraine, flat to gently undulating.

L3 - Lake-planed moraine, very flat, planed by waves in glacial lakes; small patches of sand, silt, or clay on the surface in many areas.

M3 - End moraine, occurs as hummocky ridges higher than adjacent terrain.

U3 - Hummocky moraine, occurs as non-linear hummocky patches higher than surrounding terrain.

Silty loam till (Darby, Bellfontaine, Centerburg tills):

G2 - Ground moraine, flat to gently undulating.

M2 - End moraine, occurs as hummocky ridges higher than adjacent terrain.

U2 - Hummocky moraine, occurs as non-linear hummocky patches higher than surrounding terrain.

LATE WISCONSINAN: Early Woodfordian ice deposits, 24 to 18 kA:

Loam till with thin loess (<1 m) cover (Kent, Navarre tills):

G1 - Ground moraine, flat to gently undulating.

M1 - End moraine, occurs as hummocky ridges higher than adjacent terrain.

U1 - Hummocky moraine, occurs as non-linear hummocky patches higher than surrounding terrain.

Thin loam till over sand and gravel:

UX - Buried kames and eskers, hummocky.

GX - Buried outwash, smooth to very gently undulating.

b - Indicates high concentrations of surface boulders ("Boulder Belts") when added to map unit symbols (e.g. G2b, M2b, G1b, M1b).

ILLINOIAN:

Water-deposited units:

lk - Kames, in hummocks and hollows, ice contact sand and gravel, covered with 10 cm to 3 m loess.

lo - Outwash, in small benches and high terrace areas, uniform beds of sand and gravel, some coarse silts, 0.5 to 2 m loess cover.

ll - Lacustrine deposits, clays and silts, massive or laminated; loess or colluvial cover 0.25 to .5 m thick.

Silty loam till covered with 1 to 3 m of loess (Butler, Mapledale, Millbrook, Mogadore, Titusville tills):

lg - Ground moraine, flat, relatively continuous.

ld - Dissected ground moraine, occurs on ridgetops and mixed with weathered bedrock as colluvium on slopes.

lu - Hummocky moraine, in non-continuous patches, plugs, or benches, mostly in valleys; mixed with bedrock colluvium on slopes.

PRE-ILLINOIAN:

EARLY-MIDDLE PLEISTOCENE:

Water-deposited unit:

Kl - Lacustrine deposits, mostly Minford Clay, formed in middle Pleistocene ("Kansan") ice-dammed lakes; eroded remnants of lacustrine clays and silts, laminated; often covered with thin colluvial sand, silt, or gravel.

Ko - Outwash(?), mostly sand; high terrace remnants with bright red soils.

Silty clay to clay till, strongly weathered, covered with 1 to 2 meters of loess (Cincinnati till," historically mapped as "Kansan-age" till)

Kg - Ground Moraine, relatively flat and continuous

Kd - Dissected ground moraine, occurs on ridgetops and mixed with weathered bedrock as colluvium on slopes.

CENOZOIC: Holocene, Pleistocene, and pre-Pleistocene (?):

Cc - Colluvium derived from local bedrock in unglaciated areas, includes scattered areas of residuum, weathered material, landslides, and bedrock outcrop.

Table 31. Bedrock Geological Type of the Grand River Watershed.

Bedrock Geological Type	Calculated Acres	Percent
Berea Sandstone and Bedford Shale, Undivided - Dbb	58071.3	17.38%
Ohio Shale (Upper Devonian) - Doh	207192.3	62.01%
Allegheny and Pottsville Groups, undifferentiated* (Middle and Lower Pennsylvanian) - IPap	16512.2	4.94%
Logan and Cuyahoga Formations, undivided* (Upper and Lower Mississippian) - Mlc	52345.2	15.67%

III. WATERSHED INVENTORY

Map 27. Bedrock Geology of the Grand River Watershed.

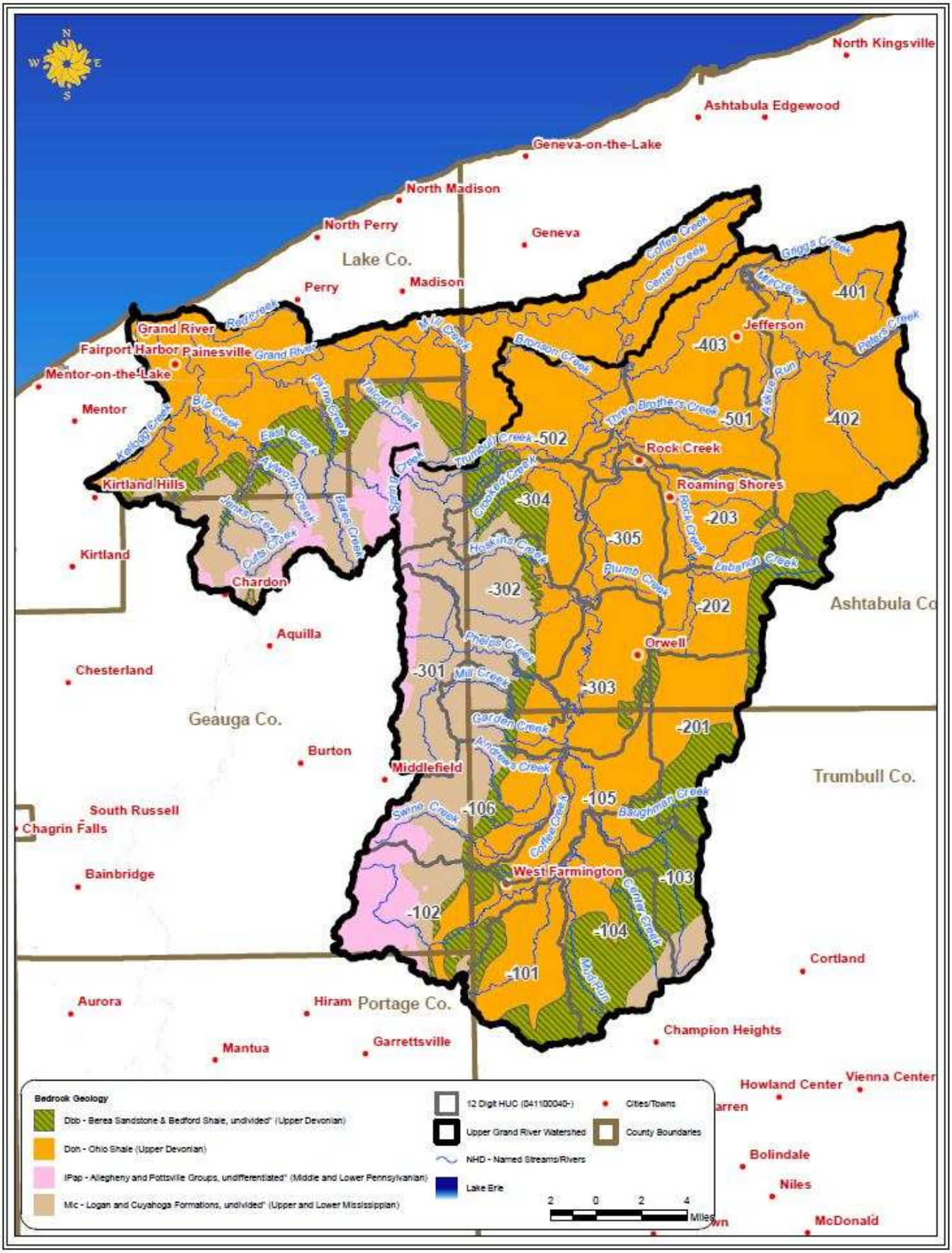


Table 32. Description of map units for Bedrock Geology.

Dbb	**Berea Sandstone and Bedford Shale, undivided* (Upper Devonian)** *(mapped interval includes Cussewago Sandstone in Ashtabula and Trumbull Counties)*—Sandstone, siltstone, and shale. Berea Sandstone, gray to shades of brown; medium grained to silty. Bedford Shale, gray, red, and brown; silty to clayey; locally abundant siltstone and sandstone interbeds. Cussewago Sandstone, brown; pebbly; massive to crossbedded; quartzose.
Doh	**Ohio Shale (Upper Devonian)** *(mapped interval includes Olentangy Shale south of central Delaware County)*—Unit consists generally of three members, in descending order: Cleveland, Chagrin, and Huron Members. Cleveland Member, shale; black; thickest in north-central portion of state; thins south and eastward; absent in northeastern portion of state. Chagrin Member, shale, siltstone, and very fine-grained sandstone; gray to greenish gray; thickest in northeastern portion of state; grades into underlying and overlying black shale members; thins southwestward, becomes Three Lick Bed in southern portion of state. Huron Member, shale; mostly black; carbonaceous; calcareous concretions common in lower portion. Olentangy Shale, mostly upper portion; thin; present but not mapped as separate unit south of central Delaware County; absent on Bellefontaine Outlier; see Olentangy Shale for description. Unit structurally deformed in Serpent Mound Impact Structure (see fig. 3).
Pap	**Allegheny and Pottsville Groups, undifferentiated* (Middle and Lower Pennsylvanian)**—Shale, siltstone, sandstone, conglomerate, limestone, underclay, coal, and flint; mainly shades of gray to black, locally greenish gray in upper one-third of unit. Sandstone, silty to pebbly; locally quartzose and/or conglomeratic in lower one-third of unit, particularly the Sharon conglomerate (not mapped) in northeastern and southeastern portions of state and the Massillon sandstone (not mapped) in Perry County. Siltstone and shale, clayey to sandy; locally contain marine fossils. Limestone; marine, mainly overlies coal or underclay beds; locally nonmarine, mainly occurs within underclay beds in upper one-third of unit. Economic limestone and underclay beds occur locally. Unit contains economic coal beds. Flint beds; locally contain marine fossils. Plant fossils locally common. Unit lithologies commonly intertongue and intergrade. Top of unit mapped at top of Upper Freeport coal bed or, where absent, its projected position.
Mlc	**Logan and Cuyahoga Formations, undivided* (Upper and Lower Mississippian)** *(mapped interval includes Maxville Limestone in Hocking, Jackson, Muskingum, Perry, Scioto, and Vinton Counties, Rushville Formation in Perry County, and [1]Shenango sandstone and shale in Trumbull County)*—Shale, siltstone, sandstone, conglomerate, and limestone. Unit consists mainly of two formations, in descending order: Logan and Cuyahoga Formations. Maxville Limestone, shades of olive, green, brown, and gray; microcrystalline to coarse grained; locally dolomitic, fossiliferous, and arenaceous; locally contains chert and shale interbeds; occurs as discrete deposits of limited extent, absent north of Dillon Lake, Muskingum County. Rushville Formation, shale with sparse limestone in lower portion; red to bluish gray; clayey; known only in western Perry County. Logan Formation, sandstone and siltstone; shades of gray, yellow, and brown; sandstone, mainly silty to medium grained, locally contains lenses and beds of coarse sand grains to fine-pebble conglomerate; siltstone, clayey to sandy; locally contains shale interbeds and partings; locally fossiliferous; absent northeast of Orrville and Rittman, Wayne County, and east of central Medina County. Cuyahoga Formation, sandstone, siltstone, and shale; mainly shades of gray, olive, brown, and yellow; sandstone, silty to conglomeratic, occurs in thin to massive beds; siltstone and shale, occur in thin to thick beds; shale locally black in northern, and red in southern portions of state; locally fossiliferous; unit lithologies commonly intertongue and intergrade; Buena Vista Member (not mapped) occurs in southern portions of state, locally economic. [1]Shenango sandstone and shale, shades of brown, yellow, and gray, to almost white; sandstone, medium to coarse grained; shale, clayey, interbedded with siltstone; occurs only in eastern Trumbull County, pinches out westward.

III. WATERSHED INVENTORY

- **Biological Features**

1. Rare, threatened and endangered species

The Natural Heritage Database, managed by the Division of Natural Areas & Preserves' Natural Heritage Program, was started in 1976.

It now contains more than 17,000 records which represent known locations for Ohio's rare plants and animals, high quality plant communities and other natural features.

Data are obtained from a broad range of sources throughout the state.

In addition to the division's needs, data are used in the department's environmental review process and are provided to consulting firms, federal, state and local government agencies, researchers, conservation groups and private citizens.
Source: Ohio Department of Natural Resources Natural Heritage Database

a. Fish

Table 33. Ohio State Listed Fish Species in the Upper Grand River Watershed.
(Source: Ohio Department of Natural Resources Natural Heritage Database)

Scientific Name	Common Name	Last Observed	State Status
Ammocrypta pellucida	Eastern Sand Darter	1989	Species of Concern
Esox masquinongy	Muskellunge	1976	Species of Concern
Ichthyomyzon fossor	Northern Brook Lamprey	1987-04	Endangered
Moxostoma carinatum	River Redhorse	1987-08-19	Species of Concern

b. Mussels

In the summer of 1996 and 1998, Dr. Martin Huehner, Hiram College, surveyed for mussels in the Grand River from Harpersville Dam to its upper reaches. In these surveys, he found numerous species, but he found three of special interest. The Black Sandshell Mussel (Ligumia recta), which is listed as Threatened in Ohio, was found throughout these stretches of the river, and at one site (RM 61.8), 60 large specimens of this mussel were found, comprising 16% of all living mussels from that site .. The Round Pigtoe mussel (Pleurobema sintoxia) (OH State Special Interest) and the Salamander Mussel (Simpsonaias ambigua) (OH State Special Interest and Federal Category 2) were found at scattered sites as well. Huehner stated that the "Grand River possesses a rich mussel fauna when compared to other tributary streams of Lake Erie in Northeastern Ohio and presence of several mussel species of special interest and others of potential special interest provide this river with additional distinction." He thought that isolated and rural nature of the Grand River's Scenic section made it an exceptionally good habitat to protect.

Table 34. Ohio State Listed Mussel Species in the Upper Grand River Watershed.
(Source: Ohio Department of Natural Resources Natural Heritage Database)

Scientific Name	Common Name	Last Observed	State Status
Elliptio crassidens	Elephant-ear	1961-10-14	Endangered
Epioblasma triquetra	Snuffbox	2004-08-18	Endangered
Lampsilis fasciola	Wavy-rayed Lampmussel	1995-08	Species of Concern
Ligumia recta	Black Sandshell	1995-08	Threatened
Pleurobema sintoxia	Round Pigtoe	1995-08	Species of Concern
Simpsonaias ambigua	Salamander Mussel	1995-08	Species of Concern
Truncilla truncata	Deertoe	1995-08	Species of Concern

III. WATERSHED INVENTORY

c. Invertebrates

Table 35. Ohio State Listed Invertebrate Species in the Upper Grand River Watershed.
(Source: Ohio Department of Natural Resources Natural Heritage Database)

Scientific Name	Common Name	Last Observed	State Status
Catocala gracilis	Graceful Underwing	1990-07	Endangered
Chimarra socia	A Caddisfly	1979-08-21	Endangered
Enallagma ebrium	Marsh Bluet	1996-08-08	Threatened
Gomphus viridifrons	Green-faced Clubtail	1995-07-09	Threatened
Helocordulia uhleri	Uhler's Sundragon	2003-05-31	Endangered
Ladona julia	Chalk-fronted Corporal	2002-06-15	Endangered
Ophiogomphus carolus	Riffle snaketail	2000-05-26	Threatened
Orconectes propinquus	Great Lakes Crayfish	1984-06-10	Species of Concern
Rheopelopia acra	A Midge	2004-08-18	Endangered

d. Mammals

Table 36. Ohio State Listed Mammal Species in the Upper Grand River Watershed.
(Source: Ohio Department of Natural Resources Natural Heritage Database)

Scientific Name	Common Name	Last Observed	State Status
Erethizon dorsatum	Porcupine	1990-04	Presumed Extirpated
Felis rufus	Bobcat	2000-06-10	Endangered
Mustela erminea	Ermine	1964-04	Species of Concern
Ursus americanus	Black Bear	2000-06-10	Endangered

e. Birds

Table 37. Ohio State Listed Bird Species in the Upper Grand River Watershed.
(Source: Ohio Department of Natural Resources Natural Heritage Database)

Scientific Name	Common Name	Last Observed	State Status
Accipiter striatus	Sharp-shinned Hawk	1985-06	Species of Concern
Bartramia longicauda	Upland Sandpiper	1986-06	Threatened
Catharus guttatus	Hermit Thrush	1993-06-12	Threatened
Circus cyaneus	Northern Harrier	1985-06	Endangered
Dendroica magnolia	Magnolia Warbler	1985-06	Species of Interest
Gallinago gallinago	Common Snipe	1984-05	Species of Interest
Ixobrychus exilis	Least Bittern	1986-07	Threatened
Junco hyemalis	Dark-eyed Junco	1993-06-13	Threatened
Oporornis philadelphia	Mourning Warbler	1984-06	Species of Interest
Rallus limicola	Virginia Rail	1987-06	Species of Concern
Sphyrapicus varius	Yellow-bellied Sapsucker	1986-06	Endangered
Troglodytes troglodytes	Winter Wren	1984-07	Species of Interest
Wilsonia canadensis	Canada Warbler	1985-06	Species of Interest

III. WATERSHED INVENTORY

f. Reptiles & amphibians

Table 38. Ohio State Listed Reptile & Amphibian Species in the Upper Grand River Watershed.
(Source: Ohio Department of Natural Resources Natural Heritage Database)

Scientific Name	Common Name	Last Observed	State Status
Clemmys guttata	Spotted Turtle	1974	Threatened
Hemidactylium scutatum	Four-toed Salamander	1978-05-16	Species of Concern
Sistrurus catenatus	Eastern Massasauga	2003-09-13	Endangered

g. Plants

Table 39. Ohio State Listed Plant Species in the Upper Grand River Watershed.
(Source: Ohio Department of Natural Resources Natural Heritage Database)

Scientific Name	Common Name	Last Observed	State Status
Actaea rubra	Red Baneberry	1989-08	Threatened
Adlumia fungosa	Mountain-fringe	1980-08	Threatened
Amelanchier sanguinea	Rock Serviceberry	1998-06-10	Endangered
Aralia hispida	Bristly Sarsaparilla	2001-09-11	Endangered
Astragalus neglectus	Cooper's Milk-vetch	1980-06	Endangered
Betula populifolia	Gray Birch	2001-09	Potentially Threatened
Botrychium lanceolatum	Triangle Grape Fern	2003-07-24	Endangered
Brachyelytrum aristosum	Bearded Shorthusk	2004-07-22	Threatened
Calla palustris	Wild Calla	2006-05-11	Threatened
Callitriche verna	Vernal Water-starwort	1989-09-09	Threatened
Carex appalachica	Appalachian Sedge	1990-06-12	Threatened
Carex arctata	Drooping Wood Sedge	1998-07-30	Endangered
Carex argyrantha	Silvery Sedge	2006-08-10	Potentially Threatened
Carex aurea	Golden-fruited Sedge	1985-05	Threatened
Carex brunnescens	Brownish Sedge	1982-06	Threatened
Carex cephaloidea	Thin-leaved Sedge	1960-06	Threatened
Carex lupuliformis	False Hop Sedge	1998-07-10	Threatened
Carex pallescens	Pale Sedge	1990-05-30	Threatened
Carex projecta	Necklace Sedge	1997-07-29	Threatened
Carex straminea	Straw Sedge	2001-09	Potentially Threatened
Castanea dentata	American Chestnut	1983-10	Potentially Threatened
Chimaphila umbellata	Pipsissewa	2000-06-02	Threatened
Corallorhiza maculata	Spotted Coral-root	1986-08	Potentially Threatened
Corallorhiza trifida	Early Coral-root	1978-05	Endangered
Cornus canadensis	Bunchberry	1984-09	Endangered
Cornus rugosa	Round-leaved Dogwood	2001-09	Potentially Threatened
Corydalis sempervirens	Rock-harlequin	1990-07	Potentially Threatened
Dalibarda repens	Robin-run-away	1984-08	Endangered
Dryopteris clintoniana	Clinton's Wood Fern	1979-07-11	Endangered
Epilobium angustifolium	Fireweed	1960-07-01	Endangered
Epilobium strictum	Simple Willow-herb	1995-09-16	Threatened
Equisetum sylvaticum	Woodland Horsetail	2005-09-27	Threatened
Gentianopsis crinita	Fringed Gentian	1984-09	Potentially Threatened
Geum rivale	Water Avens	1998-04-21	Potentially Threatened

Table 40. Ohio State Listed Plant Species in the Upper Grand River Watershed. Cont'd

Scientific Name	Common Name	Last Observed	State Status
Gratiola virginiana	Round-fruited Hedge-hyssop	1986-09	Potentially Threatened
Hypericum canadense	Canada St. John's-wort	1978-09	Endangered
Hypericum ellipticum	Few-flowered St. John's-wort	2001-08-08	Threatened
Hypericum majus	Tall St. John's-wort	2000-10-14	Potentially Threatened
Juglans cinerea	Butternut	2001-09	Potentially Threatened
Juncus balticus	Baltic Rush	1984-07	Potentially Threatened
Larix laricina	Tamarack	1955-09	Potentially Threatened
Lathyrus ochroleucus	Yellow Vetchling	2001	Endangered
Lilium superbum	Turk's-cap Lily	2001-09	Potentially Threatened
Lycopodium lagopus	One-coned Club-moss	1994-08-06	Endangered
Melampyrum lineare	Cow-wheat	1991-06	Threatened
Oryzopsis asperifolia	Large-leaved Mountain-rice	2001-09	Endangered
Persicaria robustior	Coarse Smartweed	1994-08-06	Threatened
Phegopteris connectilis	Long Beech Fern	1978-05	Potentially Threatened
Poa saltuensis	Pasture Blue Grass	1990-05	Endangered
Podostemum ceratophyllum	Riverweed	1988	Endangered
Populus balsamifera	Balsam Poplar	1996-07-12	Endangered
Potamogeton natans	Floating Pondweed	2001-09	Potentially Threatened
Potamogeton richardsonii	Richardson's Pondweed	1987-09	Potentially Threatened
Potamogeton zosteriformis	Flat-stemmed Pondweed	1987-09	Potentially Threatened
Ranunculus ambigens	Water-plantain Spearwort	1983-07-16	Presumed Extirpated
Ranunculus fascicularis	Early Buttercup	1986-05	Potentially Threatened
Rhododendron nudiflorum var. nudiflorum	Pinxter-flower	1982-05	Endangered
Rhododendron nudiflorum var. roseum	Northern Rose Azalea	1982-05	Potentially Threatened
Ribes triste	Swamp Red Currant	1993-05-05	Endangered
Shepherdia canadensis	Canada Buffalo-berry	1989-07-15	Potentially Threatened
Solidago squarrosa	Leafy Goldenrod	1985-09	Threatened
Sorbus decora	Western Mountain-ash	1978-10	Endangered
Sparganium androcladum	Keeled Bur-reed	2001-10-03	Threatened
Sparganium emersum	Small Bur-reed	2004-07-22	Endangered
Trillium undulatum	Painted Trillium	1982-05	Endangered
Vaccinium myrtilloides	Velvet-leaved Blueberry	2000-05-03	Endangered
Viburnum alnifolium	Hobblebush	1995-08-16	Potentially Threatened
Viburnum opulus var. americanum	Highbush-cranberry	1995-06-29	Endangered
Viola lanceolata	Lance-leaved Violet	1980-06	Potentially Threatened
Woodwardia areolata	Netted Chain Fern	1982-09	Potentially Threatened
Zigadenus elegans	White Wand-lily	1973-07-11	Potentially Threatened

III. WATERSHED INVENTORY

2. Invasive nonnative species and their potential impacts

Invasive species damage the lands and waters that native plants and animals need to survive. They have contributed directly to the decline of 42% of the threatened and endangered species in the United States. The annual cost to the United States economy is estimated at $120 billion a year, with over 100 million acres (an area roughly the size of California) suffering from invasive plant infestations.

On their home turf, plant and animal populations are kept in check by natural controls like predators and food supply. However, when a species is introduced—accidentally or intentionally—into a new landscape that is not used to its presence, the consequences can be devastating.

Most of these "non-native" species do not misbehave. But some spread unchecked by the lack of natural competitors and predators. They push out native species and cause ecological chaos. These are known as "invasive" species. All habitats are vulnerable to these invasions, from grasslands and forests to lakes, rivers and oceans.

a. Plants

Approximately 700-800 species of plants in Ohio are not native to the state. About 100 non-native plants are invading woodlands and displacing native spring wildflowers. Others are impacting wetlands, grasslands and prairies. The degree to which invasive plant species affect Ohio natural areas varies, but some of these plants pose serious threats to native species and the ecological integrity of Ohio's native biological diversity.

In order to protect Ohio's natural areas from these threats, organizations and agencies are teaming up as part of the Ohio Invasive Plants Council, and serving as a resource for the public and land managers on issues related to invasive species.

Source: The Nature Conservancy - Invasive Plant Distribution Database 01-29-2002

Targeted Species (13 out of 13 state listed species)

Alliaria petiolata (Garlic mustard)
Elaeagnus umbellate (Autumn olive)
Lonicera japonica (Japanese honeysuckle)
Lonicera maackii (Amur honeysuckle)
Lonicera morrowii (Morrow honeysuckle)
Lonicera tatarica (Tatarian honeysuckle)
Lythrum salicaria (Purple loosestrife)
Phalaris arundinacea (Reed canary grass)
Phragmites australis (Reed grass)
Polygonum cuspidatum (Japanese knotweed)
Rhamnus cathartica (European buckthorn)
Rhamnus frangula (Glossy buckthorn)
Rosa multiflora (Multiflora rose)

Well-established Species (34 out of 38 state listed species)

Agropyron repens (Quack grass)
Ailanthus altissima (Tree-of-heaven)
Berberis thunbergii (Japanese barberry)
Bromus inermis (Smooth brome)
Celastrus orbiculatus (Asian bittersweet)
Cirsium arvense (Canada thistle)
Conium maculatum (Poison hemlock)
Convolvulus arvensis (Field bindweed)
Coronilla varia (Crown-vetch)
Daucus carota (Queen Anne's lace)
Dioscorea batatas (Air-potato)
Dipsacus laciniatus (Cut-leaved teasel)
Dipsacus sylvestris (Common teasel)

Well-established Species (34 out of 38 state listed species) Cont'd

Epilobium hirsutum (Hairy willow-herb)
Epilobium parviflorum (Small-flowered hairy willow-herb)
Euonymus alatus (Winged euonymus)
Festuca pratensis (Meadow fescue)
Hemerocallis fulva (Day-lily)
Hesperis matronalis (Dame's rocket)
Iris pseudacorus (Yellow flag)
Ligustrum vulgare (Common privet)
Lysimachia nummularia (Moneywort)
Melilotus alba (White sweet-clover)
Melilotus officinalis (Yellow sweet-clover)
Myriophyllum spicatum (Eurasian water-milfoil)
Najas minor (Lesser naiad)
Nasturtium officinale (Water-cress)
Potamogeton crispus (Curly pondweed)
Saponaria officinalis (Bouncing Bet)
Sorghum halepense (Johnson grass)
Typha angustifolia (Narrow-leaved cattail)
Typha X glauca (Hybrid cattail)
Viburnum opulus var. opulus (European cranberry-bush)
Vinca minor (Periwinkle)

Watch List Species (8 out of 14 state listed species)

Centaurea maculosa (Spotted knapweed)
Ligustrum obtusifolium (Border privet)
Lonicera X bella (Showy pink honeysuckle)
Miscanthus sinensis (Chinese silvergrass)
Ornithogalum umbellatum (Star-of-Bethlehem)
Polygonum sachalinense (Giant knotweed)
Rosa canina (Dog rose)
Vincetoxicum nigrum (Black swallow-wort)

III. WATERSHED INVENTORY

- **Water resources**

1. Climate and Precipitation

Northeast Ohio is classified as Dfa by the Köppen-Geiger climate classification system (the worlds most widely used climate classification system). A hot (or very warm) version of a continental climate features an average temperature of at least 22 °C (71.6 °F) in its warmest month. The warmest month is usually in July, though it some cases it can be in August. Average July afternoon temperatures in this zone generally average above 26 °C (79 °F) while the average temperature of the coldest month is −3 °C (26.6 °F) or colder. In some instances, the average temperature of the coldest month can be far below −3 °C (26.6 °F).

Lake Erie affects weather and climate by impacting Northeast Ohio's energy, water and carbon systems. Changes in Lake Erie's circulation, water temperatures and ice cover can produce changes in local weather patterns. Lake Erie absorbs solar radiation reaching Earth. Lake Erie loses heat by evaporation. This heat loss drives atmospheric circulation. After water vapor is released into the atmosphere, it condenses and forms precipitation. Condensation of water evaporated from warm lake waters provides the energy for storms.

Lake Erie's moderating effects on the climate support regional specialization in viticulture, nurseries, maple sugaring and other agricultural activities.

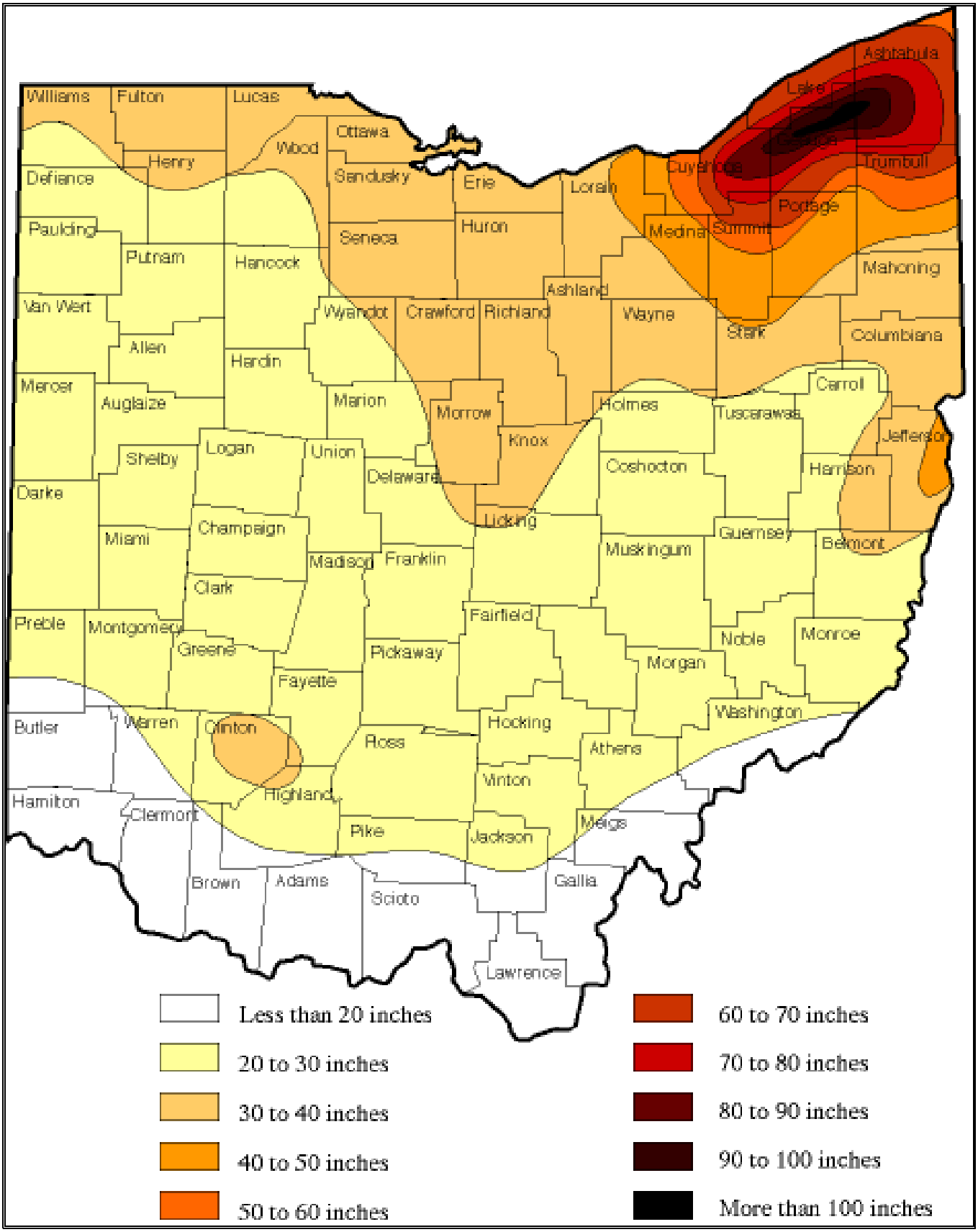
Evaporation from Lake Erie directly contributes to regional precipitation patterns. In the winter, regional snow belts along Lake Erie's south shore extend from Cleveland, Ohio, through Buffalo, New York.

Lake Erie plays a role in the Earth's carbon cycle. The sunlit layers of Lake Erie are extremely productive. As the plants in these surface waters photosynthesize, they remove carbon dioxide from the water. This loss of carbon dioxide from the waters cases carbon dioxide from the air to diffuse into the water, thus removing carbon dioxide from the atmosphere.

Lake Erie has and will continue to have, a significant influence on local climate by absorbing, storing, and moving heat, carbon and water. Lake Erie will also be affected by larger climate change patterns affecting Earth.

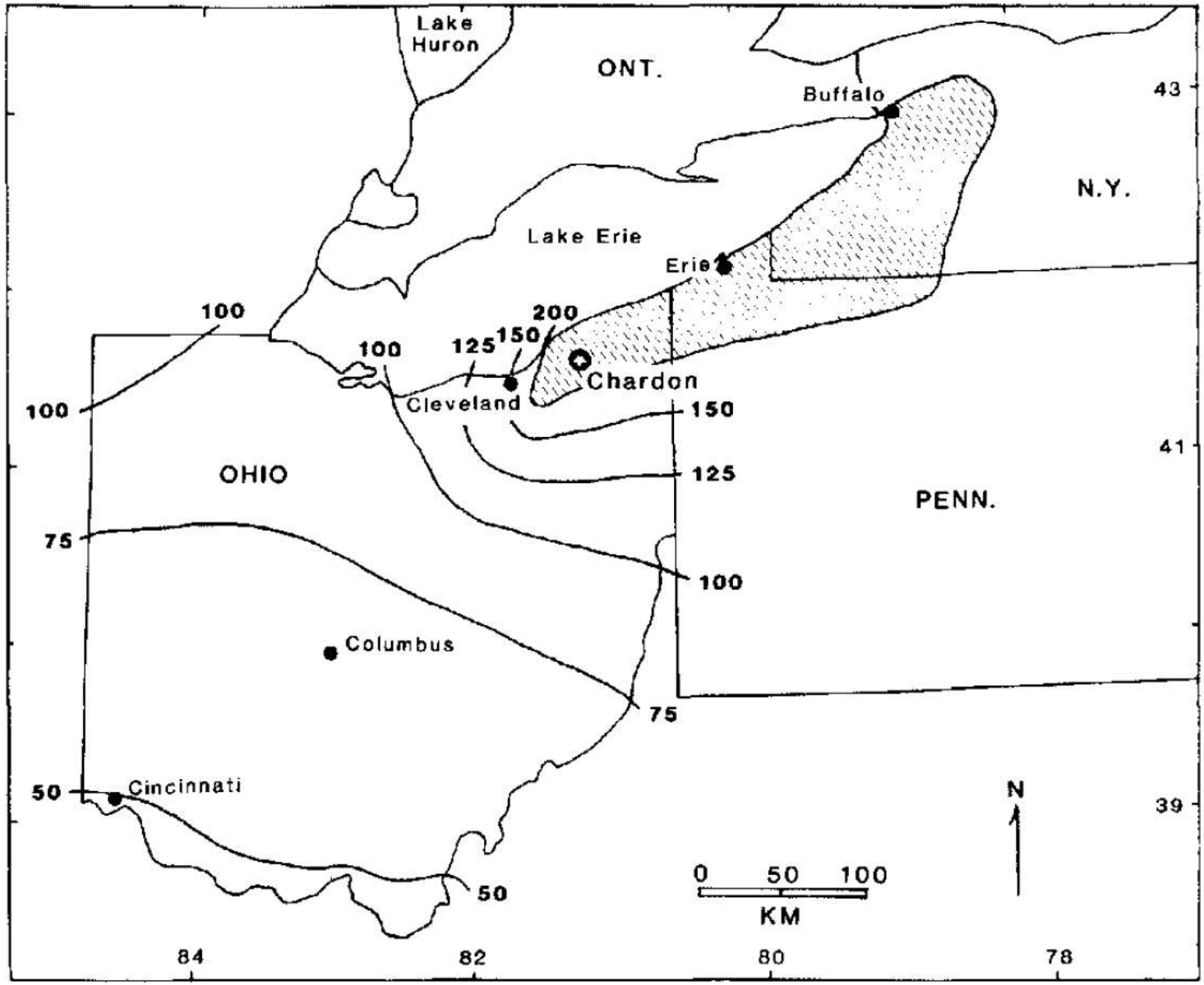
Photo 7. Grand River in Winter *(Source: GRPI)*

Map 28. **Mean Snowfall for Winter Season, 1936-1965 – State of Ohio**
(Source: From Miller and Weaver, 1971)



Map 29. Mean Annual Snowfall (cm) in Ohio, the location of Chardon (41.6°N, 81.2°W), and the Lake Erie Snowbelt. The snowbelt is approximately the area with over 200 cm mean annual snowfall.

(Source: Climatic Summary of Snowfall and Snow Depth in the Ohio Snowbelt at Chardon. (Schmidlin, 1989))



III. WATERSHED INVENTORY

III. WATERSHED INVENTORY

2. Surface Water

a. Wetlands

Table 41. Wetland Acres by 12-Digit Subwatershed for the Grand River Watershed.

HUC 12	HUC 12 Description	ACRES	%
041100040101	Dead Branch	1226	7.9
041100040102	Grand River headwaters to above Dead Branch	2029	9.6
041100040103	Baughman Creek	2248	19.1
041100040104	Grand River below Dead Branch to above Baughman Cr.	3102	15.4
041100040105	Grand River below Baughman Cr. to above Swine Cr.	4691	38.6
041100040106	Swine Creek	2070	10.4
041100040201	Snyder Ditch to U.S. Rt. 224 (Rock Creek headwaters)	3219	19.4
041100040202	Rock Creek below U.S. Rt. 224 to downstream of Lebanon Creek	1833	13.4
041100040203	Rock Creek below Lebanon Creek to mouth	1644	10.9
041100040301	Phelps Creek	3534	18.8
041100040302	Hoskins Creek	3751	21.8
041100040303	Grand River below Swine Cr. to above Hoskins Cr. [except Phelps Cr.]	4754	20.8
041100040304	Mud Creek	2422	18.0
041100040305	Grand River below Hoskins Cr. to above Rock Cr. [except Mud Cr.]	2430	19.8
041100040401	Griggs Creek	2937	22.2
041100040402	Mill Creek (2) headwaters to above Griggs Cr.	6516	18.6
041100040403	Mill Creek (2) below Griggs Cr. to Grand R.	1590	8.8
041100040501	Grand River below Rock Cr. to below Three Brothers Cr.	1588	11.4
041100040502	Grand River below Three Brothers Cr. to above Mill Cr. (2)	3701	16.0
041100040601	Grand River below Mill Cr. (2) to below Coffee Cr. (Lower Grand)	1472	10.5
041100040602	Mill Creek (3) (Lower Grand)	1160	8.6
041100040603	Grand River below Coffee Cr. to above Mill Cr. (3) (Lower Grand)	666	6.3
041100040604	Paine Creek (Lower Grand)	2221	12.1
041100040605	Grand River below Mill Cr. (3) to above Paine Cr. (Lower Grand)	721	5.8
041100040606	Big Creek (Lower Grand)	1117	3.5
041100040607	Grand River below Paine Cr. to Lake Erie [except Big Cr.] (Lower Grand)	473	2.8

Wetlands are widely recognized as important wildlife habitats and as being among the most biologically productive and biologically diverse habitats on the planet. They support specialized plant assemblages and restricted plant species. They directly and indirectly supply food to a broad range of animals including micro-organisms, invertebrates, fish, birds, mammals and reptiles. Wetlands serve to purify water by removing suspended matter (settling of particles), reducing numbers of fecal micro-organisms and using dissolved nitrogen and phosphorus for plant growth. They also provide flood control by storing and detaining storm water although this function (and that of water purification) may naturally not always be beneficial to the wetlands.

Although efforts to stop the rapid loss of wetlands have been a relatively recent development, it is vital that efforts continue or problems already faced could be made much worse. In any discussion about the loss of wetlands it should be stated that there is always going to be a chain reaction. The damage or loss of one aspect of wetlands does not just have an impact on that particular issue, but has more far-reaching consequences that have a great and often devastating effect on human and animal populations as well as the ecosystem as a whole (Map 29).

Map 30. National Wetland Inventory of the Grand River Watershed.

III. WATERSHED INVENTORY

b. Streams

i. Tributary name, length and watershed size (see Table 18), cfs, 10 year low flows, floodplain areas, sinuosity and entrenchment indices

No

The Geographic Names Information System (GNIS) is the Federal and national standard for geographic nomenclature. The U.S. Geological Survey developed the GNIS in support of the U.S. Board on Geographic Names as the official repository of domestic geographic names data. The database holds the federally recognized name of each feature and defines the feature location by state, county, USGS topographic map, and geographic coordinates.

Photo 8. Abandoned Grand River Channel *(Source: GRPI)*

This Page Intentionally left blank

Table 42. Tributary Names, Segment Lengths, Average Sinuosity of the Grand River Watershed.

0411000401
Headwaters - Grand River

GNIS_Name	Length (Miles)	Average Sinuosity*
Unnamed Tribs	308.18	n/a
Andrews Creek	7.17	n/a
Baughman Creek	8.73	1.22
Bear Creek	1.42	n/a
Center Creek	10.81	1.31
Coffee Creek	8.91	1.39
Deacon Creek	9.64	n/a
Dead Branch	10.83	1.19
Grand River	30.86	1.24
Grapevine Creek	3.68	n/a
Mud Run	11.13	n/a
Plum Creek	3.23	n/a
Swine Creek	15.55	1.16

0411000402
Rock Creek

GNIS_Name	Length (Miles)	Average Sinuosity*
Unnamed Tribs	187.42	n/a
Baughman Creek	1.73	n/a
Lebanon Creek	8.27	n/a
Plum Creek	4.54	n/a
Rock Creek	14.55	1.13
Shanty Creek	2.43	n/a
Snyder Ditch	6.45	1.11
Sugar Creek	5.00	n/a
Whetstone Creek	7.29	n/a

0411000403
Phelps Creek- Grand River

GNIS_Name	Length (Miles)	Average Sinuosity*
Unnamed Tribs	250.84	n/a
Crooked Creek	11.86	n/a
Garden Creek	3.87	n/a
Grand River	25.77	n/a
Hoskins Creek	11.07	1.13
Indian Creek	7.58	n/a
Mill Creek	9.58	1.30
Montville Ditch	1.19	n/a
Mud Creek	1.05	1.27
North Branch Phelps Creek	4.76	n/a
Phelps Creek	12.35	1.16
Plumb Creek	6.66	1.17
Rock Creek	0.01	n/a
South Branch Phelps Creek	8.44	n/a
Swine Creek	0.01	n/a

Table 34 (cont'd). Tributary Names, Segment Lengths, Average Sinuosity of the Grand River Watershed.

0411000404
Griggs Creek-Mill Creek

GNIS_Name	Length (Miles)	Average Sinuosity*
Unnamed Tribs	237.61	n/a
Askue Run	5.03	n/a
Griggs Creek	13.65	1.24
Mill Creek	33.31	1.12
Peters Creek	4.68	1.17
Smith Creek	2.82	n/a

0411000405
Three Brothers Creek-Grand River

GNIS_Name	Length (Miles)	Average Sinuosity*
Unnamed Tribs	106.69	n/a
Badger Run	5.39	n/a
Bronson Creek	7.80	1.26
Grand River	9.92	n/a
Mill Creek	0.00	n/a
Spring Creek	9.16	n/a
Three Brothers Cr.	10.82	1.16
Trumbull Creek	14.60	n/a

0411000406
Big Creek-Grand River(Lower Grand)

GNIS_Name	Length (Miles)	Average Sinuosity*
Unnamed Tribs	261.4	n/a
Aylworth Creek	4.7	n/a
Bates Creek	7.9	n/a
Big Creek	17.8	1.18
Center Creek	8.6	n/a
Coffee Creek	9.9	1.19
Cutts Creek	3.0	n/a
East Creek	6.2	n/a
Ellison Creek	5.5	n/a
Grand River	42.5	1.17
Griswold Creek	3.9	n/a
Jenks Creek	3.8	n/a
Jordan Creek	3.7	n/a
Kellogg Creek	8.2	n/a
Mill Creek	12.7	1.21
Paine Creek	8.9	1.28
Pebble Branch	2.1	n/a
Phelps Creek	4.4	n/a
Red Creek	6.8	1.15
Taber Creek	1.0	n/a
Talcott Creek	6.3	1.14

*Sinuosity: For each line (arc), sinuosity (S) is calculated as follows: S = Lt / Lsf
whereby Lt is the total length of the line, i.e. the cumulative length of all line segments, and Lsf is the distance between the start and finish locations. The metric value is written to the field Sinuosity. Another field, LineSegs, records the number of line segments that made up the line.

III. WATERSHED INVENTORY

Table 43. Surface Water Discharge in feet3/second at USGS Gage Stations in Grand River Watershed.

USGS Gage #	USGS Gage Location	Years	Discharge feet³/second
04209500	Grand River near North Bristol OH	1943-1947	101.3
04210000	Phelps Creek near Windsor OH	1943-1958	35.6
04210500	Grand River near Rome OH	1943-1947	307.4
04211000	Rock Creek near Rock Creek OH	1943-1966	75.6
04211500	Mill Creek near Jefferson OH	1943-1974	107.4
04211820	Grand River at Harpersfield OH	1997-1998	818.6
04212000	Grand River near Madison OH	1923-1974	663.2
04212100	Grand River near Painesville OH	1974-2009	1034.8

Table 44. 100 Year Floodplain in Grand River Watershed.

HUC_10	HUC 10 Name	Floodplain Acres in Watershed	% of Total Floodplain Acres
0411000401	Headwaters Grand River	9,356.80	33.79%
0411000402	Rock Creek	1,132.94	4.09%
0411000403	Phelps Creek-Grand River	6,970.27	25.17%
0411000404	Griggs Creek-Mill Creek	3,294.65	11.90%
0411000405	Three Brothers Creek-Grand River	1,219.42	4.40%
0411000406	Big Creek-Grand River (Lower Grand)	5,714.25	20.64%

Table 45. 100 Year Floodplain in Subwatersheds of the Grand River Watershed.

HUC 12	HUC 12 Description	Floodplain Acres in Watershed	% of Total Floodplain Acres
041100040101	**Dead Branch**	807	2.91
041100040102	**Headwaters Grand River** *(Grand R. headwaters to above Dead Branch)*	1,273	4.60
041100040103	**Baughman Creek**	95	0.34
041100040104	**Center Creek-Grand River** *(Grand R. below Dead Branch to above Baughman Cr.)*	974	3.52
041100040105	**Coffee Creek-Grand River** *(Grand R. below Baughman Cr. to above Swine Cr.)*	4,853	17.53
041100040106	**Swine Creek**	1,355	4.89
041100040201	**Upper Rock Creek** *[Snyder Ditch to U.S. Rt. 224 (Rock Cr. headwaters)]*	2,504	12.64
041100040202	**Middle Rock Creek** *(Rock Cr. below U.S. Rt. 224 to below of Lebanon Cr.)*	349	1.26
041100040203	**Lower Rock Creek** *(Rock Cr. below Lebanon Cr. to mouth)*	784	2.83
041100040301	**Phelps Creek**	1,448	5.23
041100040302	**Hoskins Creek**	284	1.03
041100040303	**Mill Creek (1)-Grand River** *[Grand R. below Swine Cr. to above Hoskins Cr. (except Phelps Cr.)]*	4,406	15.91
041100040304	**Mud Creek**	205	0.74
041100040305	**Plumb Creek-Grand River** *[Grand R. below Hoskins Cr. to above Rock Cr. (exc. Mud Cr.)]*	627	2.26

Table 46. (cont'd) 100 Year Floodplain in Subwatersheds of the Grand River Watershed.

HUC 12	HUC 12 Description	Floodplain Acres in Watershed	% of Total Floodplain Acres
041100040401	**Griggs Creek**	538	1.94
041100040402	**Peters Creek-Mill Creek** *(Mill Cr. (2) headwaters to above Griggs Cr.)*	1,624	5.87
041100040403	**Town of Jefferson-Mill Creek** *(Mill Cr. (2) below Griggs Cr. to Grand R.)*	1,132	4.09
041100040501	**Three Brothers Creek-Grand River** *(Grand R. below Rock Cr. to below Three Brothers Cr.)*	576	2.08
041100040502	**Bronson Creek-Grand River** *[Grand R. below Three Brothers Cr. to above Mill Cr. (2)]*	644	2.32
041100040601	**Coffee Creek-Grand River** *[Grand R. below Mill Cr. (2) to below Coffee Cr. (Lower Grand)]*	733	2.65
041100040602	**Mill Creek (3) (Lower Grand)**	203	0.73
041100040603	**Village of Mechanicsville-Grand River** *[Grand R. below Coffee Cr. to above Mill Cr. (3) (Lower Grand)]*	738	2.67
041100040604	**Paine Creek (Lower Grand)**	365	1.32
041100040605	**Talcott Creek-Grand River** *[Grand R. below Mill Cr. (3) to above Paine Cr. (Lower Grand)]*	773	2.79
041100040606	**Big Creek (Lower Grand)**	967	3.49
041100040607	**Red Creek-Grand River** *[Grand R. below Paine Cr. to Lake Erie [except Big Cr.] (Lower Grand)]*	1,936	6.99

Photo 9. Grand River Lowlands *(Source: GRPI)*

III. WATERSHED INVENTORY

ii. Tributary use designation, utilizing Ohio's water quality standards.

Map 31. Use Designations for the Grand River Watershed.

III. WATERSHED INVENTORY

Ohio Administrative Code 3745-1-10: Grand River drainage basin.

(A) The water bodies listed in table 10-1 (see Table 47) of this rule are ordered from downstream to upstream.

Tributaries of a water body are indented. The aquatic life habitat, water supply and recreation use designations are defined in rule 3745-1-07 of the Administrative Code. The state resource water use designation is defined in rule 3745-1-05 of the Administrative Code.

The most stringent criteria associated with any one of the use designations assigned to a water body will apply to that water body.

(B) Figure 1 (see Figure 4) of the appendix to this rule is a generalized map of the Grand River drainage basin.

(C) RM, as used in this rule, stands for river mile and refers to the method used by the Ohio environmental protection agency to identify locations along a water body. Mileage is defined as the lineal distance from the downstream terminus (i.e., mouth) and moving in an upstream direction.

(D) The following symbols are used throughout this rule:

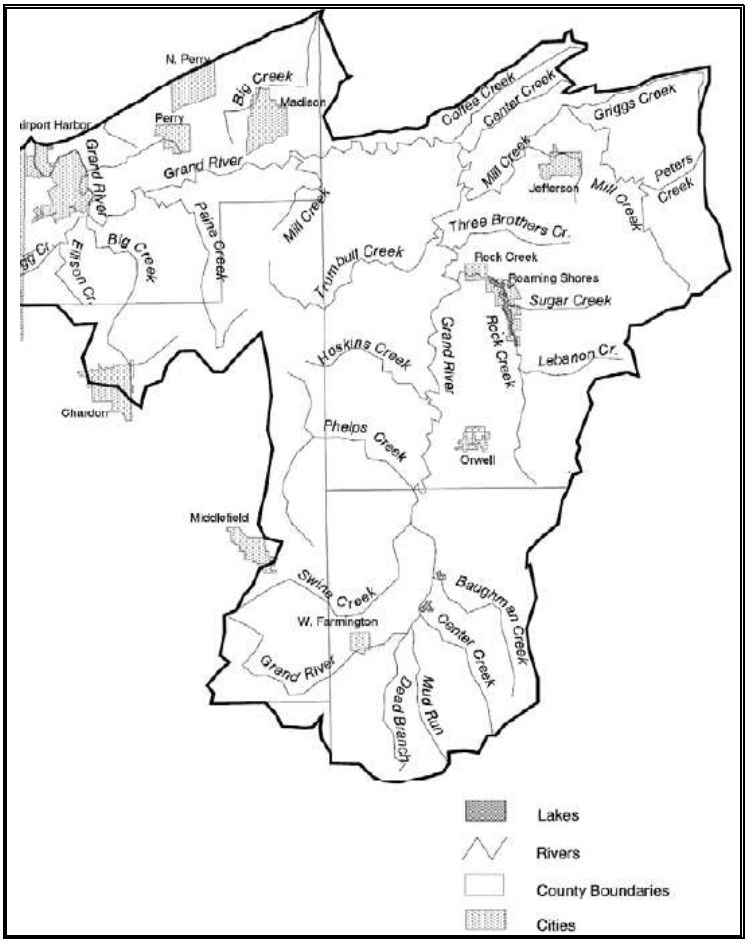
* Designated use based on the 1978 water quality standards;

+ Designated use based on the results of a biological field assessment performed by the Ohio environmental protection agency;

o Designated use based on justification other than the results of a biological field assessment performed by the Ohio environmental protection agency; and

L in the warmwater habitat column signifies that the water body segment is designated limited warmwater habitat.

Figure 4. Grand River Drainage Basin



III. WATERSHED INVENTORY

Table 47. Use designations for water bodies in the Upper Grand River drainage basin.

Water Body Segment	Use Designations													Comments
		Aquatic Life Habitat						Water Supply			Recreation			
	SRW	WWH	EWH	MWH	SSH	CWH	LRW	PWS	AWS	IWS	BW	PCR	SCR	
Grand river - headwaters to U.S. Rt. 422 (RM 95.5)		*							*	*		*		
- U.S. Rt. 422 to S.R. 608 (RM 91.8)			+						+	+		+		
- S.R. 608 to Fobes Rd. (RM 44.7)		+							+	+		+		
- at RM 89.12		+						o	+	+		+		PWS intake - West Farmington
Mill creek		+							+	+		+		
Cemetery creek		+							+	+		+		
Griggs creek		*							*	*		*		
Askue run		+							+	+		+		
Peters creek		+							+	+		+		
Bronson creek		*							*	*		*		
Trumbull creek			+						*	*		*		
Spring creek		*							*	*		*		
Three Brothers creek		*							*	*		*		
Badger run		*							*	*		*		
Rock creek		+							+	+		+		
Plum creek		*							*	*		*		
Sugar creek		*							*	*		*		
Whetstone creek		*							*	*		*		
Lebanon creek		*							*	*		*		
Shanty creek		*							*	*		*		

Table 37 (cont'd). Use designations for water bodies in the Upper Grand River Watershed.

Water Body Segment	Use Designations													Comments
		Aquatic Life Habitat						Water Supply			Recreation			
	SRW	WWH	EWH	MWH	SSH	CWH	LRW	PWS	AWS	IWS	BW	PCR	SCR	
Crooked creek			+						*	*		*		
Mud creek		*							*	*		*		
Hoskins creek			+						*	*		*		
Indian creek			+						*	*		*		
Montville ditch		*							*	*		*		
Phelps creek			+						+	+		+		
North branch		*							*	*		*		
South branch		*							*	*		*		
Mill creek														
Garden creek														
Swine creek														
Grapevine creek														
Andrews creek														
Plum creek														
Coffee creek														
Baughman creek														
Center creek														
Mud run														
Dead branch														

SRW = state resource water; WWH = warmwater habitat; EWH = exceptional warmwater habitat; MWH = modified warmwater habitat; SSH = seasonal salmonid habitat; CWH = coldwater habitat; LRW = limited resource water; PWS = public water supply; AWS = agricultural water supply; IWS = industrial water supply; BW = bathing water; PCR = primary contact recreation; SCR = secondary contact recreation.

III. WATERSHED INVENTORY

c. Lakes and reservoirs (size, uses, watersheds, detention time).

There are over 100 lakes and many more ponds in the Upper Grand River Watershed. None of the lakes or ponds are natural, consisting of impounded or dugout waterbodies. Lake Roaming Rock in Roaming Shores is the largest of these man-made lakes at 460 acres. Other man-made lakes worth mentioning include: Dillon's Upground Reservoir in Bloomfield Township, 90 acres, Lake Cardinal in Rome Township, 56 acres, Lake Asegra in Austinburg, 53 acres and Mont-Mere Lake in Montville Township, 53 acres. These man-made lakes and others in the watershed where created for use as direct water supply, flood control, recreation or sediment control.

More specific information regarding lakes and impoundments in the Grand River Watershed is available at ODNR Division of Soil and Water Resources - Dam Safety Program.

3. Ground Water

a. Aquifers (location, recharge rates, uses)

Ohio has abundant surface and ground water resources. Average rainfall ranges between 30 to 44 inches a year (increasing from northwest to southeast), which drives healthy stream flows. Infiltration of a small portion of this rainfall (3-16 inches) recharges the states aquifers and keeps the streams flowing between rains. Ohio's aquifers can be divided into three major types of productive aquifers as illustrated in Map 31. The sand and gravel valley aquifers (in blue) are distributed through the state. The valleys filled by these sands are cut into sandstone and shale in the eastern half of the state (in rose) and into carbonate aquifers (in greens) in the western half of the state. The sandstone and carbonate aquifers generally provide sufficient production for water wells except where dominated by shale, as in southwest and southeast Ohio.

Sand and Gravel Aquifers - The unconsolidated sand and gravel units, typically associated with buried valley aquifer systems, are Ohio's most productive water bearing formations or aquifers. These valleys were cut into the bedrock by pre-glacial and glacial streams and subsequently the valleys were back filled with deposits of sand, gravel and other glacial drift by glacial and alluvial processes as the glaciers advanced and receded. Buried valley aquifers are found beneath and adjacent to the Ohio River, its major tributaries, and other pre-glacial stream channels such as the Teays River. The distribution of these Quaternary sand and gravel units is presented as thin bands of blue in Map 31 (modified from ODNR Glacial Aquifer Maps, 2000). In addition to the buried valley aquifers, several other types of productive sand and gravel aquifers are included in Map 31. In the northwest corner of the state, the triangular area of sand and gravel units includes sheets of outwash or sand and gravel deposits that occur between sheets of glacial till. Present day stream processes deposit alluvial sand and gravel deposits that also serve as aquifers. Other geologic settings included in the sand and gravel aquifers are the outwash/kame and beach ridge deposits, including the Oak Opening Sands (large patches of sand and gravel in northwest Ohio.

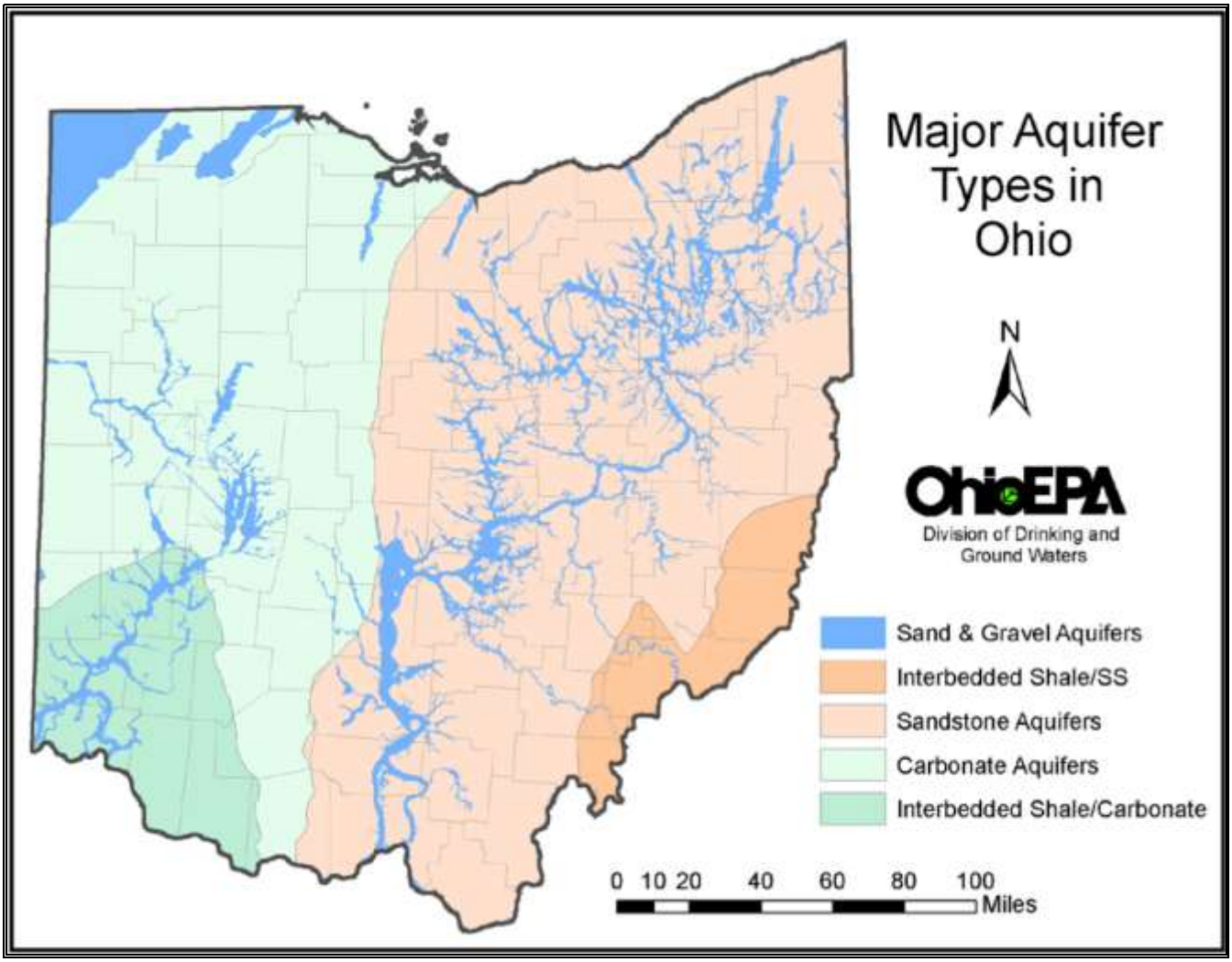
Water production from the coarser grained and thicker sand and gravel deposits ranges up to 500 to 1,000 gallons per minute. Lower yields from sand and gravel aquifers are more common. The production rate depends on the type, distribution, permeability, and thickness of permeable glacial/alluvial deposits as well as on well construction parameters, such as well diameter and length of well screen.

Sandstone Aquifers - In the eastern half of Ohio, Mississippian and Pennsylvanian sandstone units are the dominant bedrock aquifers (Map 31). Upper Paleozoic siltstone, sandstone, and conglomerate formations (Mississippian to Permian age) in eastern Ohio occur as numerous layers of siltstone and sandstone of variable thickness and areal extent separated by layers of shale and minor amounts of limestone, clay and coal. The sandstone units generally dip a few degrees to the southeast, toward the Appalachian Basin. Some of the thicker sandstones and conglomerates are capable of yielding 50 to 100 gallons per minute, but 25 gallons a minute is a good yield for these aquifers. The more productive stratigraphic units include:

- Pennsylvanian Sharon through Massillon Formations, and the Homewood Sandstone within the Pottsville and Allegheny Groups - These sandstones were deposited on a stable coastal plain under conditions of rising sea level. These aquifers are most commonly used in the northern areas of Eastern Ohio. To the southeast, farther into the Appalachian Basin, the water in these units is generally too saline for drinking water.
- Mississippian Berea Sandstone, Cuyahoga Group, Logan and Blackhand Formations - These siltstones and sandstones with minor conglomerate were sorted and deposited in deltaic complexes from material eroded from the Acadian Mountains (Late Devonian uplift) to the east. These units also extend to the SE, farther into the Appalachian Basin, but as with the Pennsylvanian units, the water becomes too saline for drinking water.

In southeastern Ohio, Upper Pennsylvanian and Permian stratigraphic sections include low yielding aquifers. The bedrock consists of varied sequences of thin-bedded shales, limestones, sandstones, clays, and coals of the Pennsylvania, Conemaugh and Monongahela Groups and the Permian Dunkard Group. Yields below 5 gallons per minute are common in these areas.

Map 32. Aquifer Types in Ohio modified from ODNR glacial and bedrock Aquifer Maps (ODNR, 2000).



III. WATERSHED INVENTORY

i. Flow regime

The natural flow of a river varies on time scales of hours, days, seasons, years, and longer. Many years of observation from a streamflow gauge are generally needed to describe the characteristic pattern of a river's flow quantity, timing, and variability— that is, its natural flow regime. Components of a natural flow regime can be characterized using various time series and probability analyses of, for example, extremely high or low flows, or of the entire range of flows expressed as average daily discharge. In watersheds lacking long-term streamflow data, analyses can be extended statistically from gauged streams in the same geographic area. The frequency of large-magnitude floods can be estimated by paleohydrologic studies of debris left by floods and by studies of historical damage to living trees. These historical techniques can be used to extend existing hydrologic records or to provide estimates of flood flows for ungauged sites.

No data is available. The Ohio EPA and ODNR have been contacted to find data sources on this topic.

Photo 10. Grand River Unnamed Tributary *(Source: GRPI)*

III. WATERSHED INVENTORY

ii. Source Water Assessment Plan (SWAP) information

The Village of West Farmington manages a community public water system providing drinking water drawn from the Grand River to residents within the village. The Grand River flows through rural, agricultural areas before reaching the water intake. Agricultural practices such as unrestricted livestock access, land application products, and manure applications can add nutrients, sediment, and chemicals to the river either directly or via a tributary.

Land use within the protection area is comprised of evergreen and deciduous forests, pasture land, row crops, and wetlands. According to the SWAP, possible impacts to surface water quality from the surrounding environment include "livestock access to the drainage systems and streams, agricultural runoff from row crop agriculture, inadequate on-lot sewage treatment systems, oil/gas production activities, new housing and commercial development that could increase runoff from roads and parking lots, and numerous road crossings over the streams". A field survey, conducted by the Ohio EPA, found areas of unrestricted livestock access along the Grand River's mainstem and tributaries. This unrestricted access can promote streambank erosion, increasing the sediment load and the amount of pathogens entering the stream. Soil surveys of the protection area conclude soils are not suitable for HSTS's with on-lot treatment. For more detailed information refer to the Drinking Water Source Assessment for the Village of West Farmington

iii. What do DRASTIC maps say about sensitivity of groundwater to local sources of contamination?

The DRASTIC method is the primary tool used by the Ohio EPA to evaluate the hydrogeologic sensitivity of the aquifer to contamination. DRASTIC is a standardized method to systematically evaluate the pollution potential of any hydrogeologic setting (Aller et al, 1985). The method uses a relative ranking scheme consisting of a combination of weights and ratings to produce a numerical value, called the DRASTIC index. The DRASTIC index helps to prioritize ground water resources with respect to their vulnerability to ground water contamination. DRASTIC applies to the uppermost aquifer, which is usually the most vulnerable (See Table 48 & maps 33 – 39).

The DRASTIC parameters are as follows:

- **D**epth to Water
- **R**echarge to the Aquifer
- **A**quifer Media
- **S**oil Media
- **T**opography
- **I**mpact (type) of Vadose Zone Media
- **C**onductivity (Hydraulic) of the Aquifer

(Source: OEPA - Ground Water Susceptibility Analysis Process Manual)

III. WATERSHED INVENTORY

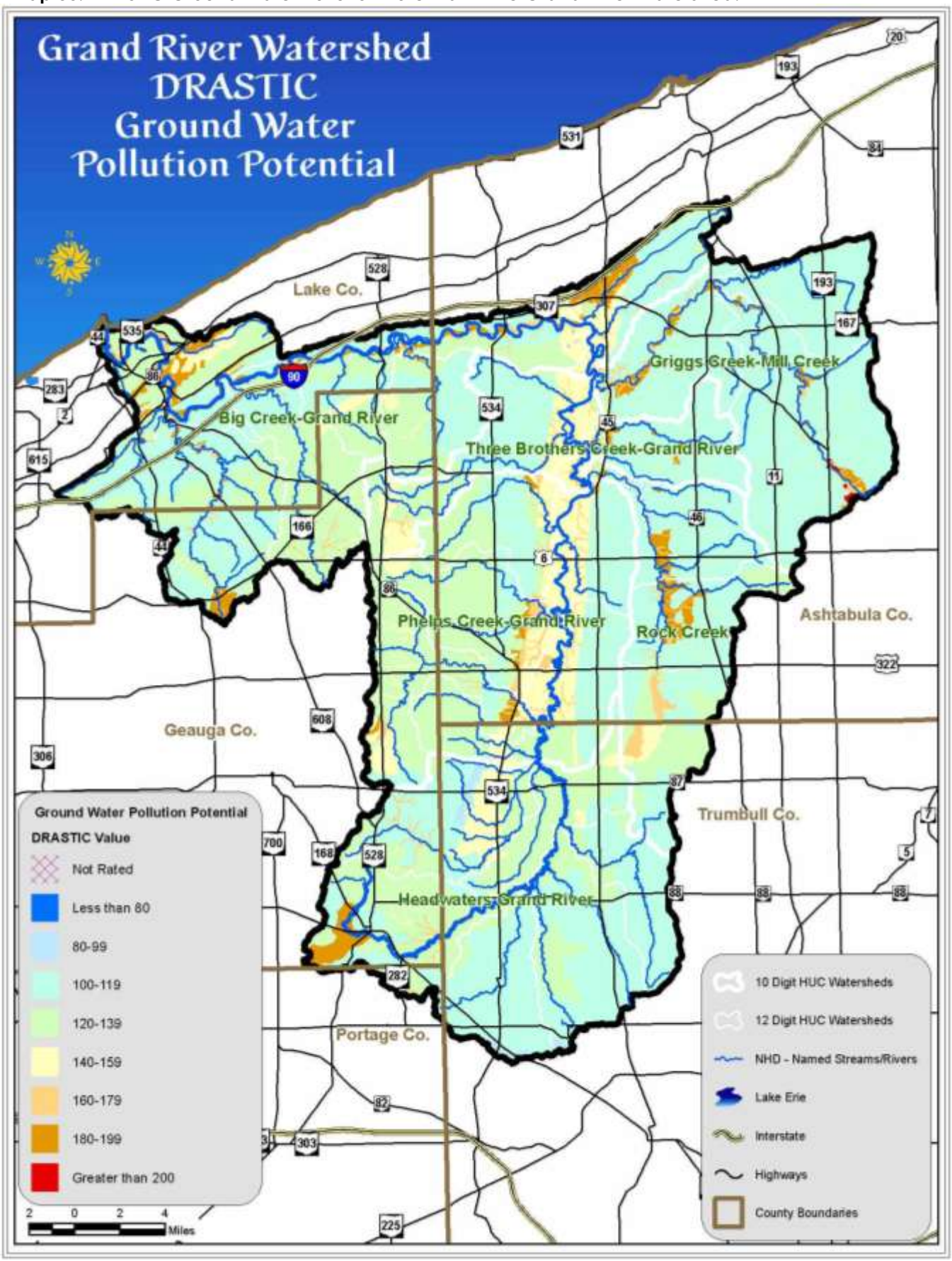
Table 48. DRASTIC Summary of the Grand River Watershed.

HUC 10	HUC 10 Name	Not Rated	Less than 80	80-99	100-119	120-139	140-159	160-179	180-199	Greater than 200
0411000401 Acres	Headwaters Grand River	0	0	1,473	52,330	38,175	4,549	1,561	2,138	0
% of Watershed		0.00%	0.00%	1.47%	52.21%	38.09%	4.54%	1.56%	2.13%	0.00%
0411000402 Acres	Rock Creek	471	0	0	27,636	11,689	969	2,141	2,178	0
% of Watershed		1.04%	0.00%	0.00%	61.30%	25.93%	2.15%	4.75%	4.83%	0.00%
0411000403 Acres	Phelps Creek-Grand River	67	0	5	22,006	39,989	16,633	4,496	1,034	0
% of Watershed		0.08%	0.00%	0.01%	26.13%	47.48%	19.75%	5.34%	1.23%	0.00%
0411000404 Acres	Griggs Creek-Mill Creek	0	0	0	56,280	4,976	45	3,039	1,408	185
% of Watershed		0.00%	0.00%	0.00%	85.36%	7.55%	0.07%	4.61%	2.14%	0.28%
0411000405 Acres	Three Brothers Creek-Grand River	0	0	0	19,079	8,769	7,048	1,724	317	0
% of Watershed		0.00%	0.00%	0.00%	51.65%	23.74%	19.08%	4.67%	0.86%	0.00%
0411000406 Acres	Big Creek-Grand River (Lower Grand)	177	0	0	46,857	49,255	6,809	8,985	5,398	0
% of Watershed		0.15%	0.00%	0.00%	39.88%	41.93%	5.80%	7.65%	4.59%	0.00%

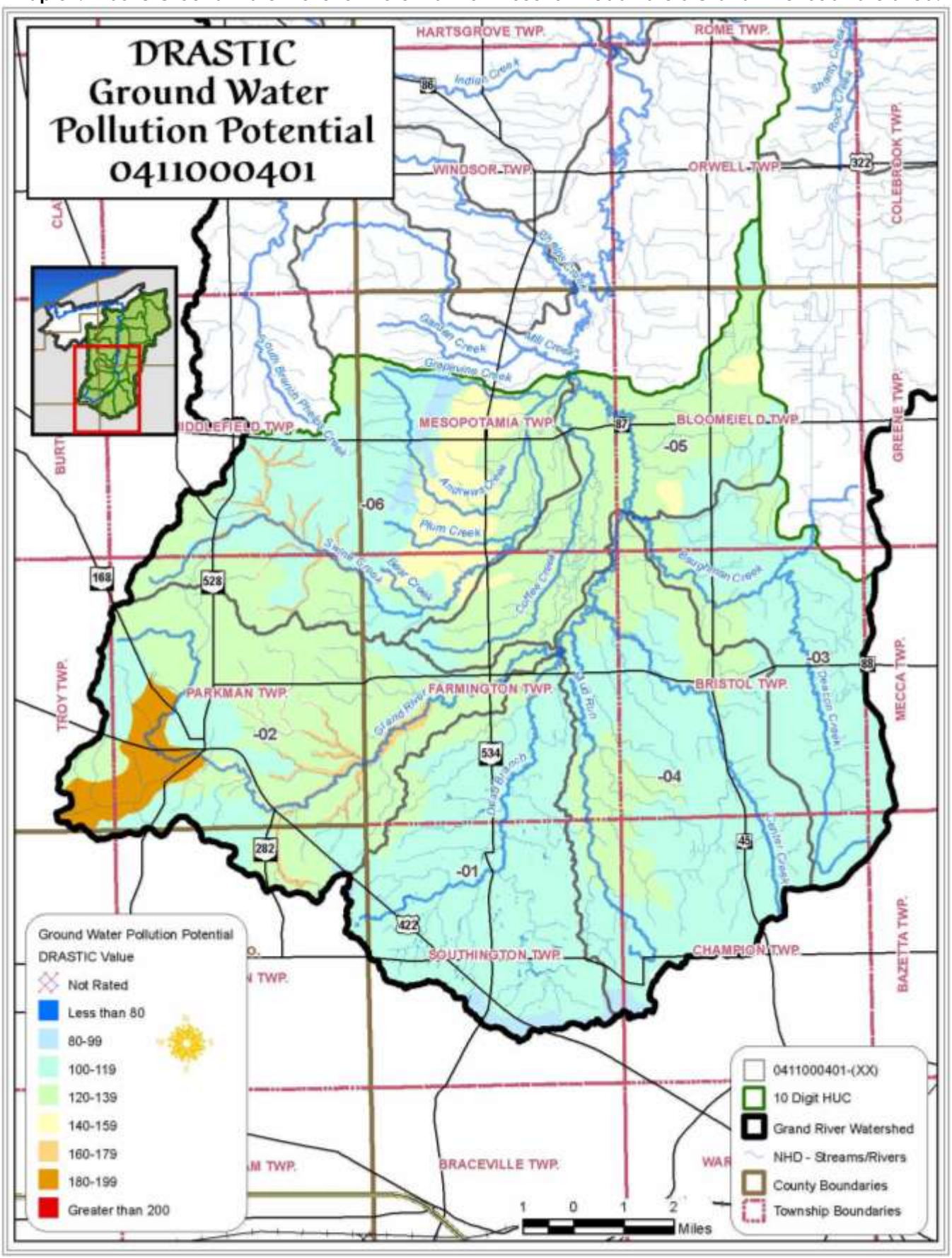
This Page Intentionally left blank

III. WATERSHED INVENTORY

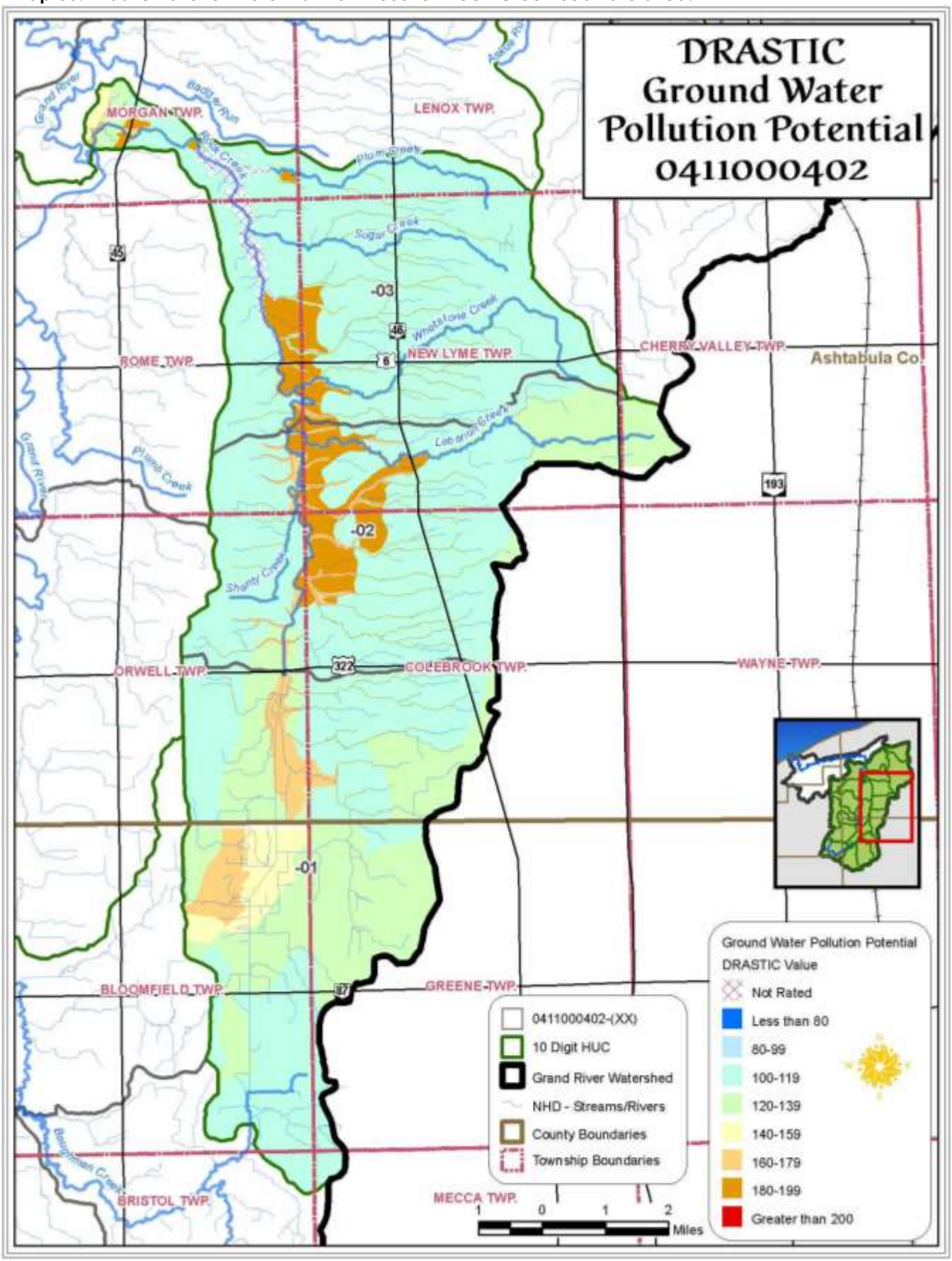
Map 33. DRASTIC Ground Water Pollution Potential in the Grand River Watershed.



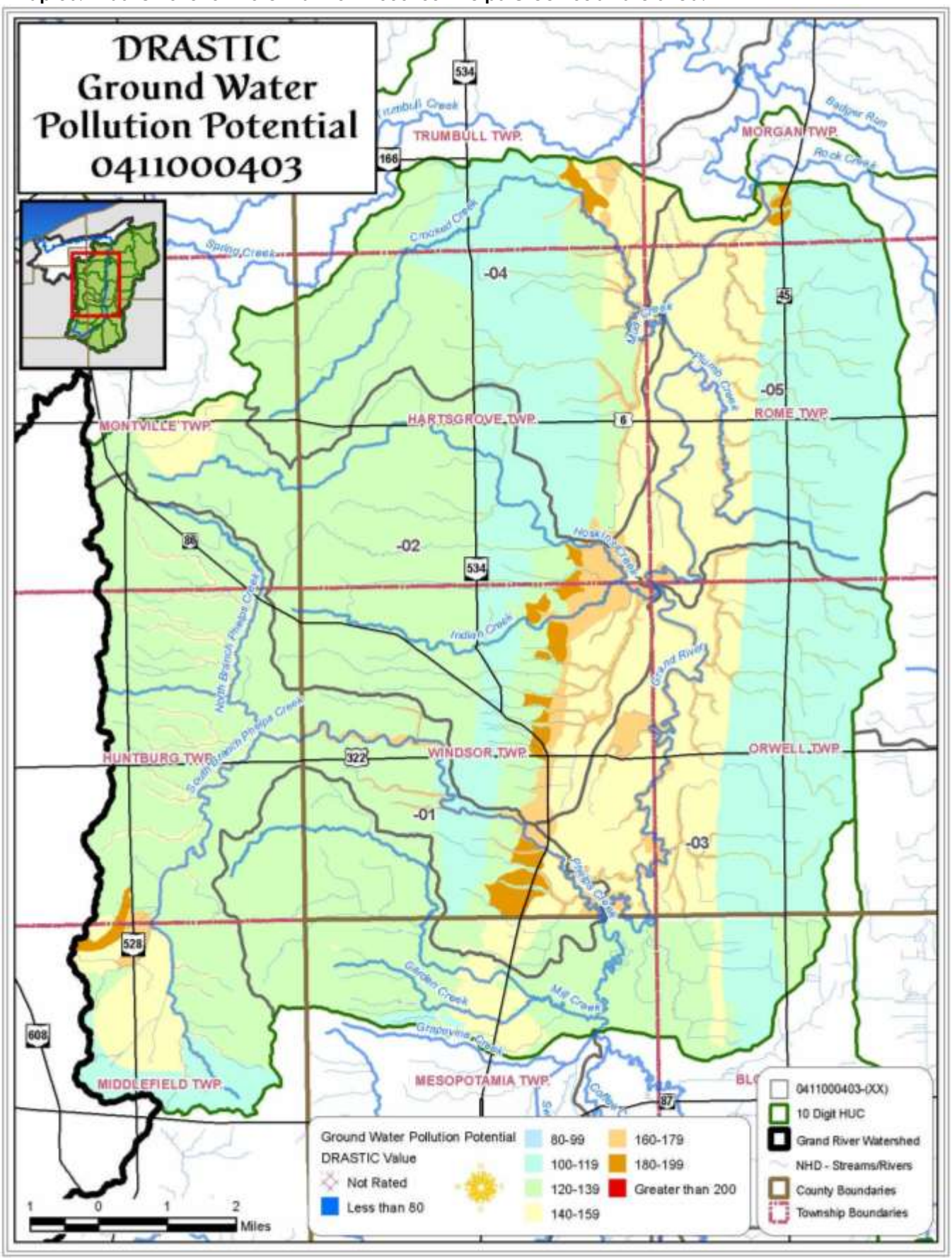
Map 34. Drastic Ground Water Pollution Potential - 0411000401 Headwaters Grand River Subwatershed.



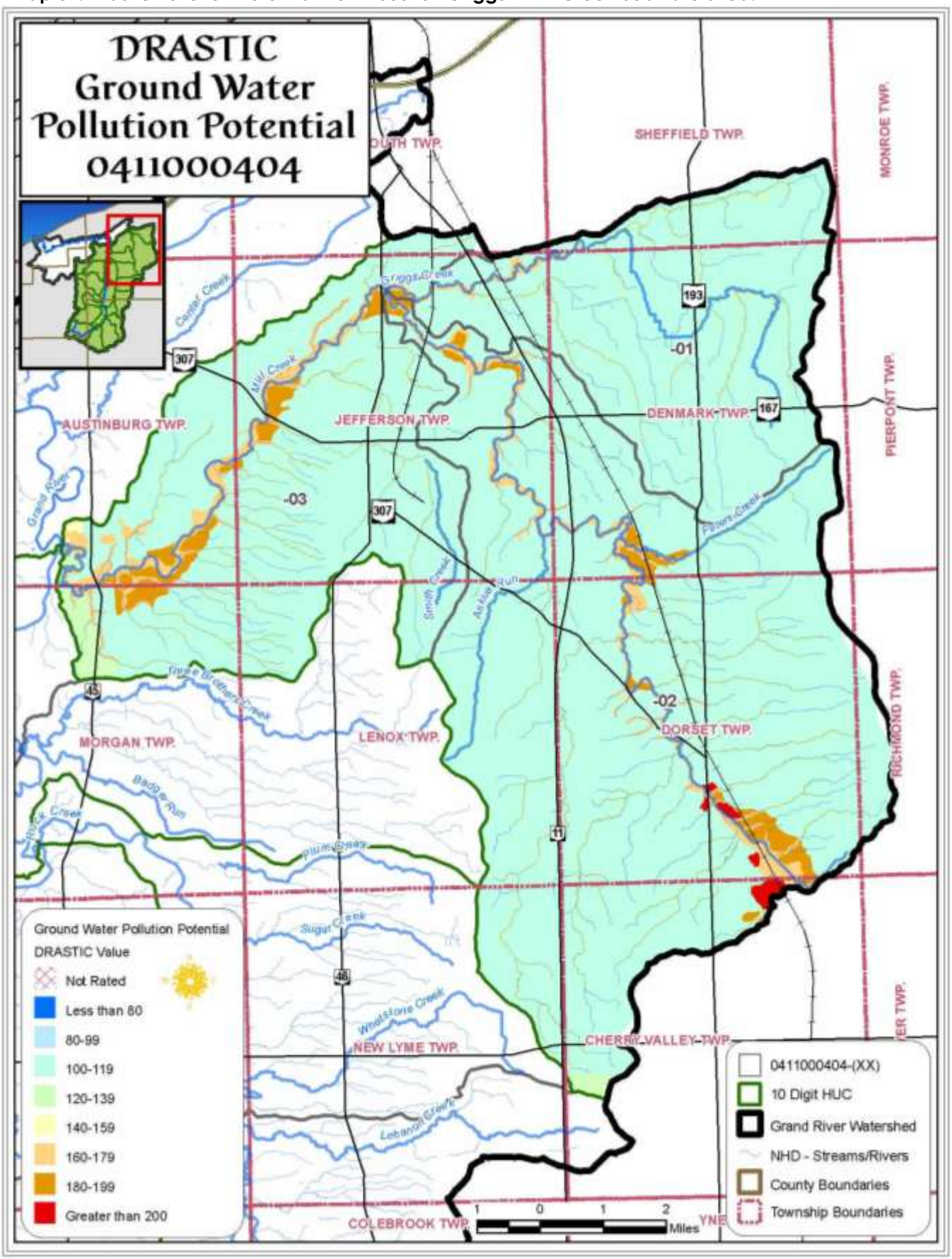
Map 35. Drastic Pollution Potential - 0411000402 Rock Creek Subwatershed.



Map 36. Drastic Pollution Potential - 0411000403 Phelps Creek Subwatershed.

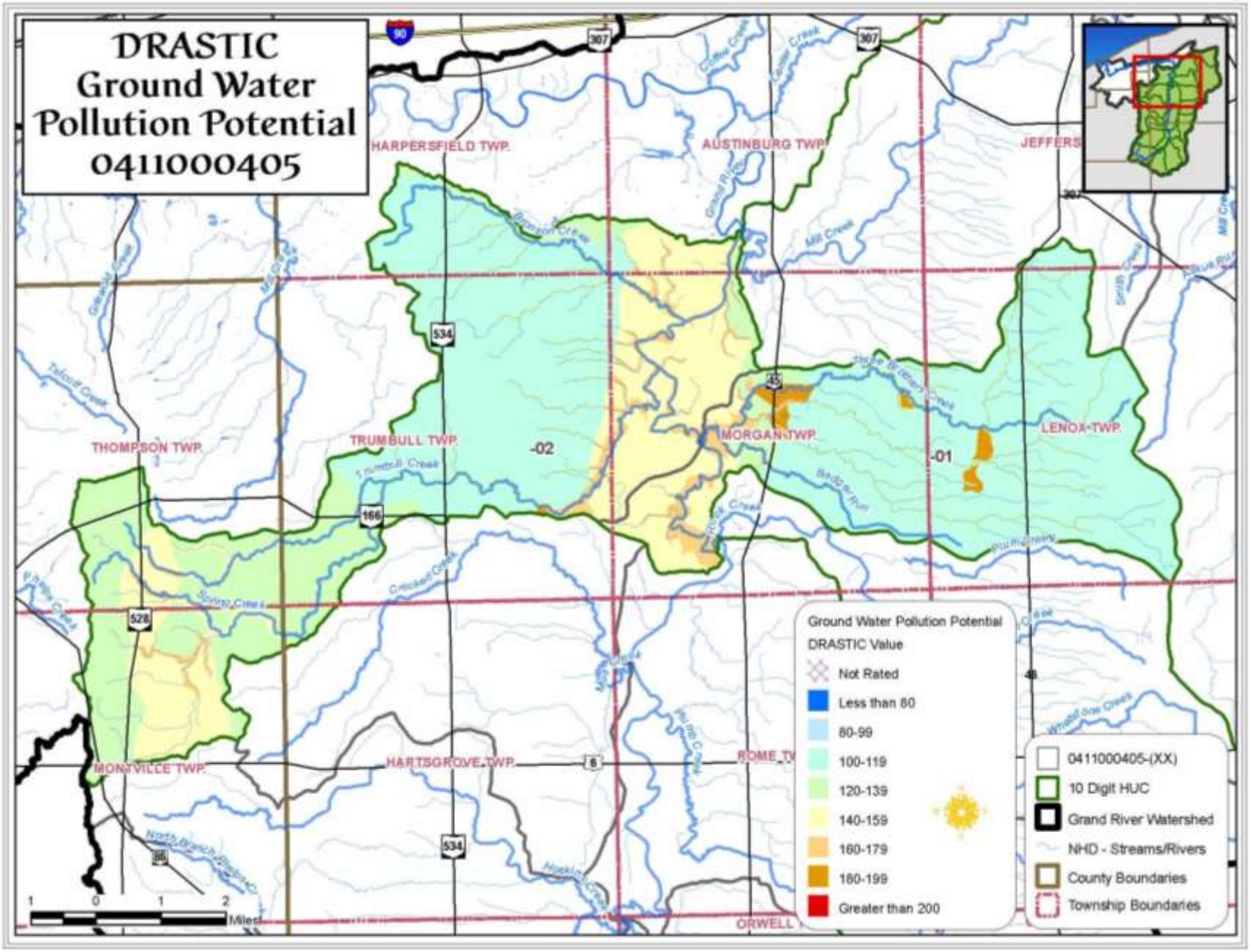


Map 37. Drastic Pollution Potential - 0411000404 Griggs - Mill Creek Subwatershed.

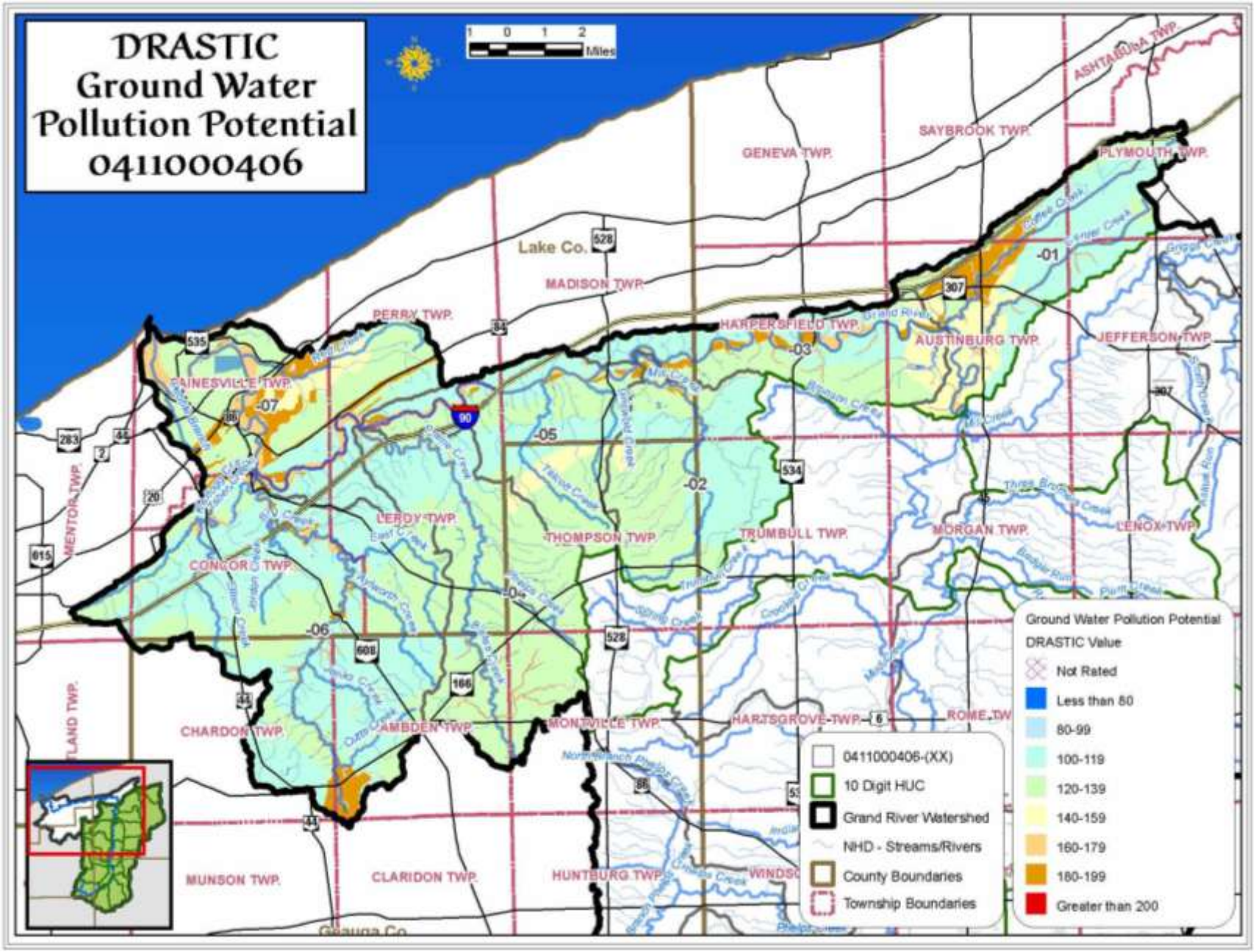


This Page Intentionally left blank

Map 38. Drastic Pollution Potential - 0411000404 Three Brothers Creek Subwatershed.



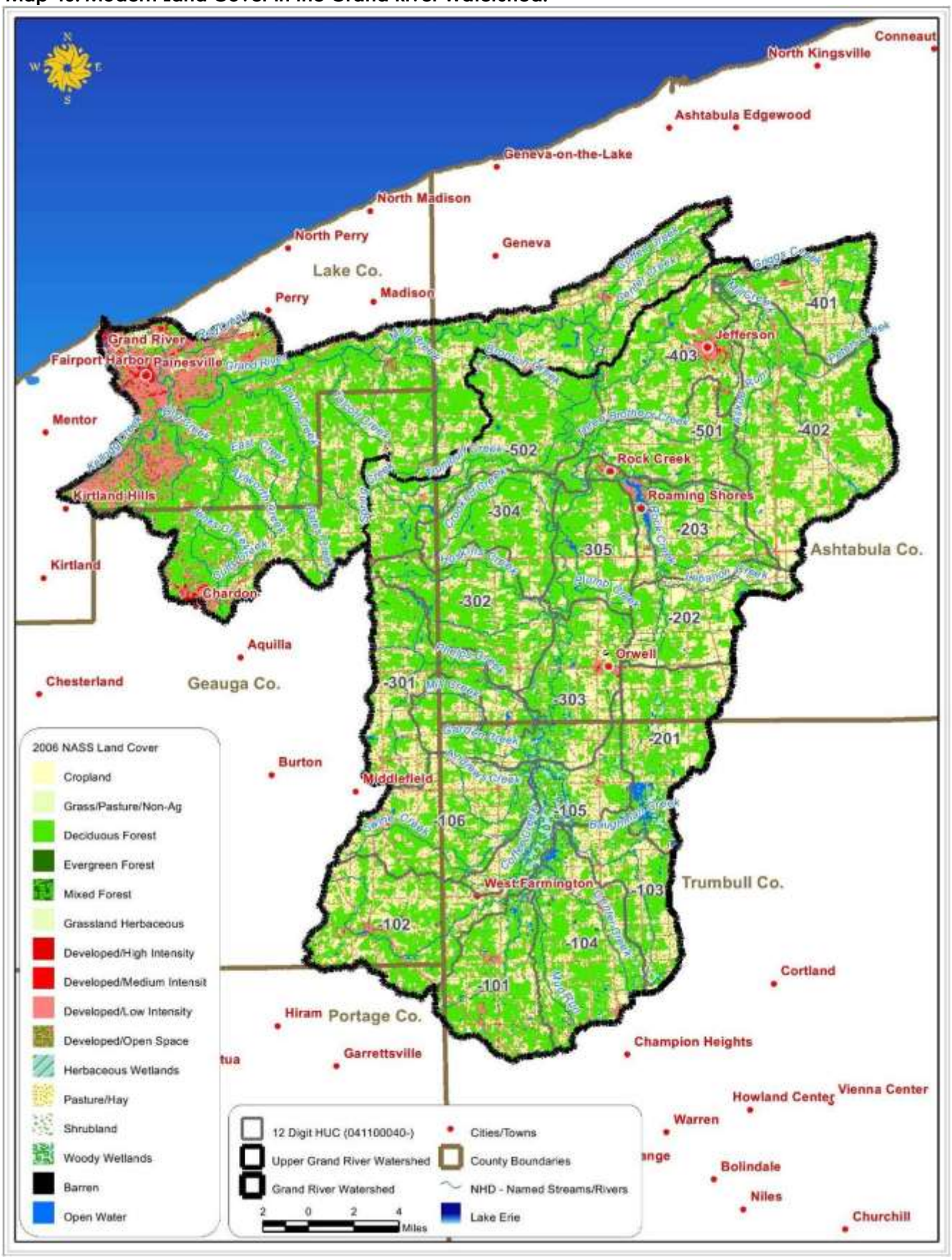
Map 39. Drastic Pollution Potential - 0411000406 Big Creek Grand River Subwatershed (lower Grand).



III. WATERSHED INVENTORY

- **Land Use including land cover description (with percentages by subwatershed)**

Map 40. Modern Land Cover in the Grand River Watershed.



This page left intentionally blank

III. WATERSHED INVENTORY

1. Urban

a. Impervious surfaces

Various studies show that stream ecosystems and water quality become degraded as impervious surfaces increase. Impairment to streams often occurs when more than 10% of the land within a watershed is covered with impervious surfaces. However, sensitive species can be affected in watersheds with less than 10% imperviousness, especially when impervious surfaces are located adjacent to water bodies. When the percentage of impervious cover exceeds 25%, most watersheds experience severe habitat and water quality impairment.

As of the 2001 National Land Cover Database Impervious Cover Analysis, the average percent impervious cover in the Upper Grand River Watershed is 1.1 percent. The highest average impervious cover in the Upper Grand River is 2.7 % in the Town of Jefferson-Mill Creek (2) subwatershed. The Village of Jefferson is by far the area with the highest amount of development in the Upper Grand River Watershed.

Table 49. Average Impervious Cover in the Grand River Watershed.
(Source: NLCD 2001 - Impervious Cover Analysis)

HUC 12	HU_12_Description	ACRES	Miles^2	Average % Impervious
041100040101	**Dead Branch**	15452	24.14	1.22
041100040102	**Headwaters Grand River**	21228	33.17	1.14
041100040103	**Baughman Creek**	11790	18.42	0.62
041100040104	**Center Creek-Grand River**	20093	31.40	0.91
041100040105	**Center Creek-Grand River**	12163	19.00	0.67
041100040106	**Swine Creek**	19816	30.96	1.18
041100040201	**Upper Rock Creek**	16635	25.99	0.74
041100040202	**Middle Rock Creek**	13658	21.34	1.00
041100040203	**Lower Rock Creek**	15056	23.53	2.09
041100040301	**Phelps Creek**	18765	29.32	1.21
041100040302	**Hoskins Creek**	17175	26.84	0.88
041100040303	**Mill Creek (1) - Grand River**	22888	35.76	1.01
041100040304	**Mud Creek**	13467	21.04	0.67
041100040305	**Plumb Creek-Grand River**	12299	19.22	0.85
041100040401	**Griggs Creek**	13216	20.65	1.07
041100040402	**Peters Creek-Mill Creek**	35025	54.73	1.05
041100040403	**Town of Jefferson-Mill Creek**	17997	28.12	2.73
041100040501	**Three Brothers Creek-Grand River**	13875	21.68	0.78
041100040502	**Bronson Creek-Grand River**	23075	36.05	0.84
041100040601	**Coffee Creek-Grand River (Lower Grand)**	14063	21.97	2.13
041100040602	**Mill Creek (3) (Lower Grand)**	13415	20.96	0.72
041100040603	**Village of Mechanicsville-Grand River (Lower Grand)**	10617	16.59	1.18
041100040604	**Paine Creek (Lower Grand)**	18424	28.79	1.17
041100040605	**Talcott Creek-Grand River (Lower Grand)**	12346	19.29	1.54
041100040606	**Big Creek (Lower Grand)**	32224	50.35	6.11
041100040607	**Red Creek-Grand River (Lower Grand)**	16805	26.26	16.51

III. WATERSHED INVENTORY

b. Home sewage treatment systems location

Inventory of HSTS

There are 17,486 HSTS systems in the watershed. Of them, approximately 16% are failing (based on a 2001 NOACA study) or 2798 systems. Based on the estimated 2798 failing systems, a load analysis was prepared for the discharge of several pollutants in the septic tank effluent (Table 51). A flow value of 320 gallons per day was used (assuming most of the flow from a typical 3-bedroom house enters the watershed).

Table 50. Septic Systems Upper Grand River Watershed.

12-digit HUC Code	Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate
041100040101	Dead Branch	1002	2.52	16%
041100040102	Headwaters -Grand River	1556	2.83	16%
041100040103	Baughman Creek	766	2.52	16%
041100040104	Center Creek-Grand River	1308	2.52	16%
041100040105	Coffee Creek-Grand River	780	2.52	16%
041100040106	Swine Creek	1391	2.71	16%
041100040201	Upper Rock Creek	877	2.49	16%
041100040202	Middle Rock Creek	505	2.42	16%
041100040203	Lower Rock Creek	557	2.42	16%
041100040301	Phelps Creek	1259	2.83	16%
041100040302	Hoskins Creek	764	2.58	16%
041100040303	Mill Creek-Grand River	1132	2.53	16%
041100040304	Mud Creek	538	2.49	16%
041100040305	Plumb Creek-Grand River	455	2.42	16%
041100040401	Griggs Creek	490	2.42	16%
041100040402	Peters Creek-Mill Creek	1298	2.42	16%
041100040403	Town of Jefferson-Mill Creek	667	2.42	16%
041100040501	Badger Run-Three Brothers Creek	516	2.42	16%
041100040502	Bronson Creek-Grand River	1625	2.72	16%

Table 51. Septic Tank Watershed Loading Upper Grand River Watershed.

Total Homes = 2798 (failing systems estimate)	Biochemical Oxygen Demand	T. Phosphorus	Ammonia	Fecal Coliform (#/100 ml)	Flow (gallons per day)
Typical Effluent Quality (mg/L)	143	13	36	3,379,051	320
Individual Home Pollutant Load (lbs/day)	0.381	0.034	0.096		320
Total Home Pollutant Load (lbs/day)	1067	97	268		895,360
Total Home Pollutant Load (lbs/year)	389755	35432	98120		

2. Forest

According to the 2006 National Land Cover Database, 185819 acres or 56 percent of the land cover in the Upper Grand River Watershed is forested, with deciduous forest representing 55 percent of the total forested land cover.

Table 52. 2006 NLCD Forest Cover in the Grand River Watershed.

12-digit HUC Code	Watershed	Forested Acres	% Land Covered
041100040101	Dead Branch	9063	59
041100040102	Headwaters -Grand River	10614	50
041100040103	Baughman Creek	5791	49
041100040104	Center Creek-Grand River	12636	63
041100040105	Coffee Creek-Grand River	7763	64
041100040106	Swine Creek	9134	46
041100040201	Upper Rock Creek	9127	55
041100040202	Middle Rock Creek	6124	45
041100040203	Lower Rock Creek	6642	44
041100040301	Phelps Creek	9891	53
041100040302	Hoskins Creek	11152	65
041100040303	Mill Creek-Grand River	13170	58
041100040304	Mud Creek	9360	70
041100040305	Plumb Creek - Grand River	8045	65
041100040401	Griggs Creek	6272	47
041100040402	Peters Creek-Mill Creek	18428	53
041100040403	Town of Jefferson-Mill Creek	9206	51
041100040501	Badger Run-Three Brothers Creek	8022	58
041100040502	Bronson Creek-Grand River	15378	67
041100040601	Coffee Creek-Grand River (Lower Grand)	6975	50
041100040602	Mill Creek (3) (Lower Grand)	8268	62
041100040603	Village of Mechanicsville-Grand River (Lower Grand)	5240	49
041100040604	Paine Creek (Lower Grand)	12576	68
041100040605	Talcott Creek-Grand River (Lower Grand)	8163	66
041100040606	Big Creek (Lower Grand)	18575	58
041100040607	Red Creek-Grand River (Lower Grand)	5012	30

This page left intentionally blank

III. WATERSHED INVENTORY

3. Agriculture

a. Crop type

Data Acquired – awaiting inclusion: 2006_USDA_Cropland_Cover

Table 53. Crop Types of the Grand River Watershed.

12-digit HUC Code	Watershed	Corn	Soy-beans	Winter Wheat	W. Wht./ Soy. Dbl. Crop	Oats	Speltz	Alfalfa	Other Hays	Other Crops
041100040101	Dead Branch	83	284	26	0	2	0	0	48	0
041100040102	Headwaters -Grand River	333	323	69	0	4	2	1	164	0
041100040103	Baughman Creek	411	796	22	1	1	0	0	100	0
041100040104	Center Creek-Grand River	338	351	35	0	3	0	0	171	0
041100040105	Coffee Creek-Grand River	211	355	58	0	2	0	1	192	0
041100040106	Swine Creek	102	384	77	0	0	2	1	184	0
041100040201	Upper Rock Creek	411	1308	184	9	3	1	4	153	0
041100040202	Middle Rock Creek	818	1946	135	25	24	31	3	98	0
041100040203	Lower Rock Creek	631	1068	39	0	0	1	9	205	0
041100040301	Phelps Creek	112	196	90	0	2	0	1	187	0
041100040302	Hoskins Creek	146	485	27	0	0	1	1	155	0
041100040303	Mill Creek-Grand River	570	806	104	1	5	2	4	291	1
041100040304	Mud Creek	181	212	14	0	0	0	0	133	0
041100040305	Plumb Creek-Grand River	647	553	17	0	0	0	0	106	0
041100040401	Griggs Creek	315	502	97	1	9	0	1	284	0
041100040402	Peters Creek-Mill Creek	1110	1747	269	3	19	1	3	484	0
041100040403	Town of Jefferson-Mill Creek	373	695	25	0	3	0	4	223	1
041100040501	Badger Run-Three Brothers Creek	144	805	10	2	0	0	15	193	0
041100040502	Bronson Creek-Grand River	254	433	41	1	0	0	5	214	0
041100040601	Coffee Creek-Grand River (Lower Grand)	460	523	68	1	2	0	0	293	0
041100040602	Mill Creek (3) (Lower Grand)	180	149	10	0	1	0	3	65	0
041100040603	Village of Mechanicsville-Grand River (Lower Grand)	154	271	30	17	0	0	0	54	0
041100040604	Paine Creek (Lower Grand)	29	131	17	0	0	1	0	23	0
041100040605	Talcott Creek-Grand River (Lower Grand)	42	13	5	0	4	0	1	23	0
041100040606	Big Creek (Lower Grand)	35	80	8	0	0	0	0	52	0
041100040607	Red Creek-Grand River (Lower Grand)	10	2	11	0	0	0	0	18	0

This Page Intentionally left blank

III. WATERSHED INVENTORY

b. Tillage

No data available. Ohio NRCS & USDA contact for this information.

c. Rotations

No data available. Ohio NRCS & USDA contact for this information.

d. Livestock Inventory

According to the 2009 USDA Agricultural Animal Analysis, Dairy Cattle made up 4143 animal units or 32 percent of all the agricultural animals in the Upper Grand River Watershed. Chicken made up 3177 animal units or 25 percent of the total agricultural animals in the watershed, representing 83 percent of poultry. Horses comprised 19 percent of the total at 2437 animal units.

In terms of 12-digit subwatersheds, Bronson Creek-Grand River contained 1391 animal units or 11 percent of the total agricultural animals in the Upper Grand River Watershed. Peters Creek-Mill Creek and the Headwaters - Grand River subwatershed followed with 10 percent and 8 percent respectively.

Table 54. Agricultural Animals of the Upper Grand River Watershed.
(Source: 2009 USDA Agricultural Animal Analysis)

Watershed	12-digit HUC Code	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck
Dead Branch	041100040101	81	110	18	3	81	93	9	22
Headwaters - Grand River	041100040102	91	214	28	72	245	309	6	87
Baughman Creek	041100040103	63	88	15	4	63	71	8	20
Center Creek-Grand River	041100040104	104	147	26	5	104	120	16	32
Coffee Creek-Grand River	041100040105	62	89	16	2	62	73	9	20
Swine Creek	041100040106	96	180	25	42	188	226	7	66
Upper Rock Creek	041100040201	88	177	14	6	97	117	4	14
Middle Rock Creek	041100040202	68	206	18	18	84	110	0	13
Lower Rock Creek	041100040203	74	223	16	16	91	127	0	11
Phelps Creek	041100040301	76	219	25	65	228	283	4	80
Hoskins Creek	041100040302	82	245	17	29	131	176	0	25
Mill Creek-Grand River	041100040303	111	275	18	19	145	192	2	21
Mud Creek	041100040304	63	195	17	18	88	122	0	13
Plumb Creek-Grand River	041100040305	64	184	18	18	74	103	0	11
Griggs Creek	041100040401	67	197	13	15	79	111	0	11
Peters Creek-Mill Creek	041100040402	177	525	45	48	208	292	0	31
Town of Jefferson-Mill Creek	041100040403	89	269	19	21	105	147	0	15
Badger Run-Three Brothers Creek	041100040501	74	206	15	15	81	118	0	12
Bronson Creek-Grand River	041100040502	142	394	29	78	283	387	0	78

e. Grazing

No data available. Ohio NRCS & USDA contact for this information.

f. Chemical use patterns

No data available. Ohio NRCS & USDA contact for this information.

g. Irrigation

No data available. Ohio NRCS & USDA contact for this information.

III. WATERSHED INVENTORY

4. Water

Open water covers 3916 acres or less that 1 percent of the land in the Grand River Watershed and a similar amount of land in the Upper Grand River Watershed (2486 acres or less than 1 percent). The highest level of open water covering land in a 12-digit subwatershed is 539 acres or almost 4 percent in Lower Rock Creek, with Lake Roaming Rock covering 460 acres of the subwatershed.

Table 55. Open Water Land Cover of the Grand River Watershed.
(Source: 2006 NLCD Land Cover Analysis)

12-digit HUC Code	Watershed	Open Water Acres	% Land Covered
041100040101	Dead Branch	186	1.2
041100040102	Headwaters - Grand River	132	0.6
041100040103	Baughman Creek	39	0.3
041100040104	Center Creek-Grand River	184	0.9
041100040105	Coffee Creek-Grand River	80	0.7
041100040106	Swine Creek	58	0.3
041100040201	Upper Rock Creek	265	1.6
041100040202	Middle Rock Creek	63	0.5
041100040203	Lower Rock Creek	539	3.6
041100040301	Phelps Creek	107	0.6
041100040302	Hoskins Creek	42	0.2
041100040303	Mill Creek-Grand River	116	0.5
041100040304	Mud Creek	7.2	0.1
041100040305	Plumb Creek-Grand River	139	1.1
041100040401	Griggs Creek	7.9	0.1
041100040402	Peters Creek-Mill Creek	70	0.2
041100040403	Town of Jefferson-Mill Creek	136	0.8
041100040501	Badger Run-Three Brothers Creek	83	0.6
041100040502	Bronson Creek-Grand River	233	1.0
041100040601	Coffee Creek-Grand River (Lower Grand)	103	0.7
041100040602	Mill Creek (3) (Lower Grand)	107	0.8
041100040603	Village of Mechanicsville-Grand River (Lower Grand)	447	4.2
041100040604	Paine Creek (Lower Grand)	46	0.2
041100040605	Talcott Creek-Grand River (Lower Grand)	218	1.8
041100040606	Big Creek (Lower Grand)	103	0.3
041100040607	Red Creek-Grand River (Lower Grand)	405	2.4

5. Non-forested wetlands

Compared to forested wetlands which constitute nearly 10 percent of the land cover in the Grand River Watershed and 12 percent of the land cover in the Upper Grand River Watershed, non-forested wetlands only make up ½ percent of the watershed. The Upper Rock Creek subwatershed boasts the most non-forested wetlands at 319 acres (about 2 percent of the subwatershed).

Table 56. Non-forested Wetlands in the Grand River Watershed.
(Source: 2006 NLCD Land Cover Analysis)

12-digit HUC Code	Watershed	Non-forested Wetlands Acres	% Land Covered
041100040101	Dead Branch	131	0.01
041100040102	Headwaters - Grand River	77	0.36
041100040103	Baughman Creek	20	0.17
041100040104	Center Creek-Grand River	147	0.73
041100040105	Coffee Creek-Grand River	117	0.96
041100040106	Swine Creek	28	0.14
041100040201	Upper Rock Creek	319	1.92
041100040202	Middle Rock Creek	26	0.19
041100040203	Lower Rock Creek	104	0.69
041100040301	Phelps Creek	128	0.68
041100040302	Hoskins Creek	103	0.60
041100040303	Mill Creek-Grand River	93	0.40
041100040304	Mud Creek	81	0.60
041100040305	Plumb Creek-Grand River	149	1.21
041100040401	Griggs Creek	20	0.15
041100040402	Peters Creek-Mill Creek	133	0.38
041100040403	Town of Jefferson-Mill Creek	90	0.50
041100040501	Badger Run-Three Brothers Creek	102	0.74
041100040502	Bronson Creek-Grand River	121	0.52
041100040601	Coffee Creek-Grand River (Lower Grand)	69	0.49
041100040602	Mill Creek (3) (Lower Grand)	47	0.35
041100040603	Village of Mechanicsville-Grand River (Lower Grand)	86	0.81
041100040604	Paine Creek (Lower Grand)	26	0.14
041100040605	Talcott Creek-Grand River (Lower Grand)	25	0.20
041100040606	Big Creek (Lower Grand)	7.8	0.02
041100040607	Red Creek-Grand River (Lower Grand)	9.2	0.00

6. Barren

Barren land (759 acres or 0.17 percent) in the Grand River Watershed trails only high intensity development (624 acres or 0.14 percent) as the smallest amount of land cover. In the Upper Grand River watershed, barren land represents only 0.05 percent (151 acres) land cover. Nine (9) 12-digit subwatersheds in the Upper Grand River Watershed lack any barren land.

Table 57. Barren Land in the Grand River Watershed.
(Source: 2006 NLCD Land Cover Analysis)

12-digit HUC Code	Watershed	Barren Land	% Land Covered
041100040101	Dead Branch	5.4	0.00
041100040102	Headwaters - Grand River	13	0.06
041100040103	Baughman Creek	3.1	0.03
041100040104	Center Creek-Grand River	7.0	0.04
041100040105	Coffee Creek-Grand River	0	0.00
041100040106	Swine Creek	0	0.00
041100040201	Upper Rock Creek	3.6	0.02
041100040202	Middle Rock Creek	0	0.00
041100040203	Lower Rock Creek	0	0.00
041100040301	Phelps Creek	7.1	0.04
041100040302	Hoskins Creek	0	0.00
041100040303	Mill Creek-Grand River	71	0.31
041100040304	Mud Creek	0	0.00
041100040305	Plumb Creek-Grand River	0	0.00
041100040401	Griggs Creek	0	0.00
041100040402	Peters Creek-Mill Creek	1.4	0.00
041100040403	Town of Jefferson-Mill Creek	15	0.08
041100040501	Badger Run-Three Brothers Creek	0	0.00
041100040502	Bronson Creek-Grand River	25	0.11
041100040601	Coffee Creek-Grand River (Lower Grand)	13	0.10
041100040602	Mill Creek (3) (Lower Grand)	136	1.02
041100040603	Village of Mechanicsville-Grand River (Lower Grand)	5.3	0.05
041100040604	Paine Creek (Lower Grand)	0	0.00
041100040605	Talcott Creek-Grand River (Lower Grand)	48	0.39
041100040606	Big Creek (Lower Grand)	129	0.40
041100040607	Red Creek-Grand River (Lower Grand)	276	1.64

III. WATERSHED INVENTORY

7. Protected Lands

Table 58. Parks and Protected Land in the Grand River Watershed.

12-digit HUC Code	Watershed	Watershed Acres	Parks & Protected Acres	Percent Protected
041100040101	Dead Branch	15452	1431	9.3
041100040102	Headwaters - Grand River	21228	808	3.8
041100040103	Baughman Creek	11790	990	8.4
041100040104	Center Creek-Grand River	20093	3397	16.9
041100040105	Coffee Creek-Grand River	12163	2841	23.4
041100040106	Swine Creek	19816	1005	5.1
041100040201	Upper Rock Creek	16635	3078	18.5
041100040202	Middle Rock Creek	13658	451	3.3
041100040203	Lower Rock Creek	15056	112	0.7
041100040301	Phelps Creek	18765	574	3.1
041100040302	Hoskins Creek	17175	1319	7.7
041100040303	Mill Creek-Grand River	22888	1442	6.3
041100040304	Mud Creek	13467	719	5.3
041100040305	Plumb Creek-Grand River	12299	1635	13.3
041100040401	Griggs Creek	13216	130	1.0
041100040402	Peters Creek-Mill Creek	35025	1352	3.9
041100040403	Town of Jefferson-Mill Creek	17997	269	1.5
041100040501	Badger Run-Three Brothers Creek	13875	704	5.1
041100040502	Bronson Creek-Grand River	23075	1473	6.4
041100040601	Coffee Creek-Grand River (Lower Grand)	14063	117	0.8
041100040602	Mill Creek (3) (Lower Grand)	13415	992	7.4
041100040603	Village of Mechanicsville-Grand River (Lower Grand)	10617	684	6.4
041100040604	Paine Creek (Lower Grand)	18424	1649	8.9
041100040605	Talcott Creek-Grand River (Lower Grand)	12346	1240	10.0
041100040606	Big Creek (Lower Grand)	32224	3046	9.5
041100040607	Red Creek-Grand River (Lower Grand)	16805	784	4.7

III. WATERSHED INVENTORY

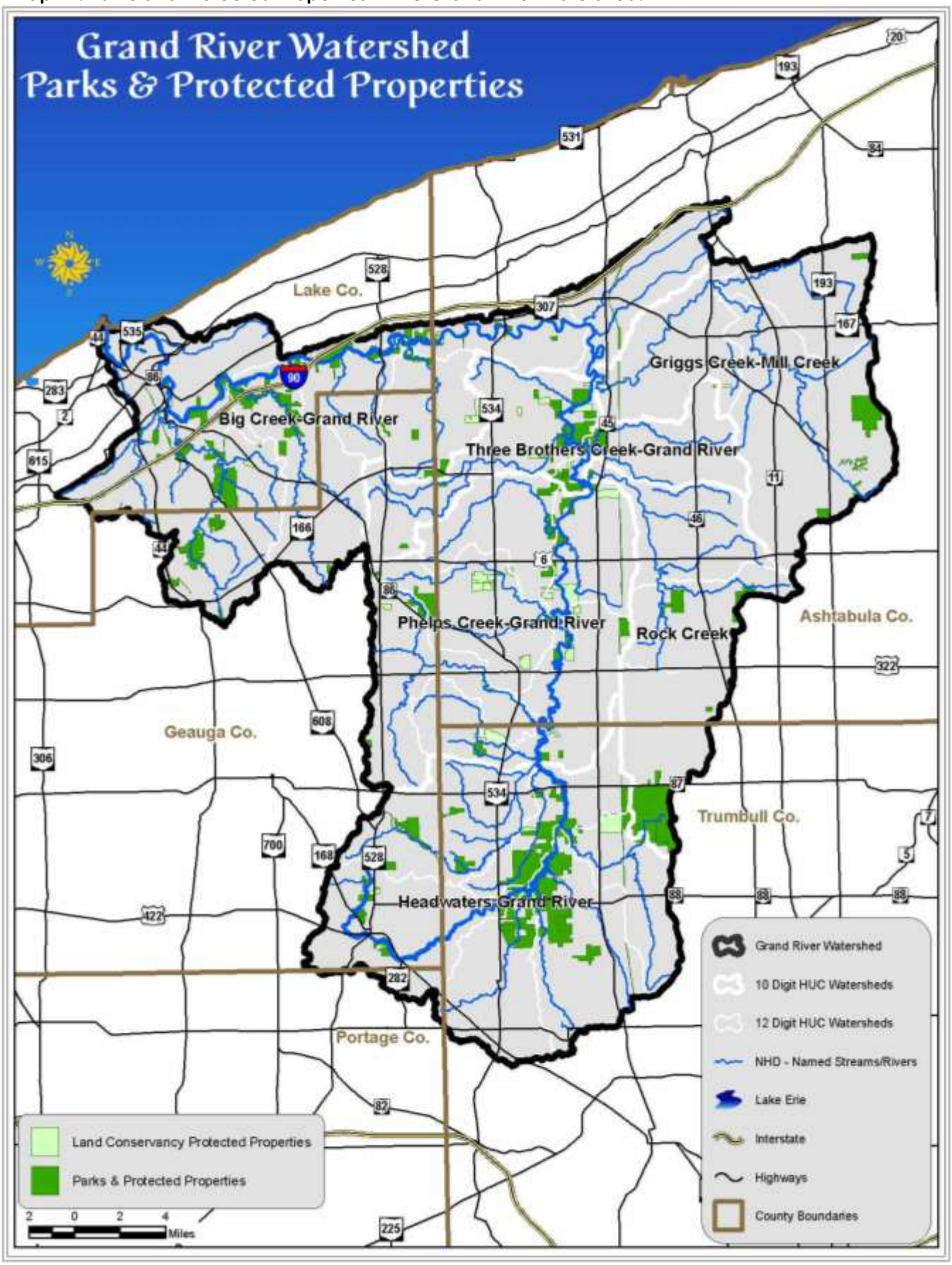
Protected Wetland Acres

Table 59. Protected Wetland Acres in the Grand River Watershed.
(Source: 2006 NLCD Land Cover Analysis)

12-digit HUC Code	Watershed	NWI Wetlands Acres on Protected Property	NWI Wetland Acres in Subwatershed	Percent Protected
041100040101	Dead Branch	430	1226	35.0
041100040102	Headwaters - Grand River	289	2030	14.2
041100040103	Baughman Creek	360	2291	15.7
041100040104	Center Creek-Grand River	1111	3102	35.8
041100040105	Coffee Creek-Grand River	2326	4691	49.6
041100040106	Swine Creek	39	2075	1.9
041100040201	Upper Rock Creek	1464	3223	45.4
041100040202	Middle Rock Creek	299	1876	16.0
041100040203	Lower Rock Creek	22	1644	1.3
041100040301	Phelps Creek	228	3540	6.4
041100040302	Hoskins Creek	611	3752	16.3
041100040303	Mill Creek-Grand River	438	4753	9.2
041100040304	Mud Creek	314	2422	13.0
041100040305	Plumb Creek-Grand River	446	2430	18.3
041100040401	Griggs Creek	78	2950	2.7
041100040402	Peters Creek-Mill Creek	312	6569	4.7
041100040403	Town of Jefferson-Mill Creek	87	1607	5.4
041100040501	Badger Run-Three Brothers Creek	202	1588	12.7
041100040502	Bronson Creek-Grand River	278	3701	7.5
041100040601	Coffee Creek-Grand River (Lower Grand)	15	1473	1.0
041100040602	Mill Creek (3) (Lower Grand)	317	1160	27.4
041100040603	Village of Mechanicsville-Grand River (Lower Grand)	44	666	6.6
041100040604	Paine Creek (Lower Grand)	43	2226	1.9
041100040605	Talcott Creek-Grand River (Lower Grand)	32	721	4.5
041100040606	Big Creek (Lower Grand)	87	1121	7.8
041100040607	Red Creek-Grand River (Lower Grand)	24	474	5.0

III. WATERSHED INVENTORY

Map 41. Parks and Protected Properties in the Grand River Watershed.



III. WATERSHED INVENTORY

a. City, county, district, state or national public forests and/or parks

ODNR Division of Wildlife has preserved 12,782 acres or 38 percent of all the protected property in the Grand River Watershed (all protected property located in the Upper Grand River Watershed). The Headwaters - Grand River Subwatershed (0411000401) contains the largest amount (9,357 acres or 50 percent) of government protected property of the 10-digit subwatersheds in the Grand River Watershed.

Table 60. City, County, District, State Protected Property in the Grand River Watershed.

Organization	0411000401 Total Acres	0411000402 Total Acres	0411000403 Total Acres	0411000404 Total Acres	0411000405 Total Acres	0411000406 Total Acres	Total
Ashtabula County Metroparks	7	14	83	102	16	176	399
Ashtabula SWCD	0	335	270	0	78	23	706
City of Akron	0	0	73	0	0	0	73
Geauga County Board of Commissioners	127	0	0	0	0	77	204
Geauga County Park District	795	0	735	0	0	1,134	2,663
NRCS	0	115	110	244	77	139	685
ODNR-Division of Parks and Recreation	67	0	2	0	0	2	70
ODNR-Division of Wildlife	7,864	3,405	488	1,026	0	0	12,782
ODNR-DNAP/TNC	0	0	342	0	0	0	342
ODNR-NATURAL AREAS	0	0	209	0	0	30	239
Parkman	6	0	0	0	0	0	6
Thompson Township Park Commission	0	0	0	0	0	71	71
Trumbull Metroparks	490	9	0	0	0	0	499
Total	**9,357**	**3,879**	**2,311**	**1,372**	**170**	**1,653**	**18,741**

b. Land protected by private foundations or land trusts

Western Reserve Land Conservancy has preserved over 4000 acres or 13 percent of all protected property in the Grand River Watershed. The Land Conservancy protects land through conservation easements and fee title land acquisition. The Phelps Creek-Grand River Subwatershed (0411000401) contains the largest amount (3,131 acres or 34 percent) of privately protected property in the Grand River Watershed.

Table 61. Private Foundation and Land Trust Protected Property in the Grand River Watershed.

Organization	0411000401 Total Acres	0411000402 Total Acres	0411000403 Total Acres	0411000404 Total Acres	0411000405 Total Acres	0411000406 Total Acres	Total
Boy Scouts	0	0	0	0	1,146	0	1,146
Cleveland Museum of Natural History	398	0	154	130	689	72	1,444
Holden Arboretum	0	0	0	0	0	77	77
Ohio Wetlands Foundation	0	0	0	0	114	383	498
R Gates	279	0	0	0	0	0	279
The Lake County Farmers Conservation	0	0	0	0	0	105	105
The Nature Conservancy	0	110	574	0	588	57	1,330
Western Reserve Land Conservancy	736	0	2,402	135	430	696	4,400
Total	**1,413**	**110**	**3,131**	**266**	**2,968**	**1,391**	**9,278**

III. WATERSHED INVENTORY

8. Status and Trends (Historical, current, projected).

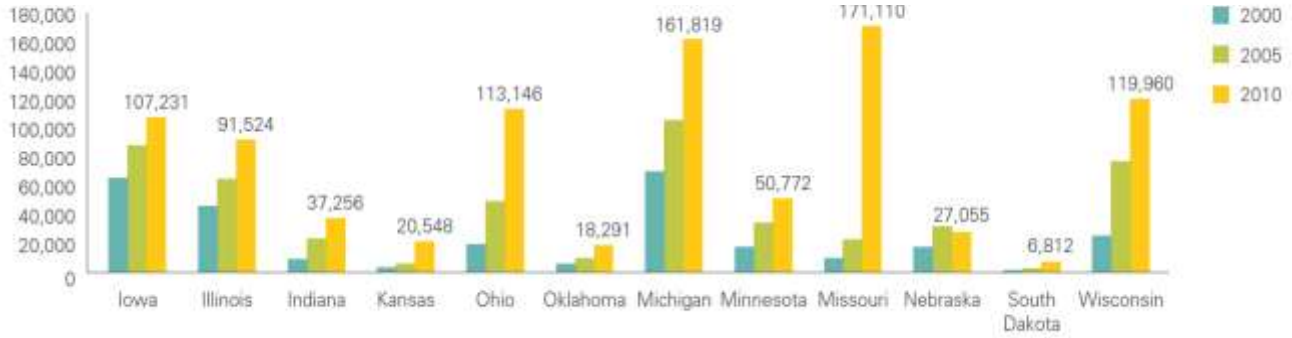
Ohio's Trends in Conservation: 2005–2010
(Source: Land Trust Alliance: 2010 National Land Trust Census)

• Land trusts in Ohio have protected 113,146 acres—this represents a 132% increase in acres conserved since 2005. Ohio ranks 27th in the nation in acres conserved, and 4th in the Midwest.

• There are now 44 land trusts operating in Ohio, including 18 staffed groups and 16 all-volunteer groups.

• Land trusts in Ohio drew upon the work of 1,229 active and the contributions of 16,871 members and financial supporters.

Figure 5. Total Acres Conserved by States in the Midwest



III. WATERSHED INVENTORY

B. Cultural Resources

- **Sites of historical, cultural or recreational significance**

Table 62. Historic Sites in the Grand River Watershed.
(Source: National Historic Register)

041100040101 – Dead Branch
1856 – Charles Harshman House 3932 Painesville-Warren State Rd, NW, Southington Township
041100040105 – Coffee Creek-Grand River
1846 – Charles Brown Gothic Cottage – OH 45 S, North Bloomfield
1820 – Brownwood – OH 45 S, North Bloomfield
1837 – Brown-Wing House – Park West Rd., North Bloomfield
041100040106 – Swine Creek
1820 – Mesopotamia Village District – OH 534 and 87, Mesopotamia
041100040202 – Middle Rock Creek
1879 – New Lyme Institute – 929 Brownville Rd., South New Lyme
1885 – New Lyme Town Hall – N of South New Lyme at 6000 NC 46, South New Lyme
041100040203 – Lower Rock Creek
1869 – Rock Creek School – 2987 High St., Rock Creek
041100040301– Phelps Creek
No Date - Windsor Mills Fort And Village Site – 6244 State Route 322, Windsor
1867 – Wiswell Road Covered Bridge – Wiswell Rd over Phelps Creek, Windsor Mills
1832 – Windsor Mills Christ Church Episcopal – Wisell Rd and US 322, Windsor Mills
041100040302 – Hoskins Creek
1800 – Windsor Corners District - US 322 and OH 534, Windsor
041100040401 – Griggs Creek
1897 – Griggs Grange No. 1467 – 1467 Brown Rd., Jefferson
041100040403 – Town of Jefferson-Mill Creek
1848 – L. W. Peck House – 2646 Eagleville Rd., Eagleville
1850 – Ashtabula County Courthouse Group – NW corner of Jefferson and Chestnut Sts., Jefferson
1877 – Jefferson Town Hall – 27 E Jefferson St., Jefferson
1872 – Lake Shore & Michigan Southern Railroad Station – 147 E Jefferson St., Jefferson
1838 – Giddings, Joshua Reed, Law Office – 112 N Chestnut St., Jefferson
041100040501 – Three Brothers Creek-Grand River
1825 – Col. Erastus House
041100040601 – Coffee Creek-Grand River (Lower Grand)
1877 - Congregational Church Of Austinburg - OH 307, Austinburg
1815 - Eliphalet Austin House – 1879 OH 45, Austinburg
041100040602 – Mill Creek (3) (Lower Grand)
No Date - Madison Fort - Address Restricted, Madison
041100040603 – Village of Mechanicsville-Grand River (Lower Grand)
1873 – Harpersfield Covered Bridge – SR 154 over the Grand River, Harpersfield
041100040604 – Paine Creek (Lower Grand)
No Date - Indian Point Fort – east of Painesville, Painesville
041100040606 – Big Creek (Lower Grand)
1898 – South Leroy Meetinghouse – NE of Painesville at OH 86 and Brakeman Rd, Painesville
041100040607 – Red Creek-Grand River (Lower Grand)
1870 – Sessions House – 57 Mentor Ave, Painesville
1810 – Lutz's Tavern – 792 Mentor Ave., Painesville
1830 – Seeley, Uri, House – 969 Riverside Dr. , Painesville
1859 – Administration Building, Lake Erie College – 391 W Washington St., Painesville
1870 – Casement House – 436 Casement Ave., Painesville
1829 – Mathews House – 309 W Washington St., Painesville
1875 – Smead House – 187 Mentor Ave., Painesville
No Date - Mentor Avenue District – Wood St and Mentor Ave from Liberty to Washington St., Painesville
1840 – Painesville City Hall – 7 Richmond St., Painesville
1873 – The Methodist Episcopal Church of Painesville – 71 N Park Place, Painesville
1865 – St. James Episcopal Church – 141 N State St., Painesville
1836 – Morley, Lewis, House – 231 N State St., Painesville
No Date - Norma Grantham Site – Address Restricted, Fairport Harbor
1871 – Fairport Marine Museum – 129 2nd St, Fairport Harbor

III. WATERSHED INVENTORY

C. Previous and Complementary Efforts

- **History of previous water quality efforts in the watershed**

  Upper Grand River Watershed Plan; "A Watershed Management Plan for the Grand River Watershed"

  This plan was written by a group of partnering agencies including: the Ashtabula Soil and Water Conservation District, Eastgate Regional Council of Governments, Geauga County Health Department, Geauga Soil and Water Conservation District, Grand River Partners, Inc., Kent State University, Lake Erie College, ODRN Division of Natural Areas and Preserves, ODNR Division of Soil and Water, ODNR Division of Wildlife, Ohio EPA Northeast District, Portage County Soil and Water Conservation District, Trumbull County Planning Commission, Trumbull County Soil and Water Conservation District, and the Trumbull Health Department.

  The purpose of this plan is to reduce water resource impairment in all waterbodies within the Grand River Watershed that do not currently meet water quality standards. It is also to identify areas that are meeting standards, and protect these areas. The goal of the plan is to restore and maintain the chemical, physical, and biological integrity of waterbodies within the watershed. Lakes, ponds, wetlands are all covered under state and federal law.

- **A listing of current efforts that will help to meet water quality standards that are occurring in the watershed.**

  Grand River (Lower) TMDL Report - The Clean Water Act requires Ohio EPA to prepare a cleanup plan for watersheds that do not meet water quality goals. The cleanup plan, known as a total maximum daily load (TMDL) report, specifies how much pollution must be reduced from various sources and recommends specific actions to achieve these reductions.

  Currently the Grand River (Lower) TMDL Report is in the final stages of the drafting process. The public review process ended November 14, 2011. The report should be completed in early 2012.

  Note: 041000404 Griggs Creek–Mill Creek (2) Subwatershed is included in the Grand River (Lower) TMDL Report

  Grand River (Upper) TMDL Report - The Clean Water Act requires Ohio EPA to prepare a cleanup plan for watersheds that do not meet water quality goals. The cleanup plan, known as a total maximum daily load (TMDL) report, specifies how much pollution must be reduced from various sources and recommends specific actions to achieve these reductions.

  Currently the Grand River (Upper) TMDL Report is in preparation.

  Note: 0411000404 Griggs Creek–Mill Creek (2 Subwatershed is excluded in from the Grand River (Upper) TMDL Report

III. WATERSHED INVENTORY

D. Physical attributes of streams and floodplain areas that support habitat, recreation, water quality, etc.

- **Early settlement conditions**

Almost all of the Grand River Watershed was forested prior to European settlement. The majority of the forested lands were covered by beech maple forests (70 percent) with areas of mixed mesophytic forest (20 percent) and pockets of mixed oak forest (4 percent) and elm-ash swamp forest (5 percent) forests making up the rest (Table 64, Map 41). Much of the existing forests were cleared for agriculture. Over time, the poorly drained soils were drained using subsurface drainage systems and agricultural ditches were created to expedite the flow of excess water from the drained fields. Portions of existing channels were dredged and straightened to improve water flow and farming ease. Today, much of the watershed has reverted back to forested land cover (55 percent) with pasture/hay (22 percent), open space (8 percent) and agricultural (6 percent) comprising the remaining land cover.

Table 63. Land Cover at the Time of the Earliest Surveys in the Grand River Watershed.
(Source: Natural Vegetation of Ohio, at the Time of the Earliest Land Surveys, Robert B. Gordon, Ohio Biological Survey, 1966)

12-digit HUC Code	Watershed	Beech Forests	Mixed Oak Forests	Elm-Ash Swamp Forests	Mixed Mesophytic Forests	Sphagnum Peat Bogs	Mixed Hemlock-Beech-Chestnut-Red Oak
041100040101	Dead Branch	10841	0	0	4611	0	0
041100040102	Headwaters - Grand River	18946	0	0	2280	0	0
041100040103	Baughman Creek	10367	0	1422	0	0	0
041100040104	Center Creek-Grand River	11901	0	3504	4687	0	0
041100040105	Coffee Creek-Grand River	12157	0	0	5	0	0
041100040106	Swine Creek	16272	1254	0	2289	0	0
041100040201	Upper Rock Creek	14859	0	2	0	1774	0
041100040202	Middle Rock Creek	13211	447	0	0	0	0
041100040203	Lower Rock Creek	13442	1614	0	0	0	0
041100040301	Phelps Creek	15974	2790	0	0	0	0
041100040302	Hoskins Creek	14257	2918	0	0	0	0
041100040303	Mill Creek-Grand River	21058	813	1017	0	0	0
041100040304	Mud Creek	12337	0	1130	0	0	0
041100040305	Plumb Creek-Grand River	11575	95	629	0	0	0
041100040401	Griggs Creek	10916	0	2300	0	0	0
041100040402	Peters Creek-Mill Creek	33546	0	1479	0	0	0
041100040403	Town of Jefferson-Mill Creek	6602	0	0	11396	0	0
041100040501	Badger Run-Three Brothers Creek	13721	0	119	35	0	0
041100040502	Bronson Creek-Grand River	16922	20	2320	3792	0	21
041100040601	Coffee Creek-Grand River (Lower Grand)	1916			12148	0	
041100040602	Mill Creek (3) (Lower Grand)	6831	438	1530	45	0	4572
041100040603	Mechanicsville-Grand River (Lower Grand)				7247	0	3371
041100040604	Paine Creek (Lower Grand)	12668		566	854	0	4336
041100040605	Talcott Creek-Grand River (Lower Grand)	1615	200	6	2178	0	8347
041100040606	Big Creek (Lower Grand)	13712	0		18504	0	7
041100040607	Red Creek-Grand River (Lower Grand)	383	10302		6100	0	0

III. WATERSHED INVENTORY

Map 42. Vegetation at the Time of Earliest Surveys in the Grand River Watershed.

This page left intentionally blank

Natural Vegetation in Ohio at the Time of the Earliest Land Surveys

(Source: Natural Vegetation of Ohio, at the Time of the Earliest Land Surveys, Robert B. Gordon, Ohio Biological Survey, 1966)

Major Vegetation Types:

Beech Forests

These forests were characterized by a large fraction of beech, sugar maple, red oak, white ash and white oak, with scattered individuals of basswood, shagbark hickory, black cherry and, more rarely, cucumber tree. The most familiar types were beech-sugar maple and "wet beech" on poorly drained flatlands. In the dissected Allegheny Plateau, where mixed mesophytic forests occurred, tuliptree (yellow poplar), red maple and/or sugar maple were associated with beech, generally in the valleys, forming the beech-maple-tuliptree subtype.

Elm-Ash Swamp Forests

These forests were consistent in having among the dominant trees of the canopy white elm, black ash and/or white ash, silver maple and/or red maple. Extremely wet phases contained cottonwood and/or sycamore. Better-drained phases or transitions recognized by Sampson (1930) are bur oak-big shellbark hickory and red oak-basswood. These "swamp oak-hickory" communities were enriched locally with swamp white oak, pin oak, white oak, black walnut and tuliptree. Contiguous areas were covered with "wet beech" forests, wet prairies, sedge swamps and fens.

Mixed Mesophytic Forests

Mixed mesophytic forests were dominated by broad-leaved and deciduous species but not exclusively so, with no single species comprising a very large fraction of the dominants. On the map there is a mosaic of types so designated. Segregates of the mixed mesophytic climax association in Ohio include oak-chestnut-tuliptree, oak-hickory-tuliptree, white oak-beech-maple and hemlock-beech-chestnut-red oak. North-facing slopes of the Portage Escarpment in Lake and Ashtabula counties were covered with the latter forest type. They are designated on the map by a black pattern overprinted on brown.

The mixed mesophytic forests of southwestern Ohio were generally different from those of eastern Ohio in that the former contained a large fraction of beech, white basswood and tuliptree.

Mixed Oak Forests

These forests included a wide variety of primary forest types, of which the most widespread were white oak-black oak-hickory and white oak. The term "black oak" as used by the first surveyors included not only Quercus velutina but also red oak and perhaps scarlet oak. The term "hickory" included the shagbark, bitternut, pignut and mockernut hickories. A white oak-black oak-chestnut type occurred in the low-lime glaciated plateau, chiefly on hilltops, and extended down the south-facing slopes. Chestnut disappeared from Ohio woodlands during the 1920's and '30's. Covering ridge tops of the unglaciated Allegheny Plateau were forests of white oak-black oak and chestnut oak-chestnut, with sour gum (Nyssa sylvatica), flowering dogwood, sassafras, Virginia pine, pitch pine and/or shortleaf yellow pine locally.

Sphagnum Peat Bogs

These occurred in undrained areas and contained remnants of the boreal evergreen forest. Remnants included tamarack (Larix laricina), poison sumac, leatherleaf (Chamaedaphne calyculata), cotton-sedge (Eriophorum spp.), round-leaved sundew and the northern pitcher-plant growing in vigorous colonies over the bog-moss (Sphagnum spp.). Only the largest of the know peat deposits are shown on the map. Numerous borings have recovered well-preserved pollen grains which reveal that spruce and fir were the earliest trees to colonize the borders of glacial lakes and "kettle-hole" ponds in the moraines. These species have since disappeared from Ohio. Rarely hemlock and white pine occurred in the surrounding forests.

III. WATERSHED INVENTORY

- **Channel and floodplain condition.**

  The channel, banks, and immediate overbanks of the Upper Grand River are similar throughout most of the watershed. The channel itself resembles a snake writhing back and forth across the flood plain. River banks and immediate overbank areas are heavily wooded with only a few clearings near road crossings. The flood plain areas farther away from the river are more varied in that they are either wooded or used for agricultural purposes. Because of the sinuous nature of the river and it's tributaries, the channel has access to the floodplain through nearly the entire reach.

- **Forested riparian corridor assessment**

  The Grand River Watershed averages a forested riparian corridor of 68 percent. Deciduous forest composes 89 percent of the forested riparian corridor, and woody wetland about 11 percent (Table 65). The large amount of forested riparian corridor, protects water quality by reducing the amount of sediment, excess nutrients, pesticides and other pollutants entering streams, ditches, lakes, wetlands and other surface waters. It reduces excess nutrients and other chemicals in shallow groundwater flow, and slows flood waters and reduces stream water volume. The forested riparian corridor also helps stabilize streambanks through root absorption and provides shade, shelter and food for fish and other aquatic species; shade is especially important for coldwater species. In addition, it provides habitat and travel corridors for diverse plants and animals, especially birds, amphibians and others that require water with adjacent woods

Table 64. Forested Riparian Corridor in the Grand River Watershed. (in acres)
(Source: 2006 NLCD Land Cover Analysis)

HUC 10	Deciduous Forest		Evergreen Forest		Woody Wetlands	
	Riparian Acres in Watershed	% of Total Riparian Acres	Riparian Acres in Watershed	% of Total Riparian Acres	Riparian Acres in Watershed	% of Total Riparian Acres
0411000401	10490	53.19%	35	0.18%	4084	20.71%
0411000402	4144	51.18%	11	0.14%	255	3.15%
0411000403	10667	67.70%	10	0.07%	983	6.24%
0411000404	6522	60.08%	9	0.08%	199	1.83%
0411000405	4243	73.35%	1	0.03%	82	1.42%
0411000406	10466	66.03%	17	0.11%	96	0.61%

- **Number of miles with forested natural riparian buffer**

Table 65. Forested Riparian Corridor in the Grand River Watershed. (in miles)
(Source: 2006 NLCD Land Cover Analysis)

HUC 10	Grand River Streams in Miles	Forested Natural Riparian Buffer in Miles	Percent Forested Natural Riparian Buffer
0411000401	430	318	74
0411000402	238	128	54
0411000403	355	263	74
0411000404	297	184	62
0411000405	164	123	75
0411000406	429	288	67
Total	**1914**	**1305**	**68**

- **Number of miles with permanent protection**

  On January 17, 1974, the Grand River became Ohio's second wild and scenic river. Designated sections include: from Harpersfield covered bridge downstream to the Norfolk and Western Railroad trestle south of Painesville (wild, 23 miles) and from US 322 bridge in Ashtabula County downstream to Harpersfield covered bridge (scenic, 33 miles). The Upper Grand River Watershed encompasses most of the Scenic Designation segment of the Grand River.

III. WATERSHED INVENTORY

Through conservation easements and ownership by conservation organizations and land trusts, 264 miles of stream in the Grand River Watershed have permanent protection.

Table 66. Permanent Protection of Streams in the Grand RIver Watershed.

HUC 10	Total NHD Miles of Streams	NHD Miles on Protected Property	Percent Protected
0411000401	430	82	74
0411000402	238	20	54
0411000403	355	47	74
0411000404	297	13	62
0411000405	164	21	75
0411000406	429	82	67
Total	**1914**	**264**	

- **Miles of natural channel**

  Currently there is no data available for locations, levels or amounts of natural channel.

- **Miles & location of modified channel**

  Currently there is no data available for locations, levels or amounts of modified channels

- **Dams**

Table 67. Dams & Impoundments in the Grand River Watershed
(Source: ODNR Division of Soil & Water Resources, Dam Safety Engineering Dam & Lake Inventory)

10-digit HUC	Dam Class Abandon	D.C. Exempt	D.C. I	D.C. II	D.C. III	D.C. IV	D. C. Unclass	Dam Class N/A (Lake)	Total
0411000401	2	28	0	4	8	9	1	5	57
0411000402	0	6	1	2	1	0	1	0	11
0411000403	1	12	2	1	0	6	0	5	27
0411000404	0	7	0	3	2	2	5	4	23
0411000405	1	2	1	1	5	4	1	2	17
0411000406	0	14	2	5	16	8	0	12	57
Total	**4**	**69**	**6**	**16**	**32**	**29**	**8**	**28**	**192**

- **Channelization**

  Currently there is no data available for locations, levels or amounts of channelization.

- **Streams with unrestricted livestock access**

  Currently there is no data available for locations, levels or amounts of streams with unrestricted livestock access.

- **Eroding banks (number and severity of sediment produced)**

  Currently there is no data available for locations, levels or amounts of eroding banks.

- **Floodplain connectivity**

  Currently there is no data available for locations, levels or amounts of floodplain connectivity.

- **Riparian levees**

  Currently there is no data available for locations, levels or amounts of riparian levees.

- **Entrenched miles**

  Currently there is no data available for locations, levels or amounts of entrenched miles.

- **Status and Trends**

1. **expected residential/commercial development**

   Currently there is no data available for locations, levels or amounts of development.

2. expected road, highway, bridge construction

Currently there is no data available for locations, levels or amounts of road construction.

E. Water Resource Quality (to meet the requirements of the Clean Water Act, lakes, streams and wetland must be included in this assessment)

- **Locationally-referenced use designations/use attainment**

1. Number of waterbodies/miles in full attainment

Currently there is no data available for the number of waterbodies/miles in full attainment in the Upper Grand River Watershed.

2. Number of threatened miles

Currently there is no data available for the number of threatened miles on the Upper Grand River Watershed.

3. Number of waterbodies/miles in partial attainment

Currently there is no data available for the number of waterbodies/miles in partial attainment in the Upper Grand River Watershed.

4. Number of segments/miles in non-attainment

Currently there is no data available for the number of segments/miles in non-attainment in the Upper Grand River Watershed.

5. Number of streams designated but not monitored

Currently there is no data available for the number of streams designated but not monitored in the Upper Grand River Watershed.

6. Lakes/quality

Currently there is no data available for the number of lakes or the water quality of the lakes in the Upper Grand River Watershed

7. Wetlands/quality

According to the National Wetlands Index, there are approximately 55213 acres of wetlands in the Upper Grand River Watershed. Currently, there is no data available for the exact number of wetlands or the water quality of the wetlands in the Upper Grand River Watershed.

8. Groundwater/quality

Sand and Gravel Aquifers - The unconsolidated sand and gravel units, typically associated with buried valley aquifer systems, are Ohio's most productive water-bearing formations or aquifers. These valleys were cut into the bedrock by pre-glacial and glacial streams and, subsequently, the valleys were back-filled with deposits of sand, gravel and other glacial drift by glacial and alluvial processes as the glaciers advanced and receded. Buried valley aquifers are found beneath and adjacent to the Ohio River, its major tributaries, and other pre-glacial stream channels such as the Teays River. The distribution of these Quaternary sand and gravel units is presented as thin bands of blue in Figure M-1 (modified from ODNR Glacial Aquifer Maps, 2000). In addition to the buried valley aquifers, several other types of productive sand and gravel aquifers are included in Figure M-1. In the northwest corner of the state, the triangular area of sand and gravel units bordering Michigan and Indiana includes sheets of outwash or sand and gravel that occur between sheets of glacial till. Present day stream processes deposit alluvial sand and gravel deposits that also serve as aquifers. Other geologic settings included in the sand and gravel aquifers are the outwash/kame and beach ridge deposits, including the Oak Opening Sands (large patches of sand and gravel in northwest Ohio).

Water production from the coarser-grained and thicker sand and gravel deposits ranges up to 500 to 1,000 gallons per minute. Lower yields from sand and gravel aquifers are more common. The production rate depends on the type, distribution, permeability, and thickness of permeable glacial/alluvial deposits and well construction parameters, such as well diameter and length of well screen.

Sandstone Aquifers - In eastern Ohio, Mississippian and Pennsylvanian sandstone units are the dominant bedrock aquifers (Figure M-1). Upper Paleozoic siltstone, sandstone, and conglomerate formations (Mississippian to Permian age) in eastern Ohio occur as numerous layers of siltstone and sandstone of variable thickness and areal extent separated by layers of shale and minor amounts of limestone, clay and coal. The sandstone units generally dip a few degrees to the southeast, toward the Appalachian Basin. Some of the thicker sandstones and conglomerates are capable of yielding 50 to 100 gallons per minute, but 25 gallons a minute is a good yield for these aquifers. The more productive stratigraphic units include:

Pennsylvanian Sharon through Massillon Formations, and the Homewood Sandstone within the Pottsville and Allegheny Groups - These sandstones were deposited on a stable coastal plain under conditions of rising sea level. These aquifers are most commonly used in the northern areas of Eastern Ohio. To the southeast, farther into the Appalachian Basin, the water in these units is generally too saline for drinking.

Mississippian Berea Sandstone, Cuyahoga Group, Logan and Blackhand Formations - These siltstones and sandstones with minor conglomerate were sorted and deposited in deltaic complexes from material eroded from the Acadian Mountains (Late Devonian uplift) to the east. These units also extend to the SE, farther into the Appalachian Basin, but as with the Pennsylvanian units, the water becomes too saline for drinking.

In southeastern Ohio, Upper Pennsylvanian and Permian stratigraphic sections include low-yielding aquifers. The bedrock consists of varied sequences of thin-bedded shales, limestones, sandstones, clays, and coals of the Pennsylvania, Conemaugh and Monongahela Groups and the Permian Dunkard Group. Yields below five gallons per minute are common in these areas.

Note: Ohio does not have statewide ground water quality standards. Summary information and data may be found in the Ohio 2012 Integrated Report - An Overview of Ground Water Quality in Ohio. (see http://www.epa.ohio.gov/portals/35/tmdl/2012IntReport/IR12SectionMfinal.pdf)

III. WATERSHED INVENTORY

- **Causes and sources of impairment or threats as presented in the 305(b) 303 (d) integrated water quality report**

The Ohio 2012 Integrated Water Quality Monitoring and Assessment Report

The Ohio Environmental Protection Agency (Ohio EPA) Division of Surface Water (DSW) has completed the Ohio 2012 Integrated Water Quality Monitoring and Assessment Report. The report indicates the general condition of Ohio's waters and identifies waters that are not meeting water quality goals. Prepared in accordance with federal guidance, the report satisfies the Clean Water Act requirements for both Section 305(b) water quality reports and Section 303(d) lists of impaired waters.

The Ohio 2012 Integrated Water Quality Monitoring and Assessment Report summarizes water quality conditions in the State of Ohio. The report satisfies Ohio's water quality reporting requirements under Sections 303(d), 305(b), and 314 of the Clean Water Act. The report was last updated in 2010.

Using methods devised to determine the suitability of waters for four specific uses—aquatic life (fish and aquatic insects), recreation such as boating and swimming, human health impacts related to fish tissue contamination, and public drinking water supplies—available data were compared with water quality goals. The results indicate which waters are meeting goals and which are not. Waters not meeting the goals for one or more of the four types of uses are referred to as impaired. The waters found to be impaired are prioritized and scheduled for further study and restoration. The report also includes the monitoring schedule that Ohio EPA plans to follow for the next several years.

The report describes the methods used to judge impairment of each type of use. The methods have evolved in each reporting cycle as the Agency gains access to more data and develops better ways to interpret them.

Results are reported for 1,538 watershed units, 38 large river units (in Ohio's 23 rivers that drain more than 500 square miles), and 3 Lake Erie nearshore units. Additional information on streams draining between 50 and 500 square miles is presented. General information on Ohio's water quality is also reported in the form of statistics and progress toward Ohio's "2020 goals."

Ohio's large rivers continue to show improvement as tracked over the last 20 years. The "100% full attainment by 2020" aquatic life goal statistic now stands at 89% full attainment. This statistic is down slightly from 2010 largely because of new assessments in four large rivers, three of which flow through highly urbanized areas and receive large quantities of flow from wastewater treatment facilities. All four of the large rivers have improved dramatically since first sampled in the early- to mid-1980s, attesting to the value of agricultural best management practices and upgraded wastewater treatment plants.

The causes and sources of impairment for the Upper Grand River listed in the Ohio 2012 Integrated Water Quality Monitoring and Assessment Report are listed in Table 68.

The Water Quality Assessment and Monitoring Schedule for the Upper Grand River is listed in Table 69.

Table 68. Ohio 2012 Integrated Report – Causes & Sources of Impairments for the Upper Grand River

Assessment Unit	Assessment Unit Name	Causes of Impairment	Sources of Impairment
041100040101	Dead Branch	• None listed	• None listed
041100040102	Headwaters Grand River	• direct habitat alterations	• highways, roads, bridges, infrastructure (new construction) • impacts from hydrostructure flow regulation/modification
041100040103	Baughman Creek	• natural conditions (flow or habitat) • ammonia (total)	• natural sources
041100040104	Center Creek-Grand River	• natural conditions (flow or habitat) • organic enrichment (sewage) biological • total dissolved solids • total kjehldahl nitrogen (TKN)	• natural sources • sewage discharges in unsewered areas
041100040105	Coffee Creek-Grand River	• None listed	• None listed
041100040106	Swine Creek	• None listed	• None listed
041100040201	Upper Rock Creek	• None listed	• None listed
041100040202	Middle Rock Creek	• nutrient/eutrophication biological • total dissolved solids	• source unknown
041100040203	Lower Rock Creek	• ammonia (total) • low flow alterations • nutrient/eutrophication biological • total dissolved solids	• dam or impoundment • source unknown
041100040301	Phelps Creek	• natural conditions (flow or habitat)	• natural sources
041100040302	Hoskins Creek	• direct habitat alterations • natural conditions (flow or habitat)	• channelization • natural sources
041100040303	Mill Creek-Grand River	• low flow alterations • natural conditions (flow or habitat)	• dam or impoundment • natural sources
041100040304	Mud Creek	• direct habitat alterations	• channelization
041100040305	Plumb Creek-Grand River	• None listed	• None listed
041100040401	Griggs Creek	• natural conditions (flow or habitat)	• natural sources
041100040402	Peters Creek-Mill Creek	• sedimentation/siltation	• channelization
041100040403	Town of Jefferson-Mill Creek	• natural conditions (flow or habitat) • unknown toxicity	• municipal point source discharges • natural sources
041100040501	Three Brothers Creek-Grand River	• natural conditions (flow or habitat)	• natural sources
041100040502	Bronson Creek-Grand River	• natural conditions (flow or habitat)	• natural sources

Table 69. 2012 Integrated Report - Water Quality Assessment and Monitoring Schedule for the Upper Grand River

Assessment Unit	Assessment Unit Name	Sq. Mi. in Ohio	Human Health	Recreation	Aquatic Life	PDW Supply	Priority Points	Next Field Monitoring	Projected TMDL
041100040101	Dead Branch	24.17	5h	5	3i	0	6	2019	2022
041100040102	Headwaters Grand River	33.21	5h	5	5	1	11	2019	2022
041100040103	Baughman Creek	18.44	5h	5	4n	0	5	2019	2022
041100040104	Center Creek-Grand River	31.43	5h	5	5	0	7	2019	2022
041100040105	Coffee Creek-Grand River	19.03	5h	5	1	0	8	2019	2022
041100040106	Swine Creek	31	5h	5	1	0	5	2019	2022
041100040201	Upper Rock Creek	26.02	5h	5	3i	0	5	2019	2022
041100040202	Middle Rock Creek	21.37	1	5	5	0	7	2019	2022
041100040203	Lower Rock Creek	23.56	5h	5	5	0	5	2019	2022
041100040301	Phelps Creek	29.36	5h	5	4n	0	6	2019	2022
041100040302	Hoskins Creek	26.87	5h	5	5	0	9	2019	2022
041100040303	Mill Creek-Grand River	35.81	5h	5	5	0	10	2019	2022
041100040304	Mud Creek	21.07	5h	5	5	0	10	2019	2022
041100040305	Plumb Creek-Grand River	19.24	5	5	1	0	7	2019	2022
041100040401	Griggs Creek	20.68	1h	4A	4n	0	0	2019	2022
041100040402	Peters Creek-Mill Creek	54.81	1	4A	4A	0	0	2019	2022
041100040403	Town of Jefferson-Mill Creek	28.17	5	4A	5	0	5	2019	2022
041100040501	Three Brothers Creek-Grand River	21.71	5h	5	4n	0	8	2019	2022
041100040502	Bronson Creek-Grand River	36.11	1	5	4n	0	6	2019	2022

0 - No waters currently utilized for water supply
1 - Use attaining
3i - Use attainment unknown
4A - Impaired; TMDL not needed
4n - Natural causes and sources
5 - Impaired; TMDL needed
5h - Historical data

III. WATERSHED INVENTORY

1. Point sources (by subwatershed or stream segment)

Point source discharges to the Upper Grand River Watershed are regulated by the Clean Water Act. A regulated discharge requires a permit issued under the National Pollutant Discharge Elimination System (NPDES). There are currently seven larger wastewater treatment facilities which discharge in the watershed, several small package plants and 17,486 HSTS. A brief description of the significant NPDES facility discharges is included in the following paragraphs listed by 12-digit subwatershed. Links are provided for Ohio EPA permits. Visit the Ohio EPA's Division of Surface Water Individual NPDES Permits (Industrial and Municipal Discharges) for more information on Ohio's Individual NPDES Permits (Industrial and Municipal Discharges). (http://www.epa.ohio.gov/dsw/permits/individuals.aspx)

041100040101 – Dead Branch Subwatershed

One significant NPDES facility discharges to Dead Branch Subwatershed: Southington Estates MHP (3PV00066) The Southington Estates MHP is operating under an NPDES permit that became effective in April 2007. The current design flow is 30,000 gpd. Effluent flow averaged 14,000 gpd in 2007 and 15,000 gpd in 2008. Current treatment processes consist of flow equalization, extended aeration activated sludge, final settling, slow surface sand filtration, and UV disinfection. Approximately 70% of the facility's effluent violations occurred between 2000 and 2002. Improvements to the facility since that time, including the installation of the equalization basin, have significantly reduced the violations.

041100040102 – Headwaters – Grand River Subwatershed

Three significant NPDES facilities discharge to Headwaters – Grand River Subwatershed: River Pines Campground, Nelsons Ledges Estates WWTP & Parkman WWTP

River Pines Campground (3PR00135)

The River Pines Campground is operating under a permit that became effective on March 15, 2006. The plant discharges to RM 0.11 of an unnamed tributary to the Grand River (confluence at RM 94.81) with a current design flow of 25,000 gpd. Effluent flow averaged approximately 8300 gpd during 2007. The plant consists of a trash tank, bar screen, extended aeration, final settling, sand filtration, chlorination, de-chlorination, and a sub-surface sand filter. The violations are distributed throughout the time period of 2000-20007. The facility had consistent exceedances of residual chlorine and fecal coliform. All of the violations for dissolved oxygen occurred in or prior to 2003. This facility ceased operation in November 2007. The WWTP has the potential to resume operation, however the intentions for the future of this plant are not known.

Nelsons Ledges Estates WWTP (3PV00009)

The Nelson Ledges Estates WWTP permit became effective on August 1, 2005. The current design flow is 0.03 mgd. Effluent flow averaged approximately 0.0187 mgd during 2007. The plant consists of an influent flow meter, a pump station, an Orbal System oxidation ditch, clarifiers, tertiary rapid sand filters, ultraviolet disinfection and post aeration. The following table shows the violations from 2000 through 2008. This facility averaged 22 violations per year with no strong trends. It discharges to an unnamed tributary to the Grand River (RM 94.81) at approximately RM 1.85.

Parkman WWTP (3PG00160)

The Geauga County Parkman Municipal Wastewater Treatment Plant first discharged in December, 2004. Design flow is 200,000 gallons per day (gpd), and the recent annual average flow is 9,000 gpd. The plant consists of a vacuum collection system, manual bar screen and automatic screen, Parshall flume, grease trap, distribution chamber, flow equalization, activated sludge aeration tanks, clarifiers, sand filters, UV disinfection, post aeration, and a V-notch weir flow measurement. Alum is used for phosphorus removal. Gravity discharge line flows to the Route 88 bridge below the dam for Shangri-La Lake, at river mile 97.8. All of the violations at the Parkman WWTP occurred from September 2008 to December 2008.

III. WATERSHED INVENTORY

041100040106 - Swine Creek Subwatershed

One significant NPDES facility discharges to Swine Creek Subwatershed: Middlefield Original Cheese Co-op (3IH00076) The Middlefield Original Cheese Co-op wastewater treatment works was originally constructed in 1994. The design flow originally was 10,350 gpd however this amount was exceeded regularly. The facility has requested an increase to 25,000 gpd. Effluent flow averaged approximately 5,000 gpd during 2007. The plant consists of a trash trap, aeration tanks, flow equalization, clarifier, sludge holding tank, dosing tank, surface sand filters, UV tank, aerobic digester, and a constructed wetland.

The Middlefield Original Cheese Coop treatment system was designed for a BOD load that was greatly underestimated. The improper design and operation allowed unauthorized bypasses of the plant during 2000 killing the wetland plants and creating violations from the release of pollutants particularly TSS. During 2002 the plant was operated at greater than the designed flow. The facility has had continual operational problems and enforcement actions were initiated in 2007.

041100040203 – Lower Rock Creek Subwatershed

Two significant NPDES facilities discharge to Lower Rock Creek Subwatershed: Village of Rock Creek WWTP & Roaming Shores WWTP

Village of Rock Creek WWTP (3PA00029)

The Village of Rock Creek WWTP was originally constructed in 1990. The current design flow is 0.07 mgd. Effluent flow averaged approximately 0.044 mgd during 2007 and 0.049 mgd in 2008. Current treatment processes consist of flow equalization, extended aeration activated sludge, secondary clarification, surface sand filtration, chlorination, and dechlorination. The facility experiences recurring permit violations for dissolved oxygen, residual chlorine, and pH (Table 3). Effluent ammonia concentrations were consistently low between 2001 and 2007 (Figure 3); however, four violations were reported during 2008.

Roaming Shores WWTP (3PB00068)

The Roaming Shores WWTP was originally constructed in 1968 and expanded in 2002. The current design flow is 0.160 mgd. Effluent flow averaged approximately 0.141 mgd during 2007 and 0.157 mgd during 2008. The plant processes consist of a sewage grinder with a bar screen, aerated flow equalization, extended aeration activated sludge, secondary clarification, rapid sand filtration, and UV disinfection. The facility had 10 violations of CBOD in 2008 and 8 violations of CBOD in 2007. All of the other violations occurred prior to April 27, 2005. During the period of 2000 to 2008 there were 108 violations - 83 of those occurred in 2000 and 2001.

041100040303 – Mill Creek (1) – Grand River Subwatershed

One significant NPDES facility discharges to Mill Creek (1) – Grand River Subwatershed: Snyder Ditch – Village of Orwell WWTP (3PB00041) The Village of Orwell WWTP was originally constructed in 1968 and most recently updated in 2004. The current design flow is 0.52 mgd. Effluent flow averaged approximately 0.27 mgd during 2007and 0.37 mgd in 2008. The plant consists of an influent flow meter, a pump station, an Orbal System oxidation ditch, clarifiers, tertiary rapid sand filters, ultraviolet disinfection and post aeration. Ninety-fifth percentile effluent concentrations of TSS and cBOD5 have trended downward since 2000. There were three violations for ammonia in 2008. All of the other violations occurred prior to August 2005.

041100040401 - Griggs Creek Subwatershed

One significant NPDES facility discharges to Griggs Creek Subwatershed: Ken's Forge, Inc. (3IS00121) The facility operates a wastewater treatment works that discharges to an unnamed tributary to Griggs Creek. Between June 2004 and August 2009, fecal coliform was detected in 8 of 12 semiannual samples. None of the samples exceeded the instantaneous maximum permit limit (2,000 fecal coliform counts/100 ml). The two discharge monitoring report (DMR) samples reported during the same period as the Ohio EPA field survey were 6/2/2004 (80 counts/100 ml) and 8/23/2004 (non-detect).

Ohio EPA's monitoring data were collected at a site (Poplar Street, G02G12) upstream of that facility; therefore, Ken's Forge could not have caused the impairment identified during the 2004 field survey. Because the fecal coliform at site G02G12 ranged from 330 to 17,000 counts/100 ml in 2004, other sources upstream of Ken's Forge are causing the impairment to Griggs Creek.

041100040402 - Peters Creek – Mill Creek (2)

Two significant NPDES facilities drain to waters within the Peters Creek – Mill Creek (2) Subwatershed: Ashtabula County Joint Vocational School (JVS) (sewerage system) and Ohio DOT Dorset Outpost Garage.

Ashtabula County Joint Vocational School (3PT00029)

This facility discharges to Mill Creek in Jefferson Township in Ashtabula County. Between May 2003 and October 2009, fecal coliform was detected in 39 of 47 samples. Four samples (2,100 to 5,800 counts/100 ml) collected in 2006, 2007, and 2008 exceeded the instantaneous maximum permit limit (2,000 counts/100 ml). During Ohio EPA's field survey, 13 samples were reported at the JVS (1 to 1,050 counts/100 ml), and only 3 of those samples were greater than 20 counts/100 ml (130, 630 and 1,050 counts/100 ml).

Mill Creek at Netcher Road (G02S04), 0.7 RM upstream of the JVS, was sampled by Ohio EPA in 2003 and 2004 (50 to 28,000 counts/100 ml). The recreation season geometric means never exceeded the PCR class B criterion. Because the agency did not monitor in-stream water quality at another site in the WAU below JVS, it is difficult to assess the impact of JVS on in-stream water quality. Because of the compliance with its permit during the 2003–2004 field survey and relatively low levels of bacteria in the effluent during that period, it is not likely that JVS was a source of the recreation use impairment to Mill Creek.

Ohio Department of Transportation's Dorset Outpost Garage (3PP00041)

Ohio Department of Transportation (ODOT) operates an outpost in Dorset Township in Ashtabula County that is immediately adjacent to an unnamed tributary of Mill Creek. The outpost's garage has a wastewater treatment works that discharges to the unnamed tributary of Mill Creek. Five fecal coliform samples were reported in the DMR from March 2003 through June 2006 (non-detect to 1,500 counts/100 ml). All those samples were below the instantaneous maximum permit limit (2,000 counts/100 ml) for fecal coliform.

Ohio EPA's sample site on Mill Creek at Clay Road (G02G13, RM 25.7) was sampled in 2003 and 2004 (150 to 18,000 counts/100 ml) and is in non-attainment of its recreation use. The garage is 1.5 RMs upstream of that site on a tributary. Ohio EPA did not collect any field samples when DMR data were reported. The closest sample was from 8/6/2003 (6,300 counts/100 ml). Thus, there are insufficient data to determine if ODOT's Dorset Outpost Garage's effluent affected the impairment of Mill Creek.

041100040403 - Town of Jefferson – Mill Creek (2)

Four significant NPDES facilities drain to waters in the Town of Jefferson – Mill Creek (2) Subwatershed: DFC MHP, Jefferson WWTP, Harassment's Bar, and King Luminaire Co., Inc.

DFC Mobile Home Park (3PV00081)

Only one sample was reported in the DMR for fecal coliform: 150 counts/100 ml on 8/7/2003. The closest site that Ohio EPA monitored was 4 RMs downstream, in the city of Jefferson. Thus, there are insufficient data to determine if the DFC Mobile Home Park (MHP) effluent affected the impairment of Cemetery Creek.

Jefferson WWTP (3PC00021)

The Jefferson WWTP discharges to Cemetery Creek, and a discussion of its effluent is presented in the TSD (Ohio EPA 2006, p. 28). The facility is directly adjacent to Cemetery Creek. DMR data are available from May 2003 through October 2009; 339 of the 363 fecal coliform samples were less than 100 counts/100 ml.

Ohio EPA collected two samples on Cemetery Creek at Poplar Street (G02S08) just below the WWTP that were evaluated for fecal coliform: 8/28/2003 (1,600 counts/100mL) and 9/10/2003 (90 counts/100 ml). The reported effluent levels on 8/26/2003 and 9/4/2003 were 38 and 5 counts/100 ml, respectively. In 2003 effluent bacteria levels never exceeded 70 counts/100 ml, and both sets of synoptic upstream, effluent, and downstream samples showed that the WWTP was diluting the in-stream bacteria levels. Thus, it is not likely that the treated effluent from Jefferson WWTP is causing the recreation use impairments.

The TSD (Ohio EPA 2006) indicates that a faulty pump was contributing to impairments on Cemetery Creek. The WWTP was cited multiple times for not reporting data at the required permit frequency. It is possible that the reported DMR exceedances were due to the faulty pump. During Ohio EPA inspections in 2010 and 2011, no pump stations were noted as faulty. Ohio EPA also identified WWTP bypasses as another potential sanitary sewer overflow-caused contribution to the in-stream impairment.

Harassment's Bar (3PR00438)

Harassment's Bar operates a wastewater treatment works that discharges to an unnamed tributary to Mill Creek in Lenox Township in Ashtabula County. However, no bacteria data for the permit are available in the DMR. Thus, there are insufficient data to determine if the Harassment's Bar effluent affected the impairment on Mill Creek.

King Luminaire Company Incorporated (3PR00324)

The wastewater treatment works at King Luminaire discharges to an unnamed tributary to Mill Creek in Jefferson Township in Ashtabula County. Between June 2004 and August 2009, fecal coliform was detected in 9 of 12 summer quarterly samples. None of the samples exceeded the instantaneous maximum fecal coliform permit limit (2,000 counts/100 ml). The two DMR samples evaluated for fecal coliform that were reported during the same period as the Ohio EPA field survey were 6/2/2004 (90 counts/100 ml) and 8/9/2004 (850 counts/100 ml). Although the data are limited, it does not appear that King Luminaire is solely causing the impairment to Mill Creek but is likely contributing to the impairment.

Potential Contaminant Source Inventory

Potential Contaminant Source Inventory is a detailed list of the potential contaminant sources within a drinking water source protection area (also known as the protection area). The purpose of the potential contaminant source inventory (PCSI) is to identify any significant activity or land use that has the potential to contaminate the ground water supplying the PWS. The information collected during the inventory will be essential to the water supplier in developing effective protection strategies.

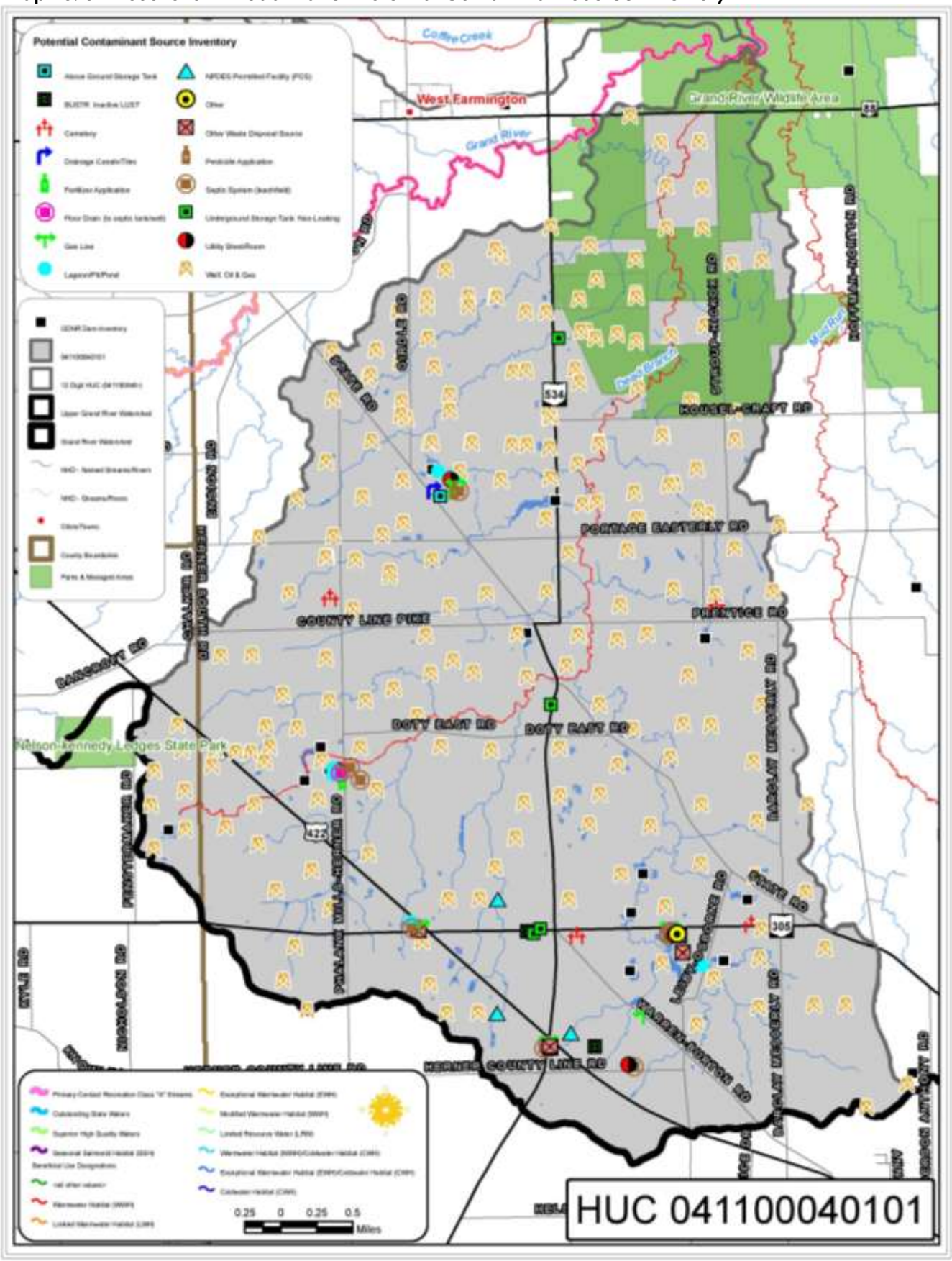
The PCSI for community water systems serving municipalities focuses on off-site potential contaminant sources. Inventories for these systems are based on the guidance established under Ohio's Wellhead Protection Program. The PCSI for a non-municipal PWS includes all of the potential contaminant sources within the protection area but focuses on the potential contaminant sources on the facility's property, such as above ground storage tanks, chemical storage areas, utility sheds, and septic systems. The detailed on-site inventory for these types of facilities will allow the PWS to focus their protective strategies on those potential contaminant sources where it has the most direct control.

Note: See the Potential Contaminant Source Inventory Process Manual for more information about the inventory process. (http://www.epa.ohio.gov/portals/28/documents/swap/swap_psci_guidance.pdf)

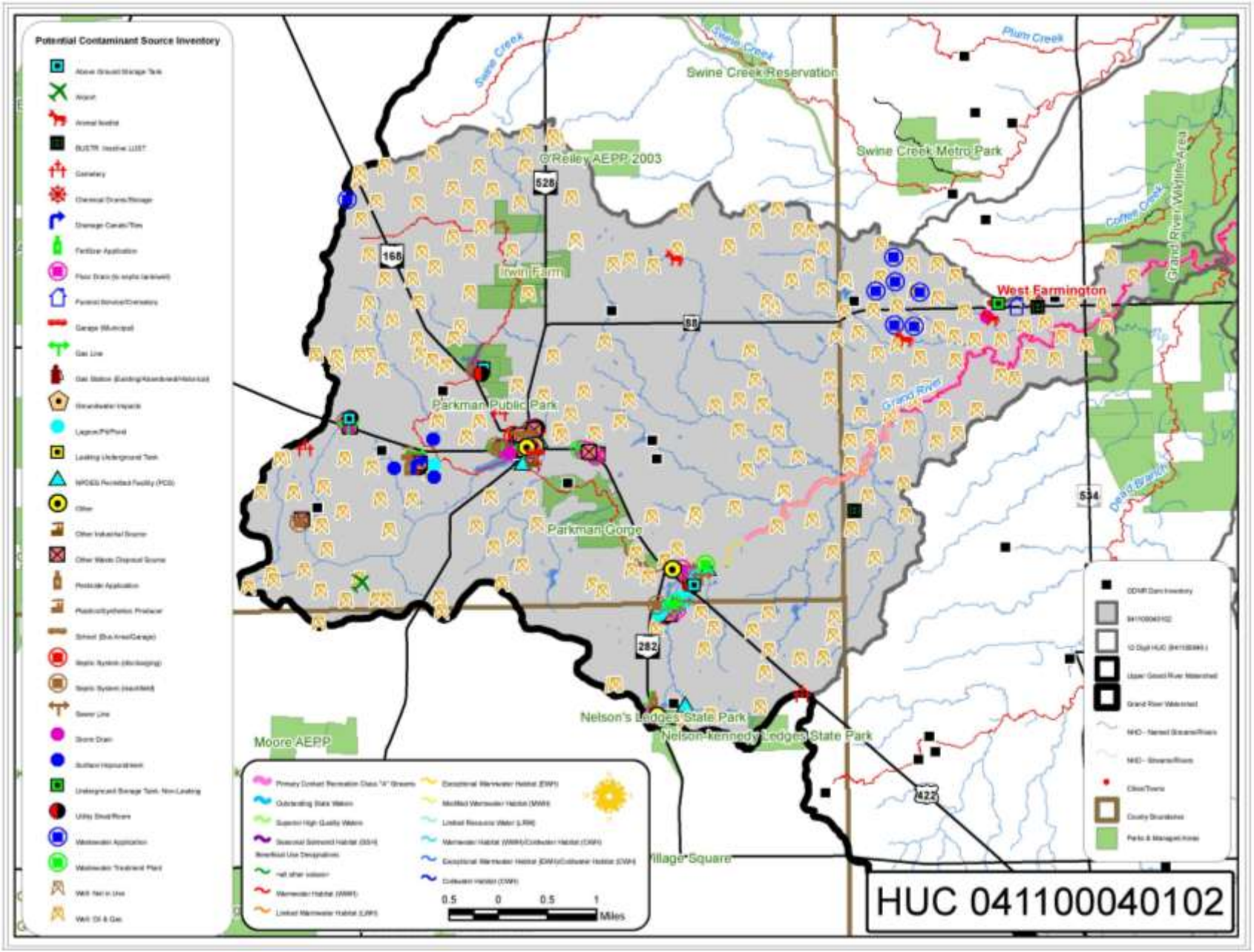
The following maps illustrate the PCSI for 12-digit subwatersheds in the Upper Grand River Watershed (See maps 43 – 62).

III. WATERSHED INVENTORY

Map 43. 041100040101 - Dead Branch Potential Contaminant Source Inventory

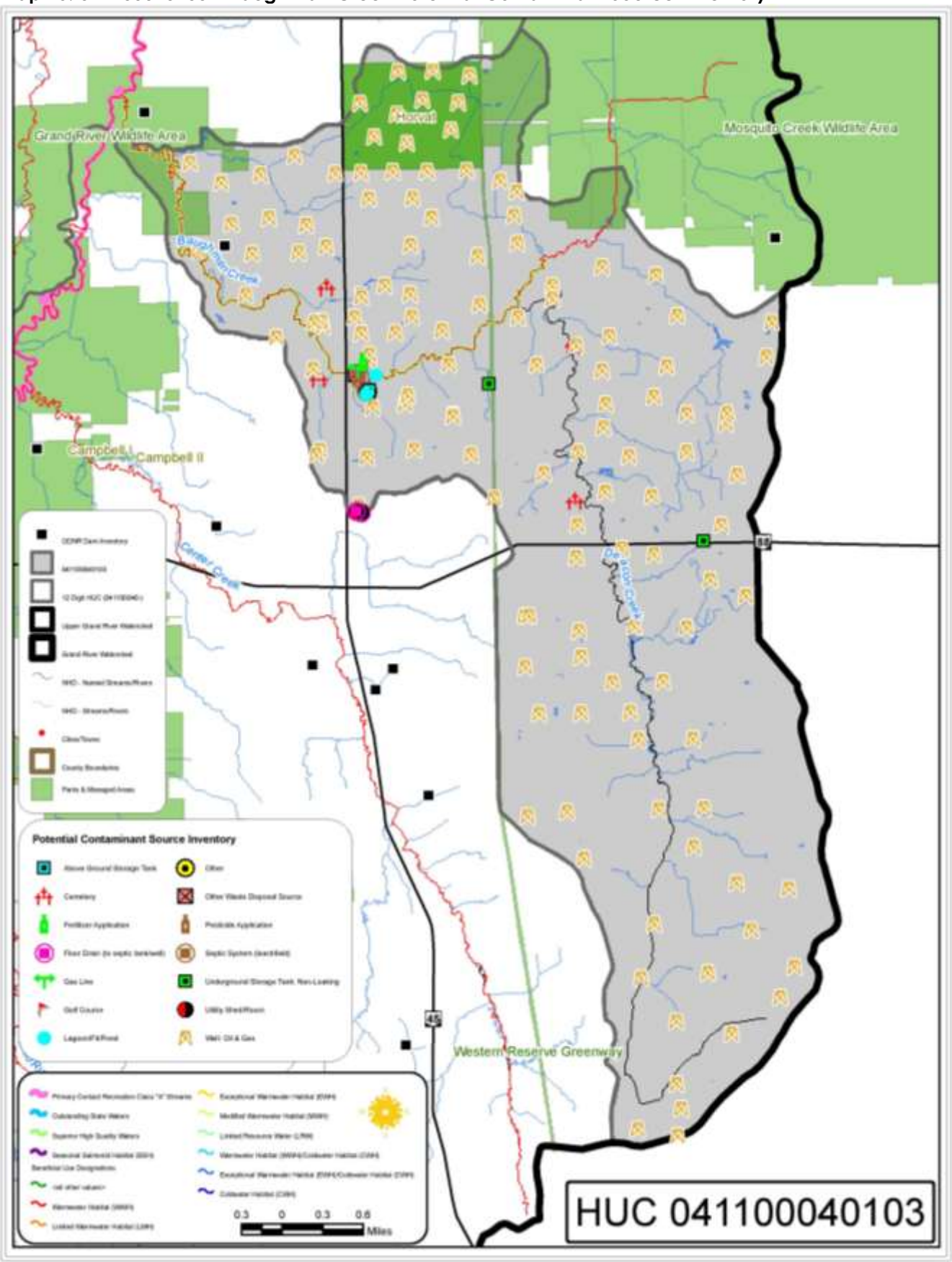


Map 44. 041100040102 – Headwaters Potential Contaminant Source Inventory



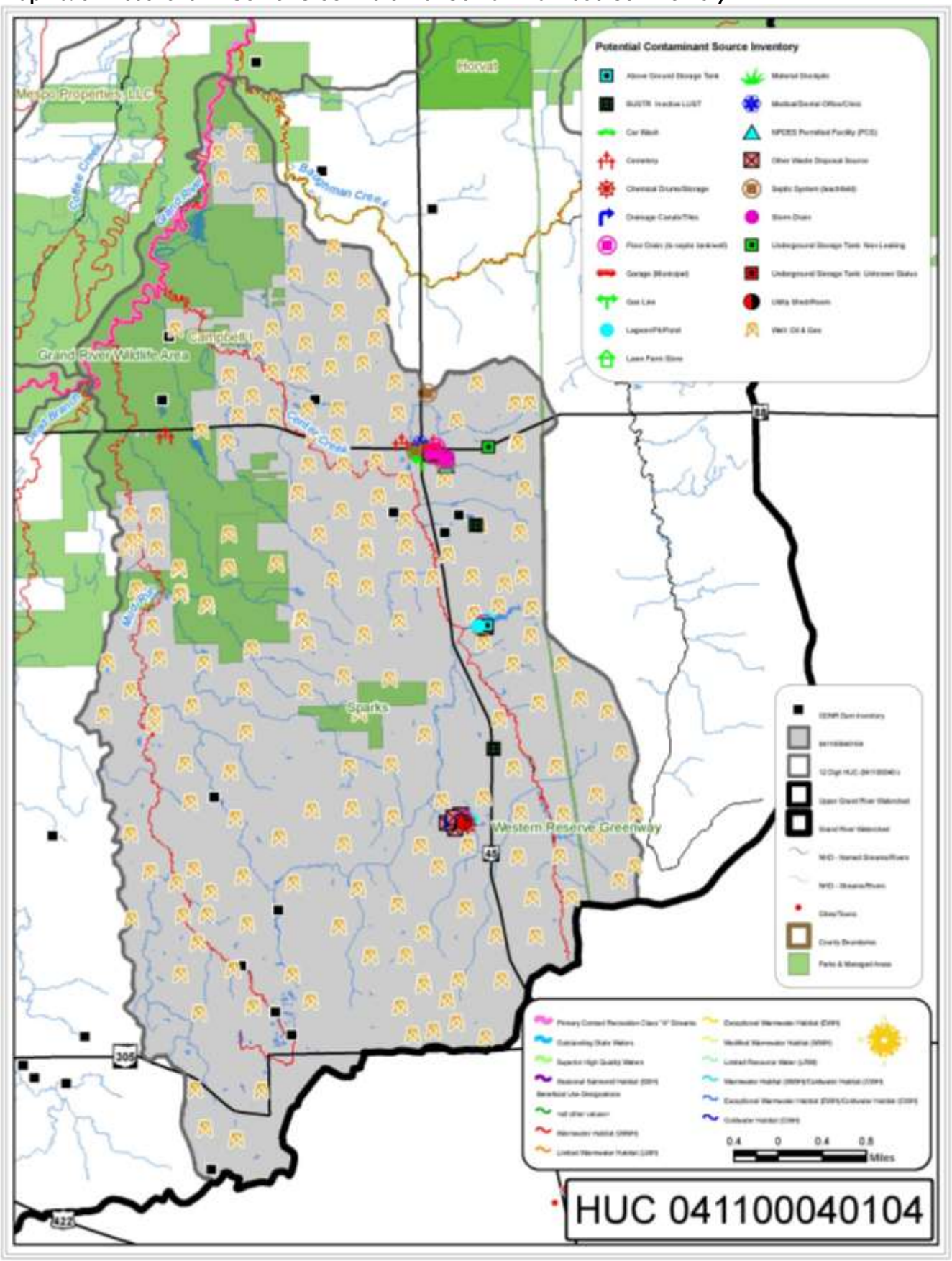
III. WATERSHED INVENTORY

Map 45. 041100040103 – Baughman Creek Potential Contaminant Source Inventory



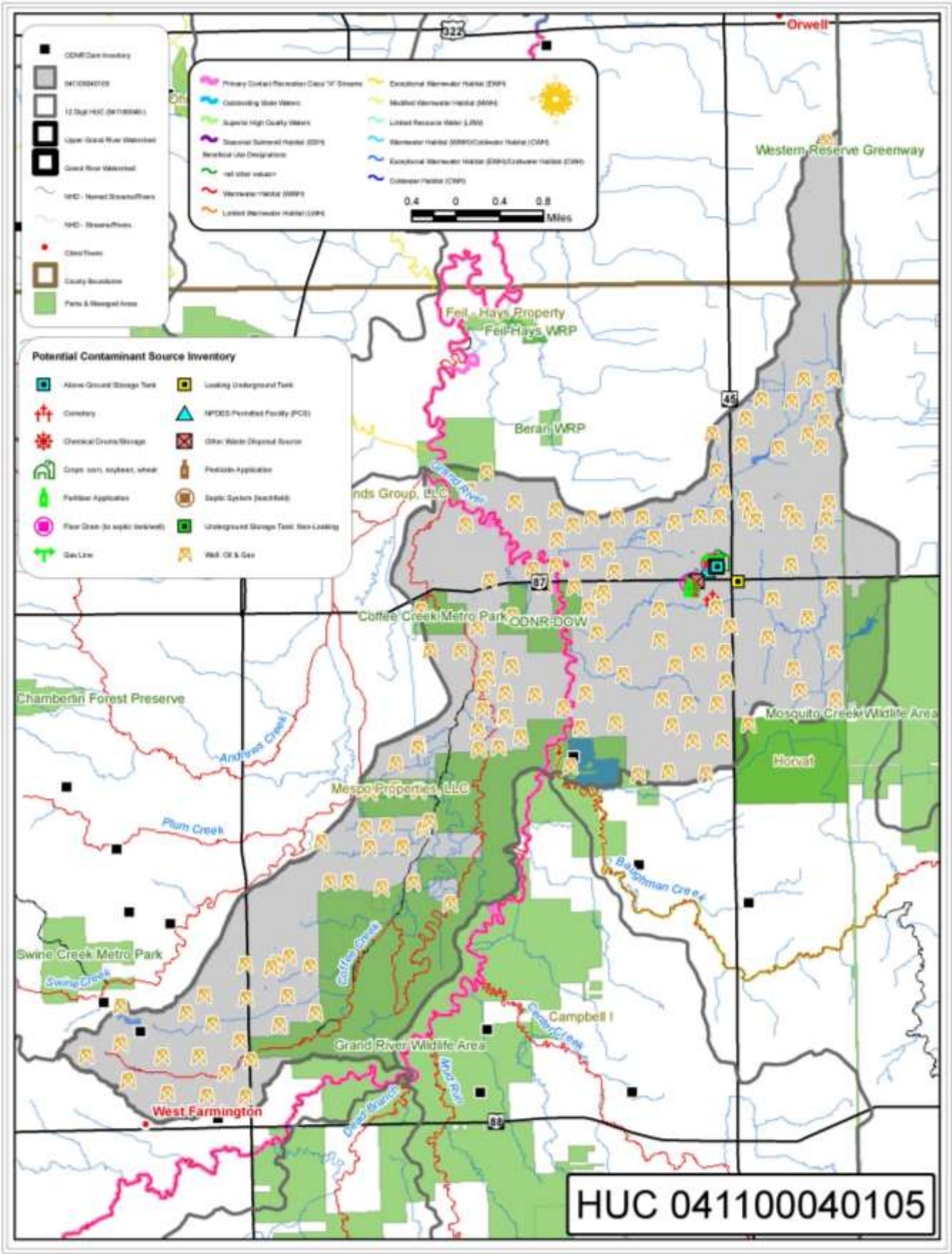
III. WATERSHED INVENTORY

Map 46. 041100040104 – Center Creek Potential Contaminant Source Inventory

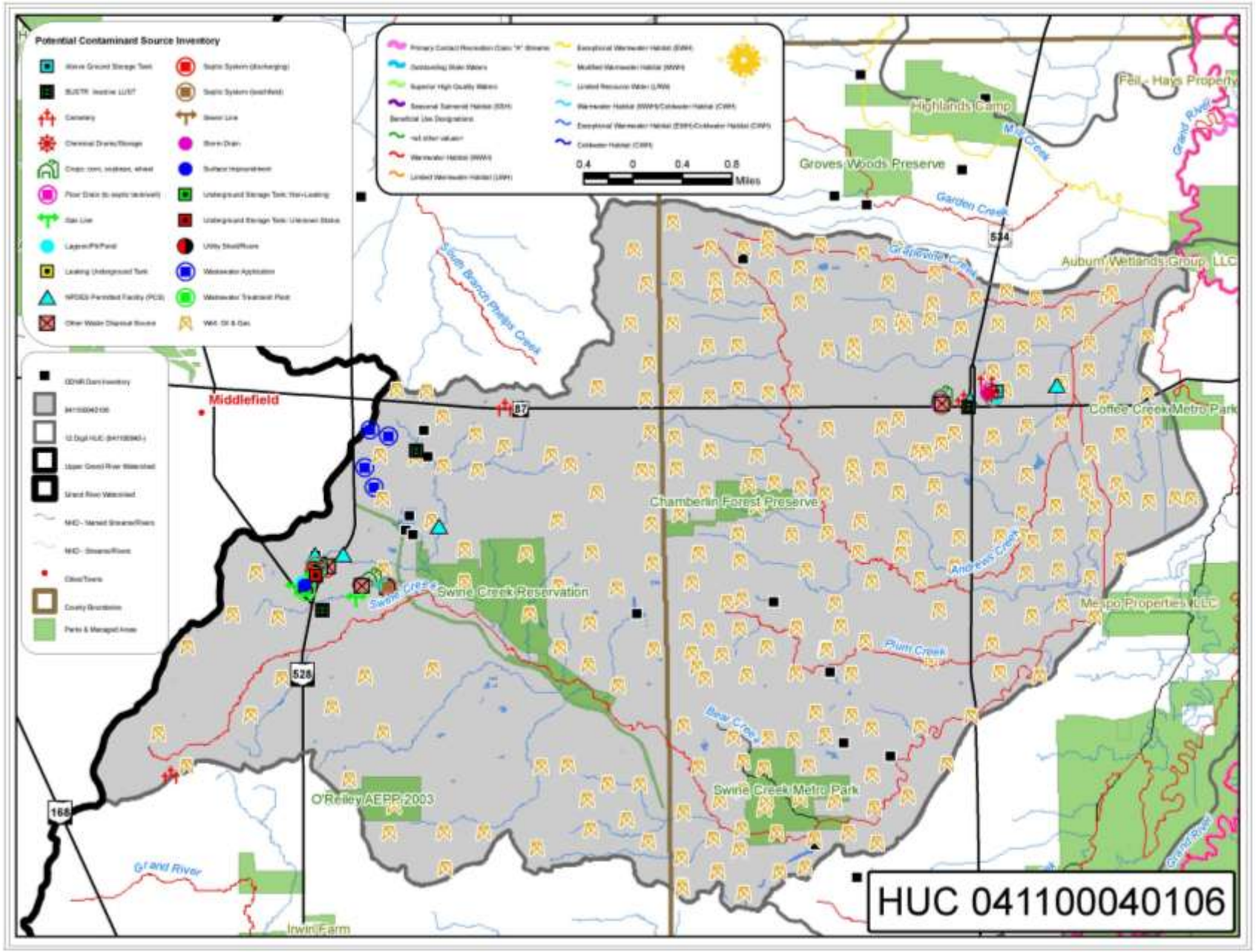


III. WATERSHED INVENTORY

Map 47. 041100040105 – Coffee Creek Potential Contaminant Source Inventory

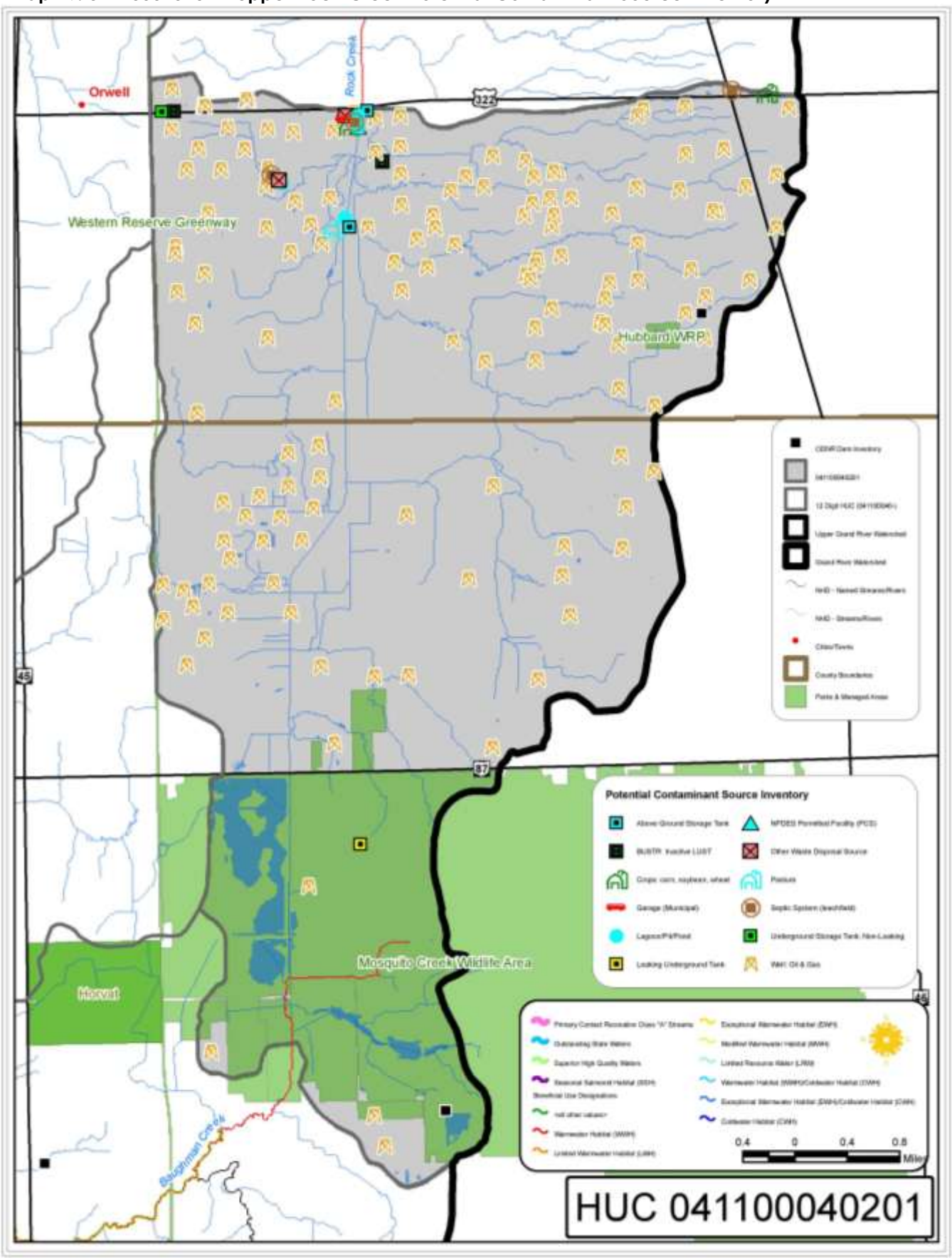


Map 48. 041100040106 – Swine Creek Potential Contaminant Source Inventory



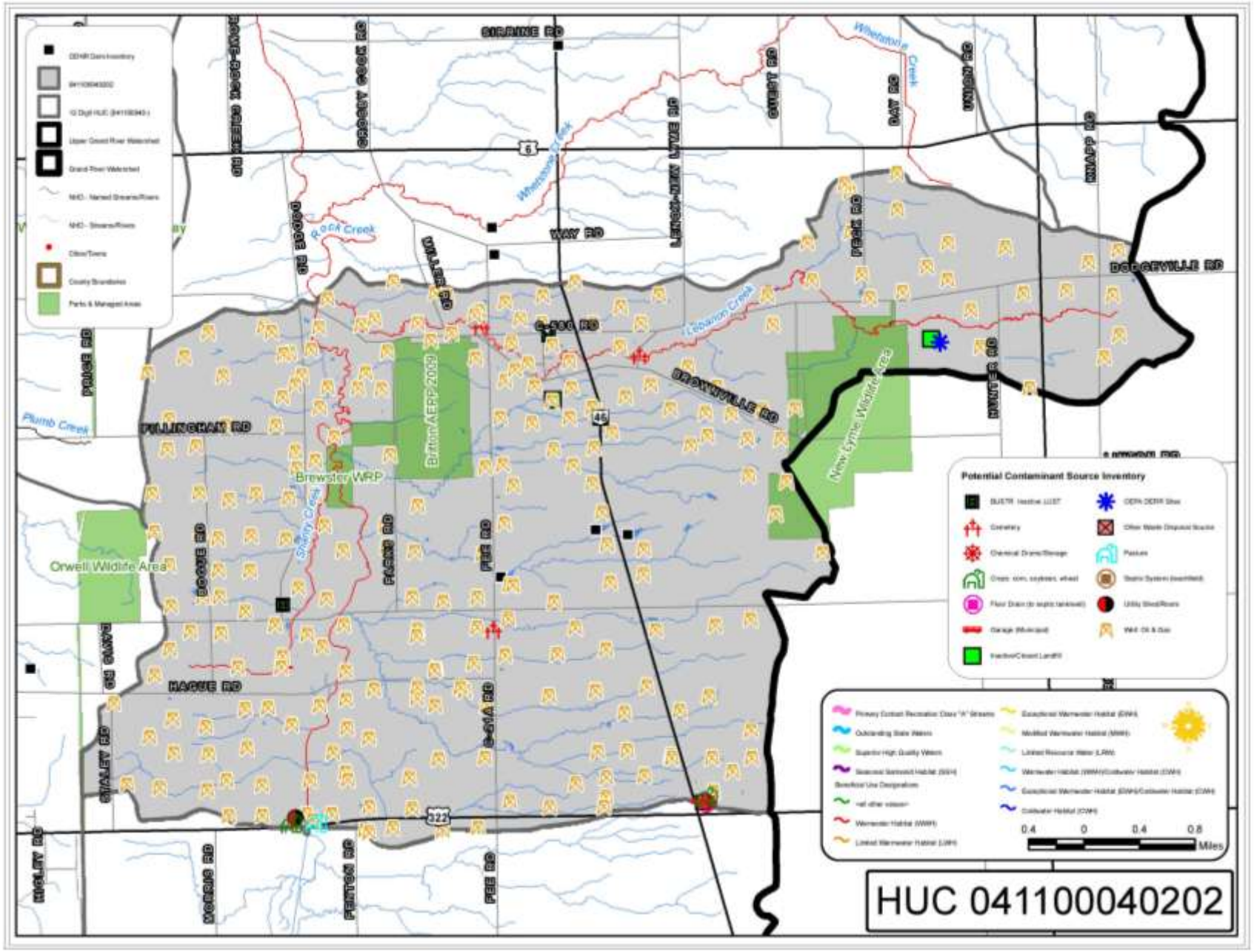
III. WATERSHED INVENTORY

Map 49. 041100040201 – Upper Rock Creek Potential Contaminant Source Inventory

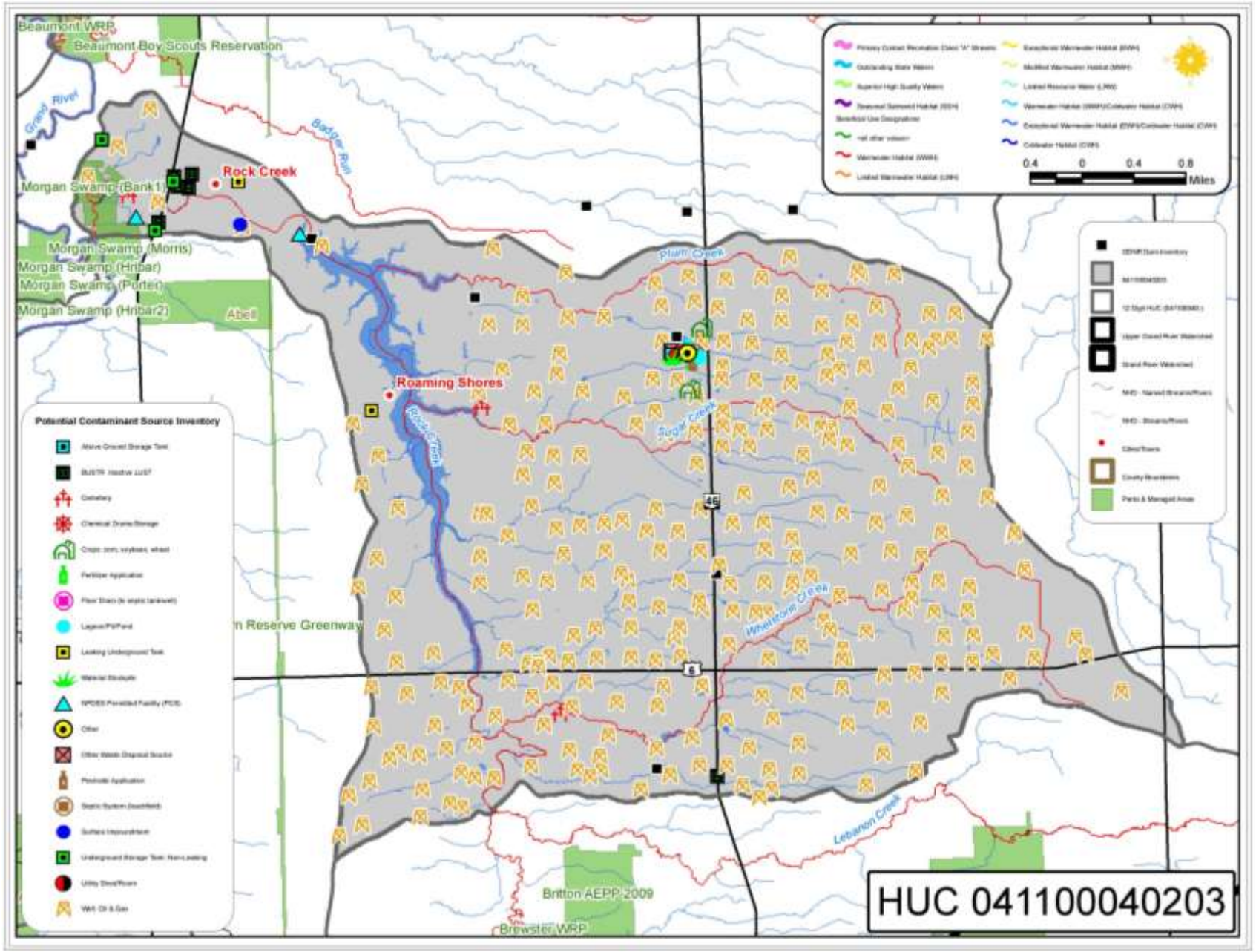


III. WATERSHED INVENTORY

Map 50. 041100040202 – Middle Rock Creek Potential Contaminant Source Inventory

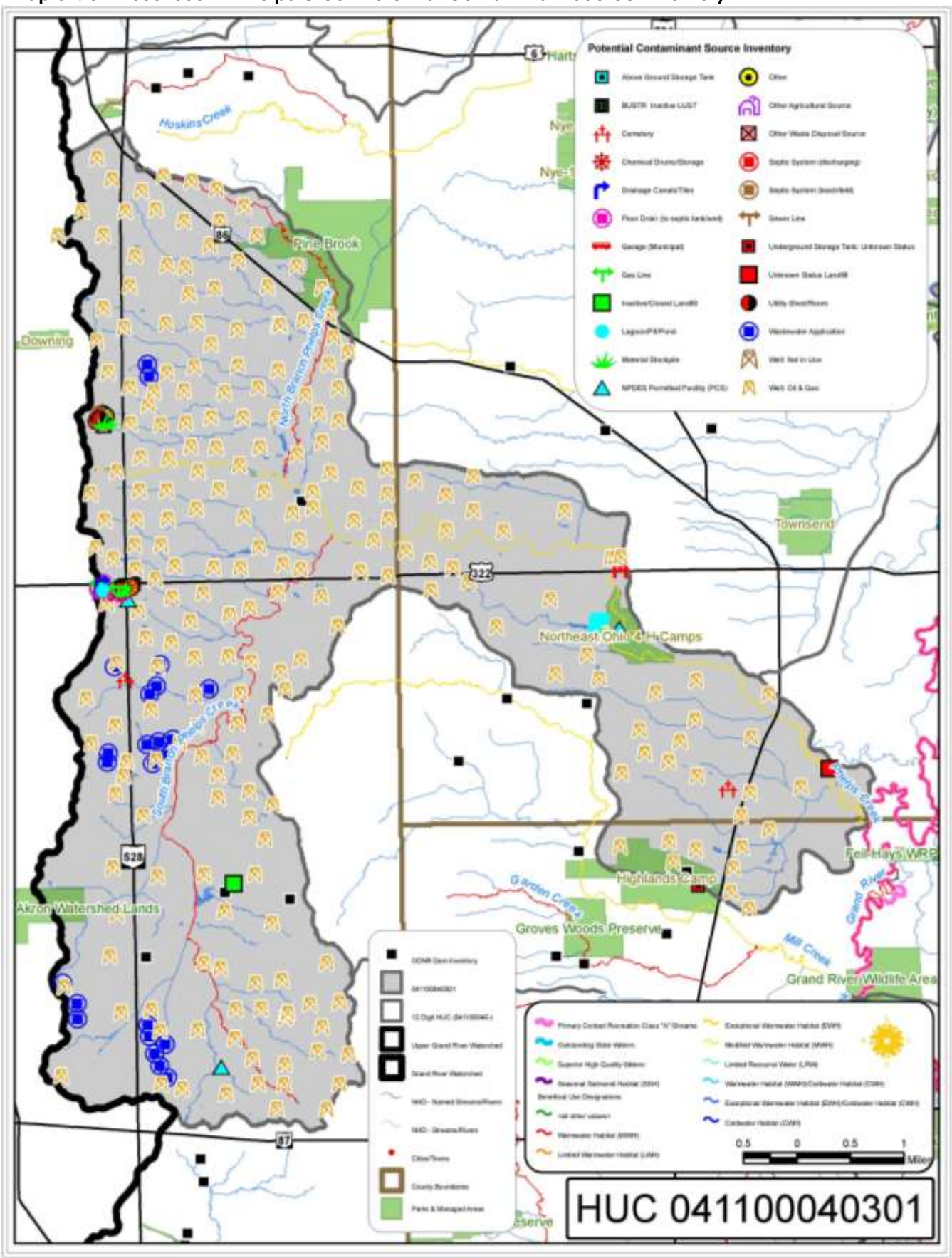


Map 51. 041100040203 – Lower Rock Creek Potential Contaminant Source Inventory



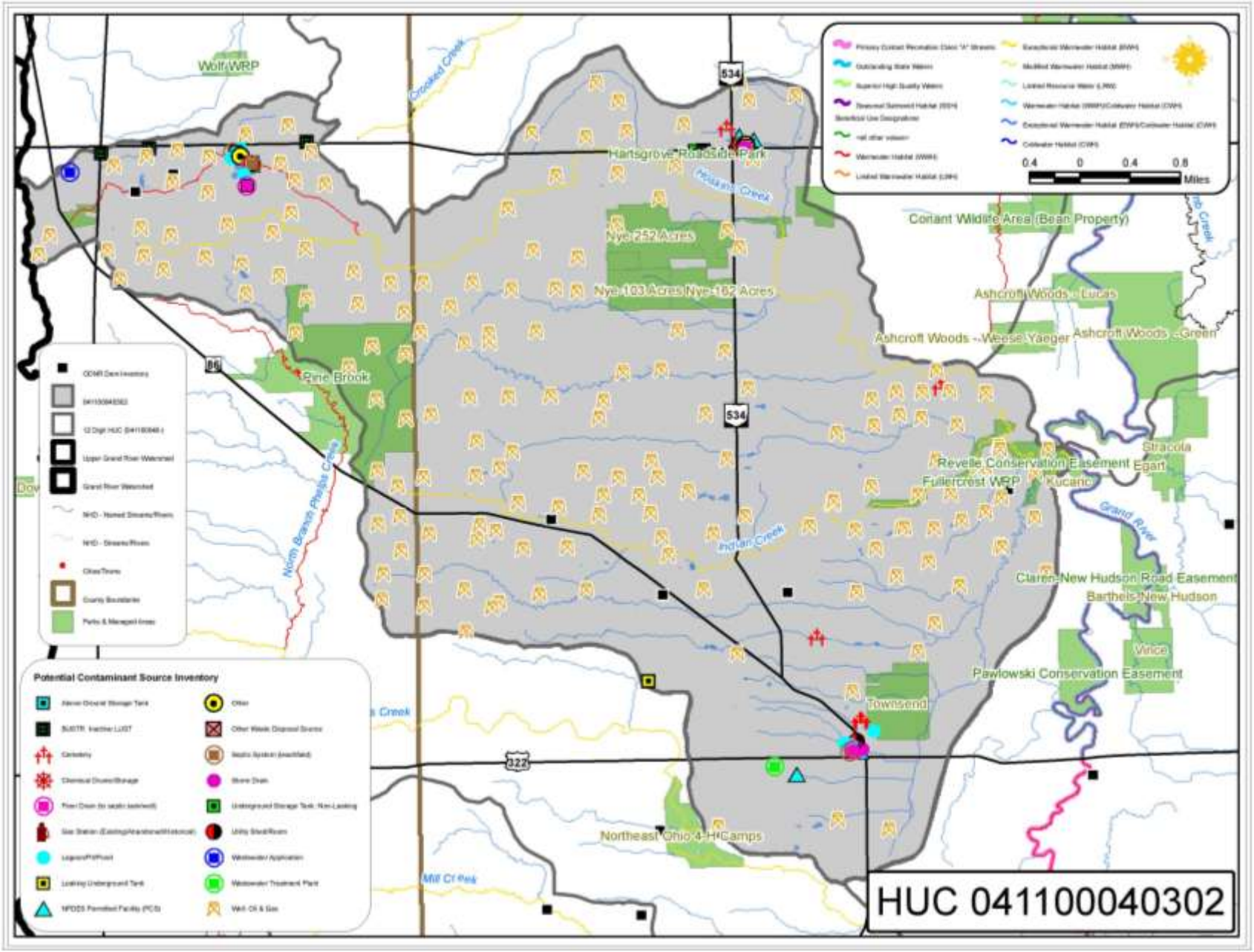
III. WATERSHED INVENTORY

Map 52. 041100040301 – Phelps Creek Potential Contaminant Source Inventory



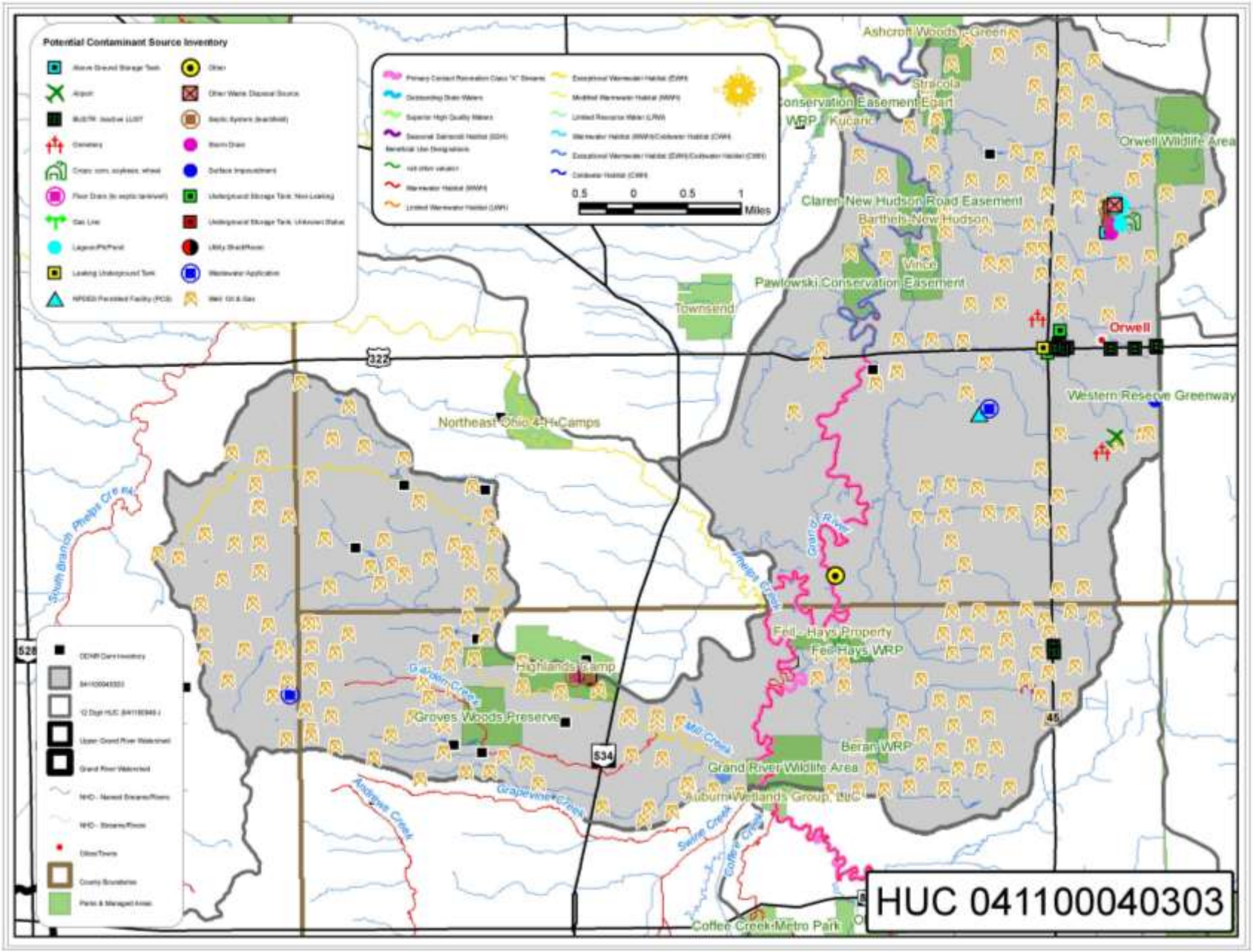
III. WATERSHED INVENTORY

Map 53. 041100040302 – Hoskins Creek Potential Contaminant Source Inventory



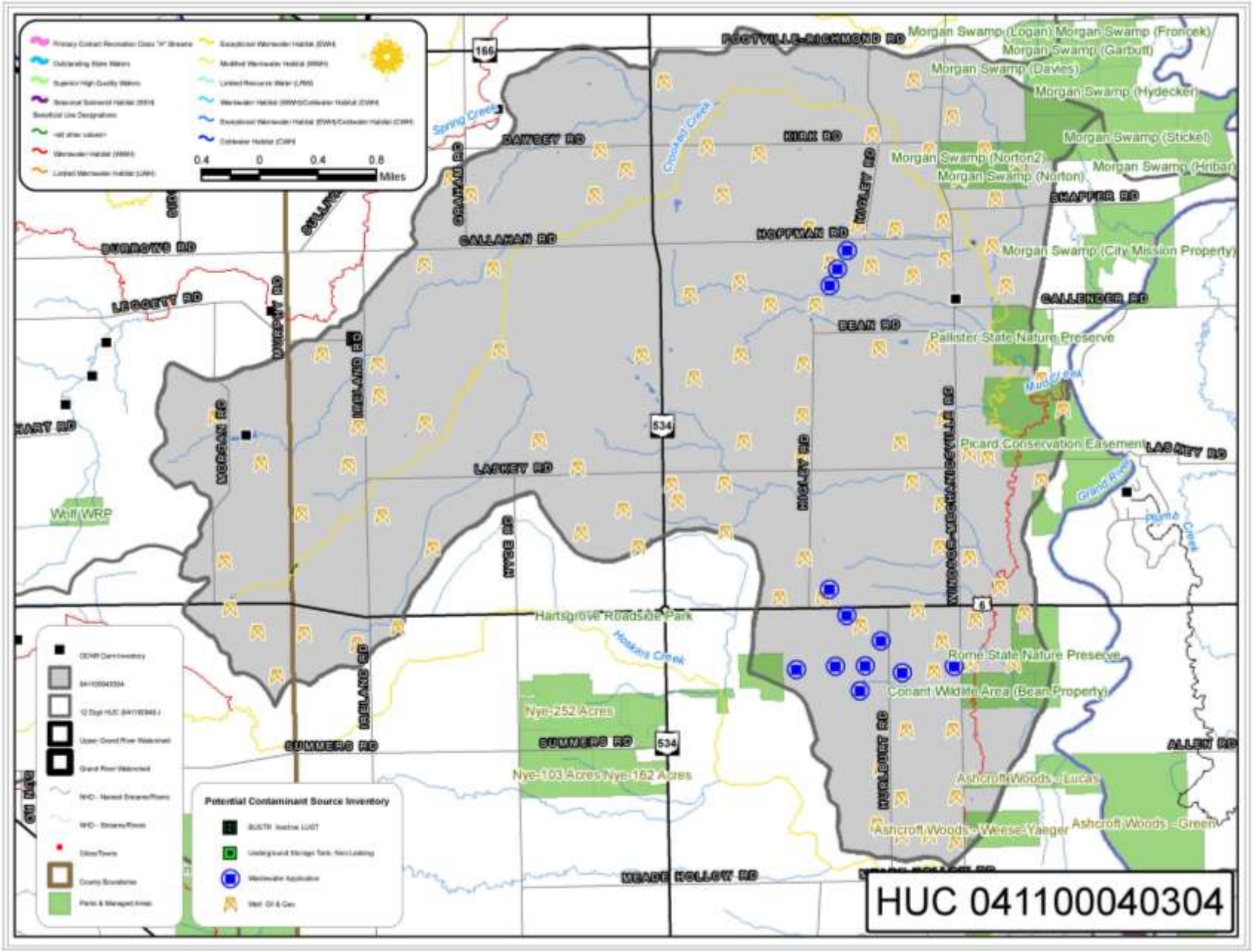
III. WATERSHED INVENTORY

Map 54. 041100040303– Mill Creek (1) Creek Potential Contaminant Source Inventory



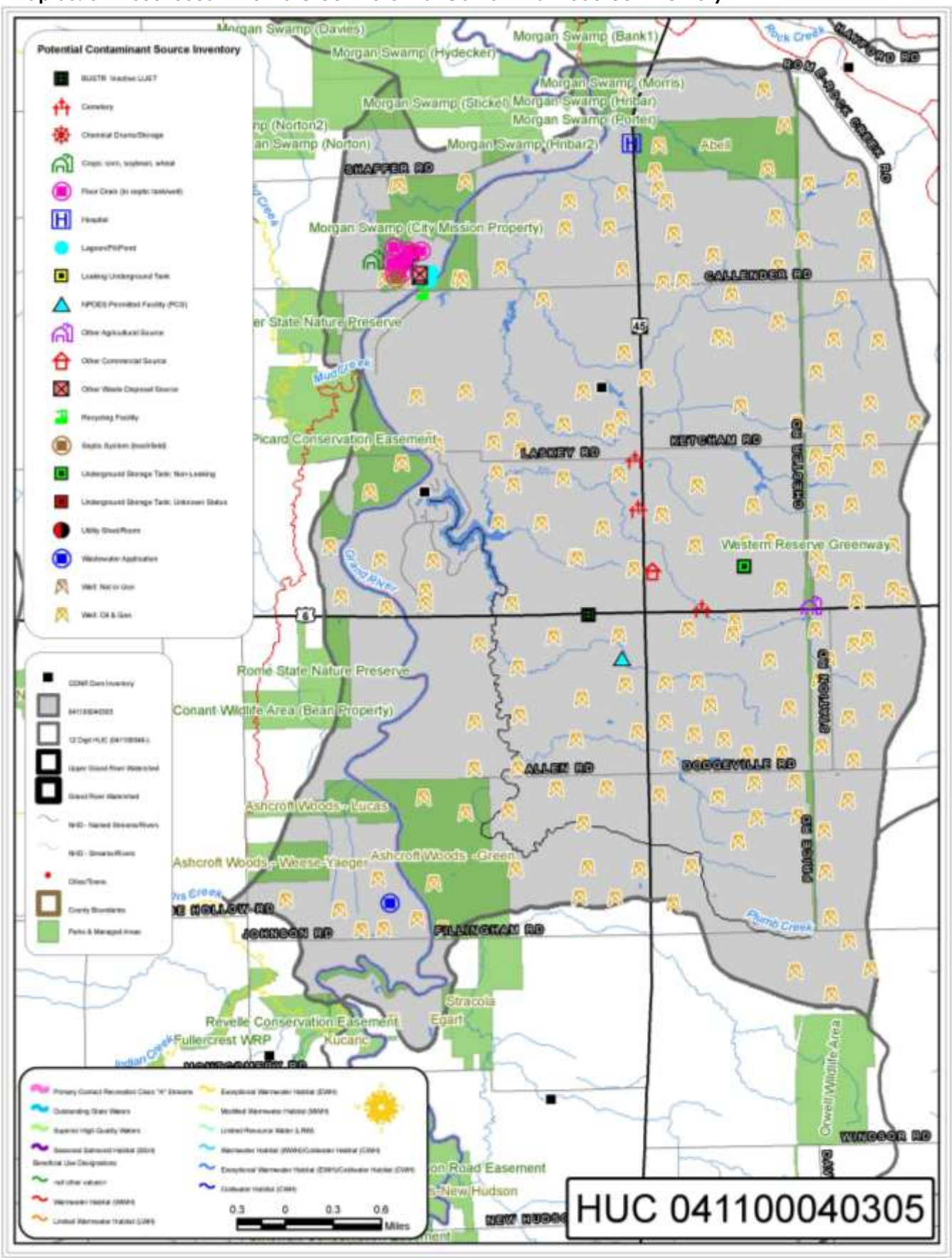
III. WATERSHED INVENTORY

Map 55. 041100040304 – Mud Creek Potential Contaminant Source Inventory



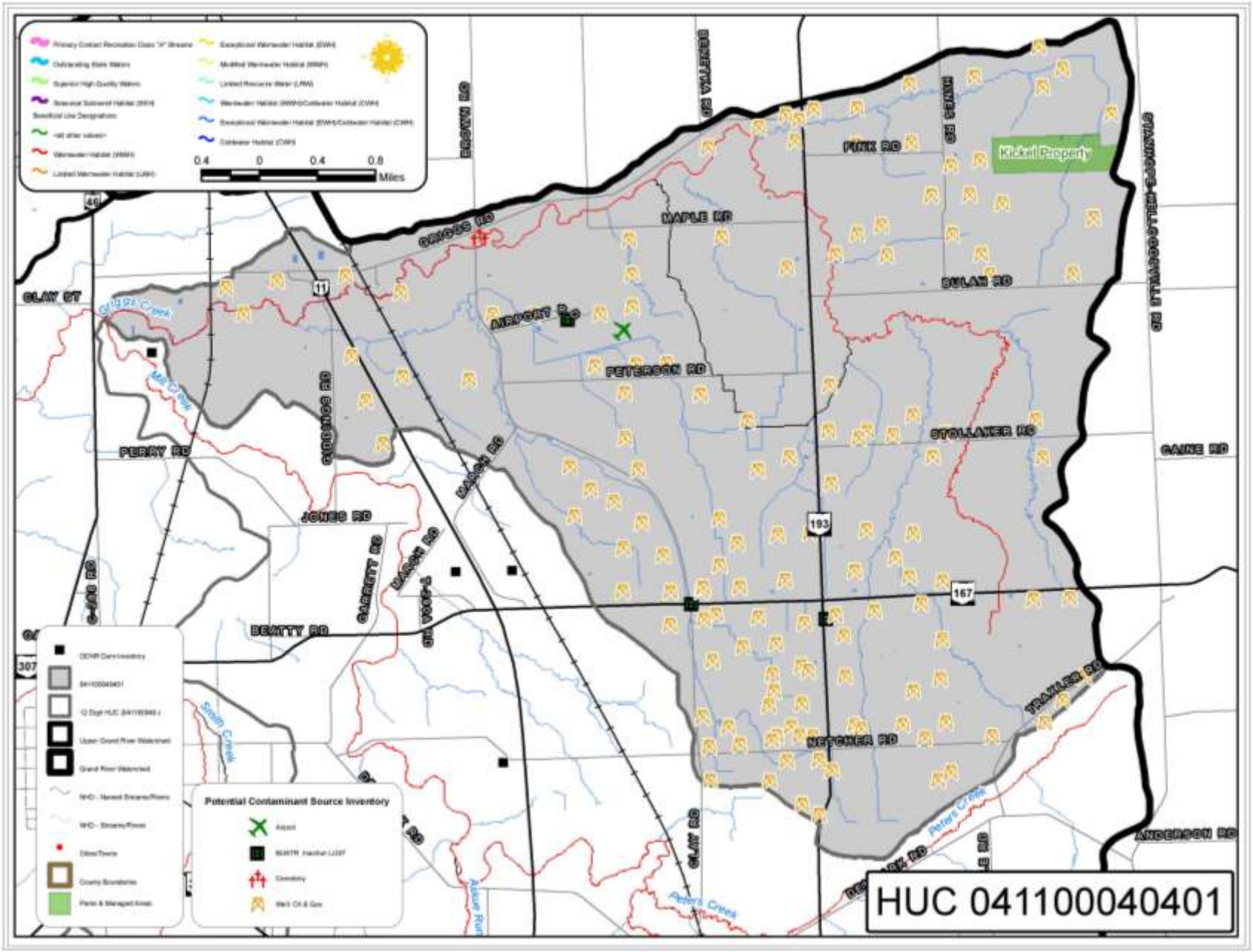
III. WATERSHED INVENTORY

Map 56. 041100040305 – Plumb Creek Potential Contaminant Source Inventory



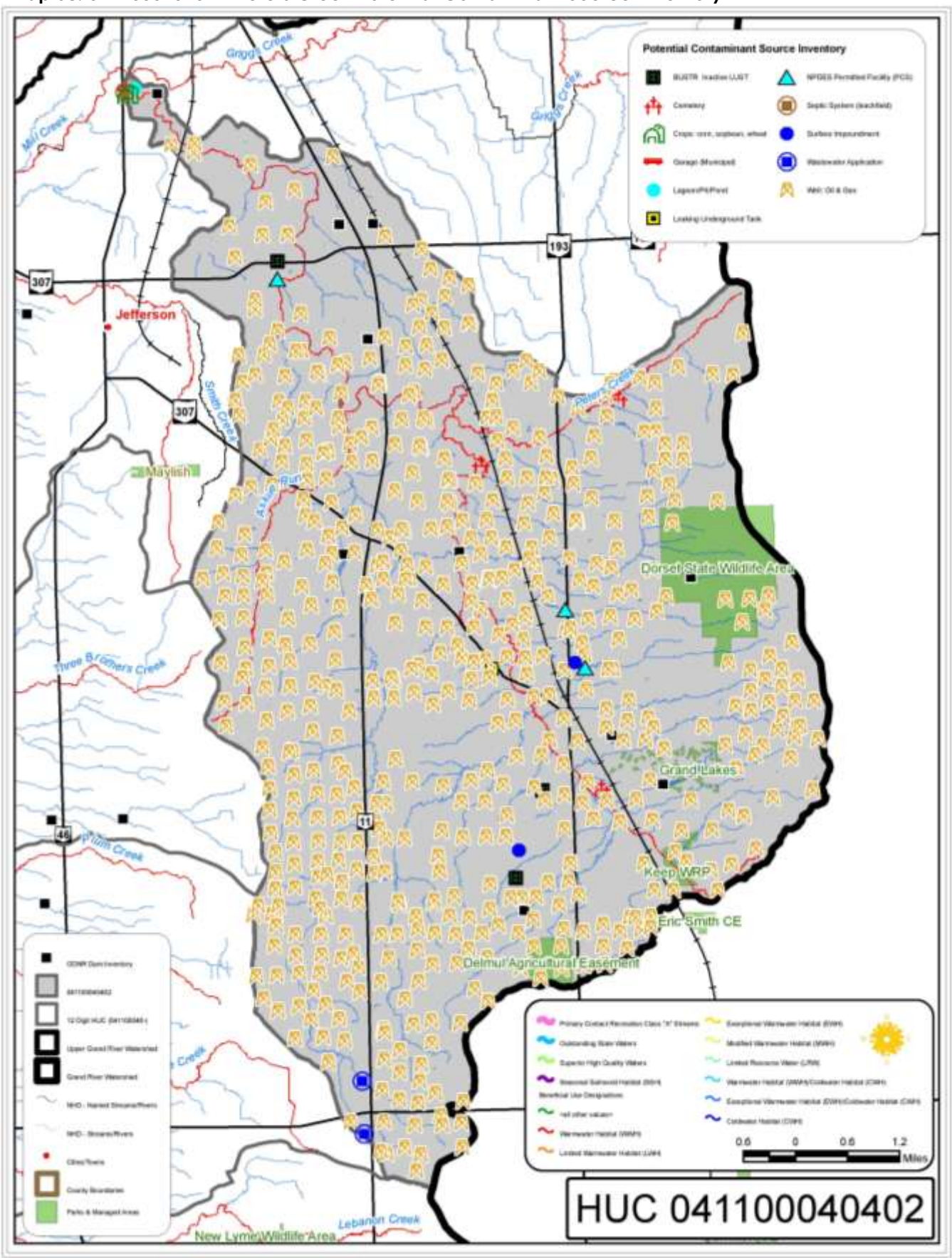
III. WATERSHED INVENTORY

Map 57. 041100040401 – Griggs Creek Potential Contaminant Source Inventory



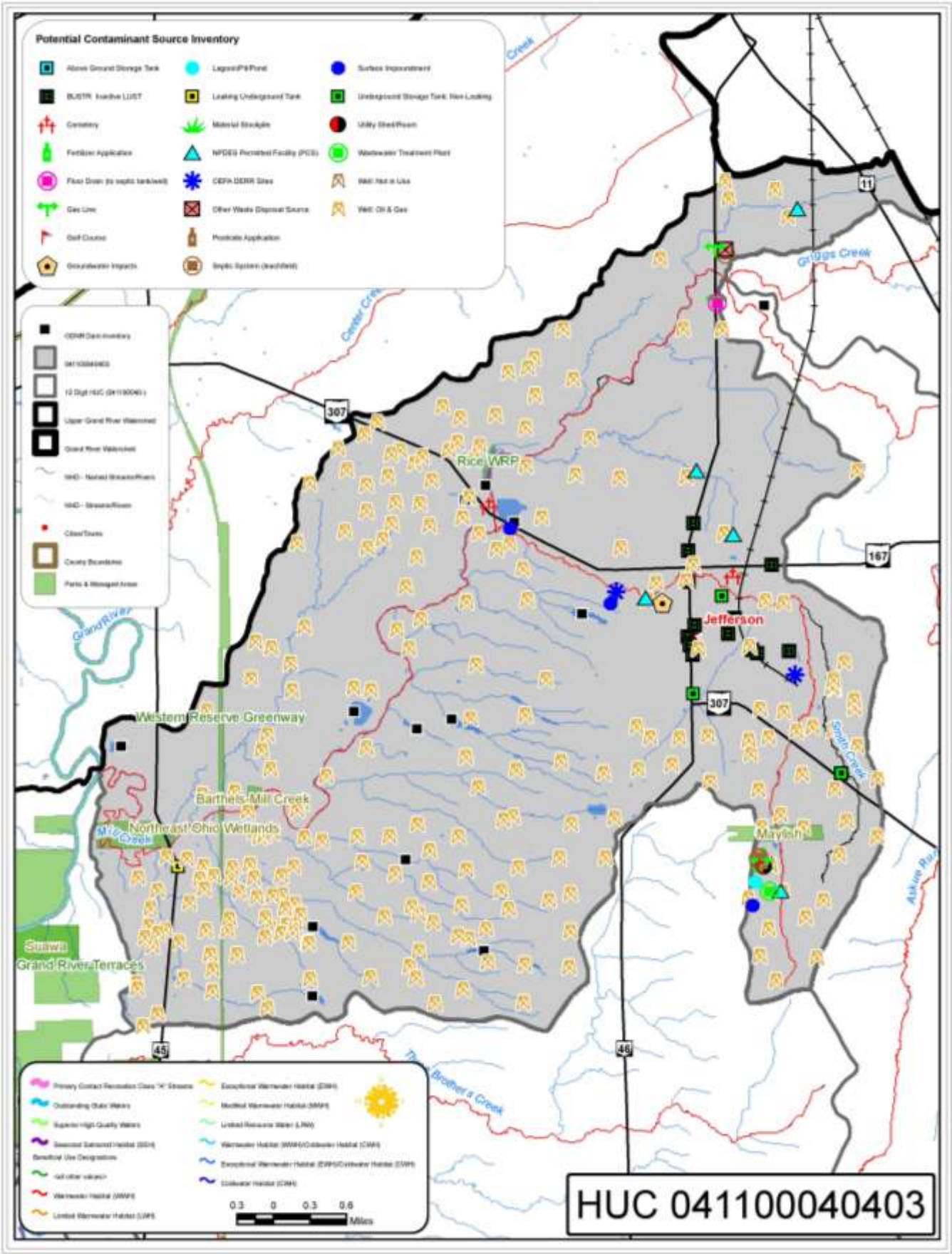
III. WATERSHED INVENTORY

Map 58. 041100040402 – Peters Creek Potential Contaminant Source Inventory



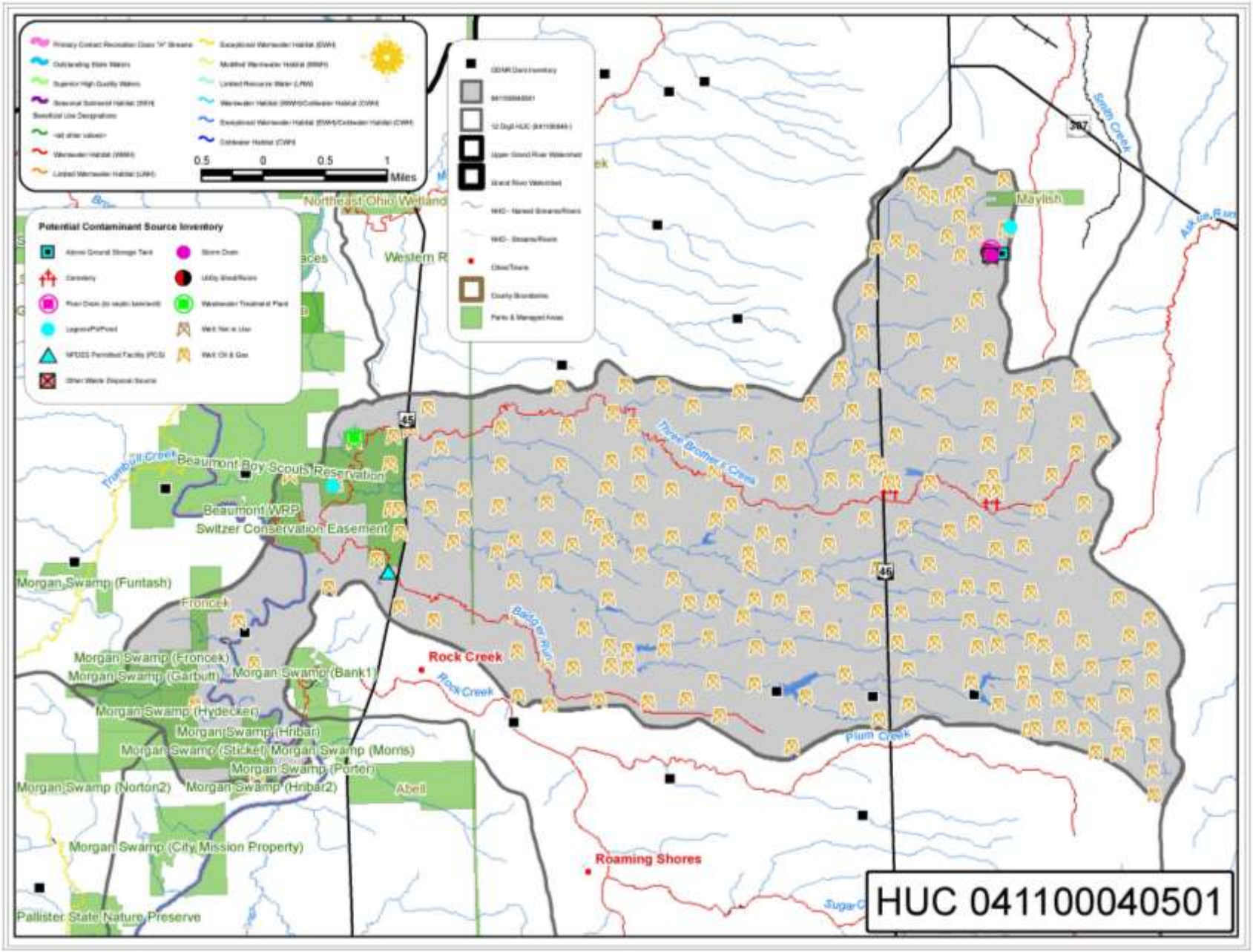
III. WATERSHED INVENTORY

Map 59. 041100040403 – Mill Creek (2) Creek Potential Contaminant Source Inventory



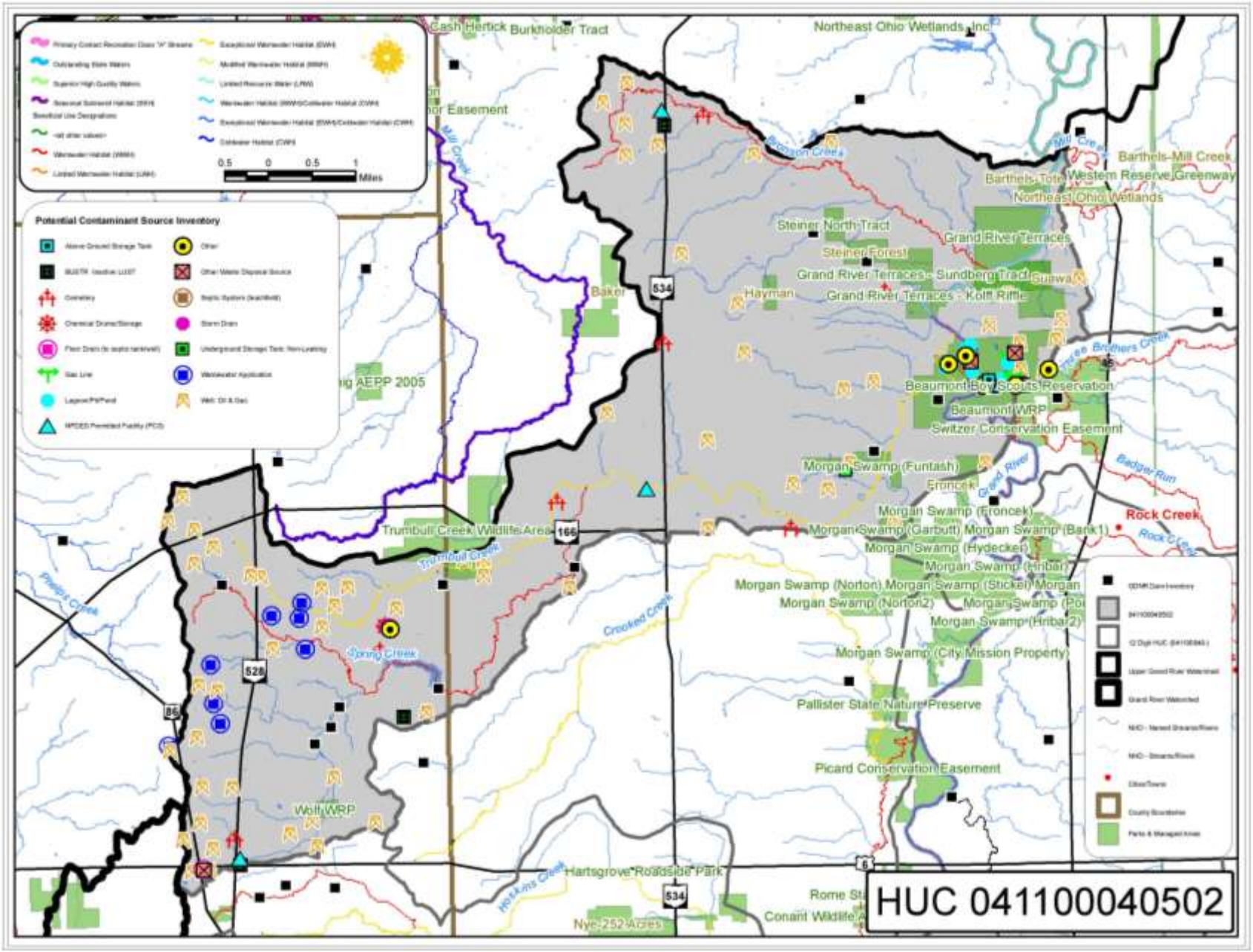
III. WATERSHED INVENTORY

Map 60. 041100040501 – Three Brothers Creek Potential Contaminant Source Inventory



III. WATERSHED INVENTORY

Map 61. Map 53. 041100040502 – Bronson Creek Potential Contaminant Source Inventory



This page left intentionally blank

2. Permitted discharges (NPDES)

Links are provided for Ohio EPA permits. Visit the Ohio EPA's Division of Surface Water Individual NPDES Permits (Industrial and Municipal Discharges) for more information on Ohio's Individual NPDES Permits (Industrial and Municipal Discharges).

Table 70. Permitted Discharges (NPDES) by 12-digit Subwatershed in the Upper Grand River Watershed
(Source: Ohio Environmental Protection Agency Individual NPDES Permits)

HUC 12	HUC 12 Name	OEPA #	USEPA #	PTYPE	FACILITY	COUNTY
041100040101	Dead Branch	3PR00227	OH0128473	Industrial	Halfway Restaurant	Trumbull
041100040101	Dead Branch	3PV00066	OH0107514	Municipal	Southington Estates LLC	Trumbull
041100040101	Dead Branch	3PT00067	OH0126187	Municipal	Southington Local Schools	Trumbull
041100040102	Headwaters Grand River	3PV00009	OH0044334	Municipal	Nelson Ledges Estate MHP	Portage
041100040102	Headwaters Grand River	3PR00274	OH0129569	Municipal	Kool Lakes Family Campground	Portage
041100040102	Headwaters Grand River	3PR00135	OH0098396	Municipal	Rigsby Ranch FKA River Pines	Geauga
041100040102	Headwaters Grand River	3PG00160	OH0134279	Municipal	Geauga Co Parkman WWTP	Geauga
041100040104	Center Creek-Grand River	3PT00065	OH0126012	Municipal	Bristol Local School	Trumbull
041100040105	Coffee Creek-Grand River	3PT00128	OH0139238	Municipal	Bloomfield High School	Trumbull
041100040106	Swine Creek	3PV00053	OH0098507	Municipal	Middlefield MHP	Geauga
041100040106	Swine Creek	3IQ00027	OH0063908	Industrial	Mercury Plastics Inc Fabrication	Geauga
041100040106	Swine Creek	3PW00029	OH0129411	Industrial	Bridge Lake Farm WWTP	Geauga
041100040106	Swine Creek	3PR00465	OH0140333	Municipal	End of Commons General Store	Trumbull
041100040106	Swine Creek	3IH00076	OH0129526	Industrial	Middlefield Orig Cheese Coop	Geauga
041100040106	Swine Creek	3IN00300	OH0123692	Industrial	Shively Land Co LLC	Trumbull
041100040201	Upper Rock Creek	3IY00160	OH0123480	Industrial	Orwell WTP	Ashtabula
041100040203	Lower Rock Creek	3PB00068	OH0045659	Municipal	Roaming Shores WWTP	Ashtabula
041100040203	Lower Rock Creek	3PA00029	OH0107204	Municipal	Rock Creek STP	Ashtabula
041100040301	Phelps Creek	3PR00424	OH0137243	Municipal	Camp Whitewood	Ashtabula
041100040301	Phelps Creek	3PT00137	OH0143065	Municipal	Cardinal Local Sch Dist	Geauga
041100040302	Hoskins Creek	3PT00074	OH0126357	Municipal	Windsor Community Center	Ashtabula
041100040302	Hoskins Creek	3PR00232	OH0128589	Municipal	Grand Valley Country Manor	Ashtabula
041100040302	Hoskins Creek	3PR00214	OH0126314	Municipal	Hartsgrove BP Convenient Station	Ashtabula
041100040302	Hoskins Creek	3PR00270	OH0129470	Municipal	Hartsgrove General Store	Ashtabula
041100040303	Mill Creek-Grand River	3PB00041	OH0026913	Municipal	Orwell WWTP	Ashtabula
041100040305	Plumb Creek-Grand River	3PP00044	OH0129984	Municipal	ODOT Rome Maintenance Outpost	Ashtabula
041100040402	Peters Creek-Mill Creek	3PP00041	OH0128449	Municipal	ODOT Dorset Outpost Garage	Ashtabula
041100040402	Peters Creek-Mill Creek	3PT00029	OH0044920	Municipal	Ashtabula County JVS	Ashtabula
041100040403	Town of Jefferson-Mill Creek	3PV00081	OH0121614	Municipal	DFC MHP	Ashtabula
041100040403	Town of Jefferson-Mill Creek	3PC00021	OH0025887	Municipal	Jefferson WWTP	Ashtabula
041100040403	Town of Jefferson-Mill Creek	3PR00438	OH0139301	Municipal	Harassment's Bar	Ashtabula
041100040403	Town of Jefferson-Mill Creek	3PR00324	OH0133027	Municipal	King Luminaire Co Inc	Ashtabula
041100040403	Town of Jefferson-Mill Creek	3IS00121	OH0131296	Industrial	Ken Forging Inc	Ashtabula
041100040501	Three Brothers Creek-Grand River	3PT00116	OH0134473	Municipal	Glenbeigh Hospital	Ashtabula
041100040502	Bronson Creek-Grand River	3PR00192	OH0125865	Municipal	Plank Road Tavern	Geauga
041100040502	Bronson Creek-Grand River	3PR00457	OH0139629	Municipal	Great Lake Medieval Faire	Ashtabula
041100040502	Bronson Creek-Grand River	3PT00136	OH0142999	Municipal	Cork Elem	Ashtabula

This Page Intentionally left blank

3. Spills and illicit discharges

Leaks and spills of hazardous substances from underground tanks, surface impoundments, bulk storage facilities, transmission lines, and accidents are major ground water pollution threats. More than a thousand leaks and spills are reported each year. This release of chemicals into the surface and near surface environment is certainly one of the greatest threats to ground water quality. Several of the sources of leaks, such as LUST, storage facilities, and surface impoundments, are included with the Highest Priority Sources. Shale gas drilling and hydrofracturing activity in Ohio has potential to impact ground water through improper handling of development and production brines. Reducing leaks and spills of brines and disposal of brines in Class II injection wells are critical activities to minimize the potential for drinking water impact.

Note: Refer to specific 12-digit subwatershed sections in Part IV - Watershed Impairments, Restoration And Protection Goals, And Implementation/Action Plan for spills and illicit discharges by 12-digit subwatershed.

4. Non point sources (by subwatershed or stream segment)

Note: Refer to specific 12-digit subwatershed sections in Part IV - Watershed Impairments, Restoration And Protection Goals, And Implementation/Action Plan for non point sources by 12-digit subwatershed.

5. An inventory of home sewage treatment systems, and a projected number of failing systems.

Inventory of Home Sewage Treatment Systems in the Upper Grand River Watershed
There are 17,486 HSTS systems in the watershed. Of them, approximately 16% are failing (based on a 2001 NOACA study) or 2798 systems. Based on the estimated 2798 failing systems, a load analysis was prepared for the discharge of several pollutants in the septic tank effluent. A flow value of 320 gallons per day was used (assuming most of the flow from a typical 3-bedroom house enters the watershed). Table 70 contains the results.

Table 71. Septic Systems Upper Grand River Watershed

12-digit HUC Code	Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %
041100040101	Dead Branch	1002	2.52	16
041100040102	Lake Estabook-Grand River	1556	2.83	16
041100040103	Baughman Creek	766	2.52	16
041100040104	Center Creek-Grand River	1308	2.52	16
041100040105	Coffee Creek-Grand River	780	2.52	16
041100040106	Swine Creek	1391	2.71	16
041100040201	Upper Rock Creek	877	2.49	16
041100040202	Middle Rock Creek	505	2.42	16
041100040203	Lower Rock Creek	557	2.42	16
041100040301	Phelps Creek	1259	2.83	16
041100040302	Hoskins Creek	764	2.58	16
041100040303	Mill Creek-Grand River	1132	2.53	16
041100040304	Mud Creek	538	2.49	16
041100040305	Plumb Creek-Grand River	455	2.42	16
041100040401	Griggs Creek	490	2.42	16
041100040402	Peters Creek-Mill Creek	1298	2.42	16
041100040403	Town of Jefferson-Mill Creek	667	2.42	16
041100040501	Badger Run-Three Brothers Creek	516	2.42	16
041100040502	Bronson Creek-Grand River	1625	2.72	16

Table 72. Septic Tank Watershed Loading

Total Homes = 2798 (failing systems estimate)	Biochemical Oxygen Demand	Total Phosphorus	Ammonia	Fecal Coliform (#/100 ml)	Flow (gallons per day)
Typical Effluent Quality (mg/L)	143	13	36	3,379,051	320
Individual Home Pollutant Load (lbs/day)	0.381	0.034	0.096		320
Total Home Pollutant Load (lbs/day)	1067	97	268		895,360
Total Home Pollutant Load (lbs/year)	389755	35432	98120		

The potential watershed load produced by failing septic systems is potentially large based on the model estimates. The total calculated load is equivalent to a 12 MGD WWTP with an average BOD5 effluent limit of 10 mg/L. It should be noted that septic tank discharges are localized in their occurrence, a group of failing systems tributary to a small stream will have a significant impact.

STEPL Model

The Spreadsheet Tool for Estimating Pollutant Load (STEPL) employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs). Additional details on the model can be found at: http://it.tetratech-ffx.com/stepl/. The model allows for sub-watershed allocation. STEPL provides a user-friendly Visual Basic (VB) interface to create a customized spreadsheet-based model in Microsoft (MS) Excel. It computes watershed surface runoff, nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5), and sediment delivery based on various land uses and management practices. For each watershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies.

The STEPL model was chosen based on several criteria. A key factor influencing model selection was compatibility with work currently done for Watershed Action Plan. STEPL has been utilized for watershed plans and is an accepted model for 319 grant projects (such as Euclid Creek). The model allows for easy demonstration of loading reductions utilizing different BMPs at a subwatershed level.

Nineteen subwatersheds (HUC 12 units) were entered into the STEPL model. Results of the model are included in Table 72. Examination of the model results indicate that the largest loadings of modeled pollutants are generated by Peters Creek-Mill Creek watershed (4110004-04-02).

Table 73. Total load by subwatershed(s)

12-digit HUC	Watershed	N Load (no BMP) lb/year	P Load (no BMP) lb/year	BOD Load (no BMP) lb/year	Sediment Load (no BMP) t/year
041100040101	Dead Branch	22303	6058	62352	1505
041100040102	Lake Estabrook-Grand River	39567	11005	104773	2772
041100040103	Baughman Creek	21797	6116	54286	1897
041100040104	Center Creek-Grand River	26031	7188	73013	1672
041100040105	Coffee Creek-Grand River	17789	5195	45458	1562
041100040106	Swine Creek	37798	10389	97484	2819
041100040201	Upper Rock Creek	26896	7714	63945	2433
041100040101	Dead Branch	22303	6058	62352	1505
041100040102	Lake Estabrook-Grand River	39567	11005	104773	2772
041100040103	Baughman Creek	21797	6116	54286	1897
041100040104	Center Creek-Grand River	26031	7188	73013	1672
041100040105	Coffee Creek-Grand River	17789	5195	45458	1562
041100040106	Swine Creek	37798	10389	97484	2819
041100040201	Upper Rock Creek	26896	7714	63945	2433
041100040202	Middle Rock Creek	26232	7140	59700	2498
041100040203	Lower Rock Creek	26540	6998	64977	2277
041100040301	Phelps Creek	32346	9005	85444	2319
041100040302	Hoskins Creek	22246	6161	56675	1723
041100040303	Mill Creek-Grand River	34838	9624	85958	2784
041100040304	Mud Creek	16618	4720	40763	1432
041100040305	Plumb Creek - Grand River	15333	4210	38049	1319
041100040401	Griggs Creek	23294	6290	54312	2173
041100040402	Peters Creek-Mill Creek	52991	13773	128117	3970
041100040403	Town of Jefferson-Mill Creek	28130	7354	70757	2242
041100040501	Badger Run-Three Brothers Creek	20742	5711	49002	1886
041100040502	Bronson Creek-Grand River	38152	10815	100729	2531
Total		**529641**	**145466**	**1335793**	**41813**

The model results (Table 72) indicate that the largest pollutant loading by land use is generated by cropland.

Table 74. Total load by land use

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Cropland	320058	89795	581072	37284
Septic	92307	36153	376918	0
Pastureland	57392	6937	175909	2654
Urban	44966	6920	171735	1034
Forest	9954	4668	23540	841
Feedlots	4964	993	6618	0
Total	**529641**	**145466**	**1335793**	**41813**

6. Number of new homes being built.

Currently there is no data available for the number of new homes being built in the Upper Grand River Watershed.

7. Number and size of animal feeding operations.

It is difficult to identify ground water impacts associated with Concentrated Animal Feeding Operations (CAFOs). Nevertheless, the growth of these operations in numbers and size makes them a significant potential source if the waste is not properly managed. The ground water threats associated with CAFOs are captured in other categories as well, such as manure and fertilizer application and surface impoundments, so they are not considered one of the ten highest priority sources.

Currently there is no Concentrated Animal Feeding Operations in the Upper Grand River Watershed. No additional data available for the number and size of animal feeding operations in the Upper Grand River Watershed.

8. Acres of Highly Erodible Land and potential soil loss.

The term "highly erodible land" means land that has, or that if used to produce an agricultural commodity, would have an excessive average annual rate of erosion in relation to the soil loss tolerance level, as established by the United States Secretary of Agriculture, and as determined by the Secretary through application of factors from the universal soil loss equation and the wind erosion equation, including factors for climate, soil erodibility, and field slope.

In United States agricultural policy, Highly erodible land (HEL) refers to land that is very susceptible to erosion, including fields that have at least 1/3 or 50 acres (200,000 m2) of soils with a natural erosion potential of at least 8 times their T value. About 104 million acres (420,000 km2) of cropland meet this definition of HEL, according to the 1997 National Resources Inventory. Farms cropping highly erodible land and under production flexibility contracts must be in compliance with a conservation plan that protects this cropland.

Table 75. Highly Erodible Land in the Upper Grand River Watershed
(Source: Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) Database)

	Highly Erodible Land	Potentially Highly Erodible Land	Not Highly Erodible Land	Unknown	Total
Acres	7027	125478	192768	7640	132505
Percent	5%	95%	145%	6%	

Note: Refer to specific 12-digit subwatershed sections in Part IV - Watershed Impairments, Restoration And Protection Goals, And Implementation/Action Plan for highly erodible land and potential soil loss by 12-digit subwatershed.

9. Is the stream culverted?

Currently there is no data available for locations or number of stream culverts in the Upper Grand River Watershed.

10. Channelized?

Currently there is no data available for the locations, levels or amount channelization in the Upper Grand River Watershed.

11. Levied?

Currently there is no data available for the locations or number of levies in the Upper Grand River Watershed.

12. Exhibiting little human impact?

Currently there is no data available for the locations, levels or areas exhibiting little human impact in the Upper Grand River Watershed.

III. WATERSHED INVENTORY

13. What's the effluent volume?

Currently there is no data available for locations, levels or amounts of effluent volume in the Upper Grand River Watershed.

14. Dammed? (How many stream miles are impounded)

Currently there is no data available for number of stream miles impounded in the Upper Grand River Watershed.

15. Officially classified and/or unofficially maintained as petition ditches?

Currently there is no data available for locations or number of petition ditches in the Upper Grand River Watershed.

- **Status and trends (areas where water quality is in attainment, but local information indicates that the current situation, if unchanged, will likely result in water quality degradation.)**

  Note: Refer to specific 12-digit subwatershed sections in Part IV - Watershed Impairments, Restoration And Protection Goals, And Implementation/Action Plan for status and trends by 12-digit subwatershed.

This Page Intentionally left blank

Part IV.
WATERSHED IMPAIRMENTS, RESTORATION AND PROTECTION GOALS, AND IMPLEMENTATION/ACTION PLAN

This Page Intentionally left blank

A. Dead Branch Subwatershed

12 Digit HUC: 041100040101
Location: Dead Branch to Grand River
Drainage Area: 24.14 miles^2, 15452 acres
Miles of stream: 65.14 miles
Average Sinuosity: 1.19
Average Impervious Cover: 1.22%

Photo 11. Dead Branch near confluence with Grand River *(Source: GRPI)*

Subwatershed Description
The Dead Branch 12-digit HUC Subwatershed represents 15 percent of the six (6) subwatersheds in the Headwaters – Grand River 10-digit HUC subwatershed to the Grand River Watershed. This watershed drains mostly forested, cultivated crops and pasture/hay land in Farmington, Jefferson, and Southington Townships in west central Trumbull County and a small portion of Nelson Township in Portage County.

As of 2006, about 3 percent or 524 acres of land development (low, medium & high intensity) has occurred in the Dead Branch Subwatershed, with 59 percent or 9063 acres of the land use as forested and 34 percent or 5228 as agricultural land use (Table 76, Map 62). Deciduous forest makes up of the majority of the forested land use, Cultivated Crops and Pasture/Hay makes up 95 percent of agricultural land use and Corn & Soybeans dominates the row crop production at 80 percent *(2009 USDA Cropland Cover)*.

Table 76. 041100040101 – Subwatershed Land Use
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Developed, High Intensity	3	0.02
Developed, Medium Intensity	33	0.21
Developed, Low Intensity	488	3.16
Developed, Open Space	305	1.98
Cultivated Crops	2720	17.62
Pasture/Hay	2254	14.59
Grassland/Herbaceous	254	1.65
Deciduous Forest	5302	34.33
Evergreen Forest	121	0.78
Mixed Forest	63	0.41
Scrub/Shrub	1847	11.96
Palustrine Forested Wetland	1480	9.59
Palustrine Scrub/Shrub Wetland	249	1.62
Palustrine Emergent Wetland	131	0.85
Bare Land	5	0.03
Open Water	186	1.20
Total	**15443**	

Floodplain

Forest and pasture make up 74 percent of the land use in the Dead Branch Subwatershed floodplain. Forest covers 60 percent or 1522 acres and pasture/hay covers 14 percent or 341 acres of the 2526 acres of flood plain. The next closest land use in the flood plain is woody wetlands at 219 acres or 9 percent. High, medium and low density development only composes 41 acres or just 2 percent of the floodplain (Table 77).

Table 77. 041100040101 – Subwatershed Land Use Within Floodplain
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

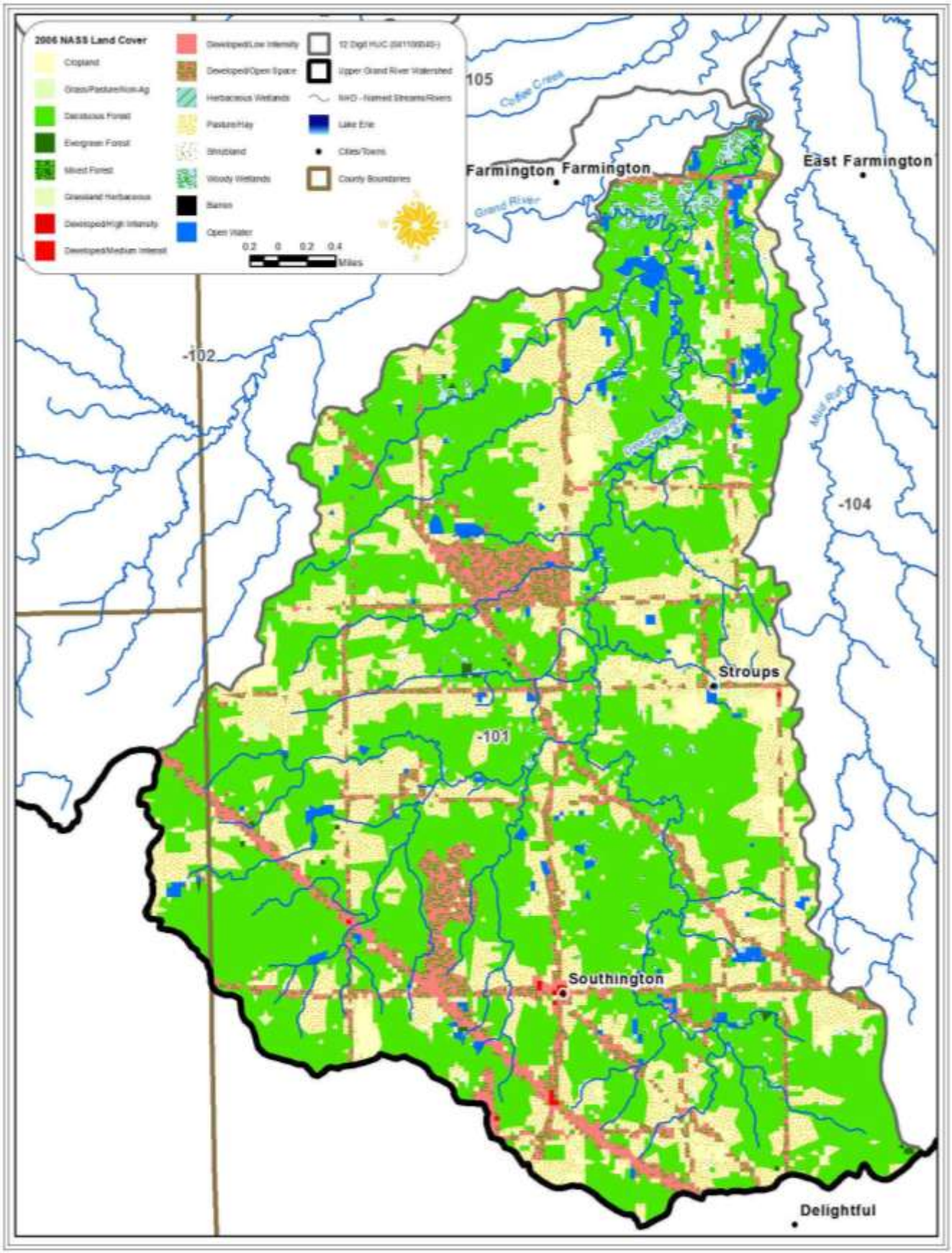
Description	Acres	Percent of Watershed
Agriculture	23	0.90%
Grass/Pasture/Non-Ag	4	0.17%
Barren	0	0.00%
Deciduous Forest	1522	60.26%
Developed/High Intensity	0	0.00%
Developed/Low Intensity	41	1.62%
Developed/Medium Intensity	0	0.00%
Developed/Open Space	187	7.40%
Evergreen Forest	7	0.27%
Grassland Herbaceous	37	1.46%
Herbaceous Wetlands	1	0.03%
Open Water	121	4.78%
Pasture/Hay	341	13.51%
Shrubland	23	0.89%
Woody Wetlands	220	8.71%
Total	**2526**	

Table 78. 041100040101 – Subwatershed Wetland Types by Acres
(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Riverine	Pond	Grand Total
157	847	26	195	1226

Map 62. 041100040101 – Subwatershed Land Use

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)



This page left intentionally blank

Soils

The major soils of the Headwaters Subwatershed are the Fitchville-Haskins-Sebring Association, Caneadea-Canadice Association, and Holly-Orrville-Tioga Association. These are characterized by deep, nearly level to gently sloping areas that vary from very poorly drained to well drained in a few locations. In general these soils suffer from flooding and seasonal wetness and ponding, and have moderately slow to very slow permeability. Typically they have high seasonable water tables. All three associations consist of soils formed from fine texture lacustrine material, glacial outwash, or glacial till. The Holly-Orrville-Tioga Association is solely associated with flat flood plains and it is common to find it on valley floors associated with the basins of former glacial lakes. About 66 percent of the soils are considered potentially highly erodible. Tables 79 & 80 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Trumbull County.

Table 79. 041100040101 – Subwatershed Highly Erodible Soil by Acres

(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
745	10241	4222	212

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Headwaters Subwatershed is made up of 84 percent from Group D Hydrologic Soil. Soils in this group have high runoff potential when thoroughly wet due to very slow infiltration rates. Water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures, with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious parent material.

Table 80. 041100040101 - Subwatershed Hydrologic Soil Groups by Acres

(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

A	B	C	D	A/D	B/D	C/D
40	76	245	12839	0	817	1262

Water Quality

The physical habitat quality of streams in the Upper Grand River basin is largely influenced by topography, drainage area, and the juxtaposition of glacial till and lacustrine deposits. Essentially this creates three distinct stream types: lowland streams, upland headwaters, and the non-wadeable Grand River mainstem.

Where the topography is flat, and the substrates are composed primarily of lacustrine silts and clays, habitat quality is generally poor and not conducive to stream faunas typical of the ecoregion. Headwater streams matching this description are found in the lowlands of the southeastern quarter of the catchment in hydrologic units 041100040101, 041100040103 and 041100040104.

Localized impacts to water quality from anthropogenic sources, principally from organic enrichment, were noted in tributaries to the Grand River. The sources of enrichment were primarily on-site sewerage, livestock, and, in some cases, an unknown source.

According to the Biological and Water Quality Study of the Upper Grand River 2007, the Ohio EPA reported the Dead Branch Subwatershed as an un-verified Warmwater Habitat (WWH) Aquatic Life Use Designation stream (Table 81). The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin. The stream is a swamp stream that has natural limitations imposed by clay substrates and low gradient. The Dead Branch was obviously ditched to drain wetlands.

Stratified by hydrologic units, HUC 0411000401, containing Dead Branch, Deacon Creek and Center Creek, had the highest TKN and NH_3-N concentrations. Concentrations of both TKN and ammonia-nitrogen (NH_3-N) were elevated in Dead Branch. The sources to Dead Branch were unknown; however, the stream was intermittent and influenced by wetlands, suggesting a natural source.

Table 81. 041100040101 – Subwatershed Aquatic Life Use (ALU) Designation
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-025 Dead Branch WWH Aquatic Life Use (unverified)			
7.86	WWH	-	Natural Limits - Wetlands
4.10	WWH	-	Natural Limits - Wetlands

The quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

Dead Branch is located in the southeastern quarter of hydrologic unit 0411000401, and was obviously ditched to drain wetlands. Dead Branch was not sampled because the silt and clay substrates were so thick as to render electrofishing unsafe. In general, this stream lacks the potential to support fish faunas consistent with expectations derived for regionally typical streams (Table 82).

Table 82. 041100040101 - Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIwb[a]	Narrative
03-025 Dead Branch - unverified WWH - wetland stream										
300170	7.86					0	0	0	DNS†	
300169	4.1					0	0	0	DNS†	

† - did not sample.

Recreational Use Designation
Dead Branch was in full attainment for recreational use at river mile 4.10 and non-attainment at river mile 7.86. The sources to Dead Branch were unknown; however, the stream is intermittent and influenced by wetlands, suggesting a natural source (Table 83).

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 83. 041100040101 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Dead Branch Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	STORET	GEOMEAN	N	Class	Attainment	Sources
Dead Branch						
7.86	300170	611	2	B	Non	Unknown
4.10	300169	77	2	B	Full	

Macroinvertebrate communities evaluated in the Upper Grand River tributaries can be grouped, to a large part, based on the physical habitat, shaped by the typography of the landscape they flow through. Macroinvertebrate communities that were not meeting their designated or recommended Aquatic Life Use expectations included Dead Branch and Tributary to Dead Branch (@ RM 6.20) (Table 84). This is due to more or less natural low gradient landscapes that were formed by the glacial Grand River Lake or other former wetland areas.

Table 84. 041100040101 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Dead Branch Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	Drain Area (mi2)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Dead Branch (03-025)										
7.86	4.8	9	31	3	2	H	0	Water boatmen (F), snails (VT,T)	-	Poor
4.10	15.1	-	38	5	2	M	0	Water boatmen (F), scuds (F)	-	Low Fair
Tributary to Dead Branch (@ RM 6.20) (03-050)										
0.40		-	37	5	5	L-M	0	Midges (MT,F,T), water boatmen (F), snails (T,F)	-	Fair

Qualitative sample relative density: L=Low, M=Moderate, H=High

- **12-digit HUC 041100040101 – Dead Branch Subwatershed Problem Statements, Goals, objectives and Action**

Summary of Impairments: The major causes of impairment for Dead Branch, a 12-digit subwatershed of Headwaters – Grand River 10-digit subwatershed, include elevated concentrations of both TKN and ammonia-nitrogen (NH_3-N). Those causes of impairment are primarily associated with unknown sources; however, the stream is intermittent and influenced by wetlands, suggesting a natural source. Currently, water quality standards developed for waterbodies in Ohio do not include standards for wetland streams. water quality standards for wetland streams should be developed. Previously surveyed wetland streams with impairments due to natural limits or natural flow should be re-sampled according to the revised standards.

Problem Statement 1: Local stakeholder concern has identified 721 acres of land with high natural area conservation value (Map 63) under threat of conversion. It was assumed that for a single family housing development on the 721 acres, 50% of the land would be preserved as open space. Of the remaining 360.5 acres developed as single-family residential, it was assumed that the development would use filter buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by impervious surfaces and residential land use (excess loading of nitrogen (N) - 1163 lbs/year, phosphorus (P) - 168 lbs/year, Biological Oxygen Demand (BOD) - 4751 lbs/year and Sediment – 9 tons/year) would push adjacent sections of Dead Branch to impairment (see table 85).

Goal: Protect 721 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 721 acres of land with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 85. Dead Branch Subwatershed Land Protection Load Estimates for land protection

Current land use loading as 721 acres of forest			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
295.5	141.4	711.1	17
New land use loading following development of 360.5 acres as single-family housing with LID			
N Load lb/year	**P Load lb/year**	**BOD lb/year**	**Sediment Load t/year**
1458.3	309	5462.0	25,5
Net increase due to land use change			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
1163	**167.6**	**4750.9**	**8.5**

Problem Statement 2: Local stakeholder concern has identified 174 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-

landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 174 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 174 acres of wetlands with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified wetland protection properties.

Problem Statement 3: Local stakeholder concern has identified 3.72 miles or 19620 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant pollutants generated by channel erosion (excess loading of sediment – 667 tons/year, N - 334 lbs/year and P - 334 lbs/year) would push adjacent sections of Dead Branch to impairment (see table 86).

Goal: Protect 3.72 miles or 19620 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 3.72 miles or 19620 linear feet of stream corridor with high natural area conservation value.

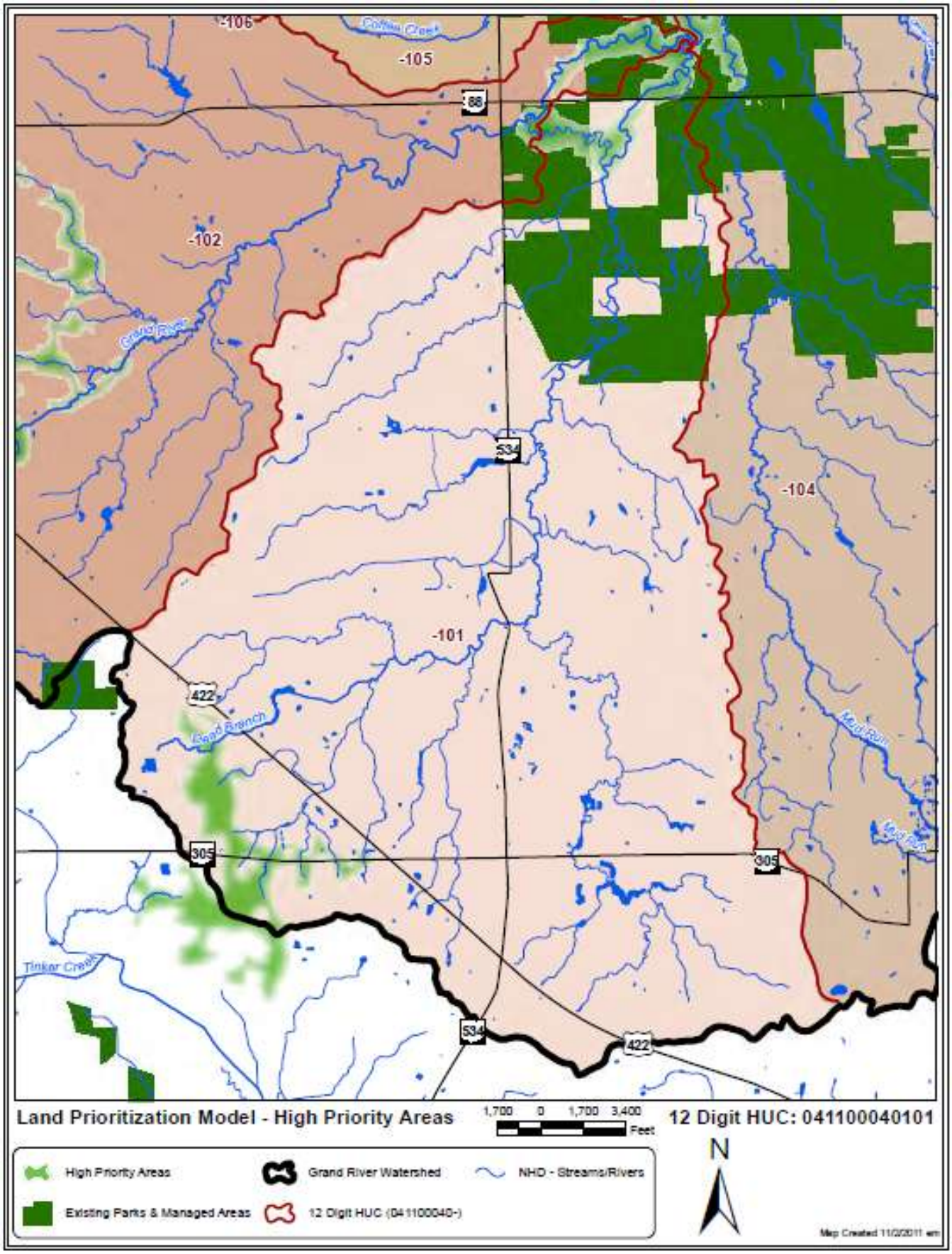
Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 86. Dead Branch Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	166.8	166.8
Phosphorus Load Reduction (lb/year)			166.8	166.8
Nitrogen Load Reduction (lb/yr)			333.5	333.5

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 63. 041100040101 Dead Branch Land Protection Prioritization Model - High Priority Areas



B. Headwaters Subwatershed

12 Digit HUC: 041100040102
Location: Grand River Headwaters to above Dead Branch
Drainage Area: 33.17 miles^2, 21228 acres
Miles of stream: 79.21 miles
Average Sinuosity: 1.24
Average Impervious Cover: 1.14%

Photo 12. Mud Run near confluence with Grand River *(Source: G. Warnock)*

Subwatershed Description
The Headwaters 12-digit HUC Subwatershed represents 21 percent of the six (6) subwatersheds in the Headwaters – Grand River 10-digit HUC subwatershed to the Grand River Watershed. This watershed drains mostly forested, cultivated crops and pasture/hay land in Parkman and Troy Townships in Geauga County, Hiram and Nelson Townships in Portage County and the Village of West Farmington, Farmington and Southington Townships in Trumbull County.

As of 2006, about 3% or 618 acres of land development (low, medium & high intensity) has occurred in the Headwaters Subwatershed, with 50 percent or 10614 acres of the land use as forested and 45 percent or 9593 acres as agricultural land use (Table 87, Map 64). Deciduous forest makes up of the majority of the forested land use, Cultivated Crops and Pasture/Hay makes up 96 percent of agricultural land use and Corn & Soybeans dominates the row crop production at 73 percent *(2009 USDA Cropland Cover)*.

Table 87. 041100040102 – Subwatershed Land Use
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Developed, High Intensity	5	0.02
Developed, Medium Intensity	64	0.30
Developed, Low Intensity	549	2.59
Developed, Open Space	165	0.78
Cultivated Crops	4696	22.14
Pasture/Hay	4478	21.11
Grassland/Herbaceous	419	1.97
Deciduous Forest	7150	33.71
Evergreen Forest	176	0.83
Mixed Forest	70	0.33
Scrub/Shrub	2214	10.44
Palustrine Forested Wetland	877	4.13
Palustrine Scrub/Shrub Wetland	127	0.60
Palustrine Emergent Wetland	77	0.36
Bare Land	13	0.06
Open Water	132	0.62
Total	**21211**	

Floodplain

Forest and pasture/hay make up 81 percent of the land use in the Headwaters Subwatershed floodplain. Forest covers 63 percent or 1978 acres and pasture/hay covers 18 percent or 560 acres of the 3135 acres of flood plain. The next largest amount of land use in the flood plain is open space at 204 acres or 6.5 percent. High, medium and low density development only composes 40 acres or just 1.28 percent of the floodplain

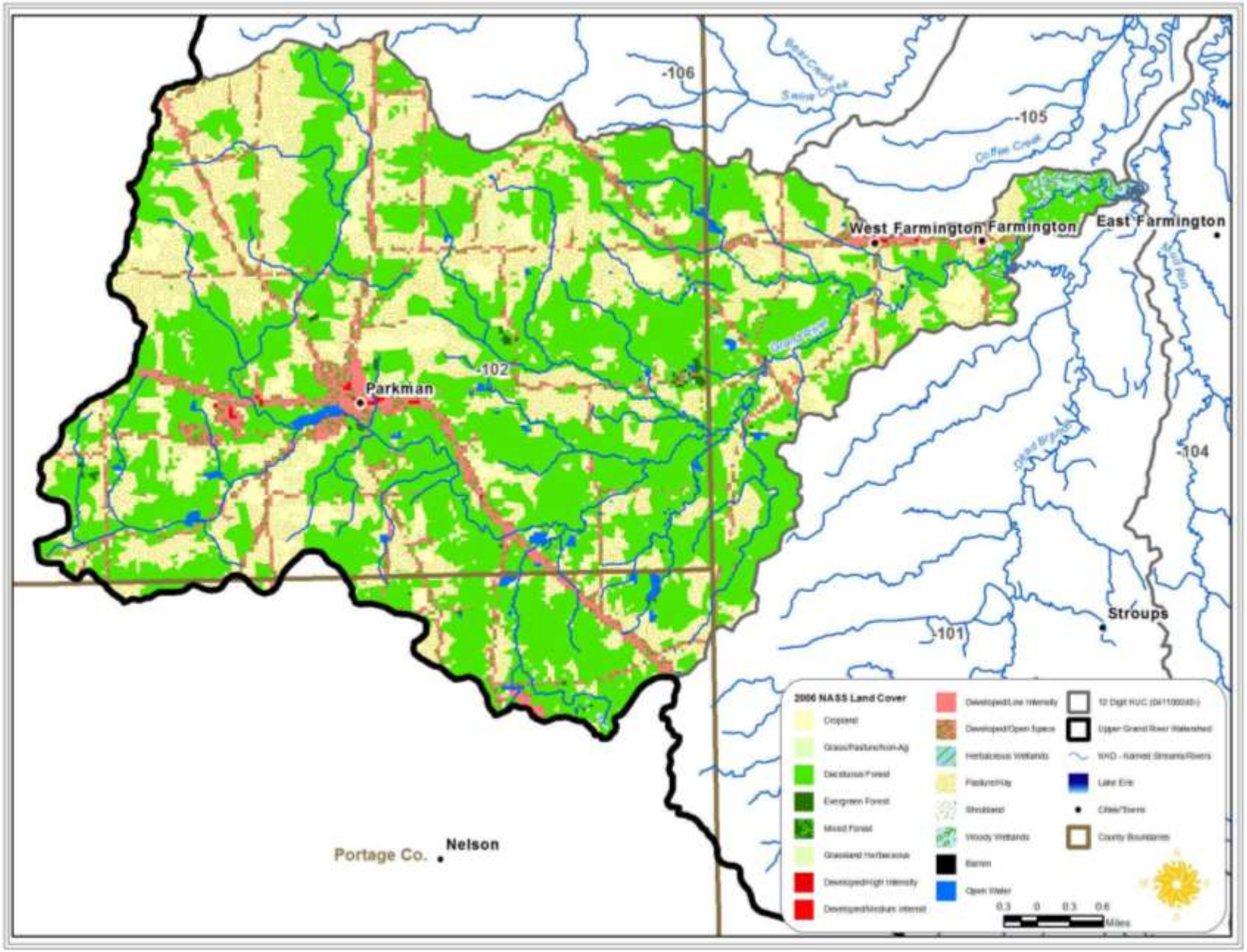
Table 88. 041100040402 – Subwatershed Land Use Within Floodplain
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Agriculture	48	1.52
Grass/Pasture/Non-Ag	5	0.15
Barren	0	0.00
Deciduous Forest	1978	63.07
Developed/High Intensity	0	0.01
Developed/Low Intensity	38	1.22
Developed/Medium Intensity	2	0.06
Developed/Open Space	204	6.49
Evergreen Forest	7	0.23
Grassland Herbaceous	73	2.33
Herbaceous Wetlands	0	0.00
Open Water	70	2.24
Pasture/Hay	560	17.86
Shrubland	8	0.25
Woody Wetlands	143	4.57
Total	**3135**	

Table 89. 041100040402 – Subwatershed Wetland Types by Acres
(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Lake	Riverine	Pond	Total
155	1580	29	56	208	2029

Map 64. 041100040102 – Subwatershed Land Use *(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)*



This Page Intentionally left blank

Soils

The major soils of the Headwaters Subwatershed are Mahoning Ellsworth and the Remsen-Geeburg-Trumbull associations formed on the glaciated uplands in fine to moderately fine textured glacial till. These are distinguished by somewhat poorly drained to moderately drained soils that are fairly deep to the bedrock. Overall these soils have slow to very slow permeability and are nearly flat to gently sloping. The Remsen-Geeburg- Trumbull association tends to be found on steeper areas along major drainage areas. The Sebring-Holly-Caneadea Association is in low lying basins mainly in the southern portion of the Headwaters Subwatershed. Its main characteristics are poorly drained soils which are mainly silty or clayey. Most are level to gently sloping and were formed from either lacustrine material in former glacial lake basins, or from alluvial material on flood plains. Streams that form in these soils are typically slow, contain ponded areas and have a low gradient. About 70 percent of the soils are considered potentially highly erodible. Tables 84 & 85 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Geauga, Portage and Trumbull County.

Table 90. 041100040102 – Subwatershed Highly Erodible Soil by Acres

(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
1551	14844	4489	273

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Headwaters Subwatershed is made up of 55 percent from Group D Hydrologic Soil. Soils in this group have high runoff potential when thoroughly wet due to very slow infiltration rates. Water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures, with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious parent material.

Table 91. 041100040102 - Subwatershed Hydrologic Soil Groups by Acres
(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

A	B	C	D	A/D	B/D	C/D
844	755	2822	11557	75	1557	3327

Water Quality
According to the Biological and Water Quality Study of the Upper Grand River 2007, the Ohio EPA reported the Grand River Headwaters transitions rapidly from a small, upland, coldwater stream to a large, lowland swamp stream. As such, three aquatic life uses are appropriate (Table 86). Upstream from the north crossing of US 422 (RM 98.95), the stream supports 11 coldwater macroinvertebrates, clearly demonstrating the CWH use. However, the fish community was intractably limited because the reach is bracketed by two impoundments, isolating the fish community and leaving the reach flow starved by the impoundment at SR 168. Downstream from the Village of Parkman, the stream transitions to an upland stream that supports an exceptional community. The habitat at Hobart Road (RM 94.3) appeared to have been destabilized by bridge construction, and the fish community narrowly missed the EWH criterion. In the absence of new or continuing stress, the habitat and community should recover in this reach.

As the stream approaches West Farmington, it transitions to a lowland, warmwater stream. The reach near West Farmington supports two rare fish species, the sand darter and northern brook lamprey. Near the hydrologic unit boundary, at Donley Road, the river begins to support a fauna typical of larger streams and rivers including redhorse suckers and walleye. In supporting a native population of walleye, sand darters and northern brook lamprey, the river is exceptional indeed, if not in the ability to achieve biological index scores meeting the EWH criteria.

Table 92. 041100040102 – Subwatershed Aquatic Life Use (ALU) Designation
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-001 Grand River Headwaters			
98.95	WWH/CWH	Partial	Habitat - Dams
95.38	EWH	Full	
94.27	EWH	Partial	Habitat – Bridge Construction
88.50	WWH	Full	

The Biological and Water Quality Study of the Upper Grand River 2007 lists habitat limitations due to impoundment and bridge construction as the causes of impairment and the major contribution to these segments of stream not meeting their aquatic life use designation. The quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

The Grand River Headwaters Subwatershed was limited by low stream flow at the impaired site at RM 99.0 (US 422) due to an impoundment located upstream. The fish community in the Grand River at RM 94.3 (Hobart Road) was impaired due to loss of habitat. The habitat at that location in 1995 had greater pool depth, a narrower channel and more variation in current velocities than 2007. In 2007, the habitat was denuded to bedrock, the channel was wider, and flow speeds were slow and moderate. No proximate cause was readily apparent, but bridge replacement at Hobart Road may have destabilized the channel morphology.

The streams in the western half of the Headwaters Subwatershed have high gradients, and possess the energy to form well-developed channels through the coarse substrates and sediments composed of coarse-grained glacial till and sandstone bedrock. Where these streams enter the lowlands, stream gradient drops and substrates become fine-grained, though sandier than streams on the southeastern side of the catchment. Typically, the faunas in these headwaters are not limited by habitat quality. The

combination of a high gradient, coarse-grained reach running into a low gradient, fine-grained reach makes these streams suitable for northern brook and American brook lamprey. Adult lamprey utilize the coarse substrate in the high gradient reach as spawning habitat, and the ammocoetes reside buried in depositional sediments, especially in the low gradient reaches. The Upper Grand River drainage is the only drainage in Ohio where these two species co-occur in the same stream.

Table 93. 041100040102 - Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIWb[a]	Narrative
03-001 Grand River - unverified WWH/CWH recommended										
200631	98.95	7	7.0	690.0	0.00	6.8	75.0	28		fair
03-001 Grand River - EWH										
G01S07	95.38	21	21.0	1065.0	0.00	14.1	80.5	56		excellent
03-001 Grand River - EWH										
G01K09	94.27	12	12.0	275.4	0.0	15.2	58.0	40		good
G01K20	88.50	26	22.5	373.4	3.6	32.1	71.0	50	8.0	excellent/good

a - MIwb is not applicable to headwater streams with drainage areas < 20 mi2.

Recreational Use Designation
The Grand River Headwaters was in non-attainment for recreational use throughout it's entire reach (river mile 98.95 – 88.50). The ubiquity of high bacteria counts clearly suggests that the bacteria indicators are not serving exclusively as surrogates for pathogens of human origin. E. coli counts followed a log-normal distribution suggesting an origin from diffuse sources such as livestock and wildlife. Additional indicators failed to point to an identifiable source, so the Headwaters source is listed as unknown (Table 88).

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 94. 041100040102 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Headwaters Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	STORET	GEOMEAN	N	Class	Attainment	Sources
Grand River Headwaters						
98.95	200631	1170	2	B	Non	Unknown
95.38	G01S07	600	2	B	Non	Unknown
94.27	G01K09	442	6	A	Non	Unknown
88.50	G01K20	971	6	A	Non	Unknown

Macroinvertebrate communities evaluated in the Upper Grand River tributaries can be grouped, to a large part, based on the physical habitat, shaped by the typography of the landscape, they flow through. The three most upstream stations sampled on the Grand River (RMs 98.95, 95.38, 94.27) were located in an upland area with relatively high gradient and substrates composed of bedrock and glacial till.

Macroinvertebrate communities collected from these stations were performing at an exceptional level with high diversity of EPT and sensitive taxa (Table 8). The most upstream station (RM 98.95) had 11 taxa of cold water macroinvertebrates, which was the highest number in the study. The other headwaters station was in the lowland area with low gradient and substrates composed primarily of smaller sized particles and woody debris (glacial Grand River Lake lacustrine deposits). Macroinvertebrate communities at this station were performing at good to exceptional levels, with generally lower diversity of EPT and sensitive taxa (Table 95).

Table 95. 041100040102 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Headwaters Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	Drain Area (mi2)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Grand River Headwaters (03-001)										
98.95	7	-	67	24	36	M	11	Hydropsychid caddisflies (MI), baetid mayflies (MI), Leuctra stoneflies (I)	-	Exceptional
95.38	14.2	-	60	21	30	M	2	Baetid mayflies (F,I), hydropsychid caddisflies (MI,F), midges (MI)	-	Exceptional
94.27	17.2	-	57	20	24	M	1	Hydropsychid caddisflies (F,MI), midges (MI), baetid mayflies (F,I)	-	Exceptional
88.53	2.1	-	52	13/15	23/34	L-M/372	0	Hydropsychid caddisflies (F), midges (F,MI), baetid mayflies (F)	54	

Qualitative sample relative density: L=Low, M=Moderate, H=High.

- **12-digit HUC 041100040102 Headwaters Subwatershed Problem Statements, Goals, objectives and Action**

Summary of Impairments: The major causes of impairment for Headwaters, a 12-digit subwatershed of Headwaters – Grand River 10-digit subwatershed, include pathogen loading (fecal coliform and E. coli) in excess of 2609 colony forming units (cfu) per year. Those causes are primarily associated with livestock.

Problem Statement 1: The presence of about 1009 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for the Grand River near RM 98.95. The most likely source is livestock manure runoff in this section of the Headwaters - Grand River Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 859 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 2 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 859 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Objective 2: Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms (approximately 500 feet of streambank per farm), resulting in an excess pathogen loading reduction of 150 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 2: The presence of about 439 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for the Grand River near RM 95.38. The most likely source is livestock manure runoff in this section of the Headwaters - Grand River Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 439 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 1 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 439 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Problem Statement 3: The presence of about 316 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for the Grand River near RM 94.27. The most likely source is livestock manure runoff in this section of the Headwaters - Grand River Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 316 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 1 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 316 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Problem Statement 4: The presence of about 845 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for the Grand River near RM 88.50. The most likely source is livestock manure runoff in this section of the Headwaters - Grand River Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 845 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 2 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 845 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Objective 2: Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms (approximately 500 feet of streambank per farm), resulting in an excess pathogen loading reduction of 150 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.

Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 5: Local stakeholder concern has identified 1663 acres of land with high natural area conservation value (Map 65) under threat of conversion. It was assumed that for a single family housing development on the 1663 acres, 50% of the land would be preserved as open space. Of the remaining 832 acres developed as single-family residential, it was assumed that the development would use filter buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by impervious surfaces and residential land use (excess loading of nitrogen (N) - 2692 lbs/year, phosphorus (P) - 390 lbs/year, Biological Oxygen Demand (BOD) - 11368 lbs/year and Sediment – 23 tons/year) would push adjacent sections of Dead Branch to impairment (see table 96).

Goal: Protect 1663 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 1663 acres of land with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 96. Headwaters Subwatershed Land Protection Load Estimates for land protection.

Current land use loading as 1663 acres of forest			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
661.8	318.7	1601.3	33.2
New land use loading following development of 831 acres as single-family housing with LID			
N Load lb/year	**P Load lb/year**	**BOD lb/year**	**Sediment Load t/year**
3353.9	709	12578.9	55.8
Net increase due to land use change			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
2692.1	**390**	**11367.9**	**22.6**

Problem Statement 6: Local stakeholder concern has identified 320 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 320 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 320 acres of wetlands with high natural area conservation value.
Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.

Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified wetland protection properties.

Problem Statement 7: Local stakeholder concern has identified 16.44 miles or 86792 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant pollutants generated by channel erosion (excess loading of sediment – 1476 tons/year, N - 2952 lbs/year and P - 1476 lbs/year) would push adjacent sections of Dead Branch to impairment (see table 97).

Goal: Protect 16.44 miles or 86792 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 16.44 miles or 86792 linear feet of stream corridor with high natural area conservation value.

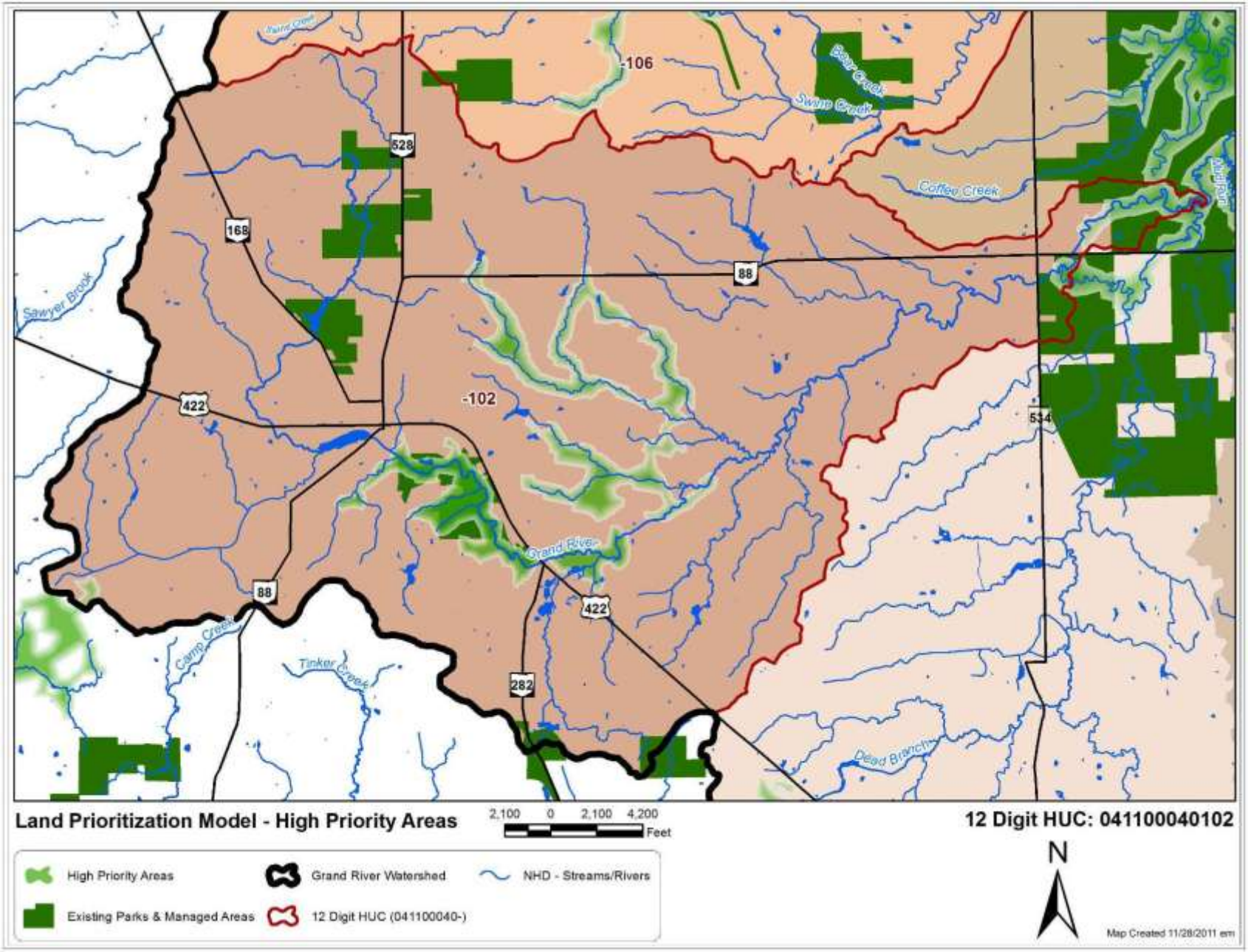
Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 97. Headwaters Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	737.7	737.7
Phosphorus Load Reduction (lb/year)			737.7	737.7
Nitrogen Load Reduction (lb/yr)			1475.5	1475.5

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 65 – 041100040102 Headwaters Subwatershed Land Protection Prioritization Model - High Priority Areas



This Page Intentionally left blank

C. Baughman Creek Subwatershed

12 Digit HUC: 041100040103
Location: Baughman Creek to the Grand River
Drainage Area: 18.42 miles^2, 11790 acres
Miles of stream: 51.93 miles
Average Sinuosity: 1.22
Average Impervious Cover: 0.62%

Photo 13. Grand River near confluence with Baughman Creek *(Source: G. Warnock)*

Subwatershed Description
The Baughman Creek 12-digit HUC subwatershed represents 12 percent of the six (6) subwatersheds in the Headwaters – Grand River 10-digit HUC subwatershed to the Grand River Watershed. This watershed drains mostly cultivated crops, forested and pasture/hay land in Bazetta, Bloomfield, Bristol, Champion and Mecca Townships in Trumbull County.

As of 2006, about 1.4 percent or 161 acres of land development (low, medium & high intensity) has occurred in the Baughman Creek Subwatershed, with 49 percent or 5791 acres of the land use as forested and 49 percent or 5765 as agricultural land use (Table 93, Map 46). Deciduous forest makes up of 48 percent of the forested land use, cultivated crops and pasture/hay makes up 96 percent of agricultural land use and corn & soybeans dominates the row crop production at 91 percent *(2009 USDA Cropland Cover)*.

Table 98. 041100040103 – Subwatershed Land Use

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Developed, High Intensity	1	0.01
Developed, Medium Intensity	8	0.07
Developed, Low Intensity	152	1.29
Developed, Open Space	5	0.04
Cultivated Crops	3443	29.22
Pasture/Hay	2097	17.80
Grassland/Herbaceous	225	1.91
Deciduous Forest	2805	23.81
Evergreen Forest	15	0.13
Mixed Forest	39	0.33
Scrub/Shrub	1199	10.18
Palustrine Forested Wetland	1543	13.10
Palustrine Scrub/Shrub Wetland	188	1.60
Palustrine Emergent Wetland	20	0.17
Bare Land	3	0.03
Open Water	39	0.33
Total	**11783**	

Floodplain

Forest and pasture make up 79 percent of the land use in the Baughman Creek Subwatershed floodplain. Forest covers 54 percent or 867 acres and pasture/hay covers 25 percent or 394 acres of the nearly 1600 acres of flood plain. The next closest land use in the flood plain is woody wetlands at 130 acres or 8 percent. High, medium and low density development only composes 4 acres or just 0.24 percent of the floodplain (Table 94).

Table 99. 041100040103 – Subwatershed Land Use Within Floodplain

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Agriculture	40	2.53
Grass/Pasture/Non-Ag	9	0.54
Barren	0	0.00
Deciduous Forest	867	54.30
Developed/High Intensity	0	0.00
Developed/Low Intensity	4	0.24
Developed/Medium Intensity	0	0.00
Developed/Open Space	86	5.36
Evergreen Forest	0	0.03
Grassland Herbaceous	17	1.05
Herbaceous Wetlands	0	0.00
Open Water	41	2.55
Pasture/Hay	394	24.67
Shrubland	9	0.59
Woody Wetlands	130	8.15
Total	**1598**	

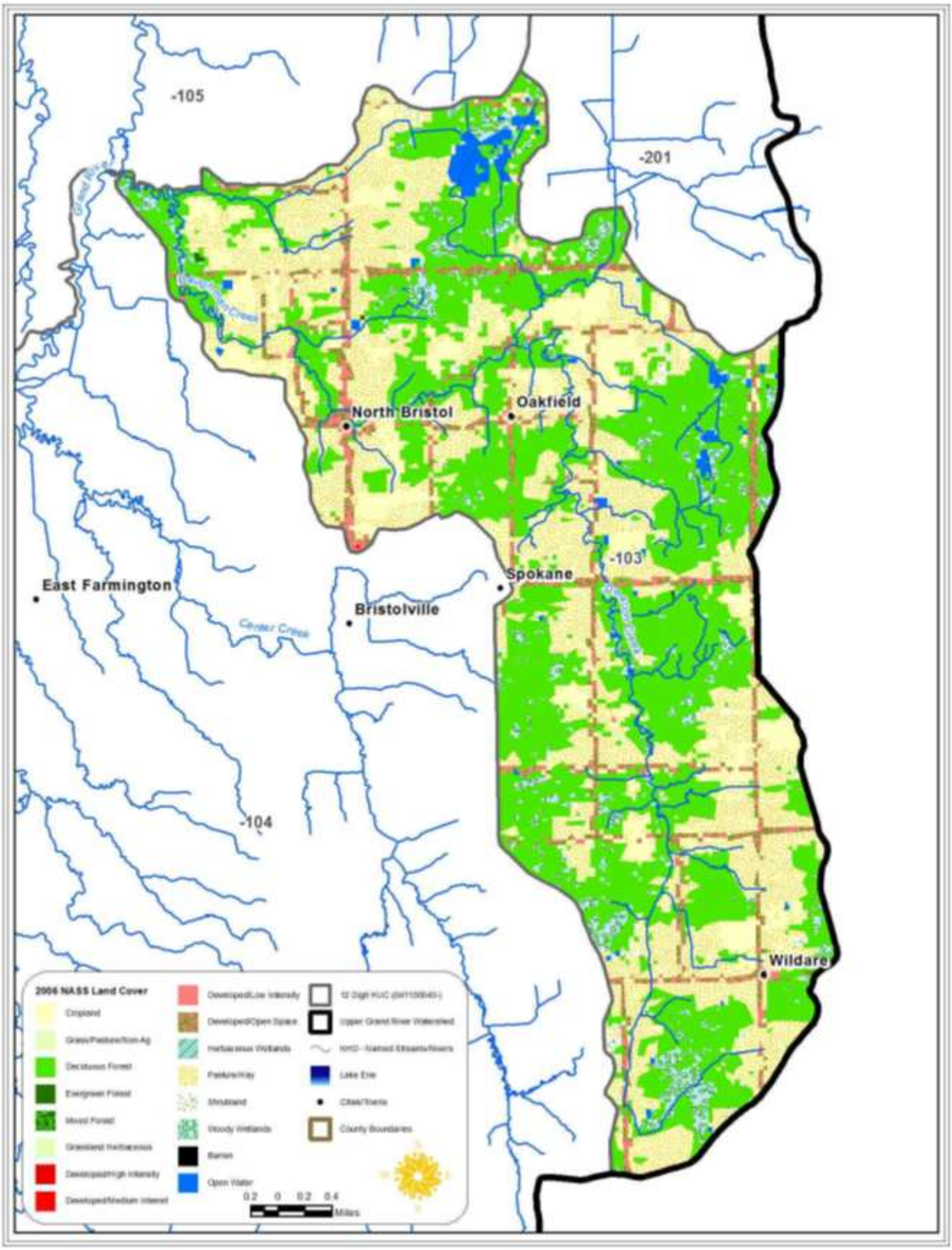
Table 100. 041100040103 – Subwatershed Wetland Types by Acres

(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Riverine	Pond	Grand Total
177	2024	0	47	2248

Map 66. 041100040103 – Subwatershed Land Use

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)


-105
-201
North Bristol
Oakfield
-103
Spokane
East Farmington
Bristolville
Center Creek
-104
Wildare
2006 NASS Land Cover
Cropland
Grass/Pasture/Non-Ag
Deciduous Forest
Evergreen Forest
Mixed Forest
Grassland Herbaceous
Developed/High Intensity
Developed/Medium Intensity
Developed/Low Intensity
Developed/Open Space
Herbaceous Wetlands
Pasture/Hay
Shrubland
Woody Wetlands
Barren
Open Water
12 Digit HUC
Upper Grand River Watershed
NHD - Named Streams/Rivers
Lake Erie
Cities/Towns
County Boundaries
0.2 0 0.2 0.4
Miles

This Page Intentionally left blank

Soils

The major soils of the Baughman Creek Subwatershed are the Fitchville-Haskins-Sebring Association, Caneadea-Canadice Association, and Holly-Orrville-Tioga Association. These are characterized by deep, nearly level to gently sloping areas that vary from very poorly drained to well drained in a few locations. In general these soils suffer from flooding and seasonal wetness and ponding, and have moderately slow to very slow permeability. Typically they have high seasonable water tables. All three associations consist of soils formed from fine texture lacustrine material, glacial outwash, or glacial till. The Holly-Orrville-Tioga Association is solely associated with flat flood plains and it is common to find it on valley floors associated with the basins of former glacial lakes. About 26 percent of the soils are considered potentially highly erodible. Tables 96 & 97 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Trumbull County.

Table 101. 041100040103 – Subwatershed Highly Erodible Soil by Acres

(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC).)

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
116	3094	8498	17

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Baughman Creek subwatershed is made up of 82% from Group C/D Hydrologic Soil. Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Some soils having clay, silty clay, or sandy clay textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments (see Table 102).

Table 102. 041100040103 - Subwatershed Hydrologic Soil Groups by Acres
(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

A	B	C	D	A/D	B/D	C/D
257	174	104	820	0	804	9606

Water Quality
The physical habitat quality of streams in the Upper Grand River basin is largely influenced by topography, drainage area, and the juxtaposition of glacial till and lacustrine deposits. Essentially this creates three distinct stream types: lowland streams, upland headwaters, and the non-wadeable Grand River mainstem.

Where the topography is flat, and the substrates are composed primarily of lacustrine silts and clays, habitat quality is generally poor and not conducive to stream faunas typical of the ecoregion. Headwater streams matching this description are found in the lowlands of the southeastern quarter of the catchment in hydrologic units 010 and 030. Deacon and Baughman Creeks have been historically modified to enhance drainage. Baughman showed evidence of recent channelization downstream from Fenton Road. Given that it demonstrates sand substrates and flow augmented by groundwater, it appears to quickly reform meanders; hence the apparent perceived need for continued maintenance.

According to the Biological and Water Quality Study of the Upper Grand River 2007, the Ohio EPA reported Baughman Creek is designated WWH. The fish and macroinvertebrate communities sampled at Fenton Road met respective criterion for WWH. Upstream from Fenton Road, a lens of sandy loam soil provides sustained baseflow, thus enabling a high quality biological community to exist in the stream despite habitat rendered marginal via historic and recent channelization.

Deacon Creek is presently undesignated in Chapter 3745-1-10 of the Ohio Administrative Code. The site located at Shaffer Road (RM 5.31) is a former wetland. At the Hyde Oakfield Road sampling site (RM 1.38), the creek is intermittent and not flowing at the time the fish sample was collected. Also, the potential for the stream to support biological communities typical of the ecoregion was naturally limited by hardpan and silt substrates of lacustrine origin. That said, both the fish and macroinvertebrate indicators scored in the poor range, coincident with high concentrations of the ammonia nitrogen and total Kjeldahl nitrogen, suggesting organic enrichment may have been an additional stress. Development of scoring expectations for swamp/wetland streams would help to objectively place this stream along the bio-condition gradient. The issue of whether organic enrichment is an addition source of stress to Deacon Creek should be investigated. The organic enrichment was most apparent in Deacon Creek as noted by consistently high concentrations of total Kjeldahl nitrogen (TKN) co-occurring with elevated concentrations of ammonia-nitrogen.

In the absence of chemical pollutants, streams with baseflow sustained by groundwater tend to do well and are resilient to occasional habitat perturbations. However, channelization should be discouraged, and sustainable channel designs in conjunction with riparian protection measures should be encouraged, given the presence of northern brook lamprey and several declining species. Baughman Creek is listed as a Superior High Quality Water for antidegradation.

Stratified by hydrologic units, HUC 0411000401, containing Dead Branch, Deacon Creek and Center Creek, had the highest TKN and NH_3-N concentrations. Water quality in Center Creek was affected by home sewage treatment systems. Deacon Creek was clearly influenced by wetlands.

Table 103. 041100040103 – Subwatershed Aquatic Life Use (ALU) Designation
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-022 Baughman Creek			
3.30	WWH	Full	
03-046 Deacon Creek			
5.31	WWH	-	Natural - Wetlands
1.38	WWH	Non	Low flow, Organic Enrichment

The quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

Baughman Creek was limited by low stream flow at the impaired site at RM 99.0 (US 422) due to an impoundment located upstream. The fish community in the Grand River at RM 94.3 (Hobart Road) was impaired due to loss of habitat. The habitat at that location in 1995 had greater pool depth, a narrower channel and more variation in current velocities than 2007. In 2007, the habitat was denuded to bedrock, the channel was wider, and flow speeds were slow and moderate. No proximate cause was readily apparent, but bridge replacement at Hobart Road may have destabilized the channel morphology.

Table 104. 041100040103 - Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIWb[a]	Narrative
03-022 Baughman Creek - EWH										
G02S06	3.3	18	18	1046	11.4	15.5	67.5	46[ns]		Very Good
03-046 Deacon Creek - unverified WWH - wetland stream										
300176	5.31					0	0	0	DNS†	
300175	1.38	9	9	176	0	9.3	53	26*		Poor

a - MIwb is not applicable to headwater streams with drainage areas < 20 mi2.
ns - Nonsignificant departure from biocriteria (<4 IBI units or <0.5 MIwb units).
* - Indicates significant departure from applicable biocriteria (>4 IBI units or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.
† - did not sample.

Recreational Use Designation
The specific waterbodies where high E. coli counts were associated with indicators of organic enrichment were Deacon Creek and Baughman Creek. The ubiquity of high bacteria counts clearly suggests that the bacteria indicators are not serving exclusively as surrogates for pathogens of human origin. E. coli counts followed a log-normal distribution suggesting an origin from diffuse sources such as livestock and wildlife. Livestock was the suspected source for Deacon and Baughman Creeks due to pastures in close proximity upstream from the sampling location (Table 105).

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 105. 041100040103 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Baughman Creek Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	STORET	GEOMEAN	N	Class	Attainment	Sources
Baughman Creek						
3.3	G02S06	1470	2	B	Non	Livestock
Deacon Creek						
5.31	300176	102	2	B	Full	
1.38	300175	6099	2	B	Non	Livestock

Macroinvertebrate communities evaluated in the Upper Grand River tributaries can be grouped, to a large part, based on the physical habitat, shaped by the typography of the landscape, they flow through. The community performance at Baughman Creek river mile 3.3 was evaluated as very good.

Macroinvertebrate communities that were not meeting their designated or recommended Aquatic Life Use expectations, due to more or less natural low gradient landscapes that were formed by the glacial Grand River Lake or other former wetland areas, included Deacon Creek.

Table 106. 041100040103 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Baughman Creek Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	Drain Area (mi2)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Baughman Creek (03-022)										
3.3	15.5	-	65	19/21	25/34	M/1154	3	Hydropsychid caddisflies (F, MI), baetid mayflies (F,I), midges (MI)	58	
Deacon Creek (03-046)										
5.31	5.2	9	23	1	0	M	0	Water boatmen (F)	-	Poor
1.38	9.3	9	17	2	4	L-M	0	Water boatmen (F)	-	Poor

IV. WATERSHED IMPAIRMENTS, RESTORATION AND PROTECTION GOALS, AND IMPLEMENTATION/ACTION PLAN

- **12-digit HUC 041100040103 – Baughman Creek Subwatershed Problem Statements, Goals, objectives and Action**

Summary of Impairments: The major causes of impairment for Baughman Creek, a 12-digit subwatershed of Headwaters – Grand River 10-digit subwatershed, include pathogen loading (fecal coliform and E. coli) in excess of 7247 colony forming units (cfu) per year. Those causes are primarily associated with livestock.

Problem Statement 1: The presence of about 1309 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Baughman Creek near RM 3.3. The most likely source is livestock manure runoff in this section of the Headwaters - Grand River Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 1309 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 1 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 1,159 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Objective 2: Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms (approximately 500 feet of streambank per farm), resulting in an excess pathogen loading reduction of 150 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 2: The presence of about 5938 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Baughman Creek near RM 3.3. The most likely source is livestock manure runoff in this section of the Headwaters - Grand River Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 5938 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 2 new manure storage facilities in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 5,788 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Objective 2: Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms (approximately 500 feet of streambank per farm), resulting in an excess pathogen loading reduction of 150 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 3: Local stakeholder concern has identified 105 acres of land with high natural area conservation value under threat of conversion. It was assumed that for a single family housing development on the 105 acres, 50% of the land would be preserved as open space. Of the remaining 360.5 acres developed as single-family residential, it was assumed that the development would use filter buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by impervious surfaces and residential land use (excess loading of nitrogen (N) - 166 lbs/year, phosphorus (P) – 23.1 lbs/year, Biological Oxygen Demand (BOD) - 685 lbs/year and Sediment – 0.2 tons/year) would push adjacent sections of Baughman Creek to impairment (see table 107).

Goal: Protect 105 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 105 acres of land with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 107. Baughman Creek Subwatershed Land Protection Load Estimates for land protection.

Current land use loading as 105 acres of forest			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
49.8	23.2	117.1	4.6
New land use loading following development of 831 acres as single-family housing with LID			
N Load lb/year	**P Load lb/year**	**BOD lb/year**	**Sediment Load t/year**
215.8	46.3	802.2	4.8
Net increase due to land use change			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
166	**23.1**	**685.1**	**0.2**

Problem Statement 4: Local stakeholder concern has identified 88 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 88 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 88 acres of wetlands with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified wetland protection properties.

Problem Statement 5: Local stakeholder concern has identified 0.16 miles or 841 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant pollutants generated by channel erosion (excess loading of sediment – 14 tons/year, N - 28 lbs/year and P - 334 lbs/year) would push adjacent sections of Baughman Creek to impairment (see table 108).

Goal: Protect 0.16 miles or 841 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 0.16 miles or 841 linear feet of stream corridor with high natural area conservation value.

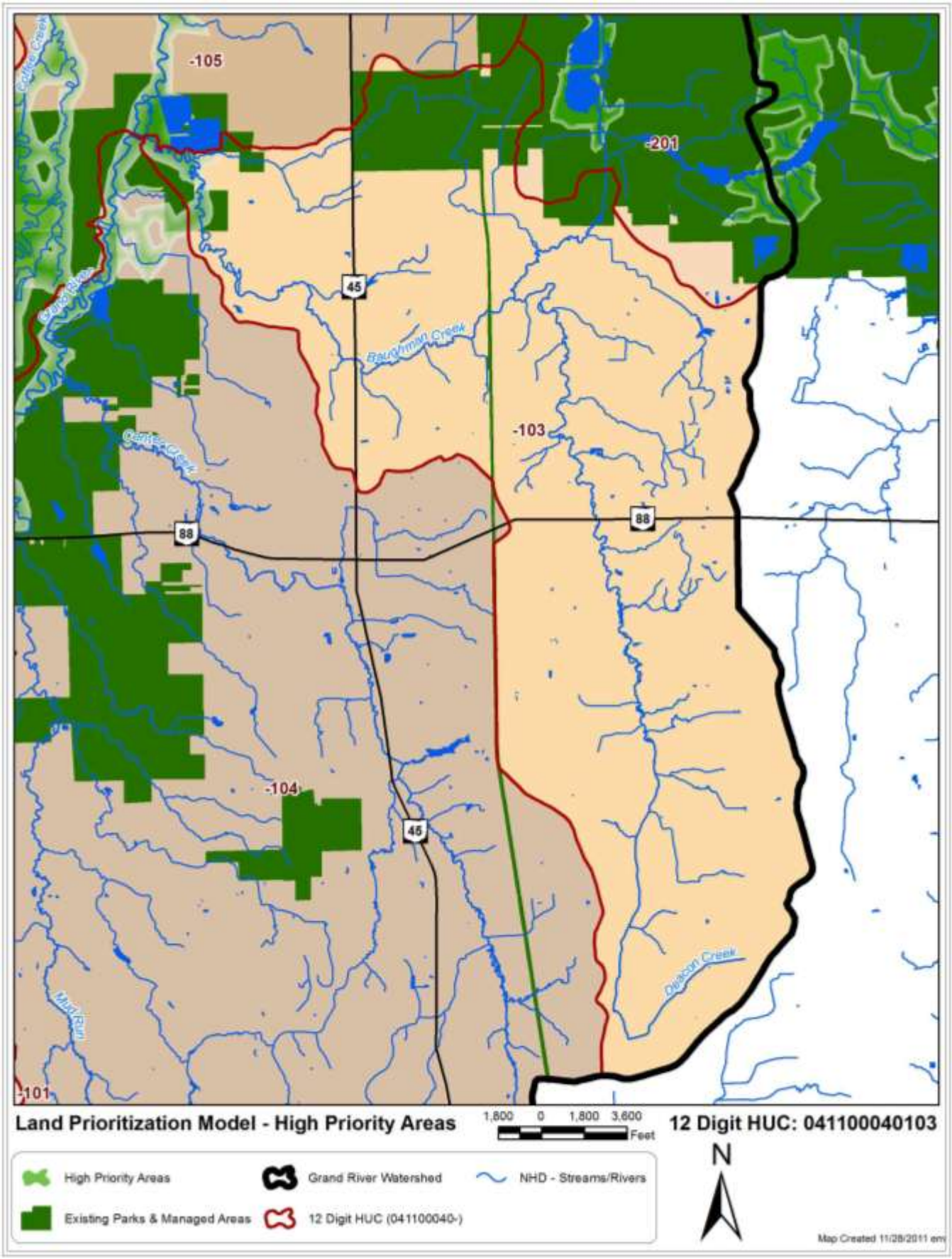
Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 108. Baughman Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	7.1	7.1
Phosphorus Load Reduction (lb/year)			7.1	7.1
Nitrogen Load Reduction (lb/yr)			14.3	14.3

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 67 – 041100040103 Baughman Creek Land Protection Prioritization Model - High Priority Areas



D. Center Creek Subwatershed

12 Digit HUC: 041100040104
Location: Grand River below Dead Branch to above Baughman Creek
Drainage Area: 31.40 miles^2, 20093 acres
Miles of stream: 94.07 miles
Average Sinuosity: 1.31
Average Impervious Cover: 0.91%

Photo 14. Center Creek @ Confluence with Grand River *(Source: G. Warnock)*

Subwatershed Description
The Center Creek 12-digit HUC Subwatershed represents 20 percent of the six (6) subwatersheds in the Headwaters - Grand River 10-digit HUC subwatershed to the Grand River Watershed. This watershed drains mostly cultivated crops, forested and pasture/hay land in Bloomfield, Bristol, Champion, Farmington, Mesopotamia and Southington Townships in Trumbull County.

As of 2006, about 2.8 percent or 552 acres of land development (low, medium & high intensity) has occurred in the Center Creek Subwatershed, with 63 percent or 12636 acres of the land use as forested and 32 percent or 6430 as agricultural land use (Table 109, Map 68). Deciduous forest makes up of 54 percent of the forested land use, Cultivated Crops and Pasture/Hay makes up 95 percent of agricultural land use and Corn & Soybeans dominates the row crop production at 76 percent *(2009 USDA Cropland Cover)*.

Table 109. 041100040104 – Subwatershed Land Use
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program)

Description	Acres	Percent of Watershed
Developed, High Intensity	6	0.03
Developed, Medium Intensity	33	0.17
Developed, Low Intensity	513	2.55
Developed, Open Space	130	0.65
Cultivated Crops	3338	16.62
Pasture/Hay	2776	13.82
Grassland/Herbaceous	315	1.57
Deciduous Forest	6799	33.85
Evergreen Forest	191	0.95
Mixed Forest	88	0.44
Scrub/Shrub	2403	11.97
Palustrine Forested Wetland	2817	14.02
Palustrine Scrub/Shrub Wetland	337	1.68
Palustrine Emergent Wetland	147	0.73
Bare Land	7	0.04
Open Water	184	0.92
Total	**20085**	

Floodplain
Forest makes up 60 percent or 2011 acres of the land use in the 3365 acres of flood plain in the Center Creek Subwatershed. The next closest land uses in the flood plain are pasture/hay at 13 percent or 442 acres and woody wetlands at 498 acres or 15 percent. High, medium and low density development only composes 23 acres or just 0.67 percent of the floodplain.

Table 110. 041100040104 – Subwatershed Land Use Within Floodplain
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

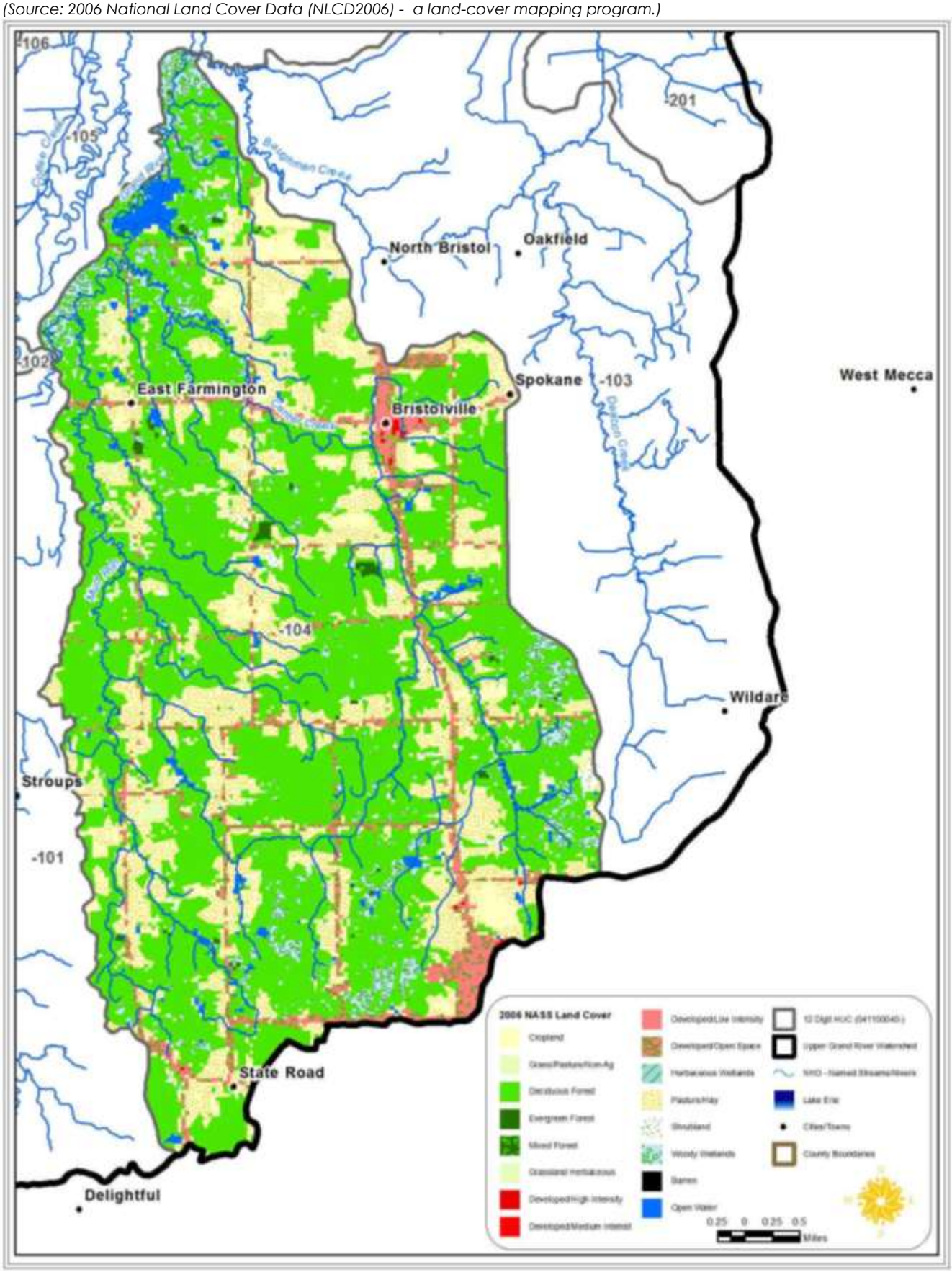
Description	Acres	Percent of Watershed
Agriculture	26	0.78
Grass/Pasture/Non-Ag	4	0.11
Barren	0	0.00
Deciduous Forest	2011	59.77
Developed/High Intensity	1	0.02
Developed/Low Intensity	21	0.62
Developed/Medium Intensity	1	0.03
Developed/Open Space	150	4.45
Evergreen Forest	13	0.38
Grassland Herbaceous	46	1.35
Herbaceous Wetlands	0	0.00
Open Water	118	3.50
Pasture/Hay	442	13.15
Shrubland	35	1.03
Woody Wetlands	498	14.80
Total	**3365**	

Table 111. 041100040104 – Subwatershed Wetland Types by Acres
(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Pond	Riverine	Grand Total
123	2724	185	71	3102

Map 68. 041100040104 – Subwatershed Land Use

(Source: 2006 National Land Cover Data (NLCD2006) - a land-cover mapping program.)



Soils

The major soils of the Center Creek Subwatershed are the Fitchville-Haskins-Sebring Association, Caneadea-Canadice Association, and Holly-Orrville-Tioga Association. These are characterized by deep, nearly level to gently sloping areas that vary from very poorly drained to well drained in a few locations. In general these soils suffer from flooding and seasonal wetness and ponding, and have moderately slow to very slow permeability. Typically they have high seasonable water tables. All three associations consist of soils formed from fine texture lacustrine material, glacial outwash, or glacial till. The Holly-Orrville-Tioga Association is solely associated with flat flood plains and it is common to find it on valley floors associated with the basins of former glacial lakes. About 47 percent of the soils are considered potentially highly erodible. Tables 108 & 109 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Trumbull County.

Table 112. 041100040104 – Subwatershed Highly Erodible Soil by Acres

(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
867	9383	9647	149

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Center Creek subwatershed is made up of 58% from Group B/D Hydrologic Soil. Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded. Group B soils typically have between 10 percent and 20 percent clay and 50 percent to 90 percent sand and have loamy sand or sandy loam textures. Some soils having loam, silt loam, silt, or sandy clay loam textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments (Table 113).

Table 113. 041100040104 - Subwatershed Hydrologic Soil Groups by Acres
(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

A	A/D	B	B/D	C	C/D	D
320	63	358	11575	2	1278	6331

Water Quality
The physical habitat quality of streams in the Upper Grand River basin is largely influenced by topography, drainage area, and the juxtaposition of glacial till and lacustrine deposits. Essentially this creates three distinct stream types: lowland streams, upland headwaters, and the non-wadeable Grand River mainstem.

Where the topography is flat, and the substrates are composed primarily of lacustrine silts and clays, habitat quality is generally poor and not conducive to stream faunas typical of the ecoregion. Headwater streams matching this description are found in the lowlands of the southeastern quarter of the catchment in hydrologic units 041100040101, 04110004010103 and 041100040104. Mud Run and Center Creeks have been historically modified to enhance drainage.

Localized impacts to water quality from anthropogenic sources, principally from organic enrichment, were noted in tributaries to the Grand River. The sources of enrichment were primarily on-site sewerage, livestock, and, in some cases, an unknown source.

According to the Biological and Water Quality Study of the Upper Grand River 2007, the Ohio EPA reported Center Creek has an unverified WWH designation. Although habitat quality has been degraded by historic channelization, substrates and soils in the surrounding sub-catchment are gravelly, and consequently, the creek should be able to support a WWH assemblage (Table 110). Apart from poor habitat, the fish and macroinvertebrate communities sampled at Corey Hunt Road (RM 3.03) and SR 45 (RM 6.25) were limited due to organic enrichment, possibly from Paradise Lake mobile home park and unsewered homes along Housel Craft Road, Corey Hunt Road, and SR 45.

Mud Run has an unverified WWH designation. Although the reach sampled had not been extensively modified for drainage, natural limitations imposed by clay substrates, low gradient, and lack of sustained flow during the summer effectively imparted modified characteristics to the stream, which appears to preclude biological communities that are consistent with expectations for a typical warmwater stream.

Stratified by hydrologic units, HUC 0411000401, containing Dead Branch, Deacon Creek and Center Creek, had the highest TKN and NH_3-N concentrations. Water quality in Center Creek was affected by home sewage treatment systems. Concentrations of both TKN and ammonia-nitrogen (NH_3-N) were elevated in Center Creek. On-site sewerage was clearly the source to Center Creek. Mud Run was clearly influenced by wetlands.

Table 114. 041100040104 – Subwatershed Aquatic Life Use (ALU) Designation
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-023 Center Creek			
6.25	WWH	Non	NH3, TKN, TDS - Unsewered
3.03	WWH	Partial	Wetlands, Residual impact from upstream
03-024 Mud Run			
4.05	WWH	Non	Natural - Wetlands

The quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin. Samples from streams with poor substrate quality, as noted by substrate scores less than 10 on the QHEI, did

not achieve the WWH biocriterion for headwaters. These streams (Dead Branch, Deacon Creek and Mud Run) are located in the southeastern quarter of hydrologic unit 0411000401, and were obviously ditched to drain wetlands. In general, these streams lack the potential to support fish faunas consistent with expectations derived for regionally typical streams.

Center Creek was historically channelized to promote drainage, and has substrates scores less than 10; however, the site at Corey Hunt Road (RM 3.0) possessed a sufficient number of warmwater attributes to suggest that the fish community was limited beyond what can be explained by habitat quality.

Table 115. 041100040104 - Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIWb[a]	Narrative
03-023 Center Creek - unverified WWH - recommended										
300174	6.25	10	10	282	0	6.4	43.5	30*		Fair
G01K13	3.03	15	15	404	0	11.6	56	28*		Fair
03-024 Mud Run - unverified WWH - wetland stream										
300172	4.05	11	11.0	768.0	0.00	8.5	53.0	22*		Poor

a - MIwb is not applicable to headwater streams with drainage areas < 20 mi2.
* - Indicates significant departure from applicable biocriteria (>4 IBI units or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

The Biological and Water Quality Study of the Upper Grand River 2007 lists natural limits as the cause of impairment and a major contribution to the segment of stream not meeting it's aquatic life use designation. The quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.
In Center Creek high *E. coli* counts were associated with indicators of organic enrichment. The ubiquity of high bacteria counts clearly suggests that the bacteria indicators are not serving exclusively as surrogates for pathogens of human origin. Where anecdotal evidence pointed to contamination from human origins, the sources appeared to be unsewered homes affecting Center Creek (Table 116).

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 116. 041100040104 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Center Creek Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	STORET	GEOMEAN	N	Class	Attainment	Sources
Center Creek						
6.25	300174	1396	2	B	Non	On-site Sewerage
Mud Run						
4.05	300172	600	2	B	Non	Unknown

Macroinvertebrate communities that were not meeting their designated or recommended Aquatic Life Use expectations, due to more or less natural low gradient landscapes that were formed by the glacial Grand River Lake or other former wetland areas, included Mud Run.

Macroinvertebrate communities evaluated in the Upper Grand River tributaries can be grouped, to a large part, based on the physical habitat, shaped by the typography of the landscape, they flow through.

Stream stations that appeared to have anthropogenic impacts included Center Creek at SR 45 (RM 6.25) which had a macroinvertebrate community evaluated as high fair with EPT (9) and sensitive taxa (14) diversities just below WWH expectations (Table 113). The riffle habitat was devoid of sensitive EPT and had an unusually high abundance of flatworms (facultative taxa often associated with enrichment effects). Unusually high siltation and algal growths were observed at this station. A possible source of pollutants was the Paradise Lake mobile home park.

Table 117. 041100040104 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Center Creek Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	Drain Area (mi2)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Center Creek (03-023)										
6.25	6.4	-	54	9	14	L-M	0	Hydropsychid caddisflies (F), flatworms (F), midges (MI,F)	-	Fair
3.03		-	68	18	19	M	0	Hydropsychid caddisflies (F), midges (F), mayflies (F)	-	Good
Mud Run (03-024)										
4.05	8.5	-	29	6	5	L-M	0	Water boatmen (F), mayflies (MI,F)	-	Fair

- **12-digit HUC 041100040104 – Center Creek Problem Statements, Goals, objectives and Action**

Summary of Impairments: The major causes of impairment for Center Creek-Grand River, a 12-digit subwatershed of Headwaters – Grand River 10-digit subwatershed, include natural causes and pathogen loading (fecal coliform and E. coli) in excess of 1675 colony forming units (cfu) per year. Those causes are primarily associated with unknown sources, failing HSTS and natural sources.

Problem Statement 1: The presence of about 1235 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Center Creek near RM 6.25. The most likely source is approximately 50 to 100 of the failing Home Sewage Treatment Systems (HSTS) in the Center Creek-Grand River Subwatershed.

Goal: Reduce pathogenic bacteria from failing HSTS discharge by about 247 cfu on average per year for five consecutive years, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Inspect the estimated 320 Home Sewage Treatment Systems (HSTS) for failure along 4 miles of Center Creek and it's tributaries.
Action1: Conduct annual inspections on 20 percent of off-lot discharging systems that directly outlet to a tributary.
Action 2: Document failed systems & develop comprehensive HSTS database as inspections are completed.
Action 3: Gather and enter data on type of system, geo-coded location, year of installation, date of last inspection, date of last pumping, and sampling results.

Objective 2: Upgrade, repair or replace a minimum of 50 failing Home Sewage Treatment Systems (HSTS) along 4 miles of Center Creek and it's tributaries.
Action 1: Implement repair or replacement procedures to bring systems into compliance.
Action 2: Introduce new, proven technology such as Wisconsin mounds, drip irrigation, and shallow trench or at-grade systems and integrate into current regulations.
Action 2: Utilize private sector service industry permit inspection program to help assure proper operation and maintenance of discharging systems and/or soilbased treatment and disposal systems.

Objective 3: Use education and outreach along with other informational programs and services to assist the estimated 320 residents with Home Sewage Treatment Systems (HSTS) in the area of Center Creek on operation and maintenance of systems and assistance with corrective measures.

Action 1: Conduct annual homeowner septic system operation and maintenance workshop for residents with HSTS.
Action 2: Assist qualified homeowners in identifying financial assistance for repairs or replacements or conversion to central sewer.

Problem Statement 2: The presence of about 439 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Mud Run near RM 4.05. The most likely source is approximately 25 to 50 of the failing Home Sewage Treatment Systems (HSTS) in the Center Creek-Grand River Subwatershed.

Goal: Reduce pathogenic bacteria from failing HSTS discharge by about 88 cfu on average per year for five consecutive years, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Inspect the estimated 320 Home Sewage Treatment Systems (HSTS) for failure along 2 miles of Mud Run and it's tributaries.
Action1: Conduct annual inspections on 20 percent of off-lot discharging systems that directly outlet to a tributary.
Action 2: Document failed systems & develop comprehensive HSTS database as inspections are completed.
Action 3: Gather and enter data on type of system, geo-coded location, year of installation, date of last inspection, date of last pumping, and sampling results.
Objective 2: Upgrade, repair or replace a minimum of 50 failing Home Sewage Treatment Systems (HSTS) along 2 miles of Mud Run and it's tributaries.
Action 1: Implement repair or replacement procedures to bring systems into compliance.
Action 2: Introduce new, proven technology such as Wisconsin mounds, drip irrigation, and shallow trench or at-grade systems and integrate into current regulations.
Action 2: Utilize private sector service industry permit inspection program to help assure proper operation and maintenance of discharging systems and/or soilbased treatment and disposal systems.

Objective 3: Use education and outreach along with other informational programs and services to assist the estimated 320 residents with Home Sewage Treatment Systems (HSTS) in the area of Mud Run on operation and maintenance of systems and assistance with corrective measures.
Action 1: Conduct annual homeowner septic system operation and maintenance workshop for residents with HSTS.
Action 2: Assist qualified homeowners in identifying financial assistance for repairs or replacements or conversion to central sewer.

Problem Statement 3: Local stakeholder concern has identified 566 acres of land with high natural area conservation value under threat of conversion. It was assumed that for a single family housing development on the 566 acres, 50% of the land would be preserved as open space. Of the remaining 283 acres developed as single-family residential, it was assumed that the development would use filter buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by impervious surfaces and residential land use (excess loading of nitrogen (N) - 610 lbs/year, phosphorus (P) - 89 lbs/year, Biological Oxygen Demand (BOD) - 2479 lbs/year and Sediment – 6 tons/year) would push adjacent sections of Center Creek-Grand River Creek to impairment (see table 118).

Goal: Protect 566 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 566 acres of land with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.

Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 118. Center Creek Subwatershed Land Protection Load Estimates for land protection.

Current land use loading as 566 acres of forest			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
141.4	68.6	344.2	5.8
New land use loading following development of 283 acres as single-family housing with LID			
N Load lb/year	**P Load lb/year**	**BOD lb/year**	**Sediment Load t/year**
751.1	158	2823	11.7
Net increase due to land use change			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
609.7	**89.4**	**2478.8**	**5.9**

Problem Statement 2: Local stakeholder concern has identified 485 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 485 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 485 acres of wetlands with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified wetland protection properties.

Problem Statement 3: Local stakeholder concern has identified 0.89 miles or 4706 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant pollutants generated by channel erosion (excess loading of sediment – 80 tons/year, N - 160 lbs/year and P - 80 lbs/year) would push adjacent sections of Center Creek-Grand River Creek to impairment (see table 119).

Goal: Protect 0.89 miles or 4706 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 0.89 miles or 4706 linear feet of stream corridor with high natural area conservation value.

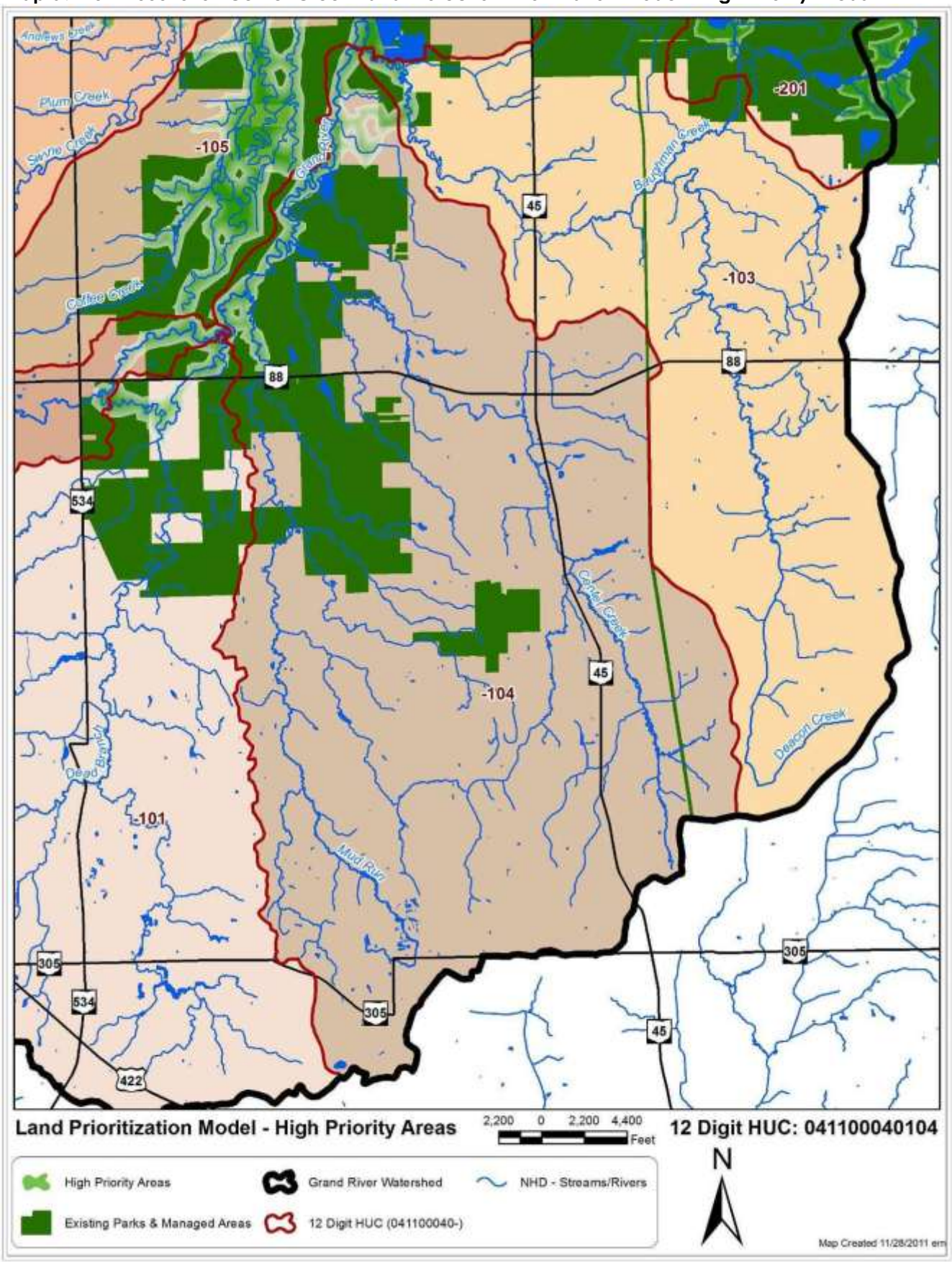
Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 119. Center Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	40	40
Phosphorus Load Reduction (lb/year)			40	40
Nitrogen Load Reduction (lb/yr)			80	80

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 69 – 041100040104 Center Creek Land Protection Prioritization Model - High Priority Areas



This Page Intentionally left blank

E. Coffee Creek Subwatershed

12 Digit HUC: 041100040105
Location: Grand River below Baughman Creek to above Swine Creek
Drainage Area: 19.00 miles^2, 12163 acres
Miles of stream: 60.6 miles
Average Sinuosity: 1.39
Average Impervious Cover: 0.67%

Photo 15. Grand River at confluence with Coffee Creek *(Source: G. Warnock)*

Subwatershed Description
The Coffee Creek 12-digit HUC Subwatershed represents 12 percent of the six (6) subwatersheds in the Headwaters - Grand River 10-digit HUC subwatershed to the Grand River Watershed. This watershed drains mostly cultivated crops, forested and pasture/hay land in Orwell Township in Ashtabula County and the Village of West Farmington and Bloomfield, Farmington and Mesopotamia Townships in Trumbull County.

As of 2006, about 1.7 percent or 208 acres of land development (low, medium & high intensity) has occurred in the Coffee Creek Subwatershed, with 64 percent or 7763 acres of the land use as forested and 32 percent or 3944 as agricultural land use (Table 120, Map 70). Palustrine forested wetland makes up of 61 percent of the forested land use, Cultivated Crops and Pasture/Hay makes up 69 percent of agricultural land use and Corn & Soybeans dominates the row crop production at 76 percent *(2009 USDA Cropland Cover)*.

Table 120. 041100040105 – Subwatershed Land Use
Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.

Description	Acres	Percent of Watershed
Developed, High Intensity	1	0.01
Developed, Medium Intensity	23	0.19
Developed, Low Intensity	182	1.50
Developed, Open Space	52	0.43
Cultivated Crops	2531	20.81
Pasture/Hay	1336	10.98
Grassland/Herbaceous	78	0.64
Deciduous Forest	1027	8.44
Evergreen Forest	31	0.26
Mixed Forest	47	0.38
Scrub/Shrub	1306	10.74
Palustrine Forested Wetland	4763	39.16
Palustrine Scrub/Shrub Wetland	589	4.84
Palustrine Emergent Wetland	117	0.96
Open Water	80	0.66
Total	**12163**	

Floodplain
Forest makes up 36 percent or 2008 acres of the land use in the 5569 acres of flood plain in the Coffee Creek Subwatershed. The next closest land uses in the flood plain are pasture/hay at 6 percent or 357 acres and open water at 261 acres or 5 percent. High, medium and low density development only composes 17 acres or just 0.31 percent of the floodplain (Table 118).

Table 121. 041100040105 – Subwatershed Land Use Within Floodplain
Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.

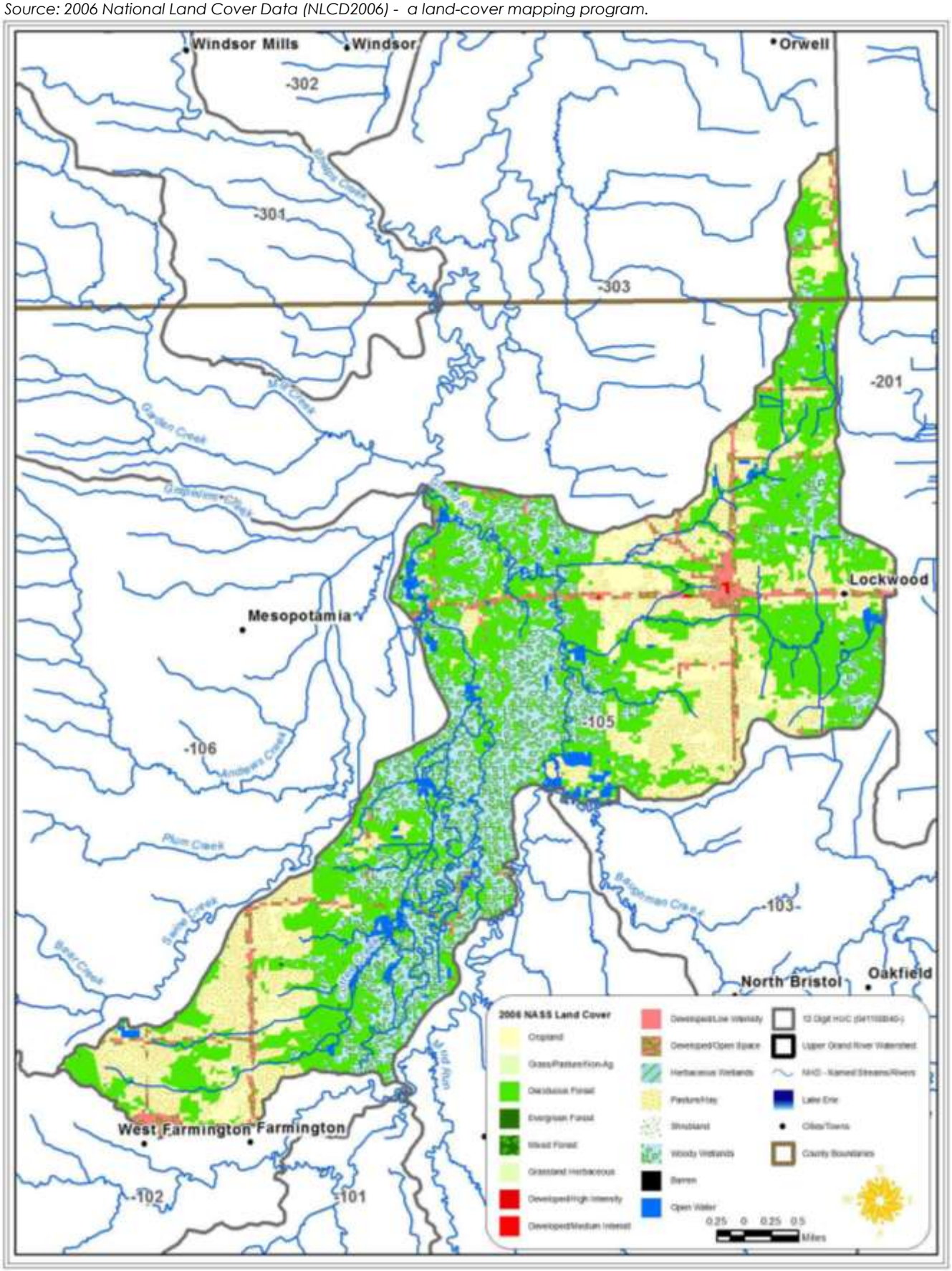
Description	Acres	Percent of Watershed
Agriculture	49	0.89%
Grass/Pasture/Non-Ag	9	0.16%
Barren	0	0.00%
Deciduous Forest	2008	36.06%
Developed/High Intensity	0	0.00%
Developed/Low Intensity	17	0.31%
Developed/Medium Intensity	0	0.00%
Developed/Open Space	142	2.56%
Evergreen Forest	6	0.10%
Grassland Herbaceous	31	0.56%
Herbaceous Wetlands	1	0.02%
Open Water	261	4.70%
Pasture/Hay	357	6.40%
Shrubland	6	0.10%
Woody Wetlands	2681	48.15%
Total	**5569**	

Table 122. 041100040105 – Subwatershed Wetland Types by Acres
Source: National Wetlands Inventory(NWI)

Emergent Wetland	Forested/Shrub Wetland	Pond	Riverine	Grand Total
198	4418	34	41	4691

Map 70. 041100040105 – Subwatershed Land Use

Source: 2006 National Land Cover Data (NLCD2006) - a land-cover mapping program.



Soils

The major soils of the Coffee Creek Subwatershed are the Fitchville-Haskins-Sebring Association, Caneadea-Canadice Association, and Holly-Orrville-Tioga Association. These are characterized by deep, nearly level to gently sloping areas that vary from very poorly drained to well drained in a few locations. In general these soils suffer from flooding and seasonal wetness and ponding, and have moderately slow to very slow permeability. Typically they have high seasonable water tables. All three associations consist of soils formed from fine texture lacustrine material, glacial outwash, or glacial till. The Holly-Orrville-Tioga Association is solely associated with flat flood plains and it is common to find it on valley floors associated with the basins of former glacial lakes. About 15 percent of the soils are considered potentially highly erodible. Tables 120 & 121 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Ashtabula & Trumbull County.

Table 123. 041100040105 – Subwatershed Highly Erodible Soil by Acres

Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC).

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
297	1885	9820	160

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Coffee Creek subwatershed is made up of 52 percent from Group D Hydrologic Soil. Soils in this group have high runoff potential when thoroughly wet due to very slow infiltration rates. Water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures, with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious parent material (Table 124).

Table 124. 041100040105 - Subwatershed Hydrologic Soil Groups by Acres
Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC).

A:	B:	C:	D:	A/D:	B/D:	C/D:
23	66	0	6260	61	1217	4370

Water Quality
The physical habitat quality of streams in the Upper Grand River basin is largely influenced by topography, drainage area, and the juxtaposition of glacial till and lacustrine deposits. Essentially this creates three distinct stream types: lowland streams, upland headwaters, and the non-wadeable Grand River mainstem.

Where the topography is flat, and the substrates are composed primarily of lacustrine silts and clays, habitat quality is generally poor and not conducive to stream faunas typical of the ecoregion.

Localized impacts to water quality from anthropogenic sources, principally from organic enrichment, were noted in tributaries to the Grand River. The sources of enrichment were primarily on-site sewerage, livestock, and, in some cases, an unknown source.

According to the Biological and Water Quality Study of the Upper Grand River 2007, the Ohio EPA reported the entire reach of the Grand River mainstem through the 0411000402 hydrologic unit (Headwaters and Phelps Creek subwatershed) has a verified WWH designation. Coffee Creek has an unverified WWH designation.

Table 125. 041100040105 – Subwatershed Aquatic Life Use (ALU) Designation
Source: Biological and Water Quality Study of the Upper Grand River 2007 - OEPA

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-001 Grand River mainstem - unverified WWH - recommended			
75.58	WWH	Full	-
03-021 Coffee Creek - unverified WWH - recommended			
0.23	WWH	-	-

The quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

Fish Communities were sampled at nine locations along the Grand River mainstem. As the stream approaches West Farmington, it transitions to a lowland, warmwater stream. The reach near West Farmington supports two rare fish species, the sand darter and northern brook lamprey. Near the hydrologic unit boundary, at County Line Donley Road, the river begins to support a fauna typical of larger streams and rivers including redhorse suckers and walleye. In supporting a native population of walleye, sand darters and northern brook lamprey, the river is exceptional indeed, if not in the ability to achieve biological index scores meeting the EWH criteria. Fish communities met standards for WWH from West Farmington (RM 88.5) downstream to Footville-Richmond Road (RM 48.6). Northern brook lamprey ammocoetes and sand darters were found in the Grand River near West Farmington.

Table 126. 041100040105 - Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIWb[a]	Narrative
03-001 Grand River Mainstem - WWH										
G01K18	75.58	31	25.5	277.5	17.0	126.2	58.0	46	8.4	Very Good/Good
03-021 Coffee Creek - unverified WWH - recommended										
G01K17	0.23	-	-	-	-	-	-	-	-	-

a - MIwb is not applicable to headwater streams with drainage areas < 20 mi2.
* - Indicates significant departure from applicable biocriteria (>4 IBI units or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

The Biological and Water Quality Study of the Upper Grand River 2007 lists natural limits as the cause of impairment and a major contribution to the segment of stream not meeting it's aquatic life use designation. The quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

The Grand River mainstem downstream from West Farmington flows through a glacial lake-bed and consequently has low gradient, and fine sediment. However, because the catchment is highly dendritic, drainage area downstream from West Farmington increases rapidly, providing sufficient energy to create meanders, and sort sediments such that substrates in the thalweg are generally sand and gravel. Furthermore, because farms in the catchment tend to be small and isolated from the immediate riparian area, and because most of the headwaters are reasonably intact, the channel is not overwhelmed with silt and clay. Lastly, the wooded riparian zone supplies a generous quantity of large woody debris to the river, which, in-turn, creates variation in current velocity that further helps sort sediments.

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 127. 041100040105 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Swine Creek Subwatershed in 2007.
Source: Biological and Water Quality Study of the Upper Grand River 2007 - OEPA

RM	STORET	GEOMEAN	N	Class	Attainment	Sources
Grand River Mainstem						
75.58	G01K18	161	2	A	Non	Unknown
Coffee Creek						
0.23	G01K17	-	-	-	-	-

Macroinvertebrate communities evaluated in the Upper Grand River tributaries can be grouped, to a large part, based on the physical habitat, shaped by the typography of the landscape, they flow through. The Coffee Creek subwatershed Grand River stations were located in a lowland area with low gradient and substrates composed primarily of smaller sized particles and woody debris (glacial Grand River Lake lacustrine deposits). Macroinvertebrate communities at these stations were performing at good to exceptional levels, with generally lower diversity of EPT (9-23) and sensitive taxa (14-31). Fourteen species of freshwater mussels were collected at these lowland stations with the most diverse populations found at Wood Curtis Road (RM 88.50).

Table 128. 041100040105 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Coffee Creek Subwatershed in 2007.

Source: Biological and Water Quality Study of the Upper Grand River 2007 - OEPA

RM	Drain Area (mi2)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Grand River Mainstem (03-001)										
75.58	126	-	43	9	16	L	0	Caddisflies (MI,F), midges (MI), baetid mayflies (F,MI)	-	Marginally Good
Coffee Creek (03-021)										
0.23	-	-	-	-	-	-	-	-	-	-

- **12-digit HUC 041100040105 – Coffee Creek Subwatershed Problem Statements, Goals, objectives and Action**

Summary of Impairments: The major causes of impairment for Coffee Creek-Grand River, a 12-digit subwatershed of Headwaters – Grand River 10-digit subwatershed, include pathogen loading (fecal coliform and E. coli) in excess of 68 colony forming units (cfu) per year. Those causes are primarily associated with livestock.

Problem Statement 1: : The presence of about 68 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Hoskins Creek near RM 2.01. The most likely source is livestock manure runoff from pastures in close proximity upstream from the sampling location on the Hoskins Creek Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 68 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective: Establish livestock1000 lineal feet of livestock exclusion fencing along streams on 1 farm (approximately 500 feet of streambank), resulting in an excess pathogen loading reduction of 68 cfu.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.
Problem Statement 2: Local stakeholder concern has identified 2194 acres of land with high natural area conservation value under threat of conversion. It was assumed that for a single family housing development on the 2194 acres, 50% of the land would be preserved as open space. Of the remaining 1097 acres developed as single-family residential, it was assumed that the development would use filter buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by impervious surfaces and residential land use (excess loading of nitrogen (N) - 2327 lbs/year, phosphorus (P) - 350 lbs/year, Biological Oxygen Demand (BOD) - 9626 lbs/year and Sediment – 26 tons/year) would push adjacent sections of Coffee Creek-Grand River Creek to impairment (see table 129).

Goal: Protect 2194 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 2194 acres of land with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding

sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 129. Coffee Creek Subwatershed Land Protection Load Estimates for land protection.

Current land use loading as 2194 acres of forest			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
530.9	259.2	1299.9	17.1
New land use loading following development of 1097 acres as single-family housing with LID			
N Load lb/year	**P Load lb/year**	**BOD lb/year**	**Sediment Load t/year**
2902.9	609.1	10925.6	42.8
Net increase due to land use change			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
2327	**349.9**	**9625.7**	**25.7**

Problem Statement 3: Local stakeholder concern has identified 1995 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 1995 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 1995 acres of wetlands with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified wetland protection properties.

Problem Statement 4: Local stakeholder concern has identified 13.02 miles or 68746 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant pollutants generated by channel erosion (excess loading of sediment – 1169 tons/year, N - 2337 lbs/year and P - 1169 lbs/year) would push adjacent sections of Coffee Creek-Grand River Creek to impairment (see table 130).

Goal: Protect 13.02 miles or 68746 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 13.02 miles or 68746 linear feet of stream corridor with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.

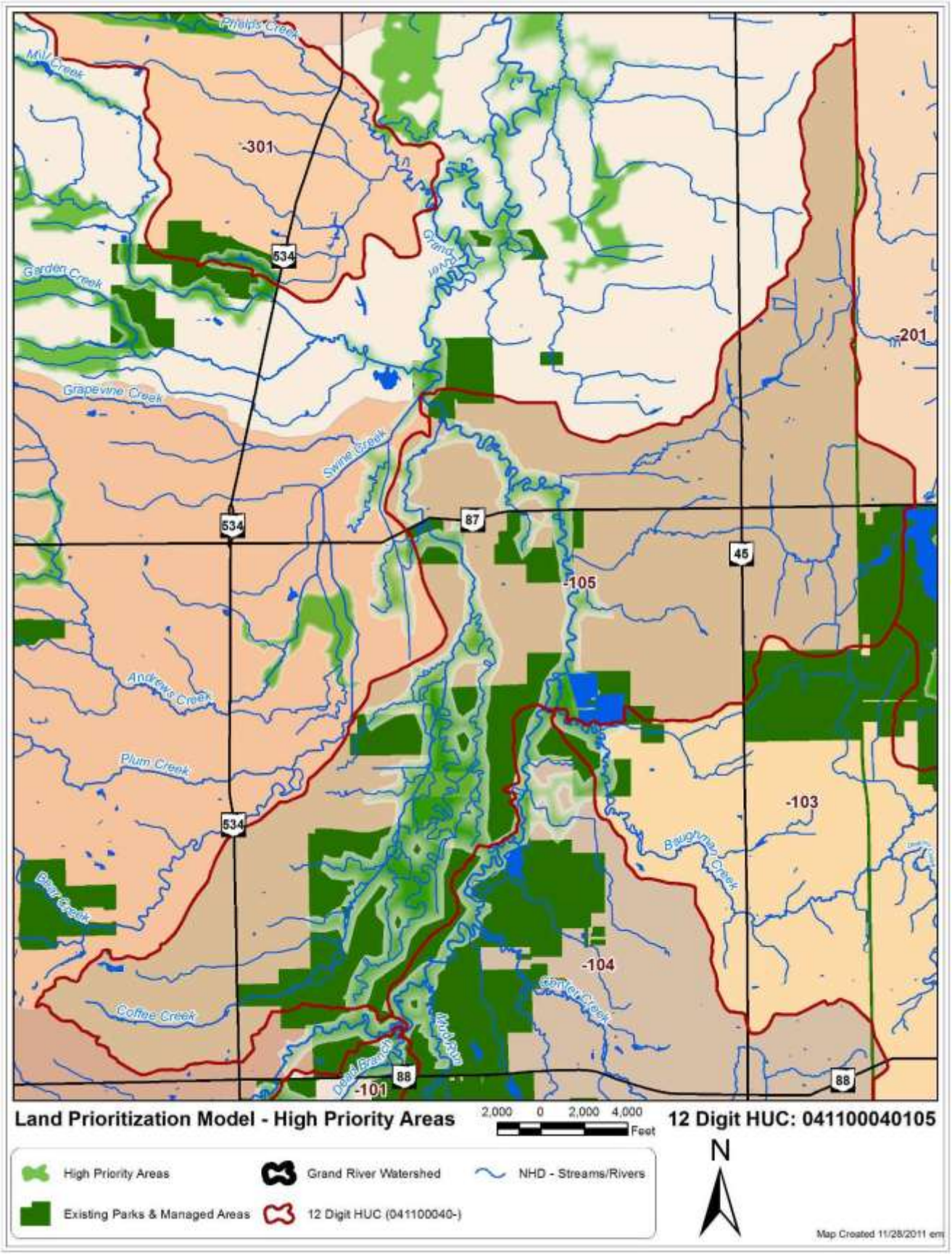
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 130. Center Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	584.3	584.3
Phosphorus Load Reduction (lb/year)			584.3	584.3
Nitrogen Load Reduction (lb/yr)			1168.7	1168.7

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 71 – 041100040105 Coffee Creek Subwatershed Land Protection Prioritization Model - High Priority Areas



F. Swine Creek Subwatershed

12 Digit HUC: 041100040106
Location: Swine Creek
Drainage Area: 30.96 miles^2, 19816 acres
Miles of stream: 79.1 miles
Average Sinuosity: 1.16
Average Impervious Cover: 1.18%

Photo 16. Grand River at the Confluence of Swine Creek *(Source: G. Warnock)*

Subwatershed Description
The Swine Creek 12-digit HUC Subwatershed represents 20 percent of the six (6) subwatersheds in the Headwaters – Grand River 10-digit HUC subwatershed to the Grand River Watershed. This watershed drains mostly cultivated crops, forested and pasture/hay land in the village of Middlefield and Middlefield and Parkman Township in Geauga County and Farmington and Mesopotamia Townships in Trumbull County.

As of 2006, about 3.8 percent or 669 acres of land development (low, medium & high intensity) has occurred in the Swine Creek subwatershed, with 46 percent or 9134 acres of the land use as forested and 48 percent or 9453 as agricultural land use (Table 131, Map 72). Deciduous forest makes up of 58 percent of the forested land use, cultivated crops and pasture/hay makes up 69 percent of agricultural land use and corn & soybeans dominates the row crop production at 65 percent *(2009 USDA Cropland Cover)*.

Table 131. 041100040106 – Subwatershed Land Use
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Developed, High Intensity	8	0.04
Developed, Medium Intensity	54	0.27
Developed, Low Intensity	607	3.06
Developed, Open Space	52	0.26
Cultivated Crops	3651	18.43
Pasture/Hay	5803	29.29
Grassland/Herbaceous	415	2.09
Deciduous Forest	5309	26.80
Evergreen Forest	96	0.48
Mixed Forest	122	0.62
Scrub/Shrub	2001	10.10
Palustrine Forested Wetland	1448	7.31
Palustrine Scrub/Shrub Wetland	159	0.80
Palustrine Emergent Wetland	28	0.14
Open Water	58	0.29
Total	**19810**	

Floodplain

Forest makes up 60 percent or 2103 acres of the land use in the 3529 acres of flood plain in the Swine Creek Subwatershed. The next closest land uses in the flood plain are pasture/hay at 17 percent or 612 acres and woody wetlands at 411 acres or 12 percent. High, medium and low density development only composes 38 acres or just 1.08 percent of the floodplain (Table 132).

Table 132. 041100040106 – Subwatershed Land Use Within Floodplain

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Agriculture	51	1.45%
Grass/Pasture/Non-Ag	8	0.24%
Barren	0	0.00%
Deciduous Forest	2103	59.59%
Developed/High Intensity	0	0.00%
Developed/Low Intensity	37	1.05%
Developed/Medium Intensity	1	0.04%
Developed/Open Space	167	4.75%
Evergreen Forest	2	0.05%
Grassland Herbaceous	77	2.18%
Herbaceous Wetlands	1	0.02%
Open Water	55	1.56%
Pasture/Hay	612	17.35%
Shrubland	4	0.11%
Woody Wetlands	411	11.64%
Total	**3529**	

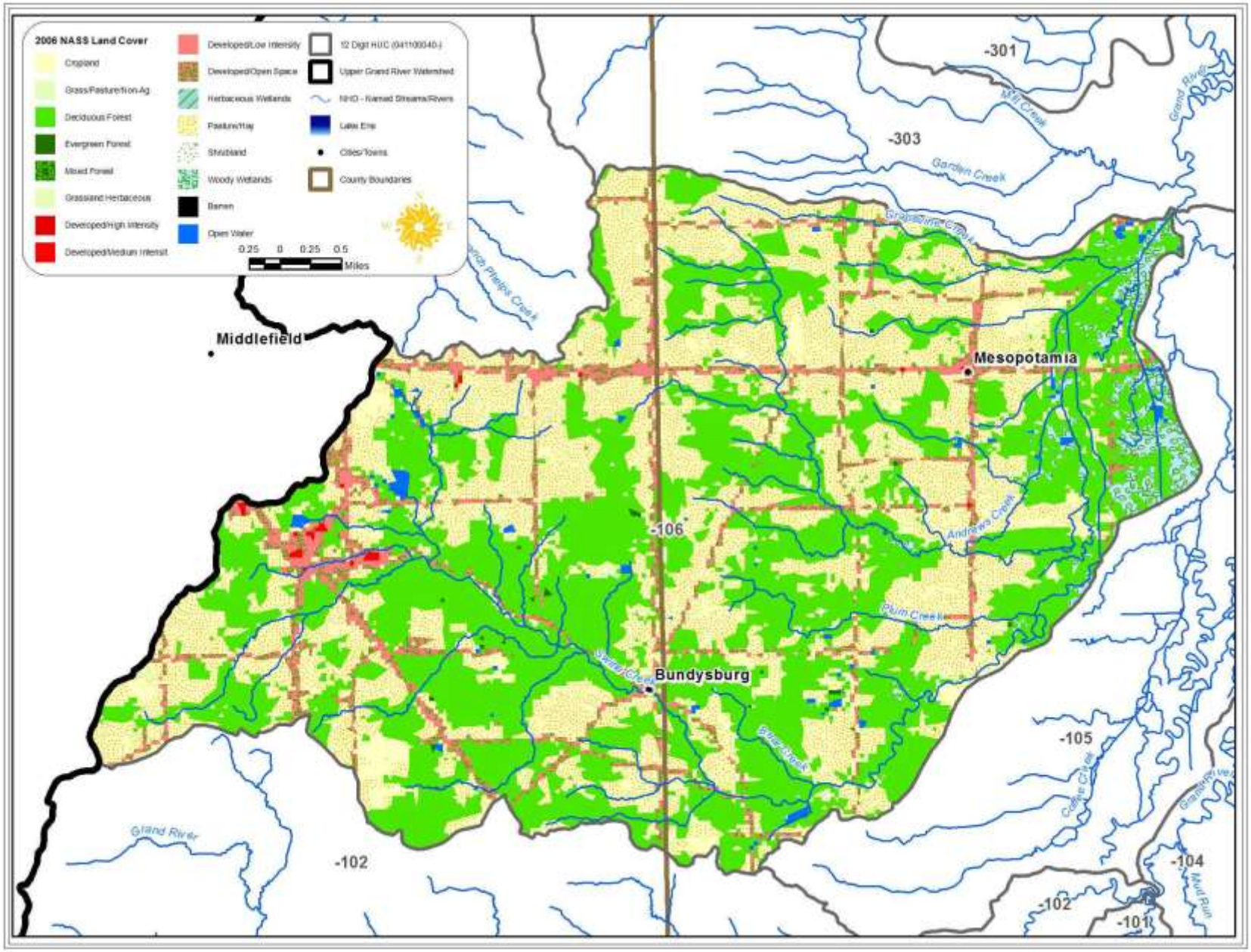
Table 133. 041100040106 – Subwatershed Wetland Types by Acres

Source: National Wetlands Inventory(NWI)

Emergent Wetland	Forested/Shrub Wetland	Pond	Grand Total
89	1827	154	2070

Map 72. 041100040106 – Subwatershed Land Use

Source: 2006 National Land Cover Data (NLCD2006) - a land-cover mapping program



This Page Intentionally left blank

Soils

The major soils of the Swine Creek Subwatershed are the Fitchville-Haskins-Sebring Association, Caneadea-Canadice Association, and Holly-Orrville-Tioga Association. These are characterized by deep, nearly level to gently sloping areas that vary from very poorly drained to well drained in a few locations. In general these soils suffer from flooding and seasonal wetness and ponding, and have moderately slow to very slow permeability. Typically they have high seasonable water tables. All three associations consist of soils formed from fine texture lacustrine material, glacial outwash, or glacial till. The Holly-Orrville-Tioga Association is solely associated with flat flood plains and it is common to find it on valley floors associated with the basins of former glacial lakes. About 60 percent of the soils are considered potentially highly erodible. Tables 4 & 5 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Geauga & Trumbull County.

Table 134. 041100040106 – Subwatershed Highly Erodible Soil by Acres

Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC).

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
1462	11857	6348	129

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Swine Creek subwatershed is made up of 43 percent from Group D Hydrologic Soil. Soils in this group have high runoff potential when thoroughly wet due to very slow infiltration rates. Water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures, with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious parent material.

Table 135. 041100040106 - Subwatershed Hydrologic Soil Groups
Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC).

A:	B:	C:	D:	A/D:	B/D:	C/D:
905	1211	1699	8411	2	1520	5925

Water Quality
The physical habitat quality of streams in the Upper Grand River basin is largely influenced by topography, drainage area, and the juxtaposition of glacial till and lacustrine deposits. Essentially this creates three distinct stream types: lowland streams, upland headwaters, and the non-wadeable Grand River mainstem.

According to the Biological and Water Quality Study of the Upper Grand River 2007, the Swine Creek has a verified WWH designation based on samples collected in the lowland reach (downstream from Girdle Road, RM 7.1). Samples collected in the upland reach at Swine Creek Park Picnic Area (RM 10.4) and at Curtis Middlefield Road (RM 8.2) demonstrate that a CWH use is appropriate given the presence of five or more coldwater macroinvertebrate taxa and mottled sculpin at both sites.

Andrews Creek holds an unverified WWH designation. That use is appropriate based on the results of fish and macroinvertebrate samples collected at Girdle Road (RM 3.6).

Plumb Creek has an unverified WWH designation. Results of samples collected at Girdle Road demonstrate that the Plum Creek is a cold water habitat stream, as six coldwater macroinvertebrate taxa and one coldwater fish species, the central mudminnow, were collected.

Table 136. 041100040106 – Subwatershed Aquatic Life Use (ALU) Designation
Source: Biological and Water Quality Study of the Upper Grand River 2007 - OEPA

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-160 Swine Creek			
10.40	CWH	Full	-
8.18	CWH	Full	-
1.72	WWH	Full	-
03-162 Andrews Creek			
3.62	WWH	Full	-
03-163 Plum Creek			
1.48	CWH	Full	Natural - Low Flow

The quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

With one exception, Plum Creek, samples from streams with poor substrate quality, as noted by substrate scores less than 10 on the QHEI, did not achieve the WWH biocriterion for headwaters. Plum Creek and portions of Swine Creek have an unverified WWH designation, results of samples collected demonstrate that the both streams have a cold water habitat stream. Andrews Creek has an unverified WWH designation and collected justify this designation.

Table 137. 041100040106 - Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIWb[a]	Narrative
03-160 Swine Creek - WWH/CWH recommended										
300178	10		15	964	0	7	71	54		Excellent
G01K16	8		18	552	0	12	72.5	52		Excellent
03-160 Swine Creek - WWH										
200628	1.7		17	514	0	18	55	44		Good
03-162 Andrews Creek - unverified WWH - recommended										
300179	3.6		16	1758	0	6	68	38		Good
03-163 Plum Creek - unverified WWH/CWH recommended										
300180	1.48	11	11	276	0	1	53	40		Good

a - MIwb is not applicable to headwater streams with drainage areas < 20 mi2.

Localized impacts to water quality from anthropogenic sources, principally from organic enrichment, were noted in tributaries to the Grand River. The sources of enrichment were primarily on-site sewerage, livestock, and, in some cases, an unknown source.

The Biological and Water Quality Study of the Upper Grand River 2007 lists natural limits as the cause of impairment and a major contribution to the segment of stream not meeting it's aquatic life use designation. The quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

Livestock were the suspected source for Swine Creek RM 1.72, Andrews and Plum Creek due to pastures in close proximity upstream from the sampling location (Table 133).

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 138. 041100040106 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Swine Creek Subwatershed in 2007.
Source: Biological and Water Quality Study of the Upper Grand River 2007 - OEPA

RM	STORET	GEOMEAN	N	Class	Attainment	Sources
Swine Creek						
10.40	300178	317	2	B	Non	Unknown
8.18	G01K16	630	6	B	Non	Unknown
1.72	200628	3429	2	B	Non	Livestock
Andrews Creek						
3.62	300179	1777	2	B	Non	Livestock
Plum Creek						
1.48	300180	693	2	B	Non	Livestock*

*The source is more likely from livestock than the ubiquitous background contamination based on anecdotal evidence.

Macroinvertebrate communities evaluated in the Upper Grand River tributaries can be grouped, to a large part, based on the physical habitat, shaped by the typography of the landscape, they flow through. Many of the streams on the western part of the basin flow through high gradient channels that in places have cut down to sandstone bedrock and receive significant groundwater. These streams generally have high EPT (19-31) and sensitive taxa (23-41) diversity, presence of cold water taxa (4-9), and uncommonly collected sensitive taxa (1-9). Stream stations that fell into this category were Swine Creek RMs 10.15, 8.18 and Plum Creek RM 1.48.

Table 139. 041100040106 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Swine Creek Subwatershed in 2007.

Source: Biological and Water Quality Study of the Upper Grand River 2007 - OEPA

RM	Drain Area (mi2)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Swine Creek (03-160)										
10.15		-	48	22	24	Moderate	7	Hydropsychid caddisflies (MI), midges(F,MI)	-	Exceptional
8	12	-	60	23	30	Moderate	5	Hydropsychid caddisflies (MI), baetid mayflies (F,I), midges (MI,F)	-	Exceptional
1.72	18	-	58	17	21	Low - Moderate	0	Hydropsychid caddisflies (F), midges (MI,F), baetid mayflies (F)	-	Good
Plum Creek (03-163)										
1.48	1.3	-	39	4	14	Low - Moderate	6	Hydropsychid caddisflies (F), midges (MI)	-	Fair
Andrews Creek (03-162)										
4	6	-	55	16	21	Low - Fair	1	Midges (MI), hydropsychid caddisflies (F), baetid mayflies (F)	-	Good

- **12-digit HUC 041100040105 – Swine Creek Subwatershed Problem Statements, Goals, objectives and Action**

Summary of Impairments: The major causes of impairment for Swine, a 12-digit subwatershed of Headwaters – Grand River 10-digit subwatershed, include pathogen loading (fecal coliform and E. coli) in excess of 68 colony forming units (cfu) per year. Those causes are primarily associated with livestock.

Problem Statement 1: The presence of about 3268 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for nearly the entire reach of Swine Creek (about 12 miles of stream). The most likely source is livestock manure runoff from pastures in close proximity upstream from the sampling location on the Swine Creek Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 3268 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 2 new manure storage facilities in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 3118 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Objective 2: Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms (approximately 500 feet of streambank per farm), resulting in an excess pathogen loading reduction of 150 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 2: The presence of about 1616 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Andrews Creek near RM 3.62. The most likely source is livestock manure runoff from pastures in close proximity upstream from the sampling location on the Swine Creek Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 1616 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 1 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 1466 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Objective 2: Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms (approximately 500 feet of streambank per farm), resulting in an excess pathogen loading reduction of 150 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 3: The presence of about 532 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Andrews Creek near RM 3.62. The most likely source is livestock manure runoff from pastures in close proximity upstream from the sampling location on the Swine Creek Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 532 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 1 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 457 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Objective 2: Establish 1000 lineal feet of livestock exclusion fencing along streams on 1 farm (approximately 500 feet of streambank per farm), resulting in an excess pathogen loading reduction of 75 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 4: Local stakeholder concern has identified 1779 acres of land with high natural area conservation value under threat of conversion. It was assumed that for a single family housing development on the 890 acres, 50% of the land would be preserved as open space. Of the remaining 1097 acres developed as single-family residential, it was assumed that the development would use filter buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by impervious surfaces and residential land use (excess loading of nitrogen (N) - 1906 lbs/year, phosphorus (P) - 276 lbs/year, Biological Oxygen Demand (BOD) - 7777 lbs/year and Sediment – 15 tons/year) would push adjacent sections of Swine Creek to impairment (see table 140).

Goal: Protect 1779 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 1779 acres of land with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 140. Swine Creek Subwatershed Land Protection Load Estimates for land protection.

Current land use loading as 1779 acres of forest			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
474.6	228	1146	25.2
New land use loading following development of 890 acres as single-family housing with LID			
N Load lb/year	**P Load lb/year**	**BOD lb/year**	**Sediment Load t/year**
2380.5	503.7	8923.4	40.4
Net increase due to land use change			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
1905.9	**275.6**	**7777.1**	**15.2**

Problem Statement 3: Local stakeholder concern has identified 448 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 448 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 448 acres of wetlands with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified wetland protection properties.

Problem Statement 4: Local stakeholder concern has identified 16.25 miles or 85793 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant pollutants generated by channel erosion (excess loading of sediment – 1459 tons/year, N - 2917 lbs/year and P - 1459 lbs/year) would push adjacent sections of Swine Creek to impairment (see table 141).

Goal: Protect 16.25 miles or 85793 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 16.25 miles or 85793 linear feet of stream corridor with high natural area conservation value.

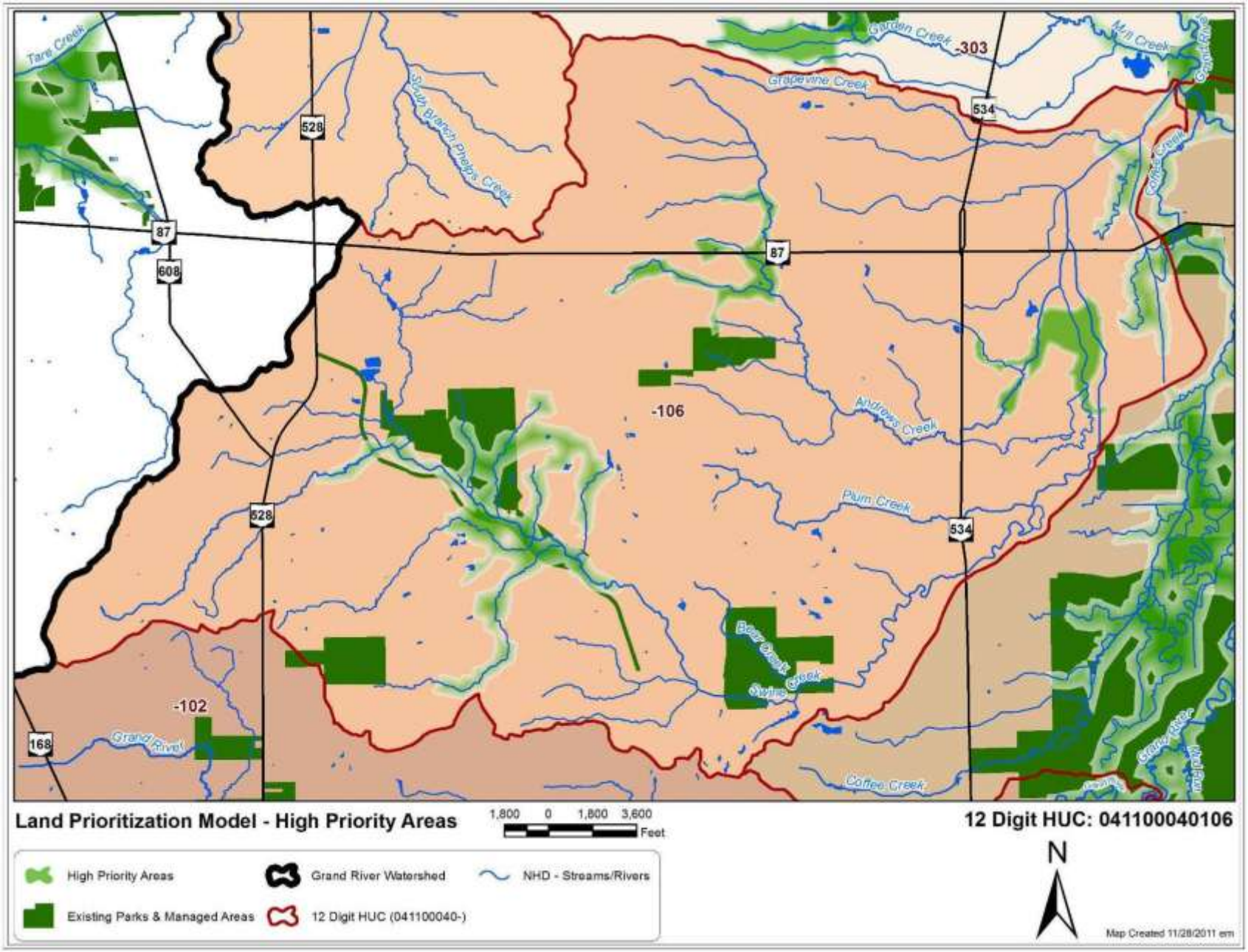
Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 141. Swine Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	729.2	729.2
Phosphorus Load Reduction (lb/year)			729.2	729.2
Nitrogen Load Reduction (lb/yr)			1458.5	1458.5

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 73 – 041100040106 Swine Creek Land Protection Prioritization Model - High Priority Areas



G. Upper Rock Creek Subwatershed

12 Digit HUC: 041100040201
Location: Snyder Ditch to U.S. Rt. 224 (Rock Creek headwaters)
Drainage Area: 25.99 miles^2, 16635 acres
Miles of stream: 82.59 miles
Average Sinuosity: 1.11
Average Impervious Cover: 0.74%

Photo 17. Rock Creek (Snyder Ditch) @ US 322 *(Source: G. Warnock)*

Subwatershed Description
The Upper Rock Creek 12-digit HUC subwatershed represents 37 percent of the three (3) subwatersheds in the Rock Creek 10-digit HUC subwatershed to the Grand River Watershed. This watershed drains mostly cultivated crops, forested and pasture/hay land in the Village of Orwell and Colebrook and Orwell Townships in Ashtabula County and Bloomfield, Bristol, Greene and Mecca Townships in Trumbull County.

As of 2006, about 2 percent or 332 acres of land development (low, medium & high intensity) has occurred in the Upper Rock Creek Subwatershed, with 55 percent or 9127 acres of the land use as forested and 40 percent or 6571 as agricultural land use (Table 138, Map 54). Deciduous forest makes up of 30 percent of the forested land use, cultivated crops and pasture/hay makes up 98 percent of agricultural land use and corn & soybeans dominates the row crop production at 82 percent *(2009 USDA Cropland Cover)*.

Table 142. 041100040201 – Subwatershed Land Use
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Developed, High Intensity	2	0.01
Developed, Medium Intensity	21	0.13
Developed, Low Intensity	309	1.86
Developed, Open Space	6	0.03
Cultivated Crops	4992	30.03
Pasture/Hay	1437	8.64
Grassland/Herbaceous	142	0.85
Deciduous Forest	2703	16.26
Evergreen Forest	53	0.32
Mixed Forest	20	0.12
Scrub/Shrub	2432	14.63
Palustrine Forested Wetland	3391	20.40
Palustrine Scrub/Shrub Wetland	528	3.18
Palustrine Emergent Wetland	319	1.92
Bare Land	4	0.02
Open Water	265	1.60
Total	**16623**	

Floodplain
Forest and pasture make up 72 percent of the land use in the Upper Rock Creek Subwatershed floodplain. Forest covers 54 percent or 1362 acres and pasture/hay covers 17 percent or 431 acres of the 2504 acres of flood plain. The next closest land use in the flood plain is woody wetlands at 188 acres or 8 percent. High, medium and low density development only composes 23 acres or just 0.9 percent of the floodplain (Table 139).

Table 143. 041100040201 – Subwatershed Land Use Within Floodplain
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

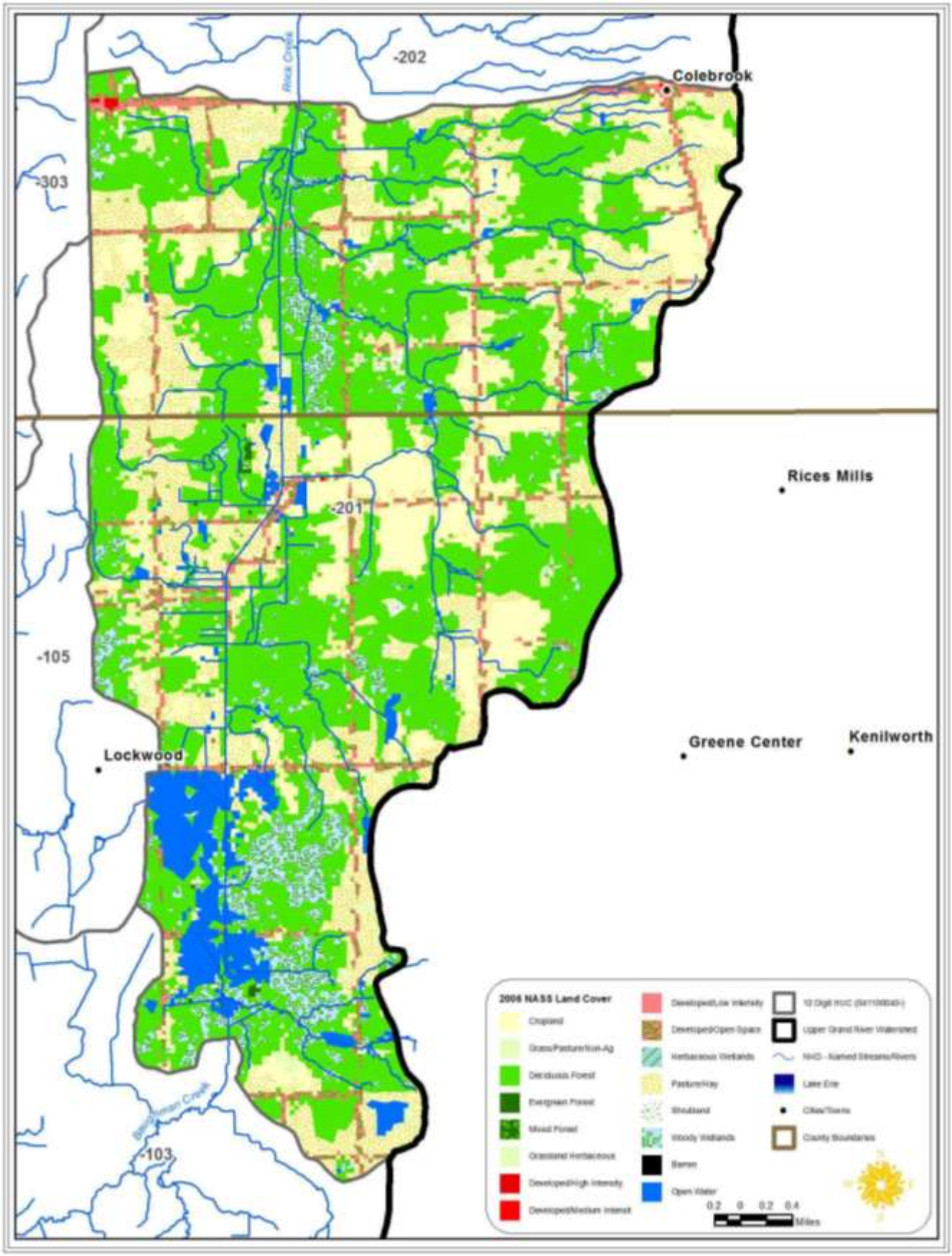
Description	Acres	Percent of Watershed
Agriculture	187	7.45
Grass/Pasture/Non-Ag	12	0.47
Barren	0	0.00
Deciduous Forest	1362	54.38
Developed/High Intensity	0	0.00
Developed/Low Intensity	22	0.88
Developed/Medium Intensity	1	0.02
Developed/Open Space	93	3.71
Evergreen Forest	3	0.13
Grassland Herbaceous	33	1.33
Herbaceous Wetlands	1	0.03
Open Water	153	6.09
Pasture/Hay	431	17.23
Shrubland	19	0.78
Woody Wetlands	188	7.51
Total	**2504**	

Table 144. 041100040201 – Subwatershed Wetland Types by Acres
(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Lake	Pond	Grand Total
750	2255	148	66	3219

Map 74. 041100040201 – Subwatershed Land Use

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)



This Page Intentionally left blank

Soils

The major soils of the Upper Rock Creek Subwatershed are the Fitchville-Haskins-Sebring Association, Caneadea-Canadice Association, and Holly-Orrville-Tioga Association. These are characterized by deep, nearly level to gently sloping areas that vary from very poorly drained to well drained in a few locations. In general these soils suffer from flooding and seasonal wetness and ponding, and have moderately slow to very slow permeability. Typically they have high seasonable water tables. All three associations consist of soils formed from fine texture lacustrine material, glacial outwash, or glacial till. The Holly-Orrville-Tioga Association is solely associated with flat flood plains and it is common to find it on valley floors associated with the basins of former glacial lakes. About 13 percent of the soils are considered potentially highly erodible. Tables 141 & 142 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Trumbull County.

Table 145. 041100040201 – Subwatershed Highly Erodible Soil by Acres

(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
5	2198	13935	456

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Upper Rock Creek subwatershed is made up of 70% from Group C/D Hydrologic Soil. Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Some soils having clay, silty clay, or sandy clay textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.

Table 146. 041100040201 - Subwatershed Hydrologic Soil Groups by Acres
Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC).

A	B	C	D	A/D	B/D	C/D
62	166	5	3034	380	1331	11463

Water Quality
The physical habitat quality of streams in the Upper Grand River basin is largely influenced by topography, drainage area, and the juxtaposition of glacial till and lacustrine deposits. Essentially this creates three distinct stream types: lowland streams, upland headwaters, and the non-wadeable Grand River mainstem.

Where the topography is flat, and the substrates are composed primarily of lacustrine silts and clays, habitat quality is generally poor and not conducive to stream faunas typical of the ecoregion.

According to the Biological and Water Quality Study of the Upper Grand River 2007, the Ohio EPA reported Snyder Ditch is undesignated in Chapter 3745-1-10 of the Ohio Administrative Code. Poor habitat quality resulting from active channel maintenance, and the results of biological samples collected at Moore Road (RM 0.6) demonstrated that the aquatic life use should be Modified Warmwater Habitat (MWH).

Table 147. 041100040201 – Subwatershed Aquatic Life Use (ALU) Designation
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-138 Snyder Ditch - undesignated/MWH recommended			
0.60	MWH	Full	

The quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

The Biological and Water Quality Study of the Upper Grand River 2007 lists natural limits as the cause of impairment and a major contribution to the segment of stream not meeting it's aquatic life use designation. The quality of fish communities in the Rock Creek subwatershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin. Snyder Ditch (a.k.a Rock Creek) is a channelized ditch with no potential to support a WWH fauna. Fish communities in Snyder Ditch, met standards for Modified Warmwater Habitat (MWH).

Table 148. 041100040201 - Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIWb[a]	Narrative
03-138 Snyder Ditch - undesignated/MWH recommended										
300199	0.6	18	14	205.5	9.2	29	50	34ns	6.4*	Marginally Good /Fair

a - MIwb is not applicable to headwater streams with drainage areas < 20 mi2.
ns - Nonsignificant departure from biocriteria (<4 IBI units or <0.5 MIwb units).
* - Indicates significant departure from applicable biocriteria (>4 IBI units or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

Recreational Use Designation
The Rock Creek subwatershed (10-digit HUC) was in non-attainment for recreational use throughout it's entire reach (with one exception, Rock Creek RM 1.23 is in full attainment of it's recreational use). The ubiquity of high bacteria counts clearly suggests that the bacteria indicators are not serving exclusively as surrogates for pathogens of human origin. E. coli counts followed a log-normal distribution suggesting an

origin from diffuse sources such as livestock and wildlife. Additional indicators failed to point to an identifiable source, so the Snyder Ditch source is listed as unknown (Table 145).

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 149. 041100040201 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Upper Rock Creek Creek Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	STORET	GEOMEAN	N	Class	Attainment	Sources
Snyder Ditch						
0.6	300199	701	2	B	Non	Unknown

Macroinvertebrate communities evaluated in the Upper Grand River tributaries can be grouped, to a large part, based on the physical habitat, shaped by the typography of the landscape, they flow through. The EPT and sensitive taxa diversity indicate Snyder Ditch is meeting it's recommended Aquatic Life Use expectations.

Table 150. 041100040201 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Upper Rock Creek Creek Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	Drain Area (mi2)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Snyder Ditch (Rock Creek) (03-138)										
0.6	29	-	47	10/12	7/16	L	0	Hydropsychid caddisflies (F), midges (F,MT)	46	

- **12-digit HUC 041100040201 – Upper Rock Creek Subwatershed Problem Statements, Goals, objectives and Action**

Problem Statement 1: According to the Biological and Water Quality Study of the Upper Grand River 2007, the Ohio EPA reported Snyder Ditch (a.k.a Rock Creek) is a channelized ditch with no potential to support a WWH fauna; direct habitat alteration is the most likely cause of impairment and the major contribution to Snyder Ditch (a.k.a Rock Creek) only meeting its recommended modified warm water use designation. The source of this impairment is most likely due to about 6 miles of channelization of Snyder Ditch (a.k.a Rock Creek) from just south of State Route 87 to just north of US Route 322, which is limiting stream faunas typical of the ecoregion.

Goal: Restore 5.7 miles or 30102 linear feet of channelized ditch, including restoration of in-stream habitat, riparian habitat restoration, re-connection to floodplain and enhancement and restoration of existing wetlands. However unlikely the potential to support WWH stream faunas, attempts should be made to improve in-stream habitat with the expectations of restoring WWH conditions.

Objective: Restore 5.7 miles or 30102 linear feet of channelized ditch, including restoration of in-stream habitat, stabilization of eroding banks, and re-connection to floodplain using ditch retrofit techniques.

Action: Pursue Ohio EPA Section 319(h) Non-point Source Program Grant or Ohio EPA Surface Water Improvement Fund (SWIF) grant, or other grants for the potential restoration project.

Problem Statement 2: Local stakeholder concern has identified 1834 acres of land with high natural area conservation value under threat of conversion. It was assumed that for a single family housing development on the 1834 acres, 50% of the land would be preserved as open space. Of the remaining 917 acres developed as single-family residential, it was assumed that the development would use filter buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by impervious surfaces and residential land use (excess loading of nitrogen (N) - 1982 lbs/year, phosphorus (P) - 292 lbs/year, Biological Oxygen Demand (BOD) - 8045 lbs/year and Sediment – 21 tons/year) would push adjacent sections of Phelps Creek to impairment (see table 151).

Goal: Protect 1834 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 1834 acres of land with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 151. Upper Rock Creek Subwatershed Land Protection Load Estimates for land protection.

Current land use loading as 1779 acres of forest			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
445.5	217.3	1090.1	14.9
New land use loading following development of 890 acres as single-family housing with LID			
N Load lb/year	**P Load lb/year**	**BOD lb/year**	**Sediment Load t/year**
2427.4	509.5	9134.7	36.1
Net increase due to land use change			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
1981.8	**292.1**	**8044.5**	**21.2**

Problem Statement 3: Local stakeholder concern has identified 833 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 833 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 833 acres of wetlands with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.

Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified wetland protection properties.

Problem Statement 4: Local stakeholder concern has identified 15.53 miles or 85011 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant pollutants generated by channel erosion (excess loading of sediment – 523 tons/year, N - 1046 lbs/year and P - 523 lbs/year) would push adjacent sections of Phelps Creek to impairment (see table 152).

Goal: Protect 15.53 miles or 85011 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 15.53 miles or 85011 linear feet of stream corridor with high natural area conservation value.

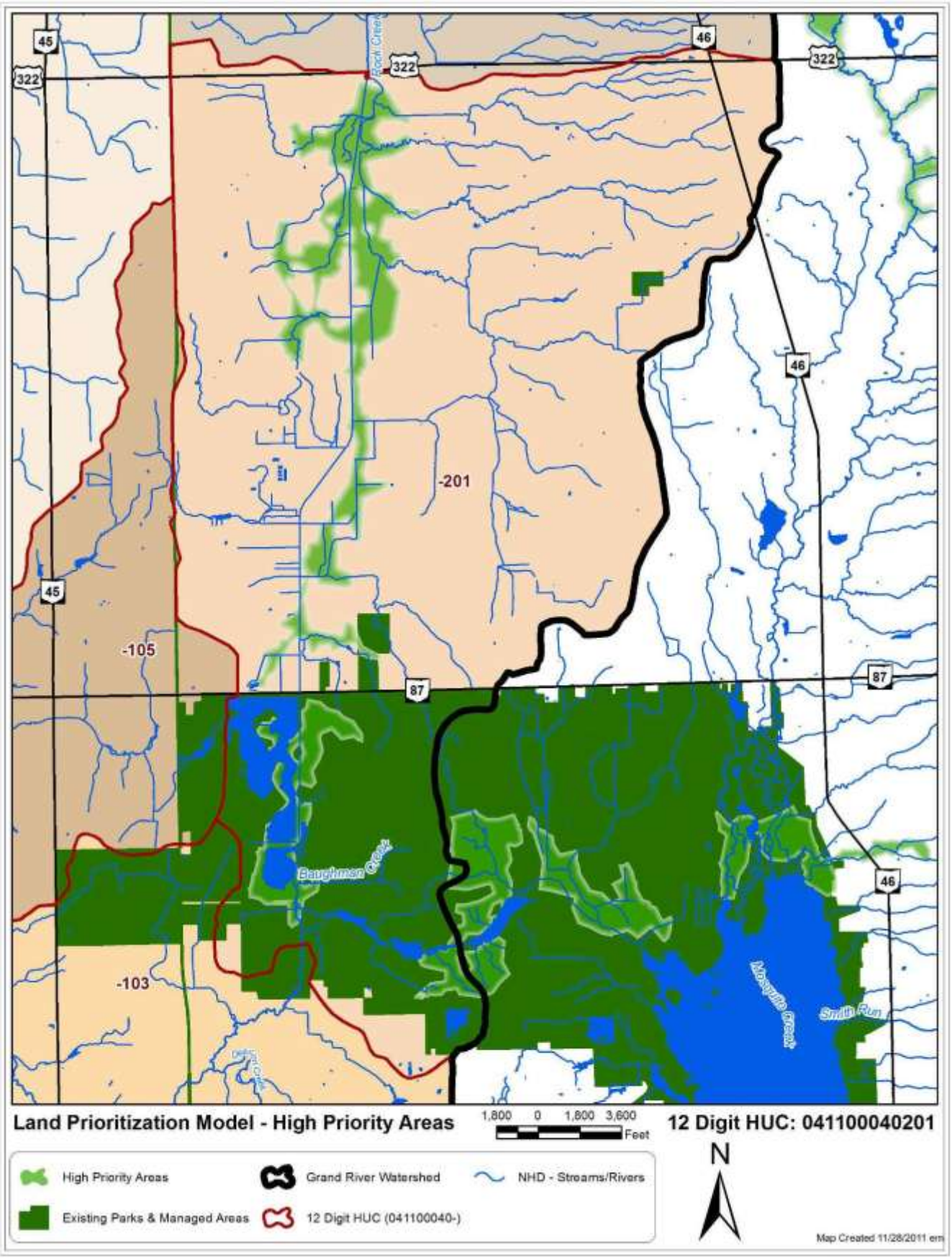
Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 152. Upper Rock Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	697.1	697.1
Phosphorus Load Reduction (lb/year)			697.1	697.1
Nitrogen Load Reduction (lb/yr)			1394.2	1394.2

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 75 – 041100040201 Upper Rock Creek Land Protection Prioritization Model - High Priority Areas



H. Middle Rock Creek Subwatershed

12 Digit HUC: 041100040202
Location: Rock Creek below U.S. Route 224 to downstream of Lebanon Creek
Drainage Area: 21.34 miles^2, 13658 acres
Miles of stream: 76.67 miles
Average Sinuosity: 1.17
Average Impervious Cover: 1.00%

Photo 18. Rock Creek @ Dodgeville Road near confluence with Lebanon Creek *(Source: G. Warnock)*

Subwatershed Description
The Middle Rock Creek 12-digit HUC Subwatershed represents 30 percent of the three (3) subwatersheds in the Rock Creek 10-digit HUC subwatershed to the Grand River Watershed. This watershed drains mostly cultivated crops, forested and pasture/hay land in the Village of Orwell and Cherry Valley, Colebrook, New Lyme, Orwell and Rome Township in Ashtabula County.

As of 2006, about 3 percent or 440 acres of land development (low, medium & high intensity) has occurred in the Middle Rock Creek Subwatershed, with 45 percent or 6124 acres of the land use as forested and 50 percent or 6871 as agricultural land use (Table 150, Map 56). Deciduous forest makes up of 62 percent of the forested land use, Cultivated Crops and Pasture/Hay makes up 98 percent of agricultural land use and Corn & Soybeans dominates the row crop production at 90 percent *(2009 USDA Cropland Cover)*.

Table 153. 041100040202– Subwatershed Land Use
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Developed, High Intensity	0	0.00
Developed, Medium Intensity	14	0.10
Developed, Low Intensity	426	3.12
Developed, Open Space	4	0.03
Cultivated Crops	4609	33.77
Pasture/Hay	2262	16.58
Grassland/Herbaceous	118	0.87
Deciduous Forest	3836	28.11
Evergreen Forest	42	0.31
Mixed Forest	27	0.20
Scrub/Shrub	1138	8.34
Palustrine Forested Wetland	950	6.96
Palustrine Scrub/Shrub Wetland	131	0.96
Palustrine Emergent Wetland	26	0.19
Open Water	63	0.46
Total	**13647**	

Floodplain

Forest and pasture make up 73 percent of the land use in the Middle Rock Creek Subwatershed floodplain. Forest covers 53 percent or 1412 acres and pasture/hay covers 19 percent or 502 acres of the 2624 acres of flood plain. The next closest land use in the flood plain is agriculture at 395 acres or 15 percent. High, medium and low density development only composes 47 acres or just 1.78 percent of the floodplain (Table 151).

Table 154. 041100040202– Subwatershed Land Use Within Floodplain
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

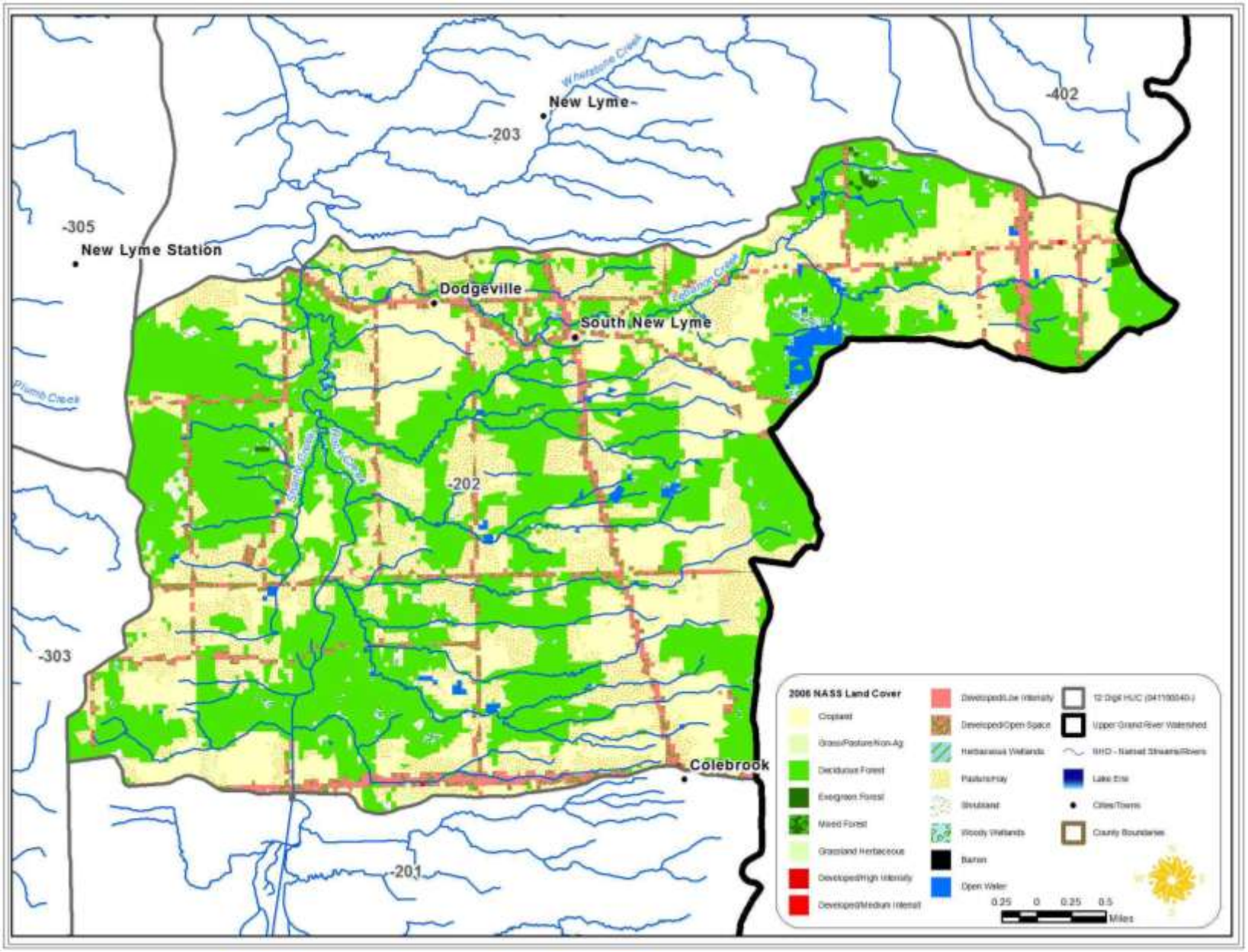
Description	Acres	Percent of Watershed
Agriculture	395	15.04
Grass/Pasture/Non-Ag	7	0.26
Barren	0	0.00
Deciduous Forest	1412	53.81
Developed/High Intensity	0	0.00
Developed/Low Intensity	46	1.75
Developed/Medium Intensity	1	0.02
Developed/Open Space	153	5.85
Evergreen Forest	0	0.00
Grassland Herbaceous	25	0.95
Herbaceous Wetlands	0	0.00
Open Water	23	0.89
Pasture/Hay	502	19.15
Shrubland	19	0.72
Woody Wetlands	41	1.55
Total	**2624**	

Table 155. 041100040202– Subwatershed Wetland Types by Acres
(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Lake	Pond	Grand Total
77	1652	32	71	1833

Map 76. 041100040202– Subwatershed Land Use

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)



This Page Intentionally left blank

Soils

The major soils of the Middle Rock Creek Subwatershed are the Fitchville-Haskins-Sebring Association, Caneadea-Canadice Association, and Holly-Orrville-Tioga Association. These are characterized by deep, nearly level to gently sloping areas that vary from very poorly drained to well drained in a few locations. In general these soils suffer from flooding and seasonal wetness and ponding, and have moderately slow to very slow permeability. Typically they have high seasonable water tables. All three associations consist of soils formed from fine texture lacustrine material, glacial outwash, or glacial till. The Holly-Orrville-Tioga Association is solely associated with flat flood plains and it is common to find it on valley floors associated with the basins of former glacial lakes. About 38 percent of the soils are considered potentially highly erodible. Tables 153 & 154 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Ashtabula and Trumbull County.

Table 156. 041100040202– Subwatershed Highly Erodible Soil by Acres

(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
44	5125	8150	226

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Middle Rock Creek subwatershed is made up of 50% from Group C/D Hydrologic Soil. Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Some soils having clay, silty clay, or sandy clay textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.

Table 157. 041100040202- Subwatershed Hydrologic Soil Groups by Acres
(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

A	B	C	D	A/D	B/D	C/D
206	0	51	4789	0	1650	6748

Water Quality
The physical habitat quality of streams in the Upper Grand River basin is largely influenced by topography, drainage area, and the juxtaposition of glacial till and lacustrine deposits. Essentially this creates three distinct stream types: lowland streams, upland headwaters, and the non-wadeable Grand River mainstem.

Where the topography is flat, and the substrates are composed primarily of lacustrine silts and clays, habitat quality is generally poor and not conducive to stream faunas typical of the ecoregion. On the northeastern side of the catchment Lebanon Creek has the drainage area, gradient, and substrates to form stream channels with features typical of headwater streams.

According to the Biological and Water Quality Study of the Upper Grand River 2007, the Ohio EPA reported Rock Creek has a verified WWH use. Biological samples collected adjacent to Dodgeville Road (RM 9.64) met WWH criteria.

Lebanon Creek has the drainage area, gradient, and substrates to form stream channels with features typical of headwater streams and an unverified WWH designation. Results of fish and macroinvertebrate samples collected at Institute Road (RM 1.93) documented that the WWH use was not being met despite marginally sufficient habitat. Water chemistry samples revealed high concentrations of total dissolved solids and nutrients, and supersaturating concentrations of dissolved oxygen. Anomalously high conductivity readings were noted for Lebanon Creek, concurrently with high nitrate-nitrogen, phosphorus, and elevated TKN values. The source of elevated nutrients and dissolved solids to Lebanon Creek was not identified. Follow-up monitoring in 2008 failed to reproduce similar values, suggesting that illicit dumping may have been the source.

Table 158. 041100040202– Subwatershed Aquatic Life Use (ALU) Designation
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-130 Rock Creek - WWH			
9.64	WWH	Full	
03-134 Lebanon Creek - unverified WWH designation			
1.93	WWH	Non	TDS, Nutrients/source unknown

The quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

The Biological and Water Quality Study of the Upper Grand River 2007 lists natural limits as the cause of impairment and a major contribution to the segment of stream not meeting it's aquatic life use designation. The quality of fish communities in the Rock Creek subwatershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

Fish communities were evaluated at four sites on Rock Creek, two upstream from Lake Roaming Rock, and two bracketing the Village of Rock Creek WWTP (Figure 24). The fish community sampled downstream from the WWTP met standards for WWH. Upstream from the WWTP, fish were limited by lack of flow, and did not meet the standard for WWH. Upstream from Lake Roaming Rock, at Rock Creek RM 9.6 (Dodgeville Road) fish communities met standards for WWH.

Lebanon Creek lacked pools greater than 40 cm deep, as bedrock was the dominant substrate. It also appeared to be transitional between headwaters and primary headwaters, given the presence of two-lined salamanders. However, sustained flow was evidenced by rainbow darters and a total of 10 fish species. Pollution, as a stressor acting beyond the natural limitations of shallow bedrock, is suggested by low relative numbers in the sample across species, and the low total number of species found.

Table 159. 041100040202- Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIWb[a]	Narrative
03-130 Rock Creek - WWH										
G01W02	9.64	20	17	220.4	9.6	52	61.5	45	7.4*	Good/Fair
03-134 Lebanon Creek - unverified WWH - recommended										
300198	1.93	10	10	146	0	4	50.5	28*		Fair

a - MIwb is not applicable to headwater streams with drainage areas < 20 mi2.
* - Indicates significant departure from applicable biocriteria (>4 IBI units or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

Recreational Use Designation
The Rock Creek subwatershed was in non-attainment for recreational use throughout it's entire reach (with one exception, Rock Creek RM 1.23 is in full attainment of it's recreational use). The ubiquity of high bacteria counts clearly suggests that the bacteria indicators are not serving exclusively as surrogates for pathogens of human origin. E. coli counts followed a log-normal distribution suggesting an origin from diffuse sources such as livestock and wildlife. Additional indicators failed to point to an identifiable source, so the Rock Creek RM 9.64 source is listed as unknown (Table 8).

In Lebanon Creek high *E. coli* counts were associated with indicators of organic enrichment. The ubiquity of high bacteria counts clearly suggests that the bacteria indicators are not serving exclusively as surrogates for pathogens of human origin. Where anecdotal evidence pointed to contamination from human origins, the elevated fecal counts in Lebanon Creek were associated with high TDS and nitrates, as well as ammonia and Kjeldahl nitrogen, suggesting a slug of untreated nitrogenous wastes, possibly from a spill or illegal dumping. (Table 157).

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 160. 041100040202– Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Middle Rock Creek Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	STORET	GEOMEAN	N	Class	Attainment	Sources
Rock Creek						
9.64	G01W02	168	6	B	Non	Unknown
Lebanon Creek						
1.93	300198	297	2	B	Non	Spill? Or WWTP

Macroinvertebrate communities evaluated in the Upper Grand River tributaries can be grouped, to a large part, based on the physical habitat, shaped by the typography of the landscape, they flow through. The macroinvertebrate community sampled upstream from Lake Roaming Rock at Dodgeville Road (RM 9.64) was evaluated as exceptional with high EPT (25) and marginally high sensitive taxa (25) diversity.

The macroinvertebrate community evaluated in Lebanon Creek at Institute Road (RM 1.93) was not meeting WWH expectations with low EPT (6) and sensitive taxa (6) diversities and the riffle habitat devoid of sensitive EPT. Organism densities were unusually low in all habitats. Unusually high TDS (2,030 mg/l), chloride (980 mg/l), and NO2+NO3 (19 mg/l) on 16 July were evidence of periodic slugs of brine pollution, possibly from road application or gas/oil drilling operations.

Table 161. 041100040202– Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Middle Rock Creek Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	Drain Area (mi2)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Snyder Ditch (Rock Creek) (03-138)										
9.64	52	-	66	25	25	L-M	0	Caddisflies (F,MI), midges (F,MI,MT), baetid mayflies (I,F)	-	Exceptional
Lebanon Creek (03-134)										
1.93	4.2	-	38	6	6	L	2	Hydropsychid caddisflies (F)	-	Fair

- **12-digit HUC 041100040202 – Middle Rock Creek Subwatershed Problem Statements, Goals, objectives and Action**

Summary of Impairments: The major causes of impairment for Middle Rock Creek, a 12-digit subwatershed of Rock Creek 10-digit subwatershed, include pathogen loading (fecal coliform and E. coli) in excess of 142 colony forming units (cfu) per year. Those causes are primarily associated with a spill or illegal dumping.

Problem Statement 1 : The presence of about 7 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Rock Creek around RM 9.64. The most likely source is livestock manure runoff from pastures in close proximity upstream from the sampling location on the Rock Creek Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 7 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective: Establish livestock 200 lineal feet of livestock exclusion fencing along streams on 1 farm (approximately 100 feet of streambank), resulting in an excess pathogen loading reduction of 7 cfu.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 2: The presence of about 135 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Lebanon Creek. The most likely source is livestock manure runoff from pastures in close proximity upstream from the sampling location on the Lebanon Creek Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 135 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective: Establish livestock 1800 lineal feet of livestock exclusion fencing along streams on 1 farm (approximately 900 feet of streambank), resulting in an excess pathogen loading reduction of 135 cfu.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.

Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 3: Local stakeholder concern has identified 1229 acres of land with high natural area conservation value under threat of conversion. It was assumed that for a single family housing development on the 1229 acres, 50% of the land would be preserved as open space. Of the remaining 614.5 acres developed as single-family residential, it was assumed that the development would use filter buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by impervious surfaces and residential land use (excess loading of nitrogen (N) - 4182 lbs/year, phosphorus (P) - 572 lbs/year, Biological Oxygen Demand (BOD) - 15029 lbs/year and Sediment – 86 tons/year) would push adjacent sections of Phelps Creek to impairment (see table 162).

Goal: Protect 1229 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 1229 acres of land with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 162. Middle Rock Creek Subwatershed Land Protection Load Estimates for land protection.

Current land use loading as 1229 acres of forest			
N Load lb/year	N Load lb/year	N Load lb/year	N Load lb/year
416.6	202.8	1015.2	17.2
New land use loading following development of 615 acres as single-family housing with LID			
N Load lb/year	N Load lb/year	N Load lb/year	N Load lb/year
2184.8	460.2	8210.6	34.3
Net increase due to land use change			
N Load lb/year	N Load lb/year	N Load lb/year	N Load lb/year
1769.9	258.3	7199.6	17.1

Problem Statement 4: Local stakeholder concern has identified 247 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 247 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 247 acres of wetlands with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified wetland protection properties.

Problem Statement 5: Local stakeholder concern has identified 16.9 miles or 89232 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant pollutants generated by channel erosion (excess loading of sediment – 523 tons/year, N - 1046 lbs/year and P - 523 lbs/year) would push adjacent sections of Phelps Creek to impairment (see table 163).

Goal: Protect 16.9 miles or 89232 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 16.9 miles or 89232 linear feet of stream corridor with high natural area conservation value.

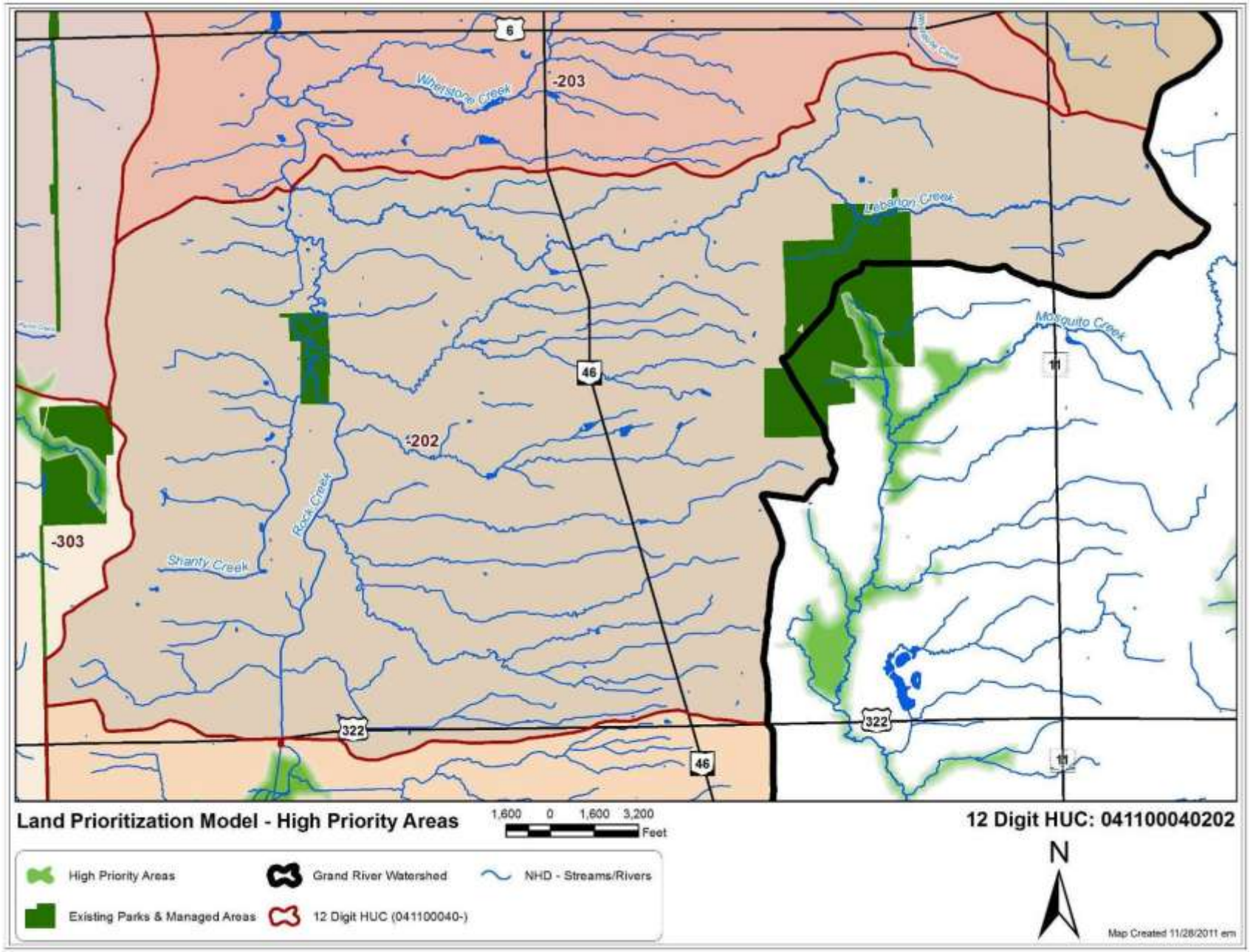
Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 163. Middle Rock Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	697.1	697.1
Phosphorus Load Reduction (lb/year)			697.1	697.1
Nitrogen Load Reduction (lb/yr)			1394.2	1394.2

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 77 – 041100040202 Middle Rock Creek Land Protection Prioritization Model - High Priority Areas



This Page Intentionally left blank

I. Lower Rock Creek Subwatershed

12 Digit HUC: 041100040203
Location: Rock Creek below Lebanon Creek to mouth
Drainage Area: 23.53 miles^2, 15056 acres
Miles of stream: 78.42 miles
Average Sinuosity: 1.10
Average Impervious Cover: 2.09%

Photo 19. Rock Creek at Falls near confluence with Grand River *(Source: G. Warnock)*

Subwatershed Description
The Lower Rock Creek 12-digit HUC subwatershed represents 33 percent of the three (3) subwatersheds in the Rock Creek 10-digit HUC subwatershed to the Grand River Watershed. This watershed drains mostly cultivated crops, forested and pasture/hay land in the Villages of Rock Creek and Roaming Shores and Cherry Valley, Lenox, Morgan and New Lyme Townships in Ashtabula County.

As of 2006, about 7 percent or 981 acres of land development (low, medium & high intensity) has occurred in the Lower Rock Creek subwatershed, with 44 percent or 6642 acres of the land use as forested and 41 percent or 6230 as agricultural land use (Table 162, Map 58). Deciduous forest makes up of 60 percent of the forested land use, Cultivated Crops and Pasture/Hay makes up 98 percent of agricultural land use and Corn & Soybeans dominates the row crop production at 90 percent *(2009 USDA Cropland Cover)*.

Table 164. 041100040203 – Subwatershed Land Use
Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.

Description	Acres	Percent of Watershed
Developed, High Intensity	6	0.04
Developed, Medium Intensity	42	0.28
Developed, Low Intensity	933	6.20
Developed, Open Space	425	2.83
Cultivated Crops	4362	28.97
Pasture/Hay	1868	12.41
Grassland/Herbaceous	136	0.90
Deciduous Forest	3981	26.44
Evergreen Forest	116	0.77
Mixed Forest	39	0.26
Scrub/Shrub	1394	9.26
Palustrine Forested Wetland	1004	6.67
Palustrine Scrub/Shrub Wetland	108	0.72
Palustrine Emergent Wetland	104	0.69
Open Water	539	3.58
Total	**15057**	

Floodplain
Forest and pasture make up 65 percent of the land use in the Lower Rock Creek Subwatershed floodplain. Forest covers 46 percent or 1371 acres and pasture/hay covers 19 percent or 560 acres of the 2969 acres of flood plain. The next closest land use in the flood plain is open water at 454 acres or 15 percent. High, medium and low density development only composes 82 acres or just 2.76 percent of the floodplain (Table 163).

Table 165. 041100040203 – Subwatershed Land Use Within Floodplain
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

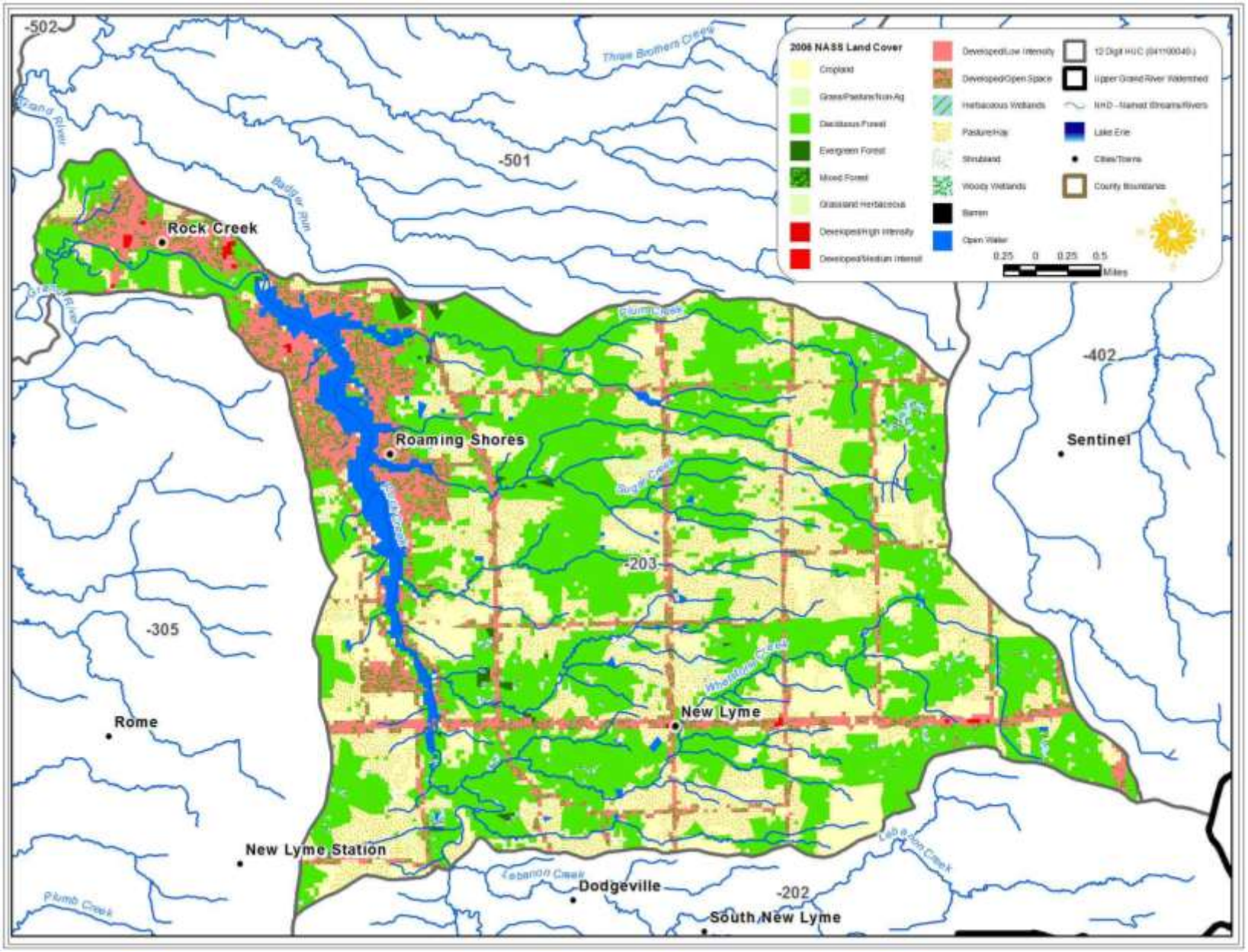
Description	Acres	Percent of Watershed
Agriculture	166	5.58
Grass/Pasture/Non-Ag	31	1.05
Barren	0	0.00
Deciduous Forest	1371	46.16
Developed/High Intensity	1	0.03
Developed/Low Intensity	81	2.71
Developed/Medium Intensity	1	0.03
Developed/Open Space	217	7.30
Evergreen Forest	8	0.26
Grassland Herbaceous	44	1.47
Herbaceous Wetlands	0	0.00
Open Water	454	15.30
Pasture/Hay	560	18.87
Shrubland	10	0.34
Woody Wetlands	27	0.90
Total	**2969**	

Table 166. 041100040203 – Subwatershed Wetland Types by Acres
(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Lake	Pond	Grand Total
32	1062	454	97	1644

Map 78. 041100040203 – Subwatershed Land Use

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)



This Page Intentionally left blank

Soils

The major soils of the Lower Rock Creek Subwatershed are the Caneadea-Canadice Association, Platea-Pierpont Association, and Platea-Sheffield Association. The Caneadea-Canadice Association are characterized by deep, nearly level to gently sloping areas that vary from very poorly drained to well drained in a few locations. In general these soils suffer from flooding and seasonal wetness and ponding, and have moderately slow to very slow permeability. Typically they have high seasonable water tables. The Caneadea-Canadice Association consists of soils formed from fine texture lacustrine material, glacial outwash, or glacial till. In addition there are also the Platea-Pierpont Association, and the Platea-Sheffield Association. These are characterized by deep, nearly level to gently sloping soils that very from somewhat poorly drained to poorly drained silty soils situated on glaciated uplands. The Platea-Pierpont Association occurs in the northern part of the county on hummocky morainal deposits. About 41 percent of the soils are considered potentially highly erodible. Tables 165 & 166 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Ashtabula County.

Table 167. 041100040203 – Subwatershed Highly Erodible Soil by Acres

(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
164	6184	8034	674

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Lower Rock Creek subwatershed is made up of 49% from Group C/D Hydrologic Soil. Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Some soils having clay, silty clay, or sandy clay textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments (Table 168).

Table 168. 041100040203 - Subwatershed Hydrologic Soil Groups by Acres
(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

A	B	C	D	A/D	B/D	C/D
182	0	129	5531	0	1606	7063

Water Quality
The physical habitat quality of streams in the Upper Grand River basin is largely influenced by topography, drainage area, and the juxtaposition of glacial till and lacustrine deposits. Essentially this creates three distinct stream types: lowland streams, upland headwaters, and the non-wadeable Grand River mainstem.

Where the topography is flat, and the substrates are composed primarily of lacustrine silts and clays, habitat quality is generally poor and not conducive to stream faunas typical of the ecoregion.

According to the Biological and Water Quality Study of the Upper Grand River 2007, the Ohio EPA reported Rock Creek has a verified WWH use. Biological samples collected adjacent to Footville - Richmond Road (RM 0.95) met WWH criteria. Samples collected at SR 46 (RM 1.23), however, narrowly missed the standard for WWH because the stream was flow-starved by Lake Roaming Rock. Additionally, nuisance levels of algae were present.

Whetstone Creek has an unverified WWH designation. Results of fish and macroinvertebrate samples collected near SR 46 (RM 2.00) documented that the WWH use was not being met. Habitat quality, though marginal, was sufficient to support a WWH fish assemblage. Water chemistry samples revealed high ammonia nitrogen and high total dissolved solid concentrations, suggesting that pollution was the cause of non-attainment.

Table 169. 041100040203 – Subwatershed Aquatic Life Use (ALU) Designation
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-130 Rock Creek			
1.23	WWH	Partial	Flow starved, Nutrients
0.95	WWH	Full	
03-133 Whetstone Creek - unverified WWH designation			
2.00	WWH	Non	TDS, NH_3/source unknown

The quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

The Biological and Water Quality Study of the Upper Grand River 2007 indicates fish communities were evaluated at four sites on Rock Creek, two upstream from Lake Roaming Rock, and two bracketing the Village of Rock Creek WWTP. The fish community sampled downstream from the WWTP met standards for WWH. Upstream from the WWTP, fish were limited by lack of flow, and did not meet the standard for WWH.

Whetstone Creek, located in hydrologic unit 0411000402, is a wetland stream with little potential to support a typical WWH fauna. However, Whetstone Creek was unique in that it was impounded by beaver dams, and supported an abundance of pumpkinseed sunfish and golden shiners - exactly what one would expect of a beaver dam pool.

Table 170. 041100040203 - Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIWb[a]	Narrative
03-130 Rock Creek - WWH										
G01K03	1.23	25	19	548.3	2.5	70	50.5	41	7.2*	Good/Fair
G01W05	0.95	24	19.5	402	21.5	70	68.5	40	8.2	Good
03-133 Whetstone Creek - unverified WWH - recommended										
300200	2	11	11	891	0	5.9	51.5	30*		Fair

a - MIwb is not applicable to headwater streams with drainage areas < 20 mi2.
* - Indicates significant departure from applicable biocriteria (>4 IBI units or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

The Rock Creek subwatershed was in non-attainment for recreational use throughout it's entire reach (with one exception, Rock Creek RM 1.23 is in full attainment of it's recreational use). The ubiquity of relatively high bacteria counts clearly suggests that the bacteria indicators are not serving exclusively as surrogates for pathogens of human origin. E. coli counts followed a log-normal distribution suggesting an origin from diffuse sources such as livestock and wildlife (Table 171).

In Whetstone Creek high *E. coli* counts were associated with indicators of organic enrichment. The ubiquity of high bacteria counts clearly suggests that the bacteria indicators are not serving exclusively as surrogates for pathogens of human origin. Where anecdotal evidence pointed to contamination from human origins, the elevated fecal counts in Whetstone Creek were associated with high TDS and nitrates, as well as ammonia and Kjeldahl nitrogen, suggesting a slug of untreated nitrogenous wastes, possibly from a spill or illegal dumping. (Table 169).

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 171. 041100040203 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Lower Rock Creek Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	STORET	GEOMEAN	N	Class	Attainment	Sources
Rock Creek						
1.23	G01K03	92	6	B	Full	
Whetstone Creek						
2	300200	212	2	B	Non	Spill?

Macroinvertebrate communities evaluated in the Upper Grand River tributaries can be grouped, to a large part, based on the physical habitat, shaped by the typography of the landscape, they flow through.

The macroinvertebrate community sampled downstream from Lake Roaming Rock was evaluated as good with diversity of EPT (13, 14) and sensitive taxa (16, 15). The stream water surface was completely covered by floating mats of filamentous algae at these sites at the time of artificial substrate placement (11 July). This nuisance algal growth may be due to a combination of nutrient enrichment and limited flow from the reservoir. The algal mats were washed downstream by a high water event prior to the artificial substrate retrieval (29 August). The discharge from the Village of Rock Creek WWTP at RM 1.05 did not affect the ICI score or diversity of EPT and sensitive taxa in the qualitative sample. However, mild impacts from the WWTP included thick silt deposits observed at the downstream station and the macroinvertebrate community had greater abundance of flatworms (pollution facultative taxa often associated with enrichment effects) and an overall increase in organism density (705 orgs./sq.ft. at RM 1.23 compared to 1162 at RM 0.95). The EPT and sensitive taxa diversity was similar in 1987 downstream from the reservoir, prior to the construction of the Village of Rock Creek WWTP.

Whetstone Creek RM 2.00 is a headwater stream station limited by low to interstitial flow. Macroinvertebrate communities evaluated at this station had lower than expected EPT (3-7) and sensitive taxa (3-11) diversity, due to the loss of surface flow as the result of the water table dropping below the level of the riffle habitats.

Table 172. 041100040203 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Lower Rock Creek Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	Drain Area (mi2)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Rock Creek (03-130)										
1.23	70	-	45	13/14	16/20	M/705	0	Caddisflies (F,MI), baetid mayflies (F,I)	44	
0.95	70	-	49	14/15	15/20	M-H/1163	0	Hydropsychid caddisflies (F), midges (MI,F), riffle beetles (F)	44	
Whetstone Creek (03-133)										
2.0	4.0	9	29	6	6	L	0	Heptageniid mayflies (F), midges (T,F), crayfish (F)	-	Fair

- **12-digit HUC 041100040203 – Lower Rock Creek Subwatershed Problem Statements, Goals, objectives and Action**

Summary of Impairments: The major causes of impairment for Lower Rock Creek, a 12-digit subwatershed of Rock Creek 10-digit subwatershed, include pathogen loading (fecal coliform and E. coli) in excess of 51 colony forming units (cfu) per year. Those causes are primarily associated with a spill or illegal dumping.

Problem Statement 1: The presence of about 51 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) associated with high TDS and nitrates, as well as ammonia and Kjeldahl nitrogen, suggesting a slug of untreated nitrogenous wastes as the cause of recreational use designation non-attainment status for Whetstone Creek a tributary of Lower Rock Creek. The most likely source is a spill or illegal dumping upstream of the sampling site at RM 2.

Goal: Determine if a spill or illegal dumping upstream of the sampling site at RM 2 is the most likely source for the presence of about 51 colony forming units (cfu) per year elevated levels of excess pathogenic bacteria in Whetstone Creek.

Objective: Sample upstream, downstream and at the RM 2 sampling site on Whetstone Creek to survey Whetstone Creek for the presence of elevated levels of excess pathogenic bacteria.
Action 1: Conduct sample survey to follow up results of Biological and Water Quality Study of the Upper Grand River 2007 for Whetstone Creek.
Action 2: If elevated levels of excess pathogenic bacteria are present in Whetstone Creek, use gathered survey data to determine most likely source of excess pathogen loading.
Action 3: Update Upper Grand River Watershed Action Plan with course of action to reduce excess pathogen loading in impaired section of Whetstone Creek.

Problem Statement 2: Local stakeholder concern has identified 481 acres of land with high natural area conservation value (Map 79) under threat of conversion. It was assumed that for a single family housing development on the 481 acres, 50% of the land would be preserved as open space. Of the remaining 240.5 acres developed as single-family residential, it was assumed that the development would use filter buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by impervious surfaces and residential land use (excess loading of nitrogen (N) - 518 lbs/year, phosphorus (P) - 76 lbs/year, Biological Oxygen Demand (BOD) - 2106 lbs/year and Sediment – 5 tons/year) would push adjacent sections of Phelps Creek to impairment (see table 173).

Goal: Protect 481 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 481 acres of land with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 173. Lower Rock Creek Subwatershed Land Protection Load Estimates for land protection.

Current land use loading as 481 acres of forest			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
120.7	58.5	293.5	5.1
New land use loading following development of 240 acres as single-family housing with LID			
N Load lb/year	**P Load lb/year**	**BOD lb/year**	**Sediment Load t/year**
638.5	134.4	2399.5	10.1
Net increase due to land use change			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
517.8	**75.9**	**2106**	**5**

Problem Statement 3: Local stakeholder concern has identified 51 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 51 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 51 acres of wetlands with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified wetland protection properties.

Problem Statement 4: Local stakeholder concern has identified 5.82 miles or 30738 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant

pollutants generated by channel erosion (excess loading of sediment – 523 tons/year, N - 1046 lbs/year and P - 523 lbs/year) would push adjacent sections of Phelps Creek to impairment (see table 174).

Goal: Protect 5.82 miles or 30738 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 5.82 miles or 30738 linear feet of stream corridor with high natural area conservation value.

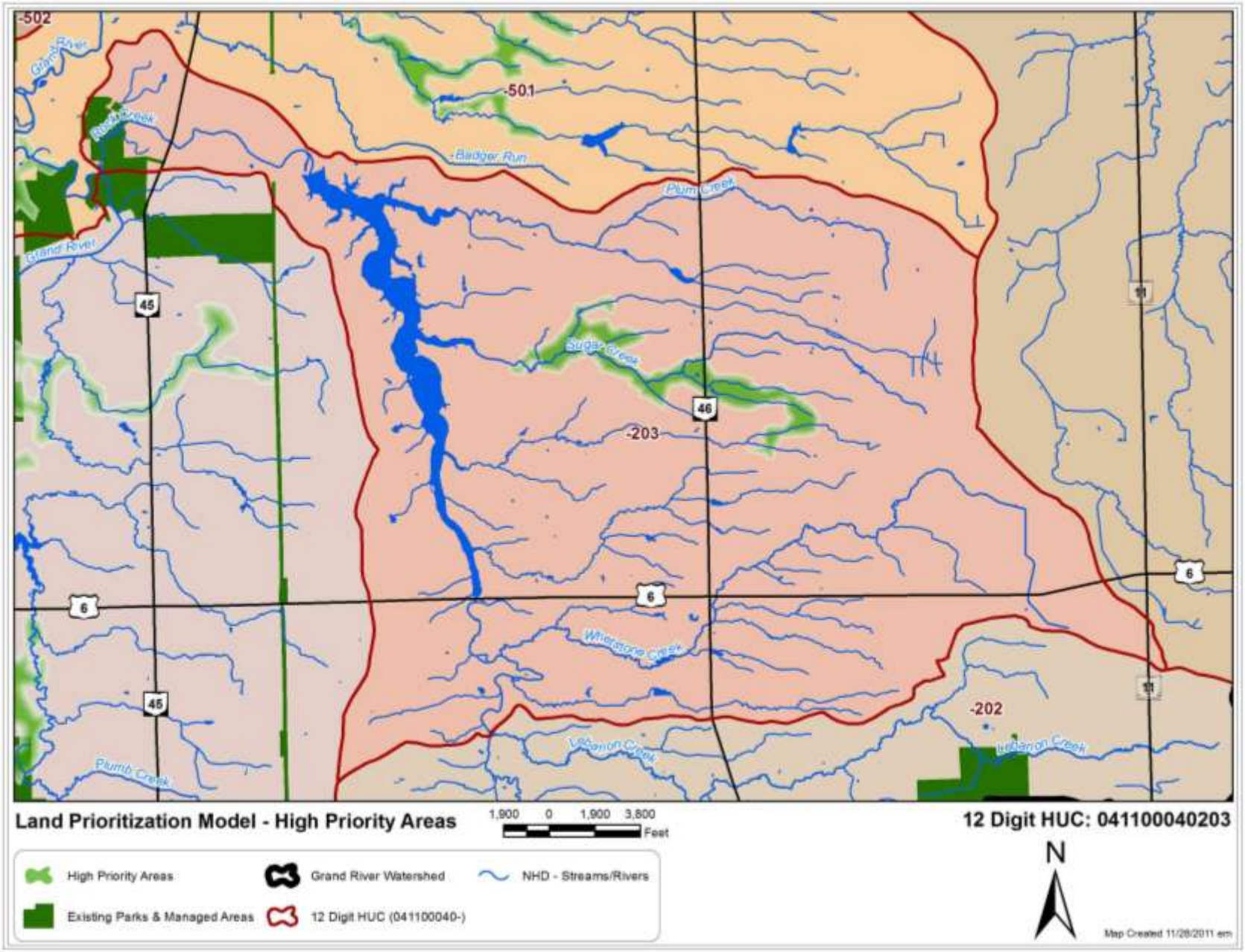
Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 174. Lower Rock Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	261.3	261.3
Phosphorus Load Reduction (lb/year)			261.3	261.3
Nitrogen Load Reduction (lb/yr)			522.5	522.5

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 79 – 041100040203 Lower Rock Creek Land Protection Prioritization Model - High Priority Areas



This Page Intentionally left blank

J. Phelps Creek Subwatershed

12 Digit HUC: 041100040301
Location: Phelps Creek
Drainage Area: 29.32 miles^2, 18765 acres
Miles of stream: 82.93 miles
Average Sinuosity: 1.16
Average Impervious Cover: 1.21%

Photo 20. Phelps Creek near confluence with Grand River *(Source: G. Warnock)*

Subwatershed Description
The Phelps Creek 12-digit HUC subwatershed represents 22 percent of the five (5) subwatersheds in the Phelps Creek 10-digit HUC subwatershed to the Grand River Watershed. This watershed drains mostly forested, cultivated crops and pasture/hay land in Windsor Township in Ashtabula county, the Village of Middlefield, Huntsburg, Middlefield and Montville Townships in Geauga County and Mesopotamia Township in Trumbull County.

As of 2006, about 4% or 809 acres of land development (low, medium & high intensity) has occurred in the Phelps Creek subwatershed, with 53 percent or 9891 acres of the land use as forested and 40 percent or 7509 acres as agricultural land use (Table 174, Map 60). Deciduous forest makes up 64 percent of the forested land use, Cultivated Crops and Pasture/Hay makes up 97 percent of agricultural land use and Corn & Soybeans dominates the row crop production at 90 percent *(2009 USDA Cropland Cover)*.
Table 175. 041100040301 – Subwatershed Land Use

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Developed, High Intensity	2	0.01
Developed, Medium Intensity	26	0.14
Developed, Low Intensity	781	4.17
Developed, Open Space	64	0.34
Cultivated Crops	2824	15.06
Pasture/Hay	4685	24.99
Grassland/Herbaceous	234	1.25
Deciduous Forest	6316	33.69
Evergreen Forest	89	0.48
Mixed Forest	82	0.44
Scrub/Shrub	1890	10.08
Palustrine Forested Wetland	1303	6.95
Palustrine Scrub/Shrub Wetland	211	1.13
Palustrine Emergent Wetland	128	0.68
Bare Land	7	0.04
Open Water	107	0.57
Total	**18749**	

Floodplain

Forest and pasture make up 83 percent of the land use in the Phelps Creek Subwatershed floodplain. Forest covers 66 percent or 2273 acres and pasture/hay covers 16 percent or 562 acres of the 3436 acres of flood plain. The next closest land uses in the flood plain are open space at 146 or 4 percent and open water at 143 acres or 4 percent. High, medium and low density development only composes 50 acres or just 1.44 percent of the floodplain (Table 175).

Table 176. 041100040301 – Subwatershed Land Use Within Floodplain

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Agriculture	60	1.75
Grass/Pasture/Non-Ag	14	0.41
Barren	0	0.00
Deciduous Forest	2273	66.15
Developed/High Intensity	0	0.00
Developed/Low Intensity	50	1.44
Developed/Medium Intensity	0	0.00
Developed/Open Space	146	4.25
Evergreen Forest	2	0.05
Grassland Herbaceous	78	2.28
Herbaceous Wetlands	2	0.07
Open Water	143	4.17
Pasture/Hay	562	16.36
Shrubland	4	0.13
Woody Wetlands	101	2.93
Total	**3436**	

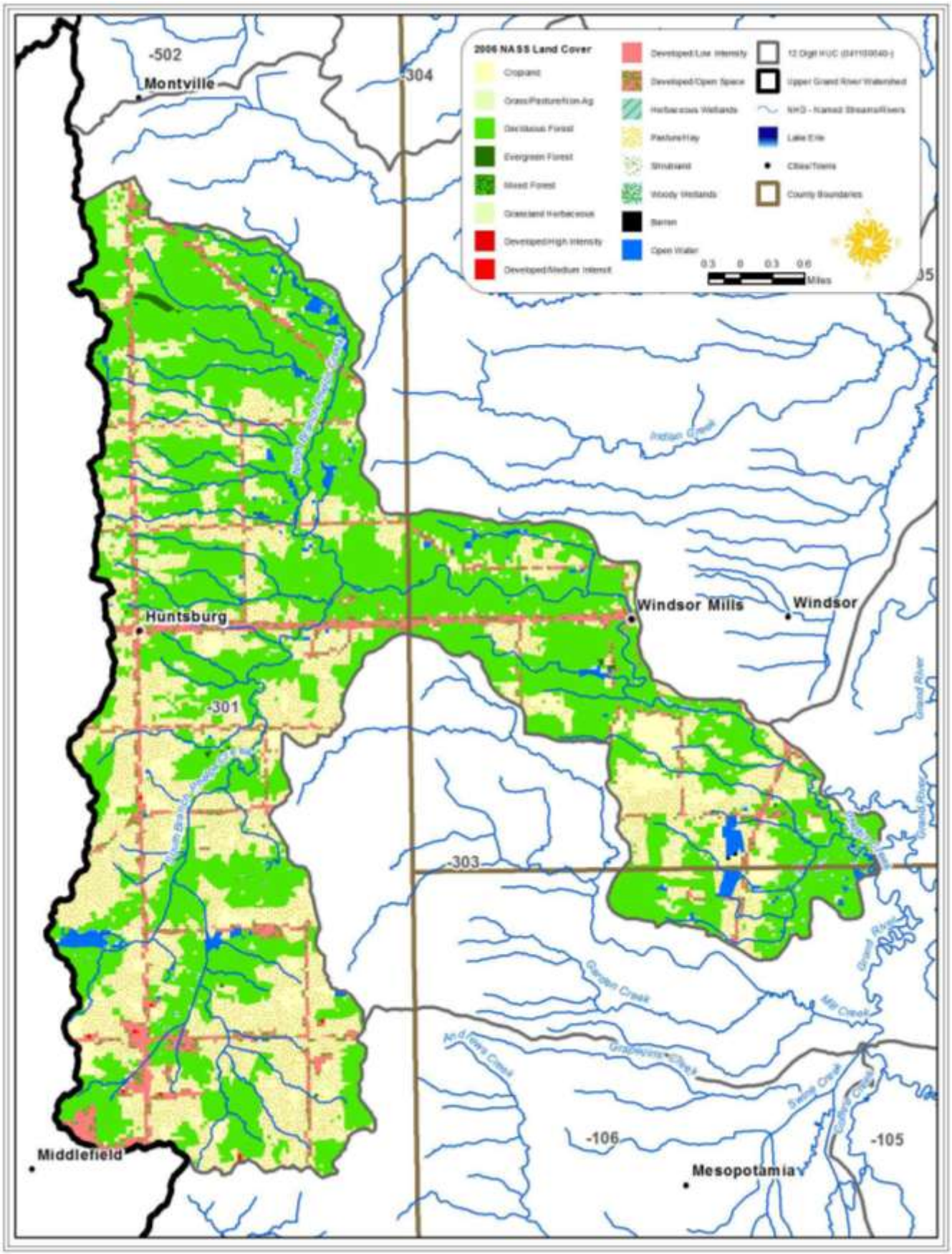
Table 177. 041100040301 – Subwatershed Wetland Types by Acres

(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Lake	Pond	Riverine	Grand Total
131	3152	60	178	13	3534

Map 80. 041100040301 – Subwatershed Land Use

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)


2006 NASS Land Cover
Cropland
Grass/Pasture/Non Ag
Deciduous Forest
Evergreen Forest
Mixed Forest
Grassland Herbaceous
Developed/High Intensity
Developed/Medium Intensit
Developed/Low Intensity
Developed/Open Space
Herbaceous Wetlands
Pasture/Hay
Shrubland
Woody Wetlands
Barren
Open Water
12 Digit HUC
Upper Grand River Watershed
NHD - Named Streams/Rivers
Lake Erie
Cities/Towns
County Boundaries
0.3 0 0.3 0.6
Miles
-502
Montville
-304
Huntsburg
Windsor Mills
Windsor
-301
-303
-106
-105
Middlefield
Mesopotamia
Indian Creek
Grand River
Gibson Creek
Mill Creek
North Fork Creek
Grassy Creek
Swine Creek
Collins Creek

This Page Intentionally left blank

Table 178. 041100040301 – Subwatershed Land Use Within Floodplain
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Agriculture	60	1.75
Grass/Pasture/Non-Ag	14	0.41
Barren	0	0.00
Deciduous Forest	2273	66.15
Developed/High Intensity	0	0.00
Developed/Low Intensity	50	1.44
Developed/Medium Intensity	0	0.00
Developed/Open Space	146	4.25
Evergreen Forest	2	0.05
Grassland Herbaceous	78	2.28
Herbaceous Wetlands	2	0.07
Open Water	143	4.17
Pasture/Hay	562	16.36
Shrubland	4	0.13
Woody Wetlands	101	2.93
Total	**3436**	

Table 179. 041100040301 – Subwatershed Wetland Types by Acres
(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Lake	Pond	Riverine	Grand Total
131	3152	60	178	13	3534

Soils

The major soils of the Phelps Creek subwatershed are Mahoning Ellsworth and the Remsen-Geeburg-Trumbull associations formed on the glaciated uplands in fine to moderately fine textured glacial till. These are distinguished by somewhat poorly drained to moderately drained soils that are fairly deep to the bedrock. Overall these soils have slow to very slow permeability and are nearly flat to gently sloping. The Remsen-Geeburg- Trumbull association tends to be found on steeper areas along major drainage areas. The Sebring-Holly-Caneadea Association is in low lying basins mainly in the southern portion of the Headwaters Subwatershed. Its main characteristics are poorly drained soils which are mainly silty or clayey. Most are level to gently sloping and were formed from either lacustrine material in former glacial lake basins, or from alluvial material on flood plains. Streams that form in these soils are typically slow, contain ponded areas and have a low gradient. About 54 percent of the soils are considered potentially highly erodible. Tables 177 & 178 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Ashtabula, Geauga, and Trumbull County.

Table 180. 041100040301 – Subwatershed Highly Erodible Soil by Acres
(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
351	10020	7826	511

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Phelps Subwatershed is made up of 37 percent from Group C/D Hydrologic Soil. Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Some soils having clay, silty clay, or sandy clay textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.

Table 181. 041100040301 - Subwatershed Hydrologic Soil Groups by Acres
(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

A	B	C	D	A/D	B/D	C/D
110	157	3509	6082	63	1783	6776

Water Quality
According to the Biological and Water Quality Study of the Upper Grand River 2007, the Ohio EPA reported the Grand River Headwaters transitions rapidly from a small, upland, coldwater stream to a large, lowland swamp stream. As such, three aquatic life uses are appropriate (See Table 6).

Phelps Creek is presently designated EWH based on a single fish sample collected at Wiswell Road (RM 4.9). Fish and macroinvertebrate samples collected in 2007 from Wiswell Road and Windsor Road Extension (T-525; RM 1.23) indicate that a CWH use is appropriate for the reach upstream from SR 534 (RM 2.1) given the combination of 3 coldwater macroinvertebrate taxa, plus redside dace and mottled sculpin. Downstream from SR 534, where the creek enters the lacustrine lowlands, a WWH use is more appropriate(See Table 6).

The North Branch of Phelps Creek has a default WWH aquatic life use. Results of fish and macroinvertebrate samples collected at Huntley Road confirm this use(See Table 6).

The South Branch of Phelps Creek has a default WWH aquatic life use. Results of fish and macroinvertebrate samples collected adjacent to US 322 (RM 0.58) confirm this use. The reach sampled at Peters Road (RM 5.2) is transitional to primary headwater habitat(See Table 6).

Table 182. 041100040301 – Subwatershed Aquatic Life Use (ALU) Designation
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-150 Phelps Creek			
4.90	EWH/CWH	Partial/Full	Redesignated to CWH
1.23	EWH/WWH	Partial/Full	Segment previously unsampled, meets WWH
03-151 North Branch Phelps Creek			
1.10	WWH	Full	Needs follow up monitoring, pond construction
03-152 South Branch Phelps Creek			
5.20	WWH	Partial	Natural - Low Flow
0.58	WWH	Full	

The Biological and Water Quality Study of the Upper Grand River 2007 indicates the quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

The streams in the western half of the Phelps Creek 10 Digit subwatershed have high gradients, and possess the energy to form well-developed channels through the coarse substrates and sediments composed of coarse-grained glacial till and sandstone bedrock. Where these streams enter the lowlands, stream gradient drops and substrates become fine-grained, though sandier than streams on the southeastern side of the catchment. Typically, the faunas in these headwaters are not limited by habitat quality. The combination of a high gradient, coarse-grained reach running into a low gradient, fine-grained reach makes these streams suitable for northern brook and American brook lamprey. Adult lamprey utilize the coarse substrate in the high gradient reach as spawning habitat, and the ammocoetes reside buried in depositional sediments, especially in the low gradient reaches. The Upper Grand River drainage is the only drainage in Ohio where these two species co-occur in the same stream.

North Branch Phelps at Huntley Road RM 0.94 shows evidence of marginal fish communities, and underperformed relative to less impacted sites located either upstream or downstream due to construction of an impoundment immediately upstream from Huntley Road (Table 7).

South Branch Phelps at Peters Road RM 5.16 is flow-starved and little riparian canopy in it's upstream network relative to the remainder of the drainage area. This habitat alteration appeared to limit fish communities, though aerial photos reveal no upstream impoundment (Table 7).

Table 183. 041100040301 - Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIWb[a]	Narrative
03-150 Phelps Creek - EWH/CWH recommended										
300190	4.9	21	17	775.3	6.5	23.5	73.5	36 ns	7.4 ns	Marginally Good
03-150 Phelps Creek - EWH/WWH recommended										
G01K06	1.2	26	20	375	4.5	25.8	65	45	7.7 ns	Good/Marginally Good
03-151 North Branch Phelps Creek - unverified WWH - recommended										
300189	1.1	13	13	555	0	6.3	66.5	38		Good
03-152 South Branch Phelps Creek - unverified WWH - recommended										
300193	5.2	11	11	603	0	4.7	69.5	34ns		Marginally Good
300192	0.6	14	14	1234	0	11.8	73.5	44		Good

a - MIwb is not applicable to headwater streams with drainage areas < 20 mi2.
ns - Nonsignificant departure from biocriteria (<4 IBI units or <0.5 MIwb units).

The ubiquity of high bacteria counts clearly suggests that the bacteria indicators are not serving exclusively as surrogates for pathogens of human origin. E. coli counts followed a log-normal distribution suggesting an origin from diffuse sources such as livestock and wildlife. Additional indicators failed to point to an identifiable source, so the Phelps Creek source is listed as unknown (Table 181).

North Branch Phelps Creek is one of the waterbodies where high E. coli counts were associated with indicators of organic enrichment. Where anecdotal evidence pointed to contamination from human origins, the sources appeared to be unsewered homes affecting the North Branch Phelps Creek (Table 8).

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 184. 041100040301 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Headwaters Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	STORET	GEOMEAN	N	Class	Attainment	Sources
Phelps Creek						
5	300190.0	72	2	A	Full	
1.23	G01K06	451	5	B	Non	Unknown
North Branch Phelps Creek						
1.10	300189	420	2	B	Non	On-site Sewerage
South Branch Phelps Creek						
5.20	300193	160	1	B	Full	
0.58	300192	88	2	B	Full	

Macroinvertebrate communities evaluated in the Upper Grand River tributaries can be grouped, to a large part, based on the physical habitat, shaped by the typography of the landscape, they flow through. Many of the streams on the western part of the basin flow through high gradient channels that in places have cut down to sandstone bedrock and receive significant groundwater. These streams generally have high EPT (19-31) and sensitive taxa (23-41) diversity, presence of cold water taxa (4-9), and uncommonly collected sensitive taxa (1-9). The stream station at Phelps Creek RM 4.90 falls into this category and has high numbers of uncommon fauna components and should receive the highest level of resource protection (Table 8).

Table 185. 041100040301 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Headwaters Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	Drain Area (mi2)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Phelps Creek (03-150)										
4.90	24	-	70	29	41	M-H	3	Caddisflies (MI,F), mayflies (MI,F,I), midges (MI,F)	-	Exceptional
1.23	25.7	-	55	19/25	25/37	L-M	2	Hydropsychid caddisflies (F), baetid mayflies (F,I), midges (F,MI)	60	
North Branch Phelps Creek (03-151)										
1.10	6	-	62	24	32	L-M	2	Caddisflies (F,MI)	-	Exceptional
South Branch Phelps Creek (03-152)										
0.58	12	-	47	15	20	L-M	1	Caddisflies (F,MI), water penny beetles (MI), flatworms (F)	-	Good

- **12-digit HUC 041100040301 – Phelps Creek Subwatershed Problem Statements, Goals, objectives and Action**

Summary of Impairments: The major causes of impairment for Phelps Creek, a 12-digit subwatershed of Phelps Creek – Grand River 10-digit subwatershed, include natural causes and pathogen loading (fecal coliform and E. coli) in excess of 550 colony forming units (cfu) per year. Those causes are primarily associated with unknown sources, failing HSTS and natural sources.

Problem Statement 1: The presence of about 260 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for North Branch Phelps Creek. The most likely source is approximately 50 to 100 of the failing Home Sewage Treatment Systems (HSTS) in the Phelps Creek Subwatershed.

Goal: Reduce pathogenic bacteria from failing HSTS discharge by about 52 cfu on average per year for five consecutive years, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Inspect the estimated 315 Home Sewage Treatment Systems (HSTS) for failure along 4 miles of North Branch Phelps Creek and it's tributaries.
Action1: Conduct annual inspections on 20 percent of off-lot discharging systems that directly outlet to a tributary.
Action 2: Document failed systems & develop comprehensive HSTS database as inspections are completed.
Action 3: Gather and enter data on type of system, geo-coded location, year of installation, date of last inspection, date of last pumping, and sampling results.

Objective 2: Upgrade, repair or replace a minimum of 50 failing Home Sewage Treatment Systems (HSTS) along 4 miles of North Branch Phelps Creek and it's tributaries.
Action 1: Implement repair or replacement procedures to bring systems into compliance.
Action 2: Introduce new, proven technology such as Wisconsin mounds, drip irrigation, and shallow trench or at-grade systems and integrate into current regulations.
Action 2: Utilize private sector service industry permit inspection program to help assure proper operation and maintenance of discharging systems and/or soilbased treatment and disposal systems.

Objective 3: Use education and outreach along with other informational programs and services to assist the estimated 315 residents with Home Sewage Treatment Systems (HSTS) in the area of North Branch Phelps Creek on operation and maintenance of systems and assistance with corrective measures.
Action 1: Conduct annual homeowner septic system operation and maintenance workshop for residents with HSTS.
Action 2: Assist qualified homeowners in identifying financial assistance for repairs or replacements or conversion to central sewer.

Problem Statement 2: The presence of about 290 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for approximately 3 miles of Phelps Creek near RM 1.23. The most likely source is approximately 50 to 100 of the failing Home Sewage Treatment Systems (HSTS) in the Phelps Creek Subwatershed.

Goal: Reduce pathogenic bacteria from failing HSTS discharge by about 58 cfu on average per year for five consecutive years, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Inspect the estimated 252 Home Sewage Treatment Systems (HSTS) for failure along 3 miles of Phelps Creek near RM 1.23.
Action1: Conduct annual inspections on 20 percent of off-lot discharging systems that directly outlet to a tributary.
Action 2: Document failed systems & develop comprehensive HSTS database as inspections are done.
Action 3: Gather and enter data on type of system, geo-coded location, year of installation, date of last inspection, date of last pumping, and sampling results.

Objective 2: Upgrade, repair or replace a minimum of 50 failing Home Sewage Treatment Systems (HSTS) along 3 miles of Phelps Creek near RM 1.23.
Action 1: Implement repair or replacement procedures to bring systems into compliance.
Action 2: Introduce new, proven technology such as Wisconsin mounds, drip irrigation, and shallow trench or at-grade systems and integrate into current regulations.
Action 2: Utilize private sector service industry permit inspection program to help assure proper operation and maintenance of discharging systems and/or soilbased treatment and disposal systems.

Objective 3: Use education and outreach along with other informational programs and services to assist the estimated 252 residents with Home Sewage Treatment Systems (HSTS) along 3 miles of Phelps Creek near RM 1.23 on operation and maintenance of systems and assistance with corrective measures.
Action 1: Conduct annual homeowner septic system operation and maintenance workshop for residents with HSTS.
Action 2: Assist qualified homeowners in identifying financial assistance for repairs or replacements or conversion to central sewer.

Problem Statement 3: Local stakeholder concern has identified 1747 acres of land with high natural area conservation value under threat of conversion. It was assumed that for a single family housing development on the 1747 acres, 50% of the land would be preserved as open space. Of the remaining 874 acres developed as single-family residential, it was assumed that the development would use filter buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by impervious surfaces and residential land use (excess loading of nitrogen (N) - 2829 lbs/year, phosphorus (P) - 410 lbs/year, Biological Oxygen Demand (BOD) - 11533 lbs/year and Sediment – 24 tons/year) would push adjacent sections of Phelps Creek to impairment (see table 184).

Goal: Protect 1747 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 1747 acres of land with high natural area conservation value.
Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 186. Phelps Creek Subwatershed Land Protection Load Estimates for land protection.

Current land use loading as 1747 acres of forest			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
694	334.3	1680.0	34.5
New land use loading following development of 874 acres as single-family housing with LID			
N Load lb/year	**P Load lb/year**	**BOD lb/year**	**Sediment Load t/year**
3522.8	744.6	13213.1	58.5
Net increase due to land use change			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
2828.8	**410.3**	**11533.1**	**24**

Problem Statement 4: Local stakeholder concern has identified 532 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 532 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 532 acres of wetlands with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified wetland protection properties.

Problem Statement 5: Local stakeholder concern has identified 16.79 miles or 88636 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant pollutants generated by channel erosion (excess loading of sediment – 1507 tons/year, N - 3014 lbs/year and P - 1507 lbs/year) would push adjacent sections of Phelps Creek to impairment (see table 185).

Goal: Protect 16.79 miles or 88636 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 16.79 miles or 88636 linear feet of stream corridor with high natural area conservation value.

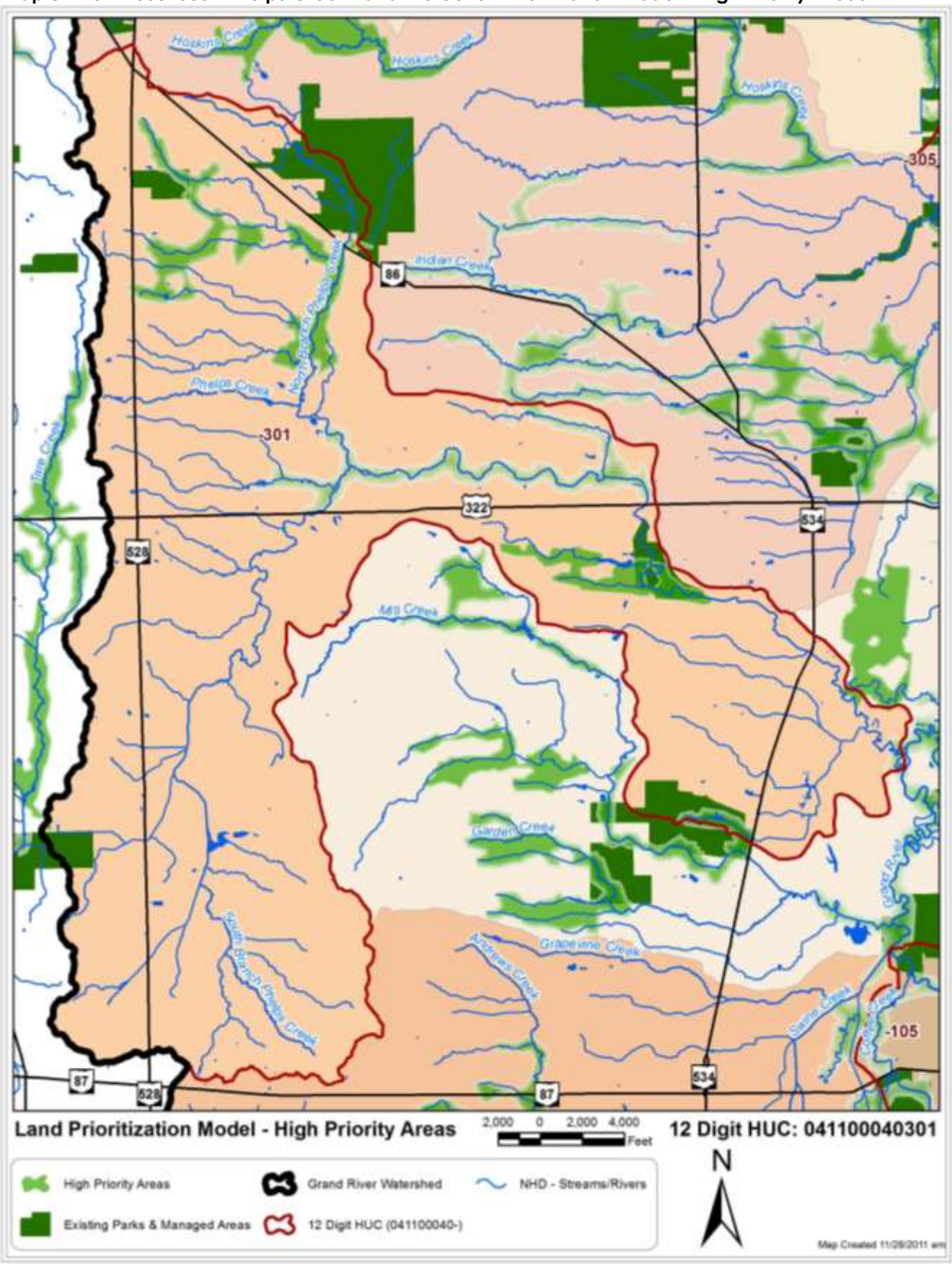
Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 187. Phelps Creek Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	753.4	753.4
Phosphorus Load Reduction (lb/year)			753.4	753.4
Nitrogen Load Reduction (lb/yr)			1506.8	1506.8

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 81 – 041100040301 Phelps Creek Land Protection Prioritization Model - High Priority Areas



K. Hoskins Creek Subwatershed

12 Digit HUC: 041100040302
Location: Hoskins Creek
Drainage Area: 26.84 miles^2, 17175 acres
Miles of stream: 74.03 miles
Average Sinuosity: 1.13
Average Impervious Cover: 0.88%

Photo 21. Hoskins Creek at Conjunction with Grand River (source: G. Warnock)

Subwatershed Description
The Hoskins Creek 12-digit HUC subwatershed represents 20 percent of the five (5) subwatersheds in the Phelps Creek 10-digit HUC subwatershed to the Grand River Watershed. This watershed drains mostly forested, cultivated crops and pasture/hay land in Hartsgrove, Orwell, and Windsor Townships in Ashtabula county and Huntsburg and Montville Townships in Geauga County.

As of 2006, about 3% or 505 acres of land development (low, medium & high intensity) has occurred in the Hoskins Creek subwatershed, with 65 percent or 11152 acres of the land use as forested and 30 percent or 5369 acres as agricultural land use (Table 186, Map 82). Deciduous forest makes up 67 percent of the forested land use, Cultivated Crops and Pasture/Hay makes up 96 percent of agricultural land use and Corn & Soybeans dominates the row crop production at 87 percent *(2009 USDA Cropland Cover)*.

Table 188. 041100040302 – Subwatershed Land Use
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed

Developed, High Intensity	0	0.00
Developed, Medium Intensity	17	0.10
Developed, Low Intensity	487	2.83
Developed, Open Space	4	0.03
Cultivated Crops	3332	19.40
Pasture/Hay	1828	10.65
Grassland/Herbaceous	209	1.22
Deciduous Forest	7490	43.61
Evergreen Forest	58	0.34
Mixed Forest	43	0.25
Scrub/Shrub	2122	12.35
Palustrine Forested Wetland	1296	7.54
Palustrine Scrub/Shrub Wetland	143	0.83
Palustrine Emergent Wetland	103	0.60
Open Water	42	0.24
Total	**17175**	

Floodplain

Forest and pasture make up 83 percent of the land use in the Hoskins Creek Subwatershed floodplain. Forest covers 74 percent or 1903 acres and pasture/hay covers 11 percent or 288 acres of the 2567 acres of flood plain. The next closest land use in the flood plain is open space at 164 or 4 percent. High, medium and low density development only composes 29 acres or just 1.51 percent of the floodplain (Table 187).

Table 189. 041100040302 – Subwatershed Land Use Within Floodplain

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Agriculture	57	2.22
Grass/Pasture/Non-Ag	11	0.44
Barren	0	0.00
Deciduous Forest	1850	72.09
Developed/High Intensity	0	0.00
Developed/Low Intensity	38	1.46
Developed/Medium Intensity	1	0.05
Developed/Open Space	164	6.38
Evergreen Forest	4	0.14
Grassland Herbaceous	65	2.52
Herbaceous Wetlands	1	0.03
Open Water	45	1.76
Pasture/Hay	282	10.99
Shrubland	7	0.27
Woody Wetlands	42	1.65
Total	**2567**	

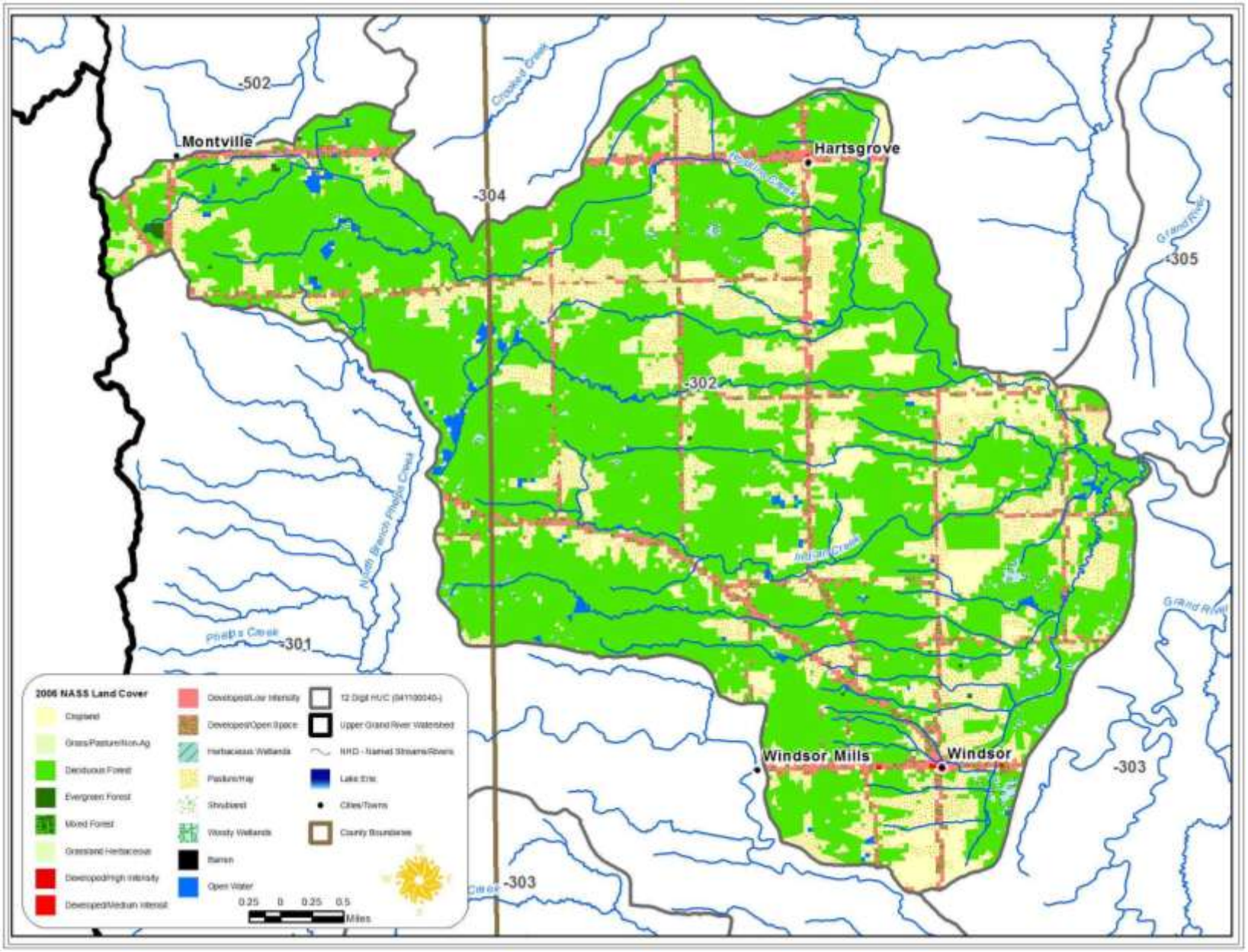
Table 190. 041100040302 – Subwatershed Wetland Types by Acres

(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Pond	Grand Total
157.8	3465.4	127.8	3751.0

Map 82. 041100040302 – Subwatershed Land Use

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)



This Page Intentionally left blank

Soils

The major soils of the Hoskins Creek subwatershed are Mahoning Ellsworth and the Remsen-Geeburg-Trumbull associations formed on the glaciated uplands in fine to moderately fine textured glacial till. These are distinguished by somewhat poorly drained to moderately drained soils that are fairly deep to the bedrock. Overall these soils have slow to very slow permeability and are nearly flat to gently sloping. The Remsen-Geeburg- Trumbull association tends to be found on steeper areas along major drainage areas. The Sebring-Holly-Caneadea Association is in low lying basins mainly in the southern portion of the Headwaters Subwatershed. Its main characteristics are poorly drained soils which are mainly silty or clayey. Most are level to gently sloping and were formed from either lacustrine material in former glacial lake basins, or from alluvial material on flood plains. Streams that form in these soils are typically slow, contain ponded areas and have a low gradient. About 30 percent of the soils are considered potentially highly erodible. Tables 189 & 190 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Ashtabula, Geauga, and Trumbull County.

Table 191. 041100040302 – Subwatershed Highly Erodible Soil by Acres

(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
236	5027	11381	526

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Hoskins Creek Subwatershed is made up of 53 percent from Group C/D Hydrologic Soil. Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Some soils having clay, silty clay, or sandy clay textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments (Table 190).

Table 192. 041100040302 - Subwatershed Hydrologic Soil Groups by Acres
(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

A	B	C	D	A/D	B/D	C/D
289	1	477	5734	25	1499	9030

Water Quality
According to the Biological and Water Quality Study of the Upper Grand River 2007, the Ohio EPA reported Hoskins Creek has a verified EWH designation base on one fish sample collected at Windsor Mechanicsville Road (RM 1.7). Fish and macroinvertebrate samples collected at two locations in 2007 demonstrate that a CWH use is a better fit given that four or more coldwater macroinvertebrate taxa were collected at both sites, along with mottled sculpin. The fish sample collected upstream from SR 534 and downstream US 6 underperformed relative to the available habitat. The stream is channelized upstream from US 6 and lacks riparian cover (See Table 6).

Indian Creek is designated EWH based on one fish sample collected at Noble Road (RM 1.4). Results of fish and macroinvertebrate samples collected downstream from Noble Road at RM 1.3 in 2007 demonstrate that a CWH use is more appropriate given the presence of 8 coldwater macroinvertebrate taxa, and redside dace and mottled sculpin (See Table 6).

The tributary at Hoskins Creek @ RM 0.4 is undesignated in Chapter 3745-1-10 of the Ohio Administrative Code. Insufficient information exists on which to assign an aquatic life use as the drainage area for the location sampled was greater than 5 mi^2, and the fish community was not evaluated (See Table 6).

The tributary at Hoskins Creek @ RM 2.45 was surveyed and the macroinvertebrate sample and field observations from the site at SR 534 (RM 1.15) determine that this stream is primary headwaters supporting four coldwater macroinvertebrate taxa. As such, it should be revaluated as Primary Headwater Habitat (PHWH) (See Table 6).

Table 193. 041100040302 – Subwatershed Aquatic Life Use (ALU) Designation
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-140 Hoskins Creek			
4.88	EWH/CWH	Partial	Channelization along US 6
2.01	EWH/CWH	Full	
03-141 Indian Creek			
1.30	EWH/CWH	Full	
03-143 Trib to Hoskins @ RM 0.4			
5.20	WWH	-	Natural - Wetlands
03-144 Trib to Hoskins @ RM 2.45			
1.15	PHWH/CWH		

The Biological and Water Quality Study of the Upper Grand River 2007 indicates the quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

Hoskins Creek RM 4.88, has undergone habitat alteration resulting from stream relocation and channelization upstream from and parallel to U.S. Route 6. The reach of Hoskins Creek sampled between SR 534 and US 6 possesses natural habitat, albeit primarily bedrock. However, upstream from US 6, the creek appears to have been historically re-routed to follow US 6 as a ditch for approximately one-half mile. Because the stream is bedrock, and not likely to score well naturally, it has limited capacity to absorb stress. The impact to habitat appears to have limited fish communities upstream from State Route 534 (downstream from U.S. Route 6). (See Table 192).

Table 194. 041100040302 - Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIWb[a]	Narrative
03-140 Hoskins Creek - EWH/CWH recommended										
300184	5	10	10	549.3	0	5.7	63.5	32*		Fine
G01K19	2.01	11	11	1502	0	13.5	62	46		Very Good
03-141 Indian Creek - EWH/CWH recommended										
200624	1	19	19	838	0	1.8	79.5	58		Excellent
03-143 Trib to Hoskins @ RM 0.4										
300196	1					7.2	0	0	DNS†	
03-144 Trib to Hoskins @ RM 2.45										
300197	1.15					2	0	0	PHW	

a - MIwb is not applicable to headwater streams with drainage areas < 20 mi2.
ns - Nonsignificant departure from biocriteria (<4 IBI units or <0.5 MIwb units).
* - Indicates significant departure from applicable biocriteria (>4 IBI units or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

The specific waterbodies where high E. coli counts were associated with indicators of organic enrichment were Hoskins Creek sample locations at RM 2.01 and RM 4.88. The ubiquity of high bacteria counts clearly suggests that the bacteria indicators are not serving exclusively as surrogates for pathogens of human origin. E. coli counts followed a log-normal distribution suggesting an origin from diffuse sources such as livestock and wildlife. Livestock was the suspected source for Hoskins Creek due to pastures in close proximity upstream from the sampling locations. Additional indicators failed to point to an identifiable source, so the source for Indian Creek and Tributary To Hoskins @ RM 2.45 is listed as unknown (Table 193).

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 195. 041100040302 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Headwaters Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	STORET	GEOMEAN	N	Class	Attainment	Sources
Hoskins Creek (03-140)						
4.88	300184	1386	2	B	Non	Livestock
2.01	G01K19	498	2	B	Non	Livestock
Indian Creek						
1.30	200624	559	2	B	Non	Unknown
Tributary To Hoskins @ RM 2.45						
1.15	300197	8200	1	B	Non	Unknown

Macroinvertebrate communities evaluated in the Upper Grand River tributaries can be grouped, to a large part, based on the physical habitat, shaped by the typography of the landscape, they flow through. Macroinvertebrate communities that were not meeting their designated or recommended Aquatic Life Use expectations, due to more or less natural low gradient landscapes that were formed by the glacial Grand River Lake or other former wetland areas, included Tributary to Hoskins Creek (@ RM 0.40).

Many of the streams on the western part of the basin flow through high gradient channels that in places have cut down to sandstone bedrock and receive significant groundwater. These streams generally have high EPT (19-31) and sensitive taxa (23-41) diversity, presence of cold water taxa (4-9), and uncommonly collected sensitive taxa (1-9). Hoskins Creek Stream station at RM 2.01 fell into this category. These stations

have high numbers of uncommon fauna components and should receive the highest level of resource protection (Table 9).

Other stations with four or more cold water macroinvertebrate taxa, and therefore would qualify for the CWH Aquatic Live Use, were Hoskins Creek RM 4.88 and Tributary to Hoskins Creek (@ RM 2.45) RM 1.15. The stream station at the Tributary to Hoskins Creek (@ RM 2.45) RM 1.15 had characteristics of PHWH streams and may best be classified thus (Table 9).

Table 196. 041100040302 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Headwaters Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	Drain Area (mi2)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Hoskins Creek (03-140)										
4.88	5.7	-	54	16	25	L	4	Caddisflies (F,MI), midges (MI), water penny beetles (MI)	-	Good
2.01	13.5	-	74	30	36	M-H	5	Caddisflies (MI,F), mayflies (F,I), midges (F,MI,MT)	-	Exceptional
Indian Creek (03-141)										
1.30	4	-	55	28	35	L-M	8	Caddisflies (MI,I,F), mayflies (MI,I), midges (MI)	-	Exceptional
Tributary to Hoskins Creek (@RM 2.45) (03-144)										
1.15	2	-	30	11	12	L	4	Caddisflies (MI,F), Nigronia fishflies (F), alderflies (F)	-	Marginal
Tributary to Hoskins Creek (@RM 0.40) (03-143)										
1.40	7	-	58	10	9	L-M	0	Scuds (F), hydropsychid caddisflies (F)	-	Fair

- **12-digit HUC 041100040302 – Hoskins Creek Subwatershed Problem Statements, Goals, objectives and Action**

Summary of Impairments: The major causes of impairment for Hoskins Creek, a 12-digit subwatershed of Phelps Creek – Grand River 10-digit subwatershed, include direct habitat alteration, pathogen loading (fecal coliform and E. coli) in excess of 10000 colony forming units (cfu) per year and natural conditions (flow or habitat). Those causes are primarily associated with channelization, livestock and natural sources.

Problem Statement 1: The presence of about 1225 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for approximately 2 miles of Hoskins Creek near RM 4.88. The most likely source is livestock manure runoff in this section of the Hoskins Creek Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 1225 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 1 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 1,075 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Objective 2: Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms (approximately 500 feet of streambank per farm), resulting in an excess pathogen loading reduction of 150 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 2: : The presence of about 335 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Hoskins Creek near RM 2.01. The most likely source is livestock manure runoff from pastures in close proximity upstream from the sampling location on the Hoskins Creek Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 335 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 1 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 260 cfu.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Objective 2: Establish livestock1000 lineal feet of livestock exclusion fencing along streams on 1 farm (approximately 500 feet of streambank), resulting in an excess pathogen loading reduction of 75 cfu.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 3: The presence of about 400 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Indian Creek. The most likely source is livestock manure runoff in the Hoskins Creek Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 400 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 1 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 325 cfu.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Objective 2: Establish 1000 lineal feet of livestock exclusion fencing along streams on 1 farms (approximately 500 feet of streambank), resulting in an excess pathogen loading reduction of 75 cfu.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 4: The presence of about 8040 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for unnamed Tributary to Hoskins Creek. The most likely source is livestock manure runoff in the Tributary to Hoskins Creek Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 8040 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 4 new manure storage facilities in adjacent agricultural areas, resulting in an excess pathogen loading reduction of 7740 cfu.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Objective 2: Establish 4000 lineal feet of livestock exclusion fencing along streams on 4 farms (approximately 500 feet of streambank per farm), resulting in an excess pathogen loading reduction of 300 cfu.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 5: Direct habitat alteration along approximately ½ mile of Hoskins Creek upstream from US Route 6 was the cause of partial aquatic life use attainment status for this portion of the stream. The source of this impairment is most likely the channelization of Hoskins Creek to follow US Route 6 as a ditch limiting fish habitat downstream to State Route 534.

Goal: Restore in-stream and riparian habitat along 1/2 mile of Hoskins Creek upstream of US Route 6 to improve fish habitat and achieve attainment of aquatic life use Designations (EWH/CWH).

Objective: Restore ½ mile of non-attaining streams, including restoration of in-stream habitat, stabilization of eroding banks, and re-connection to floodplain using ditch retrofit techniques.

Action: Pursue Ohio EPA Section 319(h) Non-point Source Program Grant or Ohio EPA Surface Water Improvement Fund (SWIF) grant, or other grants for the potential restoration project.

Problem Statement 6: Local stakeholder concern has identified 2964 acres of land with high natural area conservation value under threat of conversion. It was assumed that for a single family housing development on the 2964 acres, 50% of the land would be preserved as open space. Of the remaining 1482 acres developed as single-family residential, it was assumed that the development would use filter

buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by impervious surfaces and residential land use (excess loading of nitrogen (N) - 4309 lbs/year, phosphorus (P) – 636 lbs/year, Biological Oxygen Demand (BOD) - 17482 lbs/year and Sediment – 49 tons/year) would push adjacent sections of Hoskins Creek to impairment (see table 197).

Goal: Protect 2964 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 2964 acres of land with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 197. Hoskins Creek Subwatershed Land Protection Load Estimates for land protection.

Current land use loading as 2964 acres of forest			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
959	470	2356	26
New land use loading following development of 1482 acres as single-family housing with LID			
N Load lb/year	**P Load lb/year**	**BOD lb/year**	**Sediment Load t/year**
5268.8	1105.8	19837.5	75.2
Net increase due to land use change			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
4309.3	**635.8**	**17481.5**	**49.2**

Problem Statement 7: Local stakeholder concern has identified 790 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 790 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 790 acres of wetlands with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding

sources and applying for appropriate private and public funding intended for specified wetland protection properties.

Problem Statement 8: Local stakeholder concern has identified 27.64 miles or 145959 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant pollutants generated by channel erosion (excess loading of sediment – 2481 tons/year, N - 4962 lbs/year and P - 2481 lbs/year) would push adjacent sections of Hoskins Creek to impairment (see table 198).

Goal: Protect 27.64 miles or 145959 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 27.64 miles or 145959 linear feet of stream corridor with high natural area conservation value.

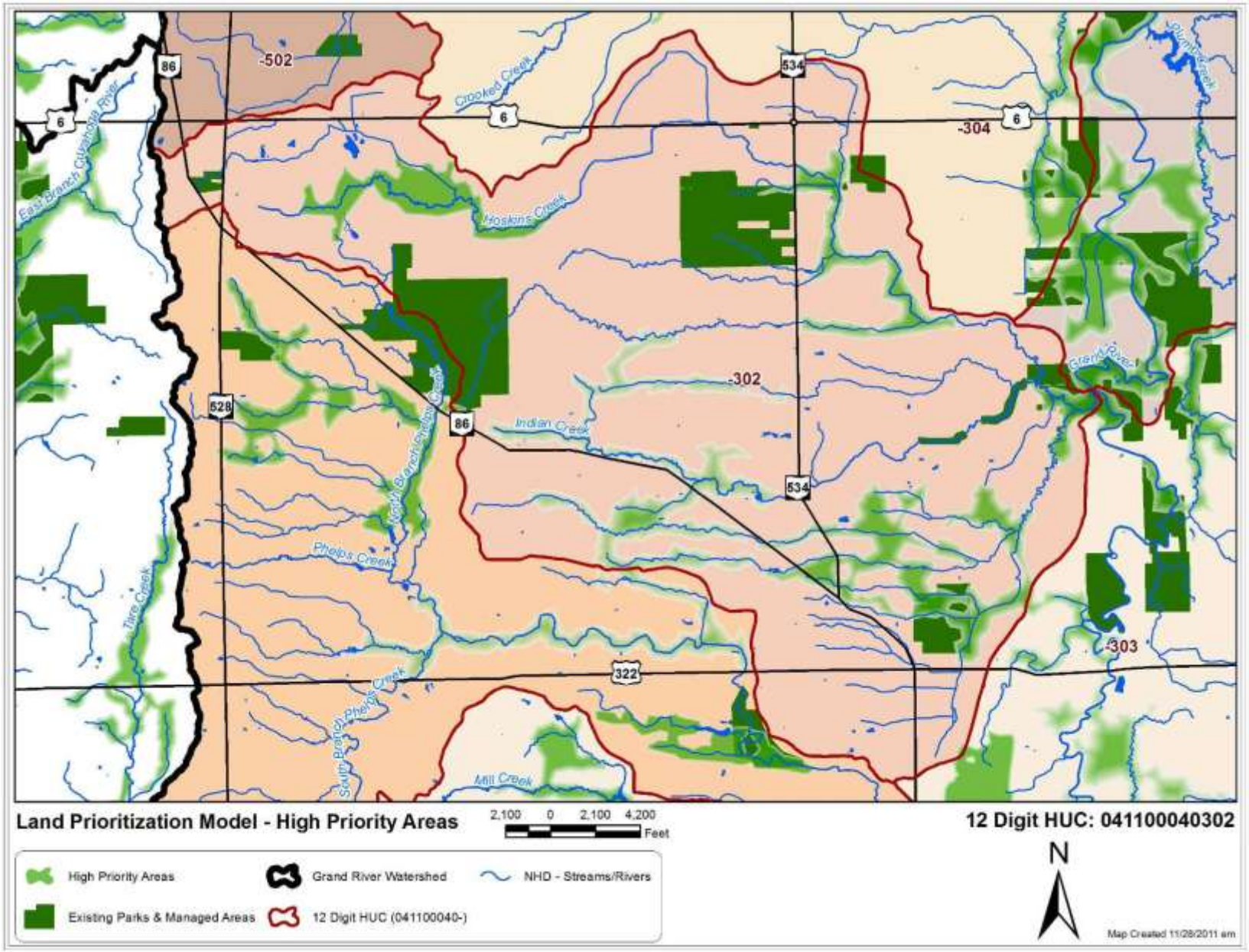
Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 198. Hoskins Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	1240.7	1240.7
Phosphorus Load Reduction (lb/year)			1240.7	1240.7
Nitrogen Load Reduction (lb/yr)			2481.3	2481.3

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 83 – 041100040302 Hoskins Creek Land Protection Prioritization Model - High Priority Areas



This Page Intentionally left blank

L. Mill Creek (1) - Grand River Subwatershed

12 Digit HUC: 041100040303
Location: Mill Creek (1)-Grand River Subwatershed
Drainage Area: 35.76 miles^2, 22888 acres
Miles of stream: 102.22 miles
Average Sinuosity: 1.30
Average Impervious Cover: 1.01%

Photo 22. Grand River near confluence with Mill Creek (1) *(Source: G. Warnock)*

Subwatershed Description
The Mill Creek (1) - Grand River 12-digit HUC subwatershed represents 27 percent of the five (5) subwatersheds in the Phelps Creek 10-digit HUC subwatershed to the Grand River Watershed. This watershed drains mostly forested, cultivated crops and pasture/hay land in the Village of Orwell and Orwell, Rome and Windsor Townships in Ashtabula county, Huntsburg and Middlefield Townships in Geauga County and Bloomfield and Mesopotamia Townships in Trumbull County.

As of 2006, about 3% or 669 acres of land development (low, medium & high intensity) has occurred in the Mill Creek (1) - Grand River subwatershed, with 58 percent or 13170 acres of the land use as forested and 38 percent or 8654 acres as agricultural land use (Table 199, Map 84). Deciduous forest makes up 43 percent of the forested land use, Cultivated Crops and Pasture/Hay makes up 97 percent of agricultural land use and Corn & Soybeans dominates the row crop production at 87 percent *(2009 USDA Cropland Cover)*.
Table 199. 041100040303 – Subwatershed Land Use

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Developed, High Intensity	24	0.10
Developed, Medium Intensity	64	0.28
Developed, Low Intensity	581	2.54
Developed, Open Space	116	0.51
Cultivated Crops	5057	22.09
Pasture/Hay	3367	14.71
Grassland/Herbaceous	231	1.01
Deciduous Forest	5612	24.52
Evergreen Forest	55	0.24
Mixed Forest	79	0.35
Scrub/Shrub	2829	12.36
Palustrine Forested Wetland	3956	17.28
Palustrine Scrub/Shrub Wetland	638	2.79
Palustrine Emergent Wetland	93	0.40
Bare Land	71	0.31
Open Water	116	0.51
Total	**22889**	

Floodplain

Forest and pasture make up 83 percent of the land use in the Mill Creek (1) - Grand River subwatershed floodplain. Forest covers 64 percent or 4171 acres and woody wetlands covers 12 percent or 752 acres of the 6453 acres of flood plain. The next closest land use in the flood plain is pasture/hay at 723 or 11 percent. High, medium and low density development only composes 43 acres or just 0.66 percent of the floodplain (Table 199).

Table 200. 041100040303 – Subwatershed Land Use Within Floodplain

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Agriculture	219	3.39
Grass/Pasture/Non-Ag	13	0.21
Barren	2	0.04
Deciduous Forest	4171	64.64
Developed/High Intensity	0	0.00
Developed/Low Intensity	42	0.64
Developed/Medium Intensity	1	0.02
Developed/Open Space	260	4.03
Evergreen Forest	4	0.06
Grassland Herbaceous	87	1.34
Herbaceous Wetlands	1	0.01
Open Water	147	2.27
Pasture/Hay	723	11.20
Shrubland	32	0.49
Woody Wetlands	752	11.66
Total	**6453**	

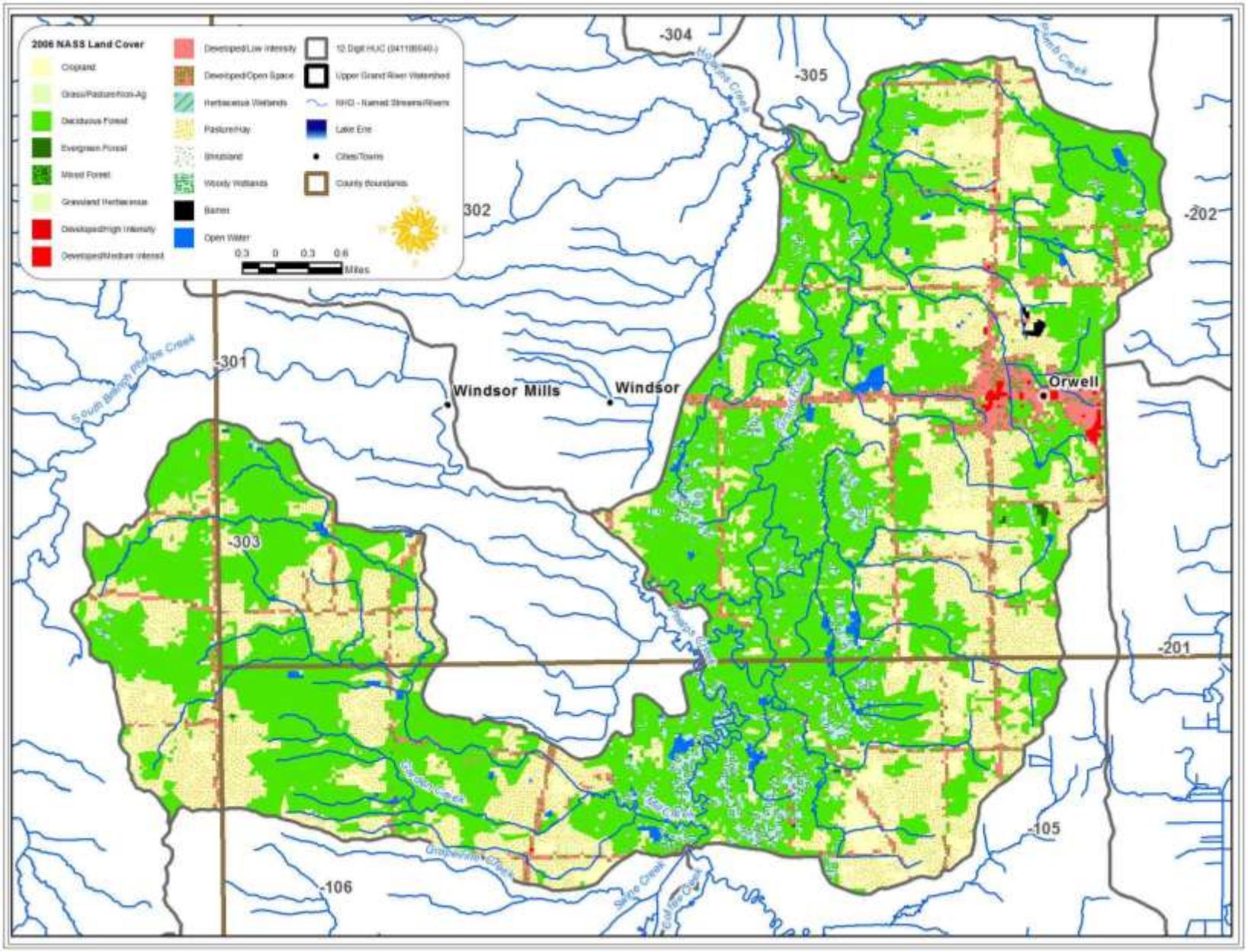
Table 201. 041100040303 – Subwatershed Wetland Types by Acres

(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Pond	Riverine	Grand Total
292	**4266**	**143**	**52**	**4754**

Map 84. 041100040303 – Subwatershed Land Use

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)



This Page Intentionally left blank

Soils

The major soils of the Mill Creek (1) - Grand River subwatershed are Mahoning Ellsworth and the Remsen-Geeburg-Trumbull associations formed on the glaciated uplands in fine to moderately fine textured glacial till. These are distinguished by somewhat poorly drained to moderately drained soils that are fairly deep to the bedrock. Overall these soils have slow to very slow permeability and are nearly flat to gently sloping. The Remsen-Geeburg-Trumbull association tends to be found on steeper areas along major drainage areas. The Sebring-Holly-Caneadea Association is in low lying basins mainly in the southern portion of the Headwaters Subwatershed. Its main characteristics are poorly drained soils which are mainly silty or clayey. Most are level to gently sloping and were formed from either lacustrine material in former glacial lake basins, or from alluvial material on flood plains. Streams that form in these soils are typically slow, contain ponded areas and have a low gradient. About 29 percent of the soils are considered potentially highly erodible. Tables 201 & 202 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Ashtabula, Geauga, and Trumbull County.

Table 202. 041100040303 – Subwatershed Highly Erodible Soil by Acres

(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
303	6544	15673	367

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Mill Creek (1) - Grand River Subwatershed is made up of 45 percent from Group D Hydrologic Soil. Soils in this group have high runoff potential when thoroughly wet due to very slow infiltration rates. Water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures, with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious parent material.

Table 203. 041100040303 - Subwatershed Hydrologic Soil Groups by Acres
(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

A	B	C	D	A/D	B/D	C/D
174	276	302	10278	0	2423	9249

Water Quality
The entire reach of the Grand River mainstem through the 04110004020 hydrologic unit has a verified WWH designation. That use was fully met at the four locations sampled within the reach. The Grand River is one of the few streams in Ohio that supports self-sustaining, native populations of walleye and muskellunge, both highly valued sport fish. As such, this reach should be considered for the Superior High Quality Water antidegradation tier.

Mill Creek (Windsor Township) has a verified EWH use based on one fish sample collected at SR 534. Results from fish and macroinvertebrate samples collected in 2007 indicate that a CWH use is appropriate for the reach upstream from SR 534 (RM 1.7) to RM 3.5. The stream at Wiswell Road (RM 4.9) may have been flow starved by an impoundment at Cox Road. The drainage area, however, was 2.8 mi^2. Downstream from SR 534, where the creek enters the lacustrine lowlands, a WWH use is appropriate.

Garden Creek has an unverified WWH designation. Based on fish and macroinvertebrate samples collected at Girdle Road (RM 2.3), the WWH use is a good fit.

Tributary to Mill (Windsor Township) @ RM 3.79 is not listed in Chapter 3745-1-10 of the Ohio Administrative Code. The site at Girdle Road (RM 0.1), based a macroinvertebrate sample, was transitional between primary headwater habitat and warmwater habitat, as such, the reach should be reassessed for Primary Headwater Habitat status.

Table 204. 041100040303 – Subwatershed Aquatic Life Use (ALU) Designation
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-001 Grand River			
4.88	WWH	Full	
2.01	WWH	Full	
03-019 Mill Creek			
4.94	PHWH or WWH?	Non	Flow starved - dst impoundment
2.30	EWH/CWH	Full	
03-048 Tributary to Mill @ RM 3.79			
0.13	WWH	-	
03-020 Garden Creek			
2.31	WWH	Full	

The Biological and Water Quality Study of the Upper Grand River 2007 indicates the quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

Seven headwater sites scattered throughout the watershed had fish communities that appeared impaired beyond what can be explained exclusively by natural limitations. Those sites are noted as having substrate scores greater than 10. Five of the seven cases were impaired by localized habitat alteration, or sequelae associated with watershed modifications. Pollution, as a stressor acting beyond the natural limitations of shallow bedrock, is suggested by low relative numbers in the sample across species, and the low total number of species found. Three of the seven impaired headwater sites were limited by low stream flows.

Two of those sites, the Grand River at RM 99.0 (US 422) and Mill Creek (Windsor Township) at RM 4.94 (Wiswell Road) were flow starved due to impoundments located upstream.

Table 205. 041100040303 - Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIWb[a]	Narrative
03-019 Mill Creek - EWH										
300186	4.94	8	8	806	0	2.8	69	26*		Poor
03-019 Mill Creek – EWH/CWH recommended										
300185	2.30	10	10	884	0	8.9	68.5	44		Good
03-020 Garden Creek -- unverified WWH - recommended										
300183	2.31	4	4	2256	0	1	62	38		Good
03-048 Trib to Mill @ RM 3.79										
300191	0.13					0	0	0		PHWH†

a - MIwb is not applicable to headwater streams with drainage areas < 20 mi2.
* - Indicates significant departure from applicable biocriteria (>4 IBI units or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.
† - Primary Headwater Habitat

Recreational Use Assessments
The ubiquity of high bacteria counts clearly suggests that the bacteria indicators are not serving exclusively as surrogates for pathogens of human origin. E. coli counts followed a log-normal distribution suggesting an origin from diffuse sources such as livestock and wildlife. Additional indicators failed to point to an identifiable source, so the Mill Creek (Windsor Township) RM 2.30 source is listed as unknown (Table 205).

Localized impacts to water quality from anthropogenic sources, principally from organic enrichment, were noted in tributaries to the Grand River. The organic enrichment was most apparent in Garden Creek, as noted by consistently high concentrations of total Kjeldahl nitrogen (TKN) co-occurring with elevated concentrations of ammonia-nitrogen. Garden Creek is one of the waterbodies where high E. coli counts were associated with indicators of organic enrichment. Livestock were clearly the source of bacteria found in Garden Creek, as the samples were essentially collected in cow pastures (Table 205).

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 206. 041100040303 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Headwaters Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	STORET	GEOMEAN	N	Class	Attainment	Sources
Mill Creek						
4.94	300186	260	1	B	Full	
2.30	300185	284	2	B	Non	Unknown
Garden Creek						
2.31	300183	474	2	B	Non	Livestock

Macroinvertebrate communities at the station near US 322 on the Grand River (RM 65.88) were performing at good to exceptional levels, with generally lower diversity of EPT (9-23) and sensitive taxa (14-31). The most diverse macroinvertebrate populations found on the Grand River mainstem, including fourteen species of freshwater mussels, were collected at lowland stations, including Grand River (RM 65.88) (See Table 9).

Headwater stream stations that were limited by low to interstitial flow included Mill Creek (Windsor Township) RM 4.94. Macroinvertebrate communities evaluated at this station had lower than expected EPT (3-7) and

sensitive taxa (3-11) diversity, due to the loss of surface flow as the result of the water table dropping below the level of the riffle habitats (See Table 9).

Many of the streams on the western part of the basin flow through high gradient channels that in places have cut down to sandstone bedrock and receive significant groundwater. These streams generally have high EPT (19-31) and sensitive taxa (23-41) diversity, presence of cold water taxa (4-9), and uncommonly collected sensitive taxa (1-9). The Mill Creek (Windsor Township) RM 2.30 stream station fell into this category (See Table 9).

Table 207. 041100040303 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Headwaters Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	Drain Area (mi2)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Grand River (03-001)										
65.88	210	-	41	9/12	15/21	L/254	0	Hydropsychid caddisflies (F), baetid mayflies (F,I), riffle beetles (MI)	40	
60.80	222	-	32	10/13	14/18	L-M/361	0	Caddisflies (F,MI), baetid mayflies (F), midges (F,MI)	40	
Mill Creek (03-019)										
4.94	2.8	9	21	1 / 3	4	L-M	0	Red midges (F)	-	Poor
2.30	9	-	44	19	23	M	4	Caddisflies (MI,F), baetid mayflies (I,F), midges (MI)	-	Very Good
Tributary to Mill Creek (@RM 3.79) (03-048)										
0.13	3.5	9	48	13	16	L-M	2	Caddisflies (MI,F), heptageniid mayflies (F), flatworms (F)	-	Good
Garden Creek (03-020)										
2.31	1.2	9	37	13	16	L	2	Caddisflies (MI,F), midges (F)	-	Good

- **12-digit HUC 041100040303 – Mill Creek (1)-Grand River Subwatershed Problem Statements, Goals, objectives and Action**

Summary of Impairments: The major causes of impairment for Mill Creek (1), a 12-digit subwatershed of Phelps Creek – Grand River 10-digit subwatershed, include low flow alterations, pathogen loading (fecal coliform and E. coli) in excess of 540 colony forming units (cfu) per year and natural conditions (flow or habitat). Those causes are primarily associated with dam or impoundment, livestock and natural sources.

Problem Statement 1: The presence of about 100 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Mill Creek (1) around RM 4.94. The most likely source is livestock manure runoff in this section of the Mill Creek (1) Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 100 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective: Establish 1 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 100 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Problem Statement 2: : The presence of about 125 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Mill Creek (1) around RM 2.30. The most likely source is livestock manure runoff from pastures in close proximity upstream from the sampling location on the Mill Creek (1) Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 125 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective: Establish 1 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 125 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Problem Statement 3: The presence of about 315 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Garden Creek. The most likely source is livestock manure runoff in the Garden Creek Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 315 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 1 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 240 cfu.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Objective 2: Establish 1000 lineal feet of livestock exclusion fencing along streams on 1 farm (approximately 500 feet of streambank), resulting in an excess pathogen loading reduction of 75 cfu.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 4: The Biological and Water Quality Study of the Upper Grand River 2007 reports a low Index of Biotic Integrity (IBI) score for samples taken from Mill Creek (1) at RM 4.94 near South Wiswell Road. The IBI score of 26 falls into the poor range and is the cause of impairment for this section of stream, which has non-attainment status for it's Aquatic Life Use (ALU) Designation. The source of the impairment is habitat alteration and low flow due to the Naji Lake Dam at Mill Creek (1) RM 5.71.

Goal: Raise IBI score by 46 percent or 12 points from an IBI score of 26 in the poor range to an IBI score of 38 in the good range.

IV. WATERSHED IMPAIRMENTS, RESTORATION AND PROTECTION GOALS, AND IMPLEMENTATION/ACTION PLAN

Objective 1: Remove or modify the Naji Lake Dam at Mill Creek (1) RM 5.71 to reconnect mill creek with the rest of the watershed and restore natural flow to the stream.

Action 1: Obtain support and conduct feasibility study to determine the benefits, impacts and costs involved with removal or modification of the Naji Lake Dam.
Action 2: Obtain support and develop an engineering plan based on the results of the dam removal or modification feasibility study.
Action 3: Determine best funding options and obtain funds for removal or modification of the Naji Lake Dam from potential funding sources:

- U.S. Army Corps of Engineers (USCOE) - Aquatic Ecosystem Restoration, Section 206, Water Resources Development Act of 1996
- U.S. Fish and Wildlife Service (USFWS) - Fish Passage Program (Grant)
- Partners for Fish and Wildlife (Grant)
- Natural Resources Conservation Service (NRCS) - Wildlife Habitat Incentive Program (Grant)
- Ohio Environmental Protection Agency (OEPA) - Division of Surface Water
- Ohio Department of Natural Resources - Division of Natural Areas and Preserves or Division of Wildlife
- Ohio Department of Transportation (ODOT) - Office of Environmental Services
- State of Ohio Water Development Authority - Ohio Water Development Authority (OWDA)
- National Fish and Wildlife Foundation - General Matching Grant Program

Source: Funding Sources for Lowhead Dam Removal - http://www.dnr.state.oh.us/water/tabid/3360/Default.aspx

Action 4: Obtain proper reviews, approvals, permits and certificates prior to removal or modification of the Naji Lake Dam.
Action 5: Determine options for sediment removal (complete removal and relocation of all accumulated material from the inundated regions; removing sediment only from the anticipated channel of the river, or allowing the river to erode a new channel through the sediment) and proceed with sediment removal.
Action 6: Remove or modify the Naji Lake Dam and stabilize site around former dam location.

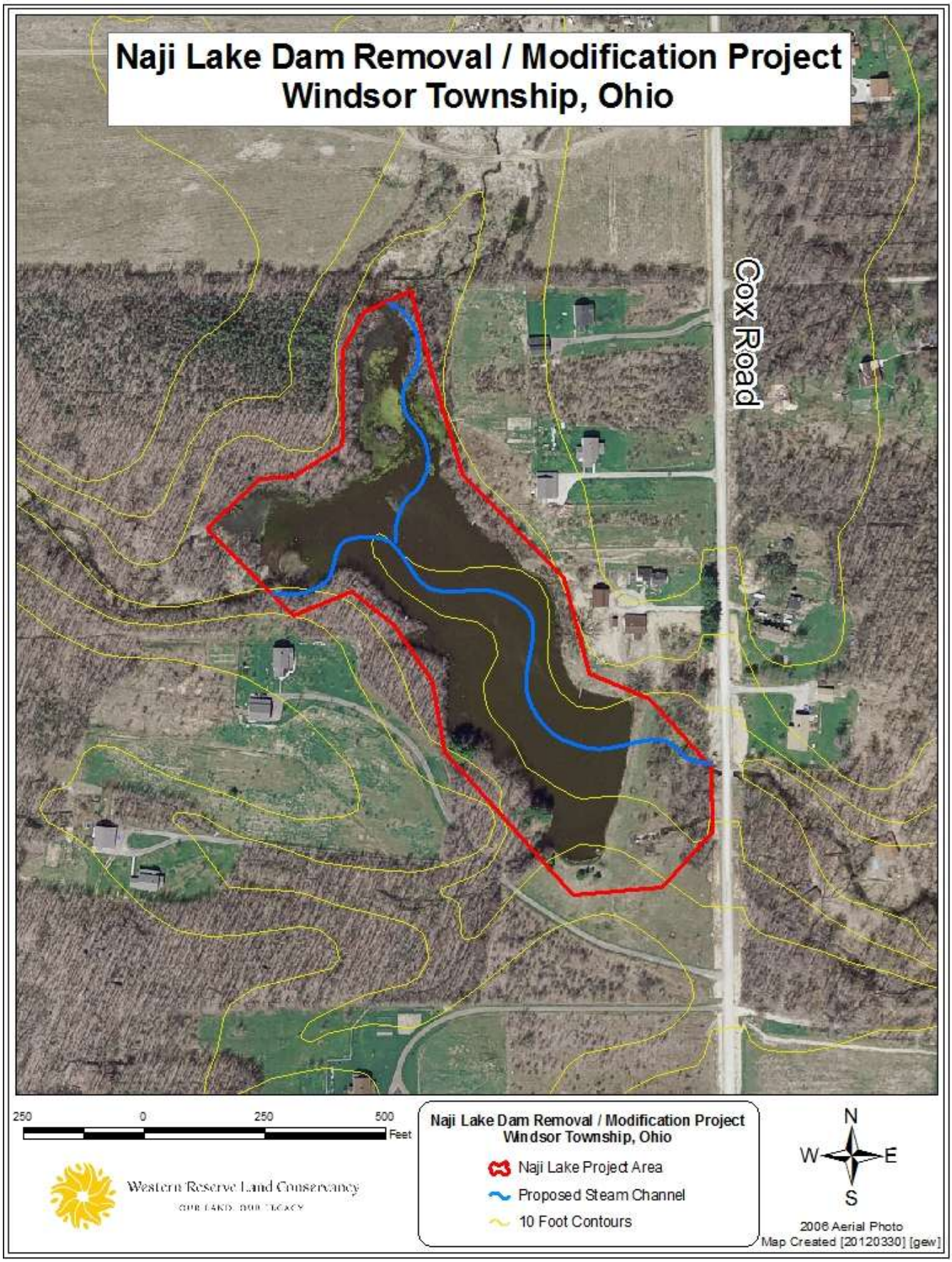
Objective 2: Stabilize banks and restore floodplains and riparian zones following removal or modification of the Naji Lake Dam. This project would encompass approximately 11 acres of floodplains and riparian zone and an estimated 3620 linear feet of stream bank.

Action 1: Obtain support and develop a restoration plan based on the results of the dam removal or modification feasibility study.
Action 3: Determine best funding options and obtain funds for removal or modification of the Naji Lake Dam from potential funding sources:

- Ohio Environmental Protection Agency (OEPA) - Surface Water Improvement Fund (SWIF) Grant
- Ohio Environmental Protection Agency (OEPA) - Division of Surface Water – Section 319(h) Grant

Action 2: Grade, add materials, native plants, shrubs and trees to stream banks, floodplains and riparian zones to return aquatic functions and natural physical habitat characteristics to a close approximation of its condition prior to alteration.
Action 3: Monitor before, during and after restoration to evaluate restoration efforts and determine if future restoration efforts are necessary to reach IBI score goal of 38 in the good range.

Map 1. Mill Creek (1) - Naji Lake Dam Removal / Modification



This Page Intentionally left blank

Problem Statement 5: Local stakeholder concern has identified 4307 acres of land with high natural area conservation value under threat of conversion. It was assumed that for a single family housing development on the 2153.5 acres, 50% of the land would be preserved as open space. Of the remaining 2153.5 acres developed as single-family residential, it was assumed that the development would use filter buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by impervious surfaces and residential land use (excess loading of nitrogen (N) - 7197 lbs/year, phosphorus (P) - 1095 lbs/year, Biological Oxygen Demand (BOD) - 31048 lbs/year and Sediment – 116 tons/year) would push adjacent sections of Mill Creek (1) Creek to impairment (see table 208.

Goal: Protect 4307 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 4307 acres of land with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 208. Mill Creek (1)-Grand River Subwatershed Land Protection Load Estimates for land protection.

Current land use loading as 4307 acres of forest			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
1384.1	679.2	3404.5	34.8
New land use loading following development of 2153.5 acres as single-family housing with LID			
N Load lb/year	**P Load lb/year**	**BOD lb/year**	**Sediment Load t/year**
8581.4	1774	34452.9	150
Net increase due to land use change			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
7197.3	**1094.8**	**31048.4**	**115.2**

Problem Statement 6: Local stakeholder concern has identified 1679 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 1679 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 1679 acres of wetlands with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.

Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified wetland protection properties.

Problem Statement 7: Local stakeholder concern has identified 38.26 miles or 202017 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant pollutants generated by channel erosion (excess loading of sediment – 3434 tons/year, N - 6868 lbs/year and P - 3434 lbs/year) would push adjacent sections of Mill Creek (1) to impairment (see table 209).

Goal: Protect 38.26 miles or 202017 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 38.26 miles or 202017 linear feet of stream corridor with high natural area conservation value.

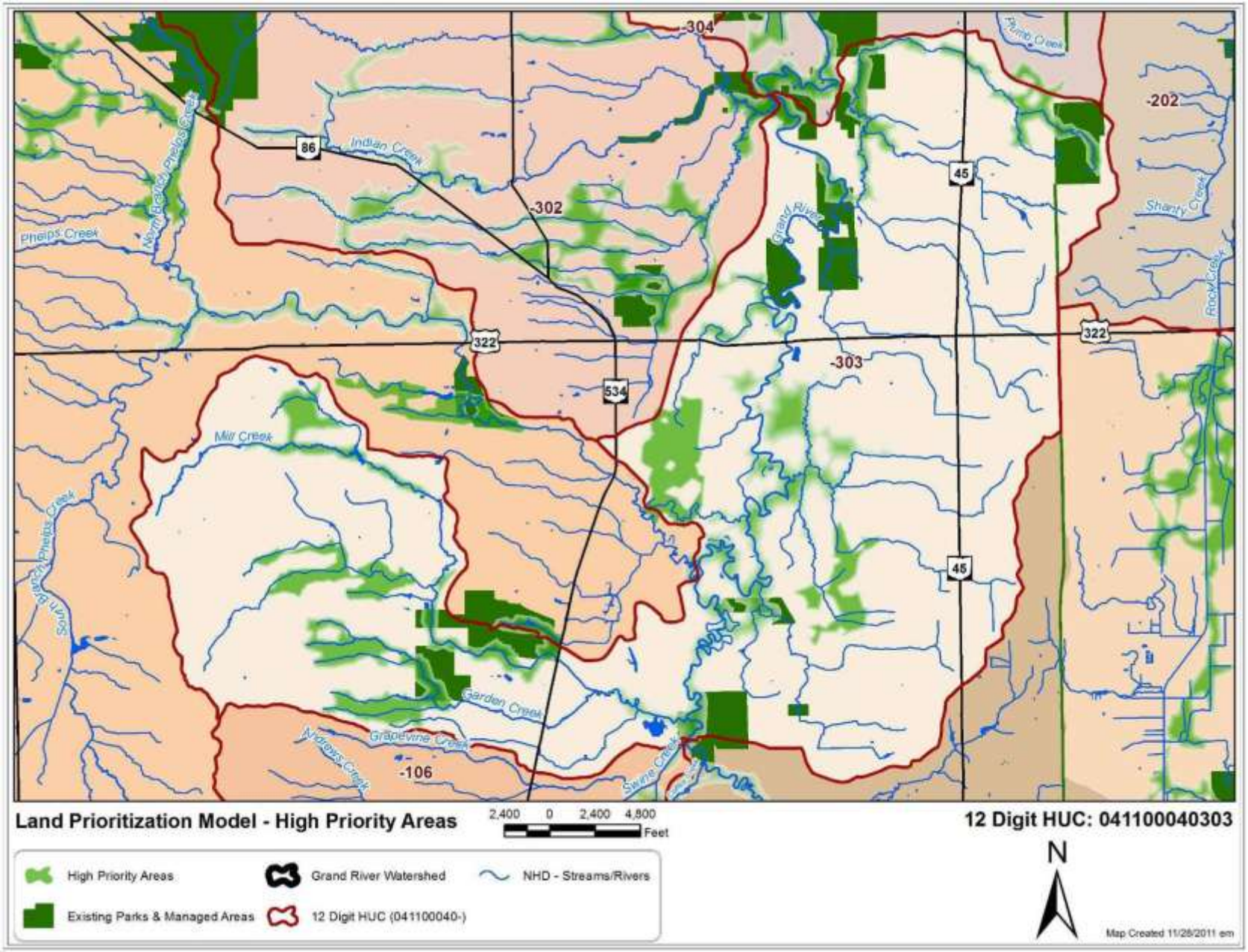
Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 209. Mill Creek (1) - Grand River Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	1717.1	1717.1
Phosphorus Load Reduction (lb/year)			1717.1	1717.1
Nitrogen Load Reduction (lb/yr)			3434.3	3434.3

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 85 – 041100040303 Mill Creek (1) - Grand River Land Protection Prioritization Model - High Priority Areas



This Page Intentionally left blank

M. Mud Creek Subwatershed

12 Digit HUC: 041100040304
Location: Mud Creek
Drainage Area: 21.04 miles^2, 13467 acres
Miles of stream: 46.05 miles
Average Sinuosity: 1.27
Average Impervious Cover: 0.67%

Photo 23. Grand River near confluence with Mud Creek *(Source: G. Warnock)*

Subwatershed Description
The Mud Creek 12-digit HUC subwatershed represents 16 percent of the five (5) subwatersheds in the Phelps Creek 10-digit HUC subwatershed to the Grand River Watershed. This watershed drains mostly forested, cultivated crops and pasture/hay land in the Hartsgrove, Morgan, Rome and Trumbull Townships in Ashtabula county, Huntsburg Township in Geauga County.

As of 2006, about 2% or 271 acres of land development (low, medium & high intensity) has occurred in the Mud Creek subwatershed, with 70 percent or 9360 acres of the land use as forested and 28 percent or 3746 acres as agricultural land use (Table 210, Map 66). Deciduous forest makes up 60 percent of the forested land use, Cultivated Crops and Pasture/Hay makes up 98 percent of agricultural land use and Corn & Soybeans dominates the row crop production at 87 percent *(2009 USDA Cropland Cover)*.

Table 210. 041100040304 – Subwatershed Land Use
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Developed, High Intensity	2	0.01
Developed, Medium Intensity	4	0.03
Developed, Low Intensity	266	1.97
Developed, Open Space	3	0.02
Cultivated Crops	2618	19.44
Pasture/Hay	1047	7.77
Grassland/Herbaceous	82	0.61
Deciduous Forest	5622	41.75
Evergreen Forest	39	0.29
Mixed Forest	67	0.50
Scrub/Shrub	1848	13.73
Palustrine Forested Wetland	1595	11.84
Palustrine Scrub/Shrub Wetland	188	1.39
Palustrine Emergent Wetland	81	0.60
Open Water	7	0.05
Total	**13468**	

Floodplain

Forest and pasture make up 86 percent of the land use in the Mud Creek subwatershed floodplain. Forest covers 77 percent or 1159 acres and pasture/hay covers 11 percent or 167 acres of the 1502 acres of flood plain. The next closest land use in the flood plain is open space at 63 or 4 percent. High, medium and low density development only composes 9 acres or just 0.61 percent of the floodplain (Table 211).

Table 211. 041100040304 – Subwatershed Land Use Within Floodplain
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

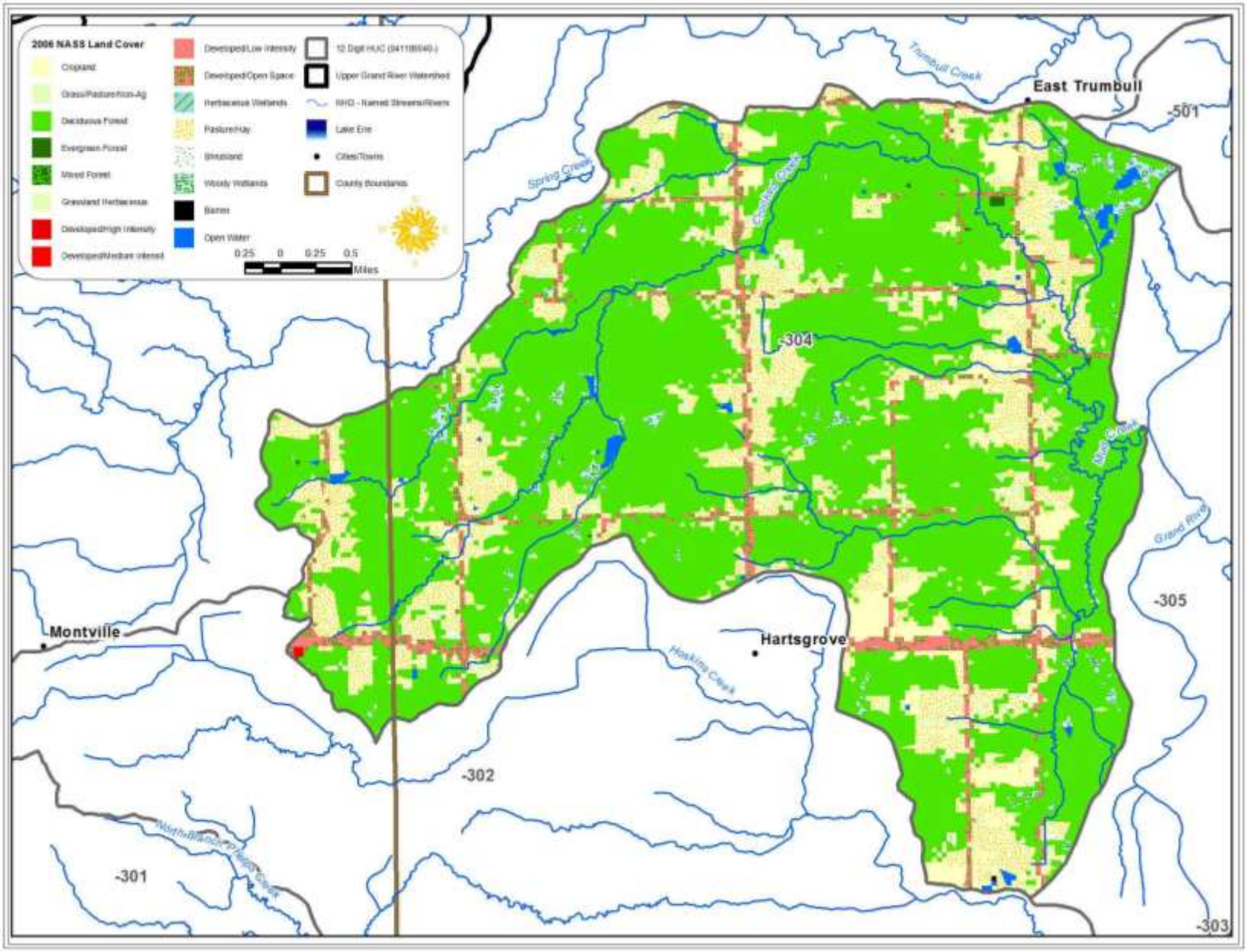
Description	Acres	Percent of Watershed
Agriculture	38	2.54
Grass/Pasture/Non-Ag	6	0.43
Barren	0	0.00
Deciduous Forest	1125	74.88
Developed/High Intensity	0	0.00
Developed/Low Intensity	9	0.61
Developed/Medium Intensity	0	0.00
Developed/Open Space	66	4.38
Evergreen Forest	1	0.04
Grassland Herbaceous	38	2.52
Herbaceous Wetlands	0	0.00
Open Water	19	1.26
Pasture/Hay	167	11.10
Shrubland	4	0.26
Woody Wetlands	30	1.98
Total	**1502**	

Table 212. 041100040304 – Subwatershed Wetland Types by Acres
(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Pond	Grand Total
85	2256	81	2422

Map 86. 041100040304 – Subwatershed Land Use

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)



This Page Intentionally left blank

Table 213. 041100040304 – Subwatershed Land Use Within Floodplain
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Agriculture	38	2.54
Grass/Pasture/Non-Ag	6	0.43
Barren	0	0.00
Deciduous Forest	1125	74.88
Developed/High Intensity	0	0.00
Developed/Low Intensity	9	0.61
Developed/Medium Intensity	0	0.00
Developed/Open Space	66	4.38
Evergreen Forest	1	0.04
Grassland Herbaceous	38	2.52
Herbaceous Wetlands	0	0.00
Open Water	19	1.26
Pasture/Hay	167	11.10
Shrubland	4	0.26
Woody Wetlands	30	1.98
Total	**1502**	

Table 214. 041100040304 – Subwatershed Wetland Types by Acres
(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Pond	Grand Total
85	2256	81	2422

Soils

The major soils of the Mud Creek subwatershed are Mahoning Ellsworth and the Remsen-Geeburg- Trumbull associations formed on the glaciated uplands in fine to moderately fine textured glacial till. These are distinguished by somewhat poorly drained to moderately drained soils that are fairly deep to the bedrock. Overall these soils have slow to very slow permeability and are nearly flat to gently sloping. The Remsen-Geeburg- Trumbull association tends to be found on steeper areas along major drainage areas. The Sebring-Holly-Caneadea Association is in low lying basins mainly in the southern portion of the Headwaters Subwatershed. Its main characteristics are poorly drained soils which are mainly silty or clayey. Most are level to gently sloping and were formed from either lacustrine material in former glacial lake basins, or from alluvial material on flood plains. Streams that form in these soils are typically slow, contain ponded areas and have a low gradient. About 34 percent of the soils are considered potentially highly erodible. Tables 213 & 214 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Ashtabula, Geauga, and Trumbull County.

Table 215. 041100040304 – Subwatershed Highly Erodible Soil by Acres
(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
113	4556	8405	394

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Mud Creek Subwatershed is made up of 53 percent from Group C/D Hydrologic Soil. Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Some soils having clay, silty clay, or sandy clay textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.

Table 216. 041100040304 - Subwatershed Hydrologic Soil Groups by Acres
(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

A	B	C	D	A/D	B/D	C/D
143	0	65	5170	0	979	7060

Water Quality
Mud Creek has an unverified WWH designation. Field observations and results of a macroinvertebrate sample collected at Higley Road (RM 3.78), where the drainage area was 1.7 square miles, suggest that the reach sampled was primary headwaters, and should be reassessed for Primary Headwater Habitat status.

Crooked Creek has a verified EWH use based on a fish sample collected at Windsor Mechanicsville Road. Samples collected in 2007 demonstrate by the presence of nine coldwater macroinvertebrate taxa and mottled sculpin indicate that upstream from Windsor Mechanicsville Road (RM 2.5), a CWH use is appropriate, and downstream, where the creek flows through the lacustrine lowlands, a WWH use is appropriate. The site at Callahan Road (RM 6.7) underperformed its potential, given the high quality of physical habitat present. Logging in the watershed upstream from Callahan Road may have been responsible.

Localized impacts to water quality from anthropogenic sources, principally from organic enrichment, were noted in tributaries to the Grand River. The sources of enrichment were primarily on-site sewerage, livestock, and, in the some cases, an unknown source. Crooked Creek is a stream where concentrations of both TKN and ammonia-nitrogen (NH_3-N) were elevated. Livestock were the source to Crooked Creek.

The macroinvertebrate sample collected at Callender Road indicated that the Tributary to Crooked Creek should be considered primary headwaters and re-evaluated for PHWH status.

Table 217. 041100040304 – Subwatershed Aquatic Life Use (ALU) Designation
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-018 Mud Creek			
3.78	WWH	-	
03-017 Crooked Creek			
6.70	CWH	Full	
3.51	EWH/CWH	Full	
1.62	WWH	Partial	Channelization, Habitat
03-049 Tributary to Crooked @ RM 6.50			
0.29	PHWH		

The Biological and Water Quality Study of the Upper Grand River 2007 indicates the quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

Several of the headwaters entering the Grand River from the west are coldwater streams, notably Trumbull Creek and Crooked Creek. Of the two, Crooked Creek has the potential to be fully restored to its maximum potential for supporting a cold water fauna, including the native brook trout. Crooked Creek at Higley Road (RM 3.5) was included with sites with exceptionally high biologic index.

Seven headwater sites scattered throughout the watershed had fish communities that appeared impaired beyond what can be explained exclusively by natural limitations. Those sites are noted in Figure 23 as having substrate scores greater than 10. Five of the seven cases were impaired, as noted in Table 16, by localized habitat alteration, or sequelae associated with watershed modifications. Organic enrichment from livestock may have contributed to the impairment noted for Crooked Creek at Callender Road (RM 1.63) given that abundance of omnivorous fishes was elevated and low dissolved oxygen concentrations were noted during the survey.

Table 218. 041100040304 - Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIWb[a]	Narrative
03-018 Mud Creek - unverified WWH										
300188	4					0.0	0.0	0	DNS†	
03-017 Crooked Creek - EWH/CWH recommended										
300182	6.70	14	14.0	800.0	0.00	3.2	80.0	38		Good
300181	3.51	17	17.0	1068.0	0.00	6.9	82.50	58		Excellent
03-017 Crooked Creek - EWH/WWH recommended										
G01K01	1.62	18	18.0	820.0	0.00	9.3	55.0	32*		Fair

a - MIwb is not applicable to headwater streams with drainage areas < 20 mi2.
* - Indicates significant departure from applicable biocriteria (>4 IBI units or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

Recreational use assessments

The ubiquity of high bacteria counts clearly suggests that the bacteria indicators are not serving exclusively as surrogates for pathogens of human origin. E. coli counts followed a log-normal distribution suggesting an origin from diffuse sources such as livestock and wildlife. Additional indicators failed to point to an identifiable source, so the Mud Creek RM 3.78 source is listed as unknown (Table 217).

Crooked Creek is one of the waterbodies where high E. coli counts were associated with indicators of organic enrichment. Livestock were clearly the source of bacteria found in Crooked Creek, as the samples were essentially collected in cow pastures. Livestock were the suspected source for other waterbodies with pastures in close proximity upstream from the sampling location. (Table 217)

Livestock were clearly the source of bacteria found in Crooked Creek, as the samples were essentially collected in cow pastures. Livestock were the suspected source for other waterbodies with pastures in close proximity upstream from the sampling location. (Table 217).

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 219. 041100040304 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Headwaters Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	STORET	GEOMEAN	N	Class	Attainment	Sources
Mud Creek						
3.78	300188.0	2147	2	B	Non	Unknown
Crooked Creek						
6.70	300182	43	2	B	Full	
3.51	300181	159	2	B	Full	
1.62	G01K01	2228	2	B	Non	Livestock

The Mud Creek RM 3.78 sampling station was one of several stations that had four or more cold water macroinvertebrate taxa, and therefore would qualify for the CWH Aquatic Live Use. The stream stations Tributary to Crooked Creek (@ RM 6.50) RM 0.29, and Mud Creek RM 3.78 had characteristics of PHWH streams and may best be classified thus. (Table 218).

The station with the highest total mayfly (Ephemeroptera), stonefly (Plecoptera), and caddisfly (Trichoptera) taxa richness (EPT) was on Crooked Creek at Higley Road (RM 3.51) with 31 taxa. (Table 219).

Table 220. 041100040304 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Headwaters Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	Drain Area (mi2)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Mud Creek (03-018)										
3.78	1.70	-	46	13	23	Low	4	Hydropsychid caddisflies (F), midges (MI)	-	Good
Crooked Creek (03-017)										
6.70	3.2	-	38	15	17	Low	1	Nigronia fishflies (F), Polycentropus caddisflies (MI)	-	Good
3.51	8.2	-	62	31	38	Low-Moderate	9	Caddisflies (MI,F), midges (MI,I,F), baetid mayflies (F,I)	-	Exceptional
1.62	9.3	-	52	12	17	Moderate	0	Hydropsychid caddisflies (F), baetid mayflies (F)	-	Good
Tributary to Crooked Creek (@RM 6.50) (03-049)										
0.29	1.9	-	28	8	12	Low	3	Nigronia fishflies (F), burrowing mayflies (MI)	-	Fair

- **12-digit HUC 041100040304 – Mud Creek Subwatershed Problem Statements, Goals, objectives and Action**

Summary of Impairments: The major causes of impairment for Mud Creek, a 12-digit subwatershed of Phelps Creek – Grand River 10-digit subwatershed, include direct habitat alteration, pathogen loading (fecal coliform and E. coli) in excess of 4053 colony forming units (cfu) per year and natural conditions (flow or habitat). Those causes are primarily associated with channelization, livestock and natural sources.

Problem Statement 1: The presence of about 1986 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Mud Creek around RM 3.78. The most likely source is livestock manure runoff in this section of the Mud Creek Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 1986 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 2 new manure storage facilities in the adjacent agricultural area, each resulting in an excess pathogen loading reduction of 918 cfu.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Objective 2: Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms (approximately 1000 feet of streambank), resulting in an excess pathogen loading reduction of 150 cfu.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 2: The presence of about 2067 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Crooked Creek around RM 1.62. The most likely source is livestock manure runoff in this section of the Mud Creek Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 2067 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 2 new manure storage facilities in the adjacent agricultural area, each resulting in an excess pathogen loading reduction of 959 cfu.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Objective 2: Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms (approximately 1000 feet of streambank), resulting in an excess pathogen loading reduction of 150 cfu.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 3: Direct habitat alteration along approximately 0.2 mile of Crooked Creek upstream from Windsor-Mechanicsville Road was the cause of partial aquatic life use attainment status for this portion of the stream. The source of this impairment is most likely the channelization of Crooked Creek to reroute the stream as a ditch limiting fish habitat north and south of Kirk Road.

Goal: Restore in-stream and riparian habitat along 0.2 mile of Crooked Creek upstream of Windsor-Mechanicsville Road to improve fish habitat and achieve attainment of aquatic life use Designations (EWH/CWH).

Objective: Restore 0.2 mile of non-attaining streams, including restoration of in-stream habitat, stabilization of eroding banks, and re-connection to floodplain using ditch retrofit techniques.

Action: Pursue Ohio EPA Section 319(h) Non-point Source Program Grant or Ohio EPA Surface Water Improvement Fund (SWIF) grant, or other grants for the potential restoration project.

Problem Statement 4: Local stakeholder concern has identified 1835 acres of land with high natural area conservation value under threat of conversion. It was assumed that for a single family housing development on the 1835 acres, 50% of the land would be preserved as open space. Of the remaining 917.5 acres developed as single-family residential, it was assumed that the development would use filter buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by impervious surfaces and residential land use (excess loading of nitrogen (N) - 2665 lbs/year, phosphorus (P) - 393 lbs/year, Biological Oxygen Demand (BOD) - 10817 lbs/year and Sediment – 29 tons/year) would push adjacent sections of Mud Creek to impairment (see table 219).

Goal: Protect 1835 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 1835 acres of land with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 221. Mud Creek Subwatershed Land Protection Load Estimates for land protection.

Current land use loading as 1835 acres of forest			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
599.2	293.1	1469.6	17.8
New land use loading following development of 917.5 acres as single-family housing with LID			
N Load lb/year	**P Load lb/year**	**BOD lb/year**	**Sediment Load t/year**
3264.6	685.6	12286.8	47.4
Net increase due to land use change			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
2665.4	**392.5**	**10817.2**	**29.2**

Problem Statement 5: Local stakeholder concern has identified 774 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 774 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 774 acres of wetlands with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified wetland protection properties.

Problem Statement 6: Local stakeholder concern has identified 13.95 miles or 73673 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant pollutants generated by channel erosion (excess loading of sediment – 1252 tons/year, N - 2504 lbs/year and P - 1252 lbs/year) would push adjacent sections of Mud Creek to impairment (see table 220).

Goal: Protect 13.95 miles or 73673 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 13.95 miles or 73673 linear feet of stream corridor with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public

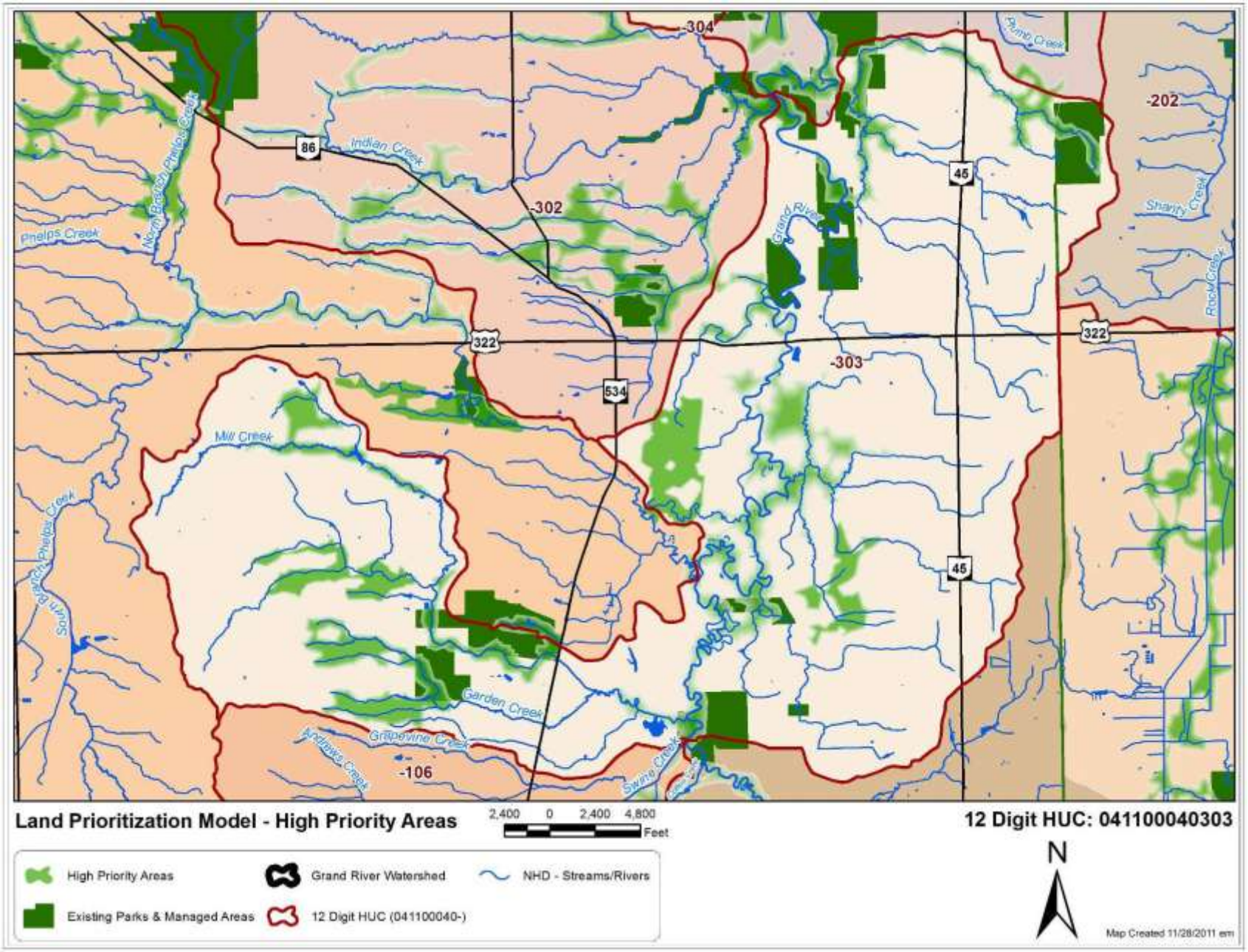
funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 222. Mud Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	626.2	626.2
Phosphorus Load Reduction (lb/year)			626.2	626.2
Nitrogen Load Reduction (lb/yr)			1252.4	1252.4

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 87 – 041100040304 Mud Creek Land Protection Prioritization Model - High Priority Areas



This Page Intentionally left blank

N. Plumb Creek - Grand River Subwatershed

12 Digit HUC: 041100040305
Location: Grand River below Hoskins Cr. to above Rock Cr. [ex Mud Cr.]
Drainage Area: 19.22 miles^2, 12299 acres
Miles of stream: 49.80 miles
Average Sinuosity: 1.17
Average Impervious Cover: 0.85%

Photo 24. Plumb Creek at confluence with Grand River *(Source: Anonymous)*

Subwatershed Description
The Plumb Creek - Grand River 12-digit HUC subwatershed represents 16 percent of the five (5) subwatersheds in the Phelps Creek 10-digit HUC subwatershed to the Grand River Watershed. This watershed drains mostly forested, cultivated crops and pasture/hay land in the Hartsgrove, Morgan, Orwell, Rome and Windsor Townships in Ashtabula county.

As of 2006, about 3% or 356 acres of land development (low, medium & high intensity) has occurred in the Plumb Creek - Grand River subwatershed, with 65 percent or 8045 acres of the land use as forested and 29 percent or 3603 acres as agricultural land use (Table 223, Map 88). Deciduous forest makes up 60 percent of the forested land use, Cultivated Crops and Pasture/Hay makes up 98 percent of agricultural land use and Corn & Soybeans dominates the row crop production at 90 percent *(2009 USDA Cropland Cover)*.

Table 223. 041100040305 – Subwatershed Land Use
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Developed, High Intensity	0	0.00
Developed, Medium Intensity	8	0.07
Developed, Low Intensity	347	2.82
Developed, Open Space	7	0.06
Cultivated Crops	2460	20.00
Pasture/Hay	1062	8.63
Grassland/Herbaceous	81	0.66
Deciduous Forest	4747	38.60
Evergreen Forest	50	0.40
Mixed Forest	39	0.32
Scrub/Shrub	1442	11.72
Palustrine Forested Wetland	1558	12.67
Palustrine Scrub/Shrub Wetland	209	1.70
Palustrine Emergent Wetland	149	1.21
Open Water	139	1.13
Total	**12300**	

Floodplain
Forest and pasture make up 73 percent of the land use in the Plumb Creek - Grand River subwatershed floodplain. Deciduous forest covers 69 percent or 1247 acres and pasture/hay covers 9 percent or 161 acres of the 1799 acres of flood plain. The next closest land use in the flood plain is open water at 101 or 6 percent. High, medium and low density development only composes 20 acres or just 1.01 percent of the floodplain (Table 223).

Table 224. 041100040305 – Subwatershed Land Use Within Floodplain
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

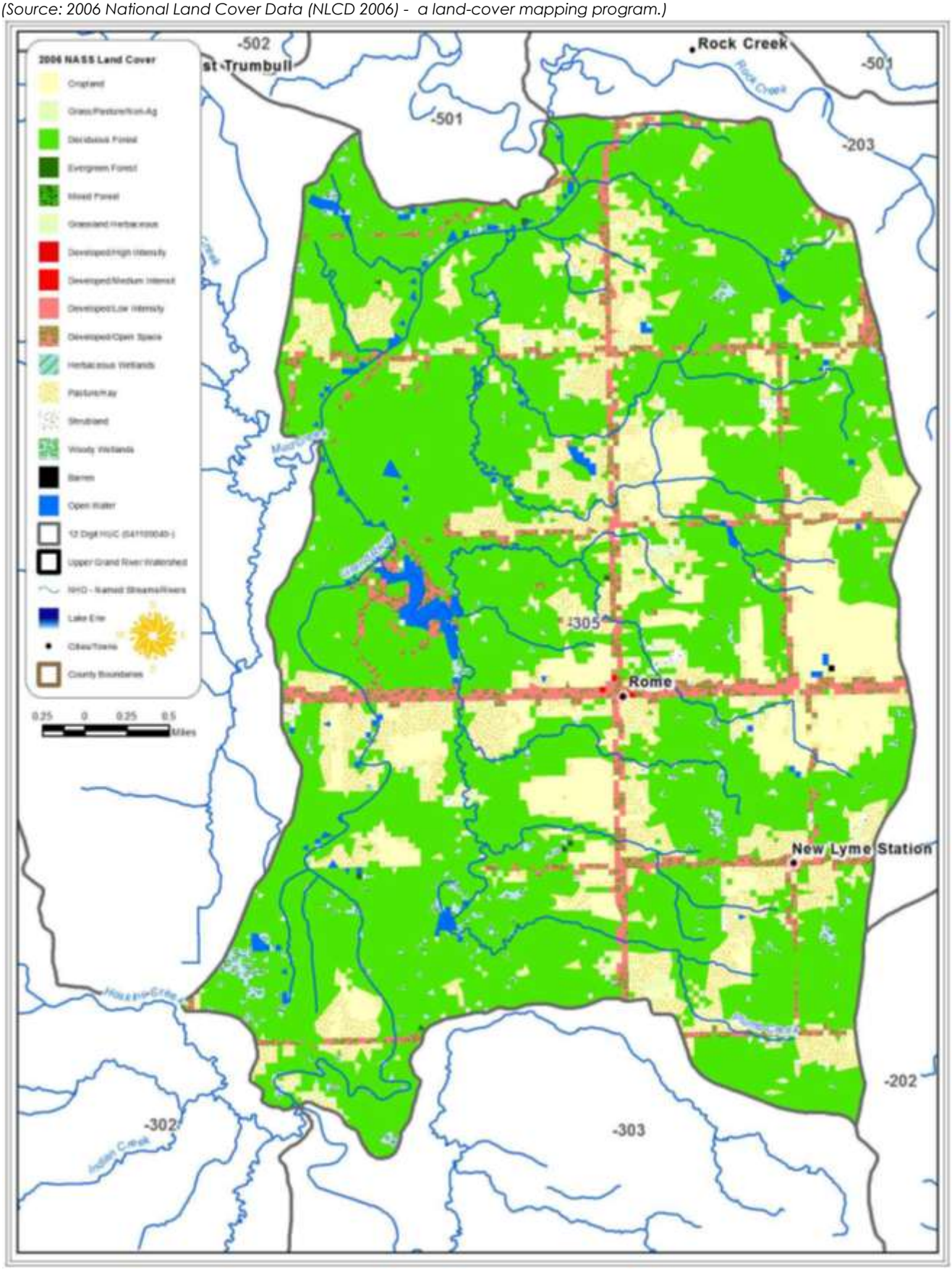
Description	Acres	Percent of Watershed
Agriculture	84	4.68
Grass/Pasture/Non-Ag	5	0.26
Barren	0	0.00
Deciduous Forest	1247	69.34
Developed/High Intensity	0	0.00
Developed/Low Intensity	20	1.10
Developed/Medium Intensity	0	0.00
Developed/Open Space	69	3.81
Evergreen Forest	1	0.03
Grassland Herbaceous	42	2.32
Herbaceous Wetlands	0	0.02
Open Water	101	5.60
Pasture/Hay	161	8.94
Shrubland	12	0.66
Woody Wetlands	58	3.24
Total	**1799**	

Table 225. 041100040305 – Subwatershed Wetland Types by Acres
(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Lake	Pond	Grand Total
56	2263	49	61	2430

Map 88. 041100040305 – Subwatershed Land Use

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)



This Page Intentionally left blank

Soils

The major soils of the Plumb Creek subwatershed The major soils of the Lower Rock Creek Subwatershed are the Caneadea-Canadice Association, Platea-Pierpont Association, and Platea-Sheffield Association. The Caneadea-Canadice Association are characterized by deep, nearly level to gently sloping areas that vary from very poorly drained to well drained in a few locations. In general these soils suffer from flooding and seasonal wetness and ponding, and have moderately slow to very slow permeability. Typically they have high seasonable water tables. The Caneadea-Canadice Association consists of soils formed from fine texture lacustrine material, glacial outwash, or glacial till. In addition there are also the Platea-Pierpont Association, and the Platea-Sheffield Association. These are characterized by deep, nearly level to gently sloping soils that very from somewhat poorly drained to poorly drained silty soils situated on glaciated uplands. The Platea-Pierpont Association occurs in the northern part of the county on hummocky morainal deposits. About 27 percent of the soils are considered potentially highly erodible. Tables 225 & 226 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Ashtabula County.

Table 226. 041100040305 – Subwatershed Highly Erodible Soil by Acres

(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
145	3304	8371	479

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Plumb Creek - Grand River Subwatershed is made up of 53 percent from Group D Hydrologic Soil. Soils in this group have high runoff potential when thoroughly wet due to very slow infiltration rates. Water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures, with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious parent material.

Table 227. 041100040305 - Subwatershed Hydrologic Soil Groups by Acres
(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

A	B	C	D	A/D	B/D	C/D
34	0	25	6393	0	995	4671

Water Quality
The condition of biological communities in the Upper Grand River basin is governed principally by post-glacial physiography. Briefly, the Upper Grand River valley was carved by a glacier, and became a lake in the immediate wake of glacial retreat. The dominant feature of the catchment now is the glacial lake-plain and lacustrine deposits that fill the valley. This has essentially resulted in three classes of streams: lowland streams, upland headwaters, and the non-wadeable Grand River mainstem. The lowland streams flank the eastern and southern edges of the valley. The upland headwaters drain from the west, but become lowland streams in character as they flow through the lacustrine deposits of the valley floor. Because the lowland streams are sluggish and have fine-grained substrates, they cannot, in all cases, be reasonably expected to support biological communities typical of the ecoregion. This is especially the case where substrates are composed primarily of muck, silt and clay.

The entire reach of the Grand River mainstem through the Phelps Creek 10-digit HUC subwatershed 0411000402 hydrologic unit has a verified WWH designation. That use was fully met at Grand River RM 55.62 within the reach. The Grand River is one of the few streams in Ohio that supports self-sustaining, native populations of walleye and muskellunge, both highly valued sport fish. As such, this reach should be considered for the Superior High Quality Water antidegradation tier.

The Grand River mainstem downstream from West Farmington flows through a glacial lake-bed and consequently has low gradient, and fine sediment. However, because the catchment is highly dendritic, drainage area downstream from West Farmington increases rapidly, providing sufficient energy to create meanders, and sort sediments such that substrates in the thalweg are generally sand and gravel. Furthermore, because farms in the catchment tend to be small and isolated from the immediate riparian area, and because most of the headwaters are reasonably intact, the channel is not overwhelmed with silt and clay. Lastly, the wooded riparian zone supplies a generous quantity of large woody debris to the river, which, in-turn, creates variation in current velocity that further helps sort sediments.

Table 228. 041100040305 – Subwatershed Aquatic Life Use (ALU) Designation
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-001 Grand River			
55.62	WWH	Full	

The Biological and Water Quality Study of the Upper Grand River 2007 indicates the quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

Fish Communities were sampled along the Grand River mainstem. Fish communities met standards for WWH from West Farmington (RM 88.5) downstream to Footville Richmond Road (RM 48.6) including U.S. Route 6 (55.62). Functionally, the fish community at the site represents one of the closest approximations Ohio has to an intact, lowland, large river fish fauna. No other river in Ohio has native, naturally reproducing populations of muskellunge, northern pike and walleye occurring together. Preservation of the bottomland forests and wetlands is essential for maintaining these populations.

Table 229. 041100040305 - Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIWb[a]	Narrative
03-001 Grand River - WWH										
G01K08	55.62	23	19.0	252.0	58.0	251.00	59.0	49	8.4	Very Good/ Marginally Good

Recreational use assessments
The ubiquity of high bacteria counts clearly suggests that the bacteria indicators are not serving exclusively as surrogates for pathogens of human origin. E. coli counts followed a log-normal distribution suggesting an origin from diffuse sources such as livestock and wildlife. Additional indicators failed to point to an identifiable source, so the Grand River RM 55.62 source is listed as unknown (Table 8).

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 230. 041100040305 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Headwaters Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	STORET	GEOMEAN	N	Class	Attainment	Sources
Grand River						
55.62	G01K08	325	6	A	Non	Unknown

Macroinvertebrate communities were evaluated at 57 stations in Upper Grand River study area. The community performance was evaluated as exceptional at 18 stations, very good at four, good at 15, marginally good at two, fair at 13, and poor at five stations. Two of these stations were on streams with primary headwater habitat (PHWH) characteristics. Twenty-one uncommonly collected sensitive taxa (excluding the freshwater mussels) were found in this study area. In addition to these, the state listed Threatened species Cambarus robustus (Cavespring Crayfish) was collected at seven sites and the Species of Concern Orconectes propinquus (Great Lakes Crayfish) was found at 49 sites in the study area. Huehner et al. (2005) reported finding populations of 19 species of freshwater mussels (Unionidae) in the Upper Grand River mainstem, including one state Threatened species and four state Species of Concern. Fourteen of these species were collected from the Grand River mainstem during this study either as live individuals or fresh-dead shells. This study area had an unusually high number of uncommonly collected sensitive taxa and state listed species, which is an indication of the exceptional resource quality in the Upper Grand River basin.

The Upper Grand River stations located in the lowland area exhibited low gradient and substrates composed primarily of smaller sized particles and woody debris (glacial Grand River Lake lacustrine deposits). Macroinvertebrate communities at these stations were performing at good to exceptional levels, with generally lower diversity of EPT (9-23) and sensitive taxa (14-31). Fourteen species of freshwater mussels were collected at these lowland stations.

Table 231. 041100040305 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Headwaters Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	Drain Area (mi²)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Grand River (03-001)										
55.62	251	15	43	13/16	15/21	L-M/280	0	Hydropsychid caddisflies (F), midges (MI), baetid mayflies (F,MI)	36	Good

- **12-digit HUC 041100040305 – Plumb Creek - Grand River Subwatershed Problem Statements, Goals, objectives and Action**

Summary of Impairments: The major causes of impairment for Plumb Creek, a 12-digit subwatershed of Phelps Creek – Grand River 10-digit subwatershed, include pathogen loading (fecal coliform and E. coli) in excess of 165 colony forming units (cfu) per year. Those causes are primarily associated with livestock.

Problem Statement 1: The presence of about 165 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Plumb Creek section of the Grand River Mainstem around RM 55.62. The most likely source is livestock manure runoff in this section of the Plumb Creek – Grand River Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 165 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective: Establish 1 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 165 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Problem Statement 2: Local stakeholder concern has identified 2057 acres of land with high natural area conservation value (Map 89) under threat of conversion. It was assumed that for a single family housing development on the 2057 acres, 50% of the land would be preserved as open space. Of the remaining 1482 acres developed as single-family residential, it was assumed that the development would use filter buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by impervious surfaces and residential land use (excess loading of nitrogen (N) - 2987 lbs/year, phosphorus (P) - 440 lbs/year, Biological Oxygen Demand (BOD) - 12127 lbs/year and Sediment – 33 tons/year) would push adjacent sections of Plumb Creek to impairment (see table 230).

Goal: Protect 2057 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 2057 acres of land with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 232. Plumb Creek - Grand River Subwatershed Land Protection Load Estimates for land protection.

Current land use loading as 2057 acres of forest			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
670.2	327.9	1644.4	19.5
New land use loading following development of 2153.5 acres as single-family housing with LID			
N Load lb/year	**P Load lb/year**	**BOD lb/year**	**Sediment Load t/year**
3658.8	768.3	13771.8	52.9
Net increase due to land use change			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
2988.6	**440.4**	**12127.4**	**33.4**

Problem Statement 3: Local stakeholder concern has identified 754 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 754 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 754 acres of wetlands with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified wetland protection properties.

Problem Statement 4: Local stakeholder concern has identified 7.75 miles or 40932 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant pollutants generated by channel erosion (excess loading of sediment – 696 tons/year, N - 1392 lbs/year and P - 696 lbs/year) would push adjacent sections of Plumb Creek to impairment (see table 231).

Goal: Protect 7.75 miles or 40932 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 7.75 miles or 40932 linear feet of stream corridor with high natural area conservation value.

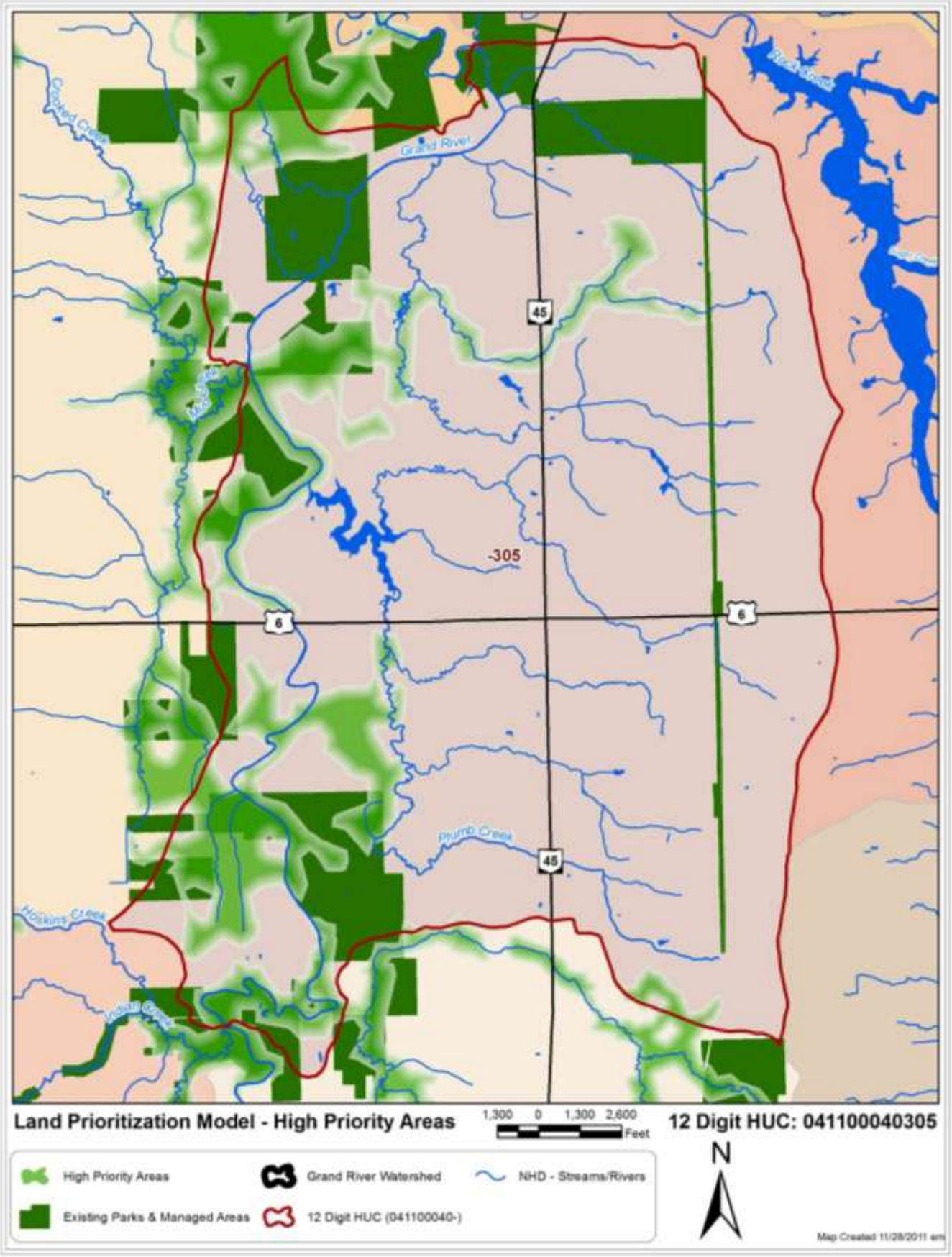
Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 233. Plumb Creek - Grand River Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	347.9	347.9
Phosphorus Load Reduction (lb/year)			347.9	347.9
Nitrogen Load Reduction (lb/yr)			695.8	695.8

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 89 – 041100040305 Plumb Creek – Grand River Land Protection Prioritization Model - High Priority Areas



This Page Intentionally left blank

O. Griggs Creek Subwatershed

12 Digit HUC: 041100040401
Location: Griggs Creek to Mill Creek (2)
Drainage Area: 20.65 miles^2, 13216 acres
Miles of stream: 61 miles
Average Sinuosity: 1.24
Average Impervious Cover: 1.07 percent

Photo 25. Mill Creek (2) at confluence with Griggs Creek *(Source: G. Warnock)*

Subwatershed Description
The Griggs Creek 12-digit HUC subwatershed represents 20 percent of the three (3) subwatersheds in the Griggs Creek – Mill Creek (2) 10-digit HUC subwatershed to the Grand River Watershed. This watershed drains mostly forested and cultivated cropland land in central Ashtabula County. The watershed includes portions of Denmark, Jefferson, Plymouth and Sheffield Townships.

As of 2006, about 3 percent or 446 acres of land development (low, medium & high intensity) has occurred in the Griggs Creek subwatershed, with 47 percent of the land use as forested and 48 percent as agricultural land use (Table 234, Map 70). Deciduous forest makes up of 54 percent of the forested land use, cultivated crops makes up 59 percent of agricultural land use and corn & soybeans dominates the row crop production at 88 percent.

Table 234. 041100040401 – Subwatershed Land Use
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Developed, High Intensity	2	0.02
Developed, Medium Intensity	29	0.22
Developed, Low Intensity	415	3.14
Developed, Open Space	65	0.49
Cultivated Crops	3769	28.54
Pasture/Hay	2508	18.99
Grassland/Herbaceous	119	0.90
Deciduous Forest	3385	25.64
Evergreen Forest	15	0.12
Mixed Forest	16	0.12
Scrub/Shrub	1190	9.01
Palustrine Forested Wetland	1579	11.96
Palustrine Scrub/Shrub Wetland	86	0.65
Palustrine Emergent Wetland	20	0.15
Open Water	8	0.06
Total	**13206**	

Floodplain
Forest and pasture make up 80 percent of the land use in the Griggs Creek Subwatershed floodplain. Forest covers 57 percent or 1151 acres and pasture/hay covers 26 percent or 527 acres of the 2015 acres of flood plain. The next closest land use in the flood plain is open space at 149 acres or 7 percent. High, medium and low density development only composes 35 acres or just 1.73 percent of the floodplain (Table 235).

Table 235. 041100040401 – Subwatershed Land Use Within Floodplain
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

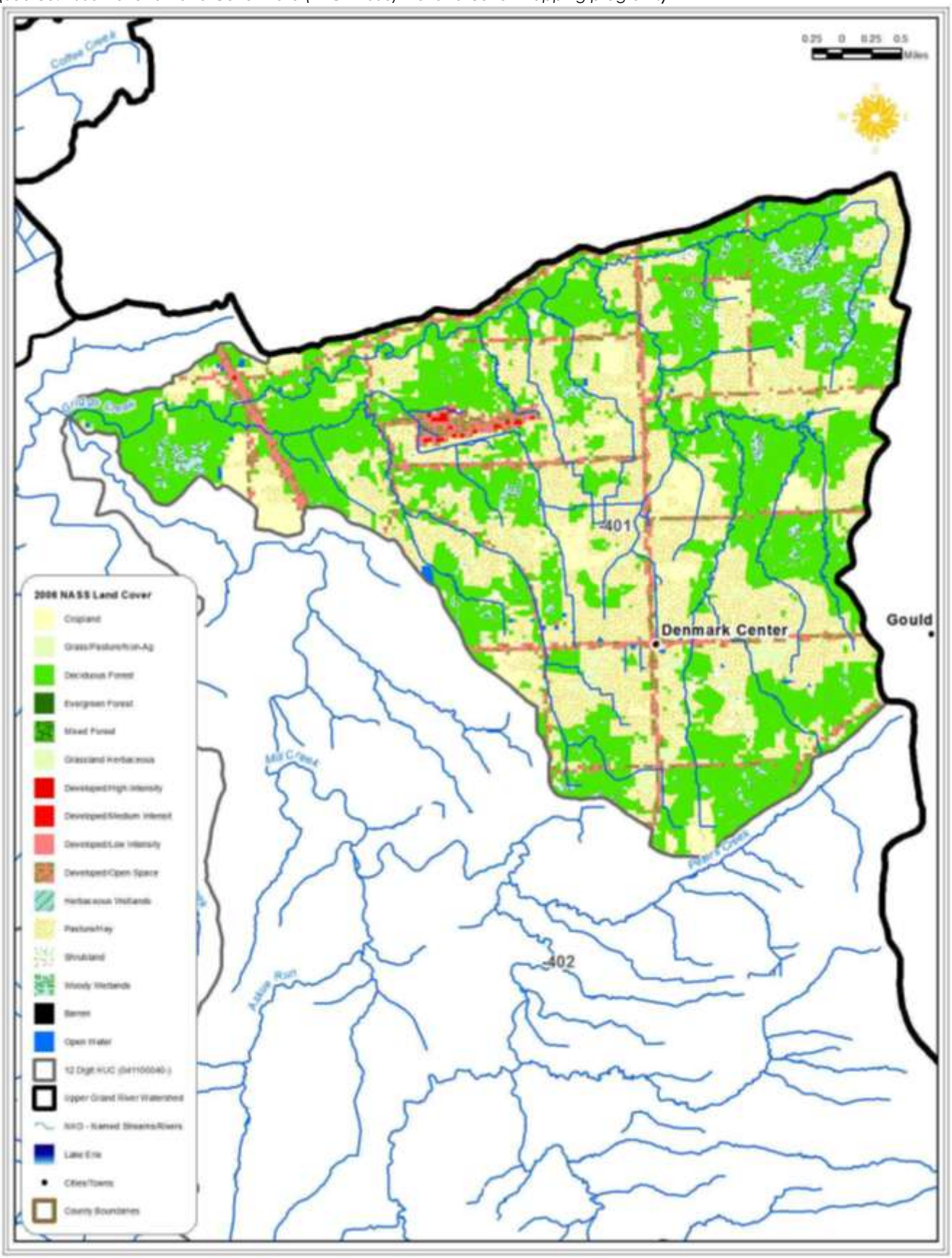
Description	Acres	Percent of Watershed
Agriculture	75	3.73
Grass/Pasture/Non-Ag	25	1.22
Barren	0	0.00
Deciduous Forest	1076	53.42
Developed/High Intensity	1	0.05
Developed/Low Intensity	33	1.64
Developed/Medium Intensity	1	0.05
Developed/Open Space	149	7.41
Evergreen Forest	0	0.00
Grassland Herbaceous	46	2.30
Herbaceous Wetlands	0	0.00
Open Water	6	0.30
Pasture/Hay	527	26.17
Shrubland	31	1.53
Woody Wetlands	44	2.19
Total	**2015**	

Table 236. 041100040401 – Subwatershed Wetland Types by Acres
(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Pond	Grand Total
81	2798	58	2937

Map 90. 041100040401 – Subwatershed Land Use

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)



This Page Intentionally left blank

Soils

The major soils of the Griggs Creek – Mill Creek (2) subwatershed are the Caneadea-Canadice Association, Platea-Pierpont Association, Platea-Sheffield Association. These are characterized by deep, nearly level to gently sloping soils that very from somewhat poorly drained to poorly drained silty soils situated on glaciated uplands. The Platea-Pierpont Association occurs in the northern part of the subwatershed on hummocky morainal deposits. About 85 percent of the soils are considered not highly erodible. About 13 percent of the soils are considered potentially highly erodible. Tables 4 & 5 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Ashtabula County.

Table 237. 041100040401 – Subwatershed Highly Erodible Soil by Acres

(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
35	1732	11296	119

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Griggs Creek subwatershed is made up of 77 percent from Group C/D Hydrologic Soil. Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Some soils having clay, silty clay, or sandy clay textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.

Table 238. 041100040401 - Subwatershed Hydrologic Soil Groups by Acres

(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

A:	B:	C:	D:	A/D:	B/D:	C/D:
14	0	41	2314	0	628	10090

Water Quality

According to the Biological and Water Quality Study of the Lower Grand River 2003 – 2004, the Ohio EPA reported there are 13.5 miles of stream with Warmwater Habitat (WWH) Aquatic Life Use Designation in the Griggs Creek Subwatershed. That use designation remains unconfirmed. The Griggs Creek reaches of the subwatershed are in partial attainment of WWH aquatic life use designation due to natural limits of a wetland at RM 2.0. The creek should be resampled in a reach not flowing through a wetland (Table 239).

The Griggs Creek Subwatershed stream section that failed to meet the aquatic life use attainment status was assessed using the Qualitative Habitat Evaluation Index (QHEI), Integrated Biological Index (IBI), and the Invertebrate Community Index (ICI). Although sampling obtained the target QHEI score of 50.5 for WWH, the IBI (34) and ICI (30) scores did not reflect the physical habitat conditions. Because sampling occurred in a wetland, biological communities indicated impact due to natural limits (RM 2.0). Consequently, Griggs Creek only partially meets the aquatic life use attainment status. The creek should be resampled in a reach not flowing through a wetland.

Table 240. 041100040401 – Subwatershed Aquatic Life Use Designation (ALU)
(Source: Biological and Water Quality Study of the Lower Grand River 2003 – 2004 – OEPA)

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-121 Griggs Creek WWH Aquatic Life Use			
2.0	WWH	Partial	Natural Limits - Wetlands

The Biological and Water Quality Study of the Lower Grand River 2003 – 2004 lists natural limits as the cause of impairment and a major contribution to the segment of stream not meeting it's aquatic life use designation. The fish sampled at the site on Griggs Creek were sampled in a beaver pond. The fish community reflect well what one would expect of fish living in a beaver pond, and therefore are likely not entirely characteristic of adjacent reaches. The creek parallels a ridge moraine rich in sand and gravel, and so should have good flow and be capable of supporting warmwater fish communities.

Table 241. 041100040401 - Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIWb[a]	Narrative
03-121 Griggs Creek Warmwater Habitat (EOLP)										
G02G12	2.0	8	8	204.0	5.41	14.1	-	34*		Fair

a - MIwb is not applicable to headwater streams with drainage areas < 20 mi2.
* - Indicates significant departure from applicable biocriteria (>4 IBI units or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

Recreational Use Assessments

The Griggs Creek – Mill Creek (2) subwatershed (10-digit HUC) was in non-attainment for recreational use throughout it's entire reach. The ubiquity of high bacteria counts clearly suggests that the bacteria indicators are not serving exclusively as surrogates for pathogens of human origin. E. coli counts followed a log-normal distribution suggesting an origin from diffuse sources such as livestock and wildlife. Additional indicators failed to point to an identifiable source, so the Griggs Creek source is listed as unknown (Table 242).

Pooled data analysis for fecal coliform in the Griggs Creek subwatershed found that the geometric mean was below the water quality criteria, but that the 90th percentile exceeded the 10 percent water quality criteria). Problem areas evident through spatial analysis of the data include Griggs Creek, where both the geometric mean (1,780 cfu/100 ml) and the 90th percentile (19,700 cfu/100 ml) exceeded the Primary Contact Recreation (PCR) water quality criteria at the single sampling location on this stream (n=8).

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 242. 041100040401 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Griggs Creek subwatershed in 2007.
Source: Biological and Water Quality Study of the Upper Grand River 2007 - OEPA

Number of Samples	Geometric Mean	90th Percentile	Minimum	Maximum	Attainment	Sources
8	1,780	19,700	250	26,000	Non	Unknown

Macroinvertebrate communities sampled in Griggs Creek (RM 3.5) were just barely meeting Warmwater Habitat expectations. Relatively low EPT and sensitive taxa diversity indicated some sort of mild impact. Both of these streams are relatively low gradient with at least Griggs Creek having beaver dams observed upstream from the collection area. It is possible that wetland conditions were exacerbating enrichment from agricultural activities and poorly operating home waste systems.

Table 243. 041100040401 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Griggs Creek subwatershed in 2007.
Source: Biological and Water Quality Study of the Upper Grand River 2007 - OEPA

RM	Drain Area (mi^2)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Griggs Creek (03-121)										
3.5	14.1	12,13,16	48	12/13	9/15	L-M/84	3	Rheotanytarsus pellucidus midges (MI), hydropsychid caddisflies (F), blackflies (F)	30	Marginally good

L – Low, M - Moderate

- **12-digit HUC 041100040401 – Griggs Creek Subwatershed Problem Statements, Goals, objectives and Action**

Summary of Impairments: The major causes of impairment for Griggs Creek, a 12-digit subwatershed of Griggs Creek – Mill Creek (2) 10-digit subwatershed, include pathogen loading (fecal coliform and E. coli) in excess of 1620 colony forming units (cfu) per year. Those causes are primarily associated with livestock.

Problem Statement 1: The presence of about 1620 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Griggs Creek. The most likely source is livestock manure runoff in this section of the Griggs Creek Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 1620 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 2 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 1,470 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Objective 2: Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms (approximately 500 feet of streambank per farm), resulting in an excess pathogen loading reduction of 150 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 2: Local stakeholder concern has identified 324 acres of land with high natural area conservation value (Map 91) under threat of conversion. It was assumed that for a single family housing development on the 324 acres, 50% of the land would be preserved as open space. Of the remaining 162 acres developed as single-family residential, it was assumed that the development would use filter buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by impervious surfaces and residential land use (excess loading of nitrogen (N) - 469 lbs/year, phosphorus (P) - 69 lbs/year, Biological Oxygen Demand (BOD) - 1906 lbs/year and Sediment – 5 tons/year) would push adjacent sections of Griggs Creek to impairment (see table 242).

Goal: Protect 324 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 324 acres of land with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 244. Griggs Creek Subwatershed Land Protection Load Estimates for land protection.

Current land use loading as 324 acres of forest			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
109.9	53.3	267.6	4.4
New land use loading following development of 162 acres as single-family housing with LID			
N Load lb/year	**P Load lb/year**	**BOD lb/year**	**Sediment Load t/year**
578.5	121.8	2173.5	9.0
Net increase due to land use change			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
468.6	**68.5**	**1905.9**	**4.6**

Problem Statement 3: Local stakeholder concern has identified 149 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 149 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 149 acres of wetlands with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified wetland protection properties.

Problem Statement 4: Local stakeholder concern has identified 5.31 miles or 28059 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant pollutants generated by channel erosion (excess loading of sediment – 477 tons/year, N - 954 lbs/year and P - 477 lbs/year) would push adjacent sections of Griggs Creek to impairment (see table 243).

Goal: Protect 5.31 miles or 28059 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 5.31 miles or 28059 linear feet of stream corridor with high natural area conservation value.

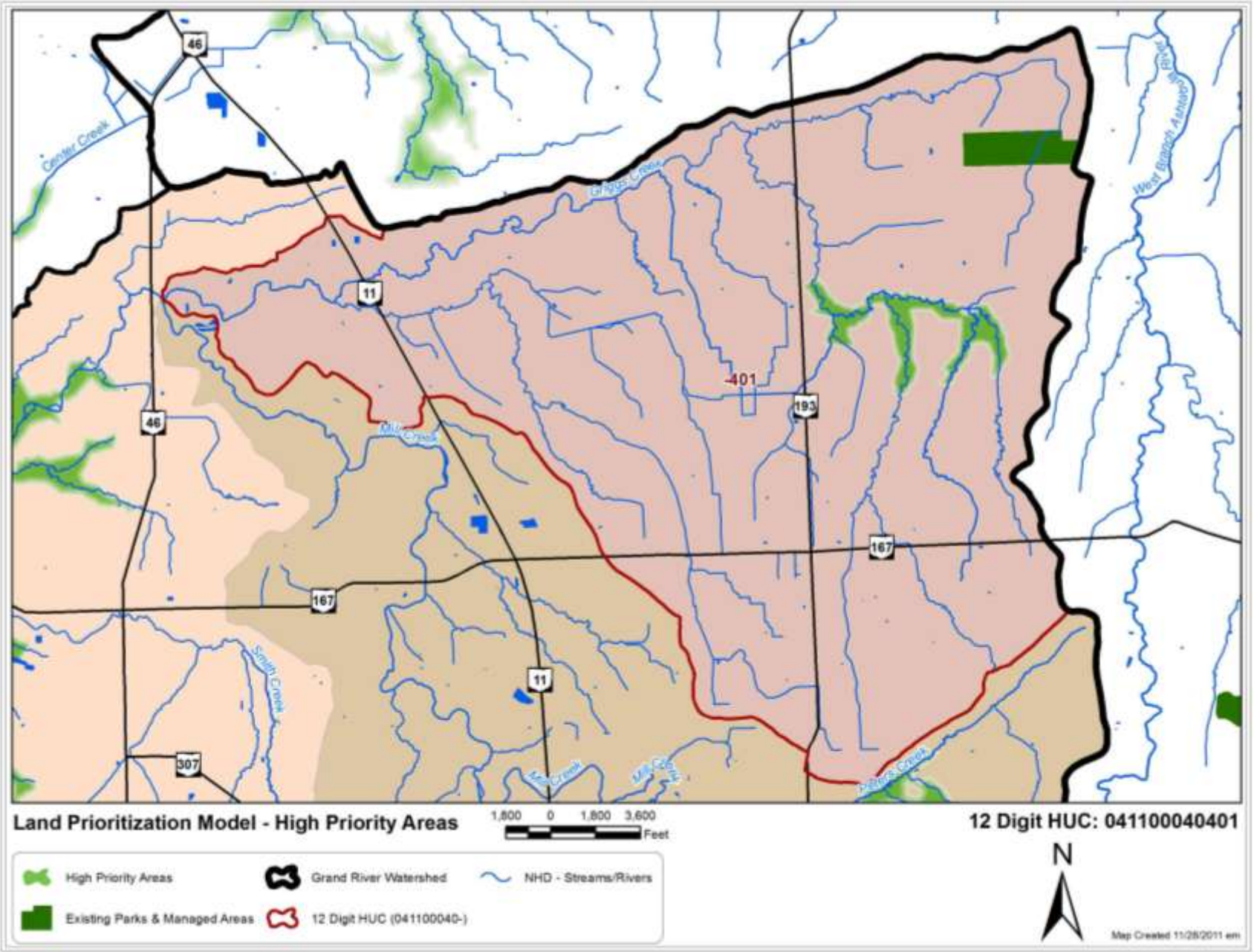
Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 245. Griggs Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	238.5	238.5
Phosphorus Load Reduction (lb/year)			238.5	238.5
Nitrogen Load Reduction (lb/yr)			477	477

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 91 - Griggs Creek Land Protection Prioritization Model - High Priority Areas



P. Peters Creek - Mill Creek Subwatershed

12 Digit HUC: 041100040402
Location: Mill Creek (2) headwaters to above Griggs Creek
Drainage Area: 54.73 miles^2, 35025 acres
Miles of stream: 153 miles
Average Sinuosity: 1.17
Average Impervious Cover: 1.05%

Photo 26. Mill Creek @ Confluence of Griggs Creek *(Source: GRPI)*

Subwatershed Description
The Peters Creek - Mill Creek 12-digit HUC subwatershed represents 53 percent of the three (3) subwatersheds in the Griggs Creek – Mill Creek (2) 10-digit HUC subwatershed. This watershed drains mostly forested and cultivated cropland in central Ashtabula County. The watershed includes portions of Cherry Valley, Denmark, Dorset, Jefferson, Lenox, New Lyme and Richmond Townships. A small portion of the Village of Jefferson is located within the boundary of the Peters Creek - Mill Creek Subwatershed.

As of 2006, about 3 percent or 1125 acres of land development (low, medium & high intensity) has occurred in the Peters Creek - Mill Creek Subwatershed; 53 percent of the land use is forested and 43 percent is agricultural land use (Table 247, Map 72). Deciduous forest makes up of 51 percent of the forested land use, cultivated crops makes up 63 percent of agricultural land use and corn & soybeans dominates the row crop production at 91 percent.

Table 246. 041100040402 – Subwatershed Land Use
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Developed, High Intensity	1	0.00
Developed, Medium Intensity	48	0.14
Developed, Low Intensity	1076	3.07
Developed, Open Space	42	0.12
Cultivated Crops	9615	27.47
Pasture/Hay	5330	15.22
Grassland/Herbaceous	265	0.76
Deciduous Forest	9441	26.97
Evergreen Forest	138	0.39
Mixed Forest	75	0.21
Scrub/Shrub	3729	10.65
Palustrine Forested Wetland	4629	13.22
Palustrine Scrub/Shrub Wetland	417	1.19
Palustrine Emergent Wetland	133	0.38
Bare Land	1	0.00
Open Water	70	0.20
Total	**35009**	

Floodplain
Forest and pasture make up 80 percent of the land use in the Griggs Creek Subwatershed floodplain. Forest covers 61 percent or 3380 acres and pasture/hay covers 22 percent or 1234 acres of the 5563 acres of flood plain. The next closest land use in the flood plain is agriculture at 301 acres or 5 percent. High, medium and low density development only composes 81 acres or just 1.45 percent of the floodplain (Table 248).

Table 247. 041100040402 – Subwatershed Land Use Within Floodplain
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

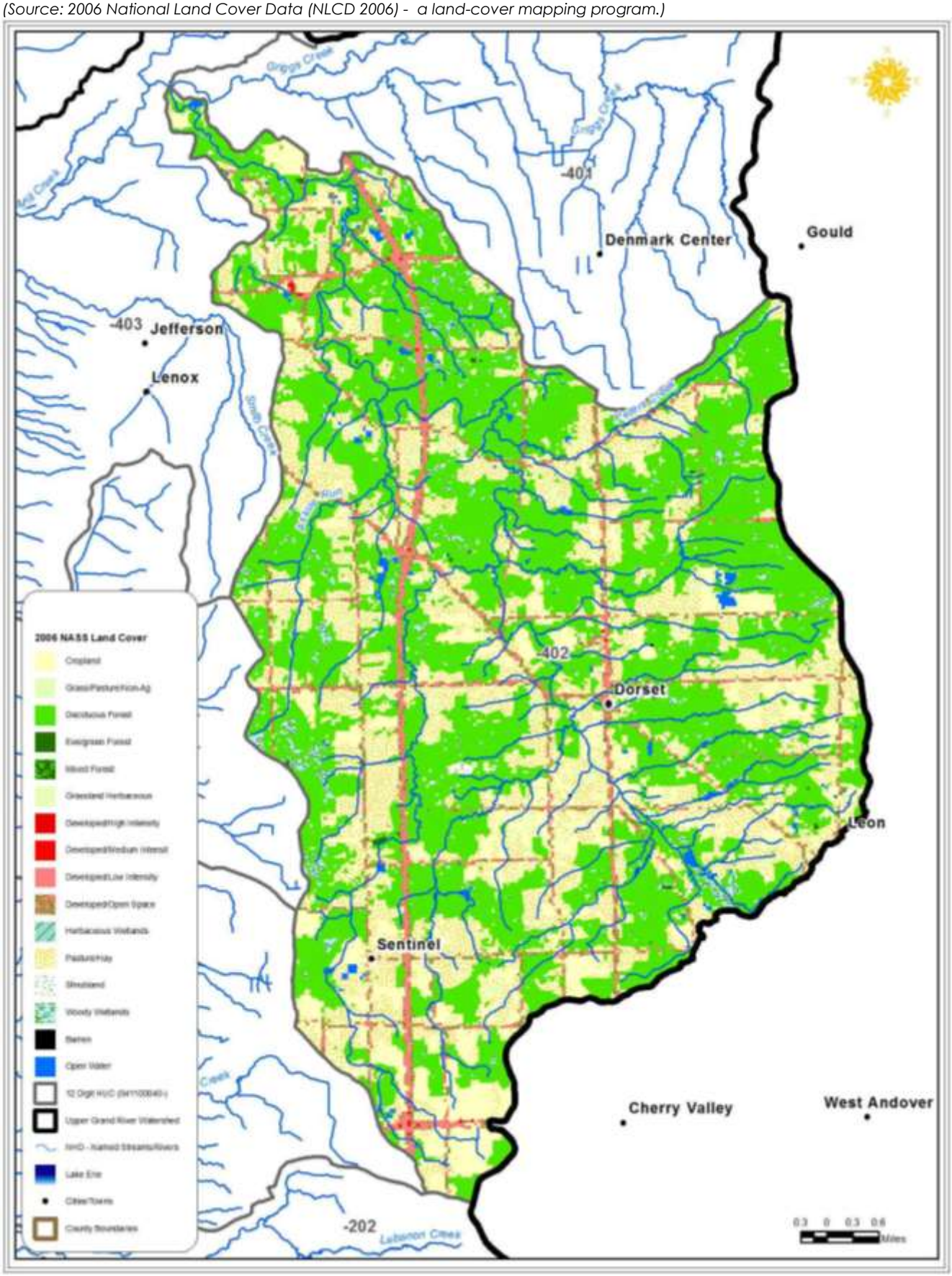
Description	Acres	Percent of Watershed
Agriculture	356	6.40
Grass/Pasture/Non-Ag	48	0.86
Barren	1	0.02
Deciduous Forest	3223	57.94
Developed/High Intensity	0	0.00
Developed/Low Intensity	79	1.42
Developed/Medium Intensity	2	0.03
Developed/Open Space	301	5.42
Evergreen Forest	7	0.13
Grassland Herbaceous	92	1.65
Herbaceous Wetlands	0	0.00
Open Water	70	1.26
Pasture/Hay	1234	22.19
Shrubland	30	0.53
Woody Wetlands	120	2.16
Total	**5563**	

Table 248. 041100040402 – Subwatershed Wetland Types by Acres
(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Other	Pond	Grand Total
212	6052	3	250	6516

Map 92. 041100040402 – Subwatershed Land Use

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)



This Page Intentionally left blank

Table 249. 041100040402 – Subwatershed Land Use Within Floodplain
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Agriculture	356	6.40
Grass/Pasture/Non-Ag	48	0.86
Barren	1	0.02
Deciduous Forest	3223	57.94
Developed/High Intensity	0	0.00
Developed/Low Intensity	79	1.42
Developed/Medium Intensity	2	0.03
Developed/Open Space	301	5.42
Evergreen Forest	7	0.13
Grassland Herbaceous	92	1.65
Herbaceous Wetlands	0	0.00
Open Water	70	1.26
Pasture/Hay	1234	22.19
Shrubland	30	0.53
Woody Wetlands	120	2.16
Total	**5563**	

Table 250. 041100040402 – Subwatershed Wetland Types by Acres
(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Other	Pond	Grand Total
212	6052	3	250	6516

Soils

The major soils of the Griggs Creek – Mill Creek (2) subwatershed are the Caneadea-Canadice Association, Platea-Pierpont Association, Platea-Sheffield Association. These are characterized by deep, nearly level to gently sloping soils that very from somewhat poorly drained to poorly drained silty soils situated on glaciated uplands. The Platea-Pierpont Association occurs in the northern part of the subwatershed on hummocky morainal deposits. About 25 percent of the soils are considered potentially highly erodible. Tables 250 & 251 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Ashtabula County.

Table 251. 041100040402 – Subwatershed Highly Erodible Soil by Acres
(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
151	8632	25269	730

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Griggs Creek subwatershed is made up of 57% from Group C/D Hydrologic Soil. Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Some soils having clay, silty clay, or sandy clay textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.

Table 252. 041100040402 – Subwatershed Hydrologic Soil Groups by Acres
(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

A:	B:	C:	D:	A/D:	B/D:	C/D:
254	0	273	11818	0	2374	19635

Water Quality
Stream habitat in Mill Creek and its tributaries varies widely from location to location, both within and between streams, depending on the type and thickness of glacial deposits and depth of bedrock. Further upstream, the topography is flat, and the creek flows through glacial drift of varying thickness and over sandstone bedrock. The habitat is characterized by slow, deep pools with vegetated margins (Lizard's Tail) and short riffles.

According to the Biological and Water Quality Study of the Lower Grand River 2003 – 2004 the Ohio EPA reported there are 30.7 miles of stream with Warmwater Habitat (WWH) Aquatic Life Use Designation in the Peters Creek - Mill Creek Subwatershed. Askue Run and Peters Creek are in full attainment of WWH aquatic life use designation. The Mill Creek reaches of the subwatershed are in full attainment of WWH aquatic life use designation with the exception of the headwaters section near the junction of Clay Road and SR 307 (RM 25.6). The stream in this reach is impaired by sedimentation due to agricultural channelization of the headwaters upstream from this point (Table 252).

Table 253. 041100040402 – Subwatershed Aquatic Life Use Designation
(Source: Biological and Water Quality Study of the Lower Grand River 2003 – 2004 – OEPA)

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-120 Mill Creek WWH Aquatic Life Use			
25.6/25.7	WWH	NON	Sedimentation Agricultural Channelization
18.2/17.8	WWH	Full	
03-122 Askue Run WWH Aquatic Life Use			
0.1	WWH	Full	
03-123 Peters Creek WWH Aquatic Life Use			
0.2/0.6	WWH	Full	

Peters Creek - Mill Creek Subwatershed stream section that failed to meet the aquatic life use attainment status was assessed using the Qualitative Habitat Evaluation Index (QHEI), Integrated Biological Index (IBI), and the Invertebrate Community Index (ICI). Although several sampling stations obtained the target QHEI score of 72 for WWH, the IBI (30) and ICI (Fair) scores did not reflect the physical habitat conditions. Biological communities were impacted by channel modifications (RM 25.62), siltation (RM 25.62), and nutrient enrichment (Table 253).

The habitat of Mill Creek, upstream from the confluence with Griggs Creek, is dominated by shallow flow over shale and sandstone bedrock. The headwater site at Clay Road was a swamp stream. For the mainstem as a whole, the habitat is capable of supporting warmwater fish communities. However, because shallow bedrock dominates the drainage, baseflow is very low during the summer, and is the limiting habitat factor.

The two (2) main tributaries to Mill Creek in the Peters Creek - Mill Creek Subwatershed are Askue Run and Peters Creek both contain habitat suitable for warmwater stream fish communities in accordance with expectations for their size and ecoregion. Peters Creek, at the location sampled, is a classic northern swamp forest stream. It has an abundance of tag alder choking and braiding the channel, along with stands of quaking aspen in the surrounding upland (Table 253).

Table 254. 041100040402 - Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIWb[a]	Narrative
03-120 Mill Creek WWH Aquatic Life Use										
G02G13	25.60	10	10	305.1	5.47	21.6	72.0	30*	6.0*	Fair
G02S04	18.20	21	21	1593.8	6.93	47	80.5	52	9.3	Very Good/ Exceptional
03-122 Askue Run WWH Aquatic Life Use										
G02G19	0.1	12	12	307.0	0.00	5.6	50.5	-	38	Marginal
03-123 Peters Creek WWH Aquatic Life Use										
G02G20	0.2	11	11	552.0	0.00	3.7	76.5	-	42	Good

a - MIwb is not applicable to headwater streams with drainage areas < 20 mi2.
* - Indicates significant departure from applicable biocriteria (>4 IBI units or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

Recreational Use Designation

Surface waters in the Mill Creek hydrologic unit tended to have elevated concentrations of nutrients, with mean concentrations of nitrate-nitrite nitrogen, TKN and total phosphorus in water samples approaching or exceeding the 90th percentile of similar-sized reference streams within the Erie-Ontario Lake Plain ecoregion. Sources of nutrients include agricultural land use which is higher within the headwaters reach of Mill Creek than compared to areas downstream, and is generally reflected in nutrient concentrations (TKN, TP, and NH_3N) elevated relative to the reference condition, and an increase in the number of modified habitat attributes. Collectively, these stressors acted to impair the aquatic community in Mill Creek in the vicinity of Clay Road (River Mile 25.7).

Pooled data analysis for fecal coliform in the Peters Creek - Mill Creek subwatershed found that the geometric mean exceeded the Primary Contact Recreation (PCR) water quality criteria, and the 90th percentile also exceeded the PCR water quality criteria. Problem areas evident through spatial analysis of the data include the upstream reaches of Mill Creek. Fecal coliform counts at the most upstream sampling location on Mill Creek at Clay Rd. (RM 25.67) were elevated above the Primary Contact Recreation (PCR) water quality criteria.

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 255. 041100040402 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Peters Creek - Mill Creek subwatershed in 2007.
Source: Biological and Water Quality Study of the Upper Grand River 2007 - OEPA

Number of Samples	Geometric Mean	90th Percentile	Minimum	Maximum	Attainment	Sources
22	821	28,000	33	28,000	Partial	Unknown

Macroinvertebrate communities were evaluated at 10 stations in the Griggs Creek - Mill Creek assessment unit (WAU 04110004050). The community performance was evaluated as exceptional at four stations, good at one, marginally good at two, fair at one, and low fair at two. The station with the highest number of total sensitive taxa was Mill Creek at Netcher Road (RM 17.8) with 42 taxa. The state listed Species of Concern crayfish *Orconectes propinquus* (Great Lakes Crayfish) was collected at stations at Mill Creek (RM 17.80 and 25.70), Askue Run (RM 0.10) and Peters Creek (RM 0.60).

The most upstream macroinvertebrate community sampled in Mill Creek (RM 25.7) was performing at a depressed level with an ICI value of 24 (Fair) and low diversity of EPT and sensitive taxa. The stream in this area is low gradient with beaver dams and is stained brown with tannins from the adjacent swamp forests. The most common organisms at this station were tolerant oligochaetes, (aquatic segmented worms), *Crangonyx sp.* (scud), and *Dicrotendipes simpsoni* (midge), that, along with the low community performance, would be consistent with a low D.O. impact to the community. The remaining communities sample in Mill Creek were performing at an exceptional level with relatively high EPT and sensitive taxa diversity. This study found eight species of freshwater mussels (Unionidae) to be extant in Mill Creek.

Table 256. 041100040402 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Peters Creek-Mill Creek Subwatershed in 2007.
Source: Biological and Water Quality Study of the Upper Grand River 2007 - OEPA

RM	Drain Area (mi2)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Mill Creek (03-120)									
25.7*	21.6	-	36	6/7	6/14	L/436	Blackflies (F)	24	Fair
17.8	49	-	73	21/21	34/42	M/1181	Caddisflies (F,MI), midges (MI,F), baetid mayflies (F,I)	52	Exceptional
Peters Creek (03-123)									
0.6	3.3	-	33	11	12	L-M	Hydropsychid caddisflies (F), midges (MI,F)	-	Marginal - Good
Askue Run (03-122)									
0.1	5.6	-	64	17	24	L-M	Midges (F,MI), hydropsychid caddisflies (F)	-	Good

L – Low, M – Moderate

- **12-digit HUC 041100040402 – Peters Creek-Mill Creek Subwatershed Problem Statements, Goals, objectives and Action**

Summary of Impairments: The major causes of impairment for Peters Creek – Mill Creek (2), a 12-digit subwatershed of Griggs Creek – Mill Creek (2) 10-digit subwatershed, include 3970 tons of excess sediment loading (embeddedness). Those causes are primarily associated with physical habitat degradation (channel modifications) from direct alteration of the stream channel and poor land use planning.

Problem Statement 1: The Biological and Water Quality Study of the Upper Grand River 2007 reports a low Index of Biotic Integrity (IBI) score of 30 and a invertebrate community index (ICI) score of 24 for samples

taken from Mill Creek (2) in the area of RM 25.62. The presence of about 3970 tons of excess sediment loading (embeddedness) from adjacent cropland is the cause of Aquatic Life Use (ALU) Designation non-attainment status for nearly 8 miles of Mill Creek (2). The source of the impairment is physical habitat degradation (channel modifications) from direct alteration of the stream channel and poor land use planning which has resulted in continued habitat degradation and removal of riparian vegetation in this section of the Peters Creek – Mill Creek (2) Subwatershed.

Goal: Raise IBI score by 33 percent or 10 points from an IBI score of 30 in the poor range to an IBI score of 40 in the good range and raise ICI score by 42 percent or 10 points from an ICI score of 24 in the poor range to an ICI score of 34 in the good range by reducing 3970 tons of excess sediment loading from the impaired section of Mill Creek (2) near RM 25.62.

Objective 1: Reduce soil erosion from unprotected cropland by about 629 tons per year (.82 ton per acre per year) for five (5) years by establishing 767 new acres per year of cover crops to avoid sediment runoff.

Action 1: Target outreach and quality technical assistance to generate higher levels of cover crop implementation.
Action 2: Conduct personal interviews with farmers, survey questionnaire mailings, form farmer focus groups and conduct local informational meetings.

Objective 2: Reduce soil erosion from unprotected cropland by about 162 tons per year (.82 ton per acre per year) for five (5) years by establishing 198 new acres per year of reduced tillage/residue management to avoid sediment runoff.

Action 1: Target outreach and quality technical assistance to generate higher levels of no-till implementation.
Action 2: Conduct personal interviews with farmers, survey questionnaire mailings, form farmer focus groups and conduct local informational meetings.

Objective 3: Reduce soil erosion from unprotected cropland by about 3 tons per year (.82 ton per acre per year) for five (5) years by establishing 3.5 new acres per year of filter strips per year to trap sediments before entering the stream.

Action 1: Target outreach and quality technical assistance to generate higher levels of filter strip implementation.
Action 2: Conduct personal interviews with farmers, survey questionnaire mailings, form farmer focus groups and conduct local informational meetings.

Objective 4: Reduce soil erosion from unprotected cropland by about 381 pounds per year (1640 pounds per acre per year) for five (5) years by establishing 0.23 new acres per year of grassed waterways to control sediment runoff.

Action 1: Evaluate areas of concentrated flow to determine need for combining additional best management practices, e.g. grassed waterway and filter strip.
Action 2: Target outreach and quality technical assistance to generate higher levels of grassed waterway implementation.
Action 3: Conduct personal interviews with farmers, survey questionnaire mailings, form farmer focus groups and conduct local informational meetings.

Objective 5: Reduce soil erosion from unprotected cropland by about 762 pounds per year (1640 pounds per acre per year) for five (5) years by establishing 0.46 new acres per year of critical area plantings to trap sediments before entering the stream.

Action 1: Target outreach and quality technical assistance to generate higher levels of critical area planting implementation.
Action 2: Conduct personal interviews with farmers, survey questionnaire mailings, form farmer focus groups and conduct local informational meetings.
Action 3: Evaluate areas of concentrated flow to determine need for combining additional best management practices, e.g. critical area planting and filter strip.

Problem Statement 2: Local stakeholder concern has identified 983 acres of land with high natural area conservation value under threat of conversion. It was assumed that for a single family housing development on the 983 acres, 50% of the land would be preserved as open space. Of the remaining 491.5 acres developed as single-family residential, it was assumed that the development would use filter buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by impervious surfaces and residential land use (excess loading of nitrogen (N) - 1426 lbs/year, phosphorus (P) - 210 lbs/year, Biological Oxygen Demand (BOD) - 5791 lbs/year and Sediment – 15 tons/year) would push adjacent sections of Peters Creek to impairment (Table 257).

Goal: Protect 983 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 983 acres of land with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 257. Peters Creek-Mill Creek (2) Subwatershed Land Protection Load Estimates for land protection.

Current land use loading as 983 acres of forest			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
325.1	158.6	795.5	10.8
New land use loading following development of 491.5 acres as single-family housing with LID			
N Load lb/year	**P Load lb/year**	**BOD lb/year**	**Sediment Load t/year**
1750.9	368.1	6586.1	26
Net increase due to land use change			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
1425.8	**209.5**	**5790.6**	**15.2**

Problem Statement 3: Local stakeholder concern has identified 201 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 201 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 201 acres of wetlands with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified wetland protection properties.

Problem Statement 4: Local stakeholder concern has identified 11.80 miles or 62299 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant pollutants generated by channel erosion (excess loading of sediment – 1059 tons/year, N - 2118 lbs/year and P - 1059 lbs/year) would push adjacent sections of Peters Creek to impairment (Table 258).

Goal: Protect 11.80 miles or 62299 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 11.80 miles or 62299 linear feet of stream corridor with high natural area conservation value.

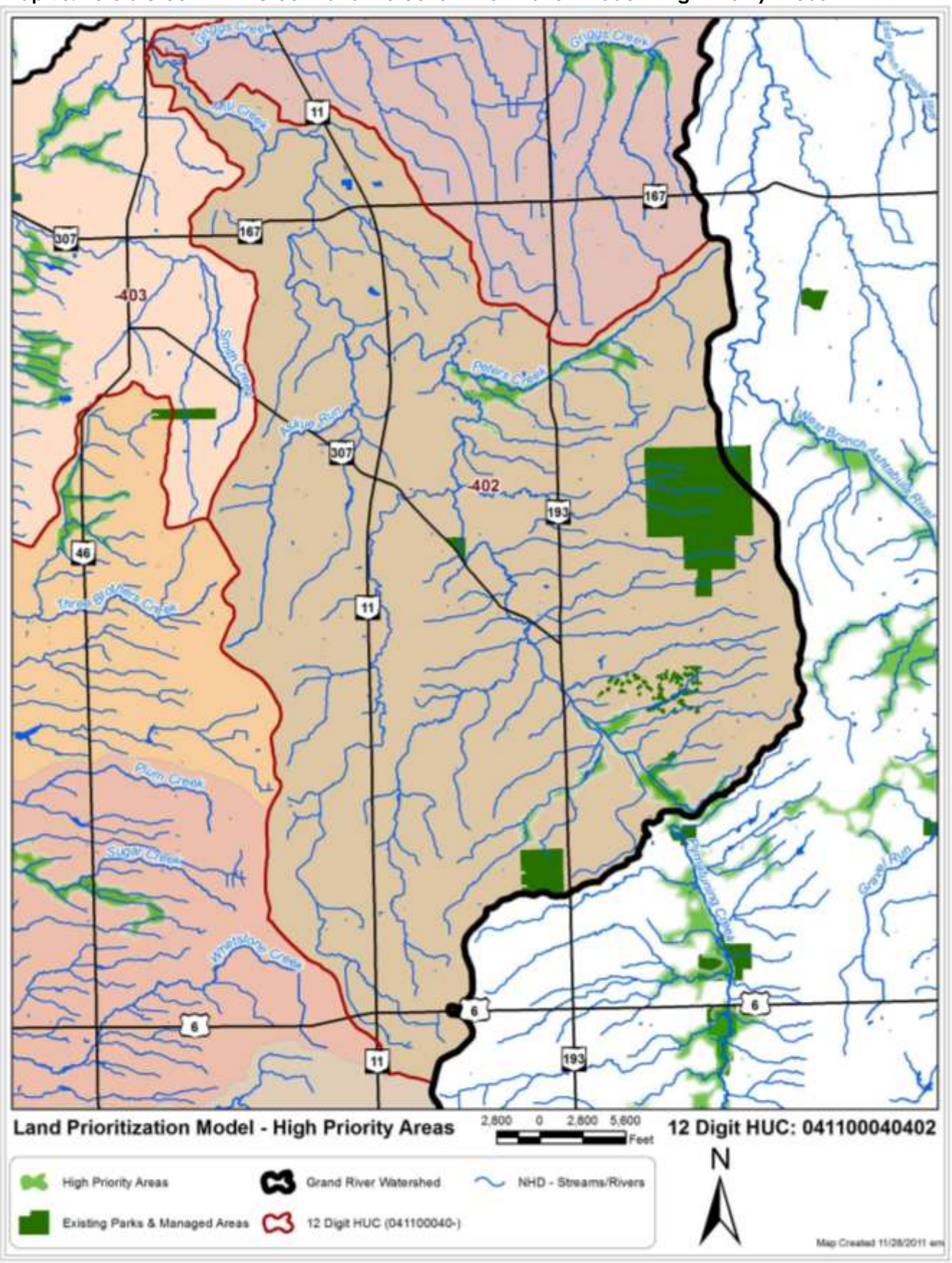
Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 258. Peters Creek-Mill Creek (2) Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	529.5	529.5
Phosphorus Load Reduction (lb/year)			529.5	529.5
Nitrogen Load Reduction (lb/yr)			1059.1	1059.1

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 93. Peters Creek - Mill Creek Land Protection Prioritization Model - High Priority Areas



Q. Village of Jefferson – Mill Creek Subwatershed

12 Digit HUC: 041100040403
Location: Mill Creek (2) below Griggs Creek to Grand River
Drainage Area: 28.79 miles^2, 18424 acres
Miles of stream: 83 miles
Average Sinuosity: 1.12
Average Impervious Cover: 2.73%

Photo 27. Grand River @ Cork Cold Springs Road - North of Confluence with Mill Creek (2) *(Source: GRPI)*

Subwatershed Description
The Village of Jefferson – Mill Creek 12-digit HUC subwatershed represents 27 percent of the three (3) subwatersheds in the Griggs Creek – Mill Creek (2) 10-digit HUC subwatershed to the Grand River Watershed. This watershed drains mostly forested and pasture/hay land in central Ashtabula County. The watershed includes portions of Austinburg, Jefferson, Lenox, Morgan and Plymouth Townships. Almost the entire Village of Jefferson is located within the boundary of the Village of Jefferson – Mill Creek Subwatershed.

Although this subwatershed contains areas with the highest level of development (low, medium & high intensity) at 7.4 percent and highest average impervious cover at 2.73 percent in the entire Upper Grand River Watershed, 49 percent of the land use is forested and 31 percent is agricultural land use (Table 259, Map 94). Deciduous forest makes up of 98 percent of the forested land use, pasture/hay makes up 74 percent of agricultural land use and corn & soybeans dominates the row crop production at 81 percent.

Table 259. 041100040403 – Subwatershed Land Use
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Developed, High Intensity	52	0.29
Developed, Medium Intensity	173	0.96
Developed, Low Intensity	1107	6.15
Developed, Open Space	471	2.62
Cultivated Crops	4405	24.47
Pasture/Hay	2176	12.09
Grassland/Herbaceous	165	0.92
Deciduous Forest	5678	31.55
Evergreen Forest	64	0.35
Mixed Forest	70	0.39
Scrub/Shrub	1453	8.07
Palustrine Forested Wetland	1861	10.34
Palustrine Scrub/Shrub Wetland	81	0.45
Palustrine Emergent Wetland	90	0.50
Bare Land	15	0.08
Open Water	136	0.75
Total	**17996**	

Floodplain

Forest and pasture make up 81 percent of the land use in the Village of Jefferson – Mill Creek subwatershed floodplain. Forest covers 69 percent or 2267 acres and pasture/hay covers 13 percent or 439 acres of the 5563 acres of flood plain. The next closest land use in the flood plain is agriculture at 205 acres or 6 percent. High, medium and low density development only composes 69 acres or just 2.10 percent of the floodplain (Table 260).

Table 260. 041100040403 – Subwatershed Land Use Within Floodplain
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

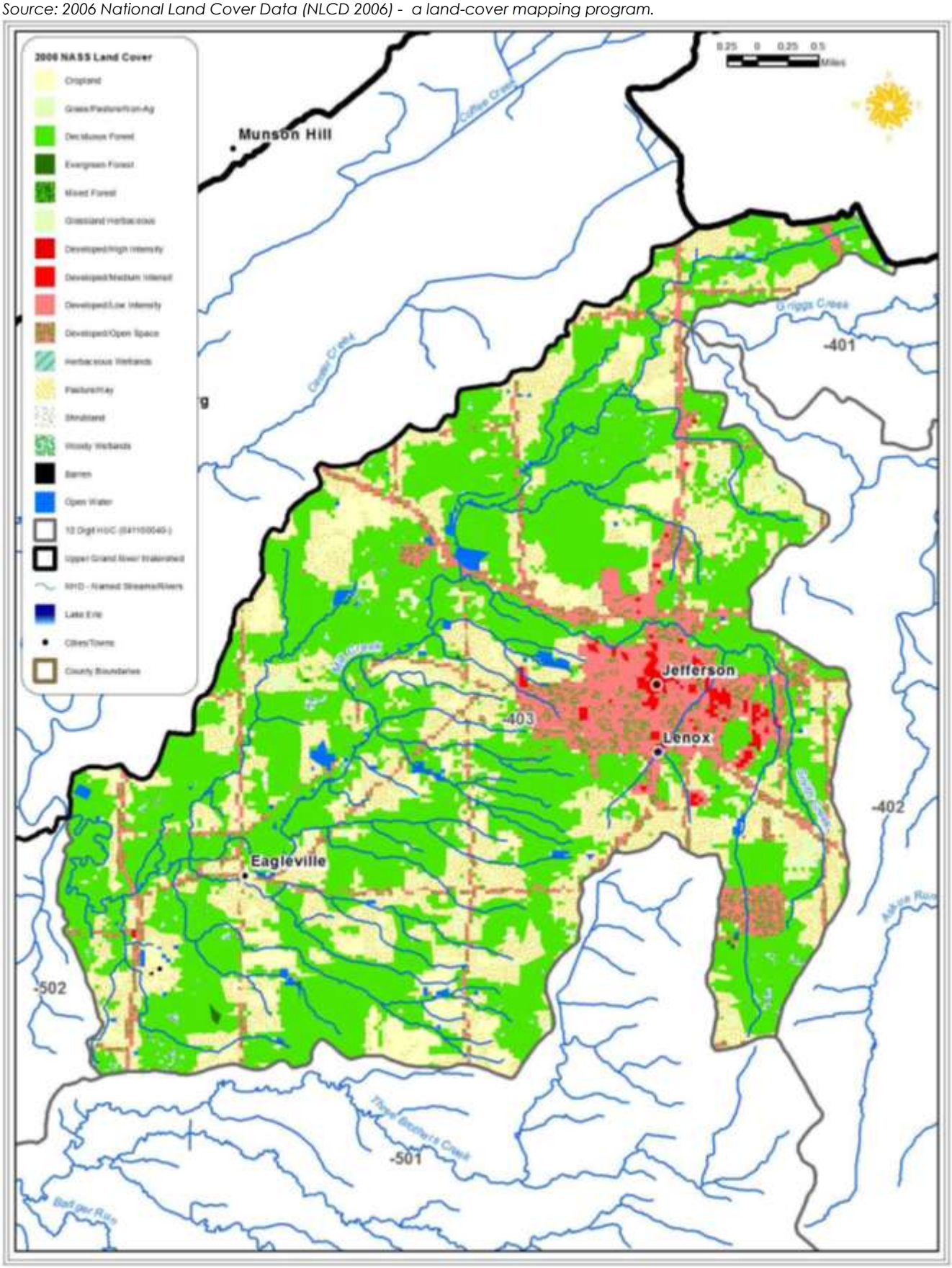
Description	Acres	Percent of Watershed
Agriculture	110	3.35
Grass/Pasture/Non-Ag	16	0.50
Barren	0	0.00
Deciduous Forest	2223	67.79
Developed/High Intensity	4	0.11
Developed/Low Intensity	60	1.82
Developed/Medium Intensity	5	0.16
Developed/Open Space	205	6.25
Evergreen Forest	2	0.05
Grassland Herbaceous	69	2.10
Herbaceous Wetlands	0	0.00
Open Water	105	3.20
Pasture/Hay	439	13.39
Shrubland	8	0.23
Woody Wetlands	35	1.05
Total	**3279**	

Table 261. 041100040403 – Subwatershed Wetland Types by Acres
(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Lake	Pond	Grand Total
40	1369	21	160	1590

Map 94. Table 1. 041100040403 – Subwatershed Land Use

Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.



This Page Intentionally left blank

Soils

The major soils of the Griggs Creek – Mill Creek (2) 10-digit HUC subwatershed are the Caneadea-Canadice Association, Platea-Pierpont Association, Platea-Sheffield Association. These are characterized by deep, nearly level to gently sloping soils that very from somewhat poorly drained to poorly drained silty soils situated on glaciated uplands. The Platea-Pierpont Association occurs in the northern part of the subwatershed on hummocky morainal deposits. About 30 percent of the soils are considered potentially highly erodible. Tables 262 & 263 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Ashtabula County.

Table 262. 041100040403 – Subwatershed Highly Erodible Soil by Acres

(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
138	5466	11824	544

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Village of Jefferson – Mill Creek subwatershed is made up of 57 percent from Group C/D Hydrologic Soil. Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Some soils having clay, silty clay, or sandy clay textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.

Table 263. 041100040403 – Subwatershed Hydrologic Soil Groups by Acres

(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

A:	B:	C:	D:	A/D:	B/D:	C/D:
357	0	132	5006	0	2160	10066

Water Quality

Stream habitat in Mill Creek and its tributaries varies widely from location to location, both within and between streams, depending on the type and thickness of glacial deposits and depth of bedrock. Near Eagleville, the mainstem cuts through sandstone bedrock as it drops into the Grand River Valley; consequently, the habitat in this reach ranges from shallow flow over denuded bedrock (Forman Road [RM 4.1]) to richer habitat characterized by deeper pools and aggregations of fractured bedrock and till (adjacent to the Eagleville cemetery [RM 3.7]). For the mainstem as a whole, the habitat is capable of supporting warmwater fish communities. However, because shallow bedrock dominates the drainage, baseflow is very low during the summer, and is the limiting habitat factor

The main tributary to Mill Creek in the Village of Jefferson – Mill Creek Subwatershed is Cemetery Creek. Though the stream flows through a residential area, Cemetery Creek has, neither been channelized nor denuded of its riparian buffer. The otherwise high quality substrates were moderately embedded with silt from upstream sources. Downstream from Poplar Street, the stream was historically channelized, though most warmwater habitat features have been recovered over time.

According to the Biological and Water Quality Study of the Lower Grand River 2003 – 2004 the Ohio EPA reported there are 19.2 miles of stream with Warmwater Habitat (WWH) Aquatic Life Use Designation in the Village of Jefferson – Mill Creek Subwatershed. The Mill Creek reaches of the subwatershed are in full attainment of WWH aquatic life use designation with the exception of a section at RM 4.1 which exhibits a natural limit due to featureless bedrock.

Cemetery Creek is designated WWH. That use was not met at the two locations sampled. A detectable impact was evident downstream from Cemetery Creek, but the impact did not result in the loss of aquatic life use. The WWH is appropriate for the Creek downstream from the Jefferson WWTP, where suitable habitat quality and perennial flow do not limit the fish community. Downstream from the WWTP, the biological communities were impaired by a failing sewer pump station. The WWTP has since applied for renewal NPDES discharge permit # 3PC00021 (2005 & 2010). It is likely the failing sewer pump has been fixed or replaced since the sampling in 2004. Additional sampling to determine the current status of this portion of the stream is necessary. Upstream from the WWTP, flow is so limited as to warrant further assessment for Primary Headwater Habitat (PHWH) classification.

Table 264. 041100040403 – Subwatershed Aquatic Life Use Designation (ALU)
(Source: Biological and Water Quality Study of the Lower Grand River 2003 – 2004 – OEPA)

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-120 Mill Creek WWH Aquatic Life Use			
9.7	WWH	Full	
6.5/7.2	WWH	Full	
4.1	WWH	Partial	Natural Limits - featureless bedrock
3.7/2.9	WWH	Full	
03-124 Cemetery Creek WWH Aquatic Life Use			
2.1/2.4	WWH	NON	Flow alteration - Urban runoff
1.3/1.2	WWH	NON	Organic Enrichment/Toxicity - Sewer pump station

In Mill Creek, fish communities met the WWH biocriteria for wadeable streams at all locations sampled. A slight impact to the fish community from the Jefferson WWTP was evident in the samples collected at Calpin Road (RM 6.5) and Foreman Road (RM 4.1), as evidenced by marginal fish community performance driven by elevated abundance of bluntnose minnows, an omnivore favored by organic enrichment.

Fish communities in Cemetery Creek failed to meet standards both upstream and downstream from the Jefferson WWTP, though conditions have improved slightly downstream from the plant compared to 1995 when acute toxicity was very apparent. Now, the toxicity is chronic and apparently caused by a failing

sewer pump station. Upstream from the plant, urban runoff, organic enrichment and limited flows combine to impair the fish community.

The macrohabitats at two locations on Cemetery Creek, RMs 1.2 and 2.1 were evaluated with the QHEI. The site at Chestnut Street (RM 2.1) flows through a residential area but has, remarkably enough, neither been channelized nor denuded of its riparian buffer. The otherwise high quality substrates were moderately embedded with silt from upstream sources. The QHEI score of 78.0 suggest this site is capable of supporting a WWH fauna. Downstream from Poplar Street, the stream was historically channelized though most warmwater habitat features have been recovered over time. The QHEI score of 64.5 paired with only one high-influence modified habitat attribute suggest the stream is capable of supporting a WWH stream fish community.

Table 265. 041100040403 - Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIWb[a]	Narrative
03-120 Mill Creek WWH Aquatic Life Use										
G02S05	10.00	25	22	474.8	7.75	80	79.5	47	8.5	Good/Very Good
G02G17	6.50	25	25	1320.0	11.97	87	87.5	36	8.7	Good/Marginal
G02G11	4.10	20	20	740.0	2.32	92	58.0	30*	7.7	Marginal/Fair
G02G18	3.70	23	23	399.0	5.20	101	83.5	48	8.1	Good/Very Good
03-124 Cemetery Creek WWH Aquatic Life Use										
G02S09	2.1/2.4	12	12	1829.8	0.00	4.7	78.0	26*	-	Poor
G02S08	1.3/1.2	11	11	2151.0	0.00	4.9	64.5	26*	-	Poor

a - MIwb is not applicable to headwater streams with drainage areas < 20 mi2.
* - Indicates significant departure from applicable biocriteria (>4 IBI units or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

Recreational Use Designation
Attainment of the geometric mean fecal coliform criteria in conjunction with elevated 90th percentile values is indicative that non-point sources are the main causes of the observed condition. Likely non-point sources for fecal coliform contamination within the Village of Jefferson - Mill Creek subwatershed include poorly operating onsite home sewage treatment systems and runoff from agricultural operations. With the exception of the City of Jefferson, the Village of Jefferson - Mill Creek subwatershed is largely unsewered. In addition, agricultural land use is intensive within many portions of the Village of Jefferson - Mill Creek subwatershed. Efforts to reduce fecal coliform loadings with the watershed should focus upon characterization of the relative contributions of these sources and the institution of appropriate best management practices that will reduce loadings caused by runoff events.

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 266. 041100040403 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Village of Jefferson - Mill Creek subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

Number of Samples	Geometric Mean	90th Percentile	Minimum	Maximum	Attainment	Sources
21	308	1900	20	4,700	Full	

According to the Biological and Water Quality Study of the Lower Grand River 2003 – 2004 the Ohio EPA, sensitive taxa found in the Griggs Creek - Mill Creek assessment unit (WAU 04110004050) which are noteworthy because they are not commonly collected were the mayfly *Serratella deficiens* in Mill Creek (RM 2.9), the midge *Synorthocladius semivirens* in Mill Creek (RMs 7.2, 2.9), and the freshwater mussel *Ptychobranchus fasciolaris* (Kidney Shell) (state listed Species of Concern) in Mill Creek (RM 3.2 - a 2004

qualitative sample not used in this analysis). The state listed Species of Concern crayfish *Orconectes propinquus* (Great Lakes Crayfish) was collected at Mill Creek RM 1.70, 3.20, 7.20 and 9.70.

The Cemetery Creek stations were only supporting degraded communities with low diversity of EPT and sensitive taxa. The upstream station (RM 2.4) was impacted by channel modifications, embedded substrates, and apparently urban runoff. The downstream station (RM 1.2) was located in an area with improved habitat, but was downstream from the Jefferson WWTP (RM 1.65) and the rest of Jefferson. There was no indication of a severe impact from the WWTP, but there also was no improvement from upstream conditions. The communities upstream and downstream from the Jefferson WWTP were also found to be highly degraded in 1995. The upstream station had two EPT and two sensitive taxa compared to one EPT and two sensitive taxa downstream.

Table 267. 041100040403 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Village of Jefferson–Mill Creek Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	Drain Area (mi2)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Mill Creek (03-120)									
9.7	80	-	73	25/-	36/-	M/-	Caddisflies (F,MI), midges (F,MI), baetid mayflies (I,F)	-	Exceptional
7.2*	87	16	63	23/24	28/36	M/387	Hydropsychid caddisflies (F,MI), fingernail clams (F), water penny beetle larvae (MI)	46	Exceptional
2.9*	101	16	54	22/27	26/41	L-M/543	Hydropsychid caddisflies (MI), Isonychia mayflies (MI)	52	Exceptional
Cemetery Creek (03-124)									
2.4*	4.5	-	29	3	5	Low	Baetid mayflies (F), hydropsychid caddisflies (F)	-	Low - Fair
1.2*	5	-	26	4	3	Moderate	Hydropsychid caddisflies (F), midges (F)	-	Low - Fair

L – Low, M – Moderate

- **12-digit HUC 041100040403 – Village of Jefferson-Mill Creek (2) Subwatershed Problem Statements, Goals, objectives and Action**

Summary of Impairments: The major causes of impairment for Village of Jefferson – Mill Creek (2), a 12-digit subwatershed of Griggs Creek – Mill Creek (2) 10-digit subwatershed, include 2242 tons of excess sediment loading (embeddedness). Those causes are primarily associated with physical habitat degradation (channel modifications) from direct alteration of the stream channel and poor land use planning.

Problem Statement 1: The Biological and Water Quality Study of the Upper Grand River 2007 reports a low Index of Biotic Integrity (IBI) score of 26 for samples taken from sample sites on Cemetery Creek near RM 2.4 & 2.1. The presence of about 2242 tons of excess sediment loading (embeddedness) from adjacent cropland and urban development is the cause of Aquatic Life Use (ALU) Designation non-attainment status for nearly 8 miles of Mill Creek (2). The source of the impairment is physical habitat degradation (channel modifications) from direct alteration of the stream channel and poor land use planning which has resulted in continued habitat degradation and removal of riparian vegetation in this section of the Village of Jefferson – Mill Creek (2) Subwatershed.

Goal: Raise IBI score by 54 percent or 14 points from an IBI score of 26 in the poor range to an IBI score of 40 in the good range by reducing 2242 tons of excess sediment loading from the impaired section of Mill Creek (2) near RM 25.62.

Objective 1: Reduce soil erosion from unprotected cropland by about 355 tons per year (.82 ton per acre per year) for five (5) years by establishing 433 new acres per year of cover crops to avoid sediment runoff.

Action 1: Target outreach and quality technical assistance to generate higher levels of cover crop implementation.
Action 2: Conduct personal interviews with farmers, survey questionnaire mailings, form farmer focus groups and conduct local informational meetings.

Objective 2: Reduce soil erosion from unprotected cropland by about 91 tons per year (.82 ton per acre per year) for five (5) years by establishing 112 new acres per year of reduced tillage/residue management to avoid sediment runoff.

Action 1: Target outreach and quality technical assistance to generate higher levels of no-till implementation.
Action 2: Conduct personal interviews with farmers, survey questionnaire mailings, form farmer focus groups and conduct local informational meetings.

Objective 3: Reduce soil erosion from unprotected cropland by about 1.6 tons per year (.82 ton per acre per year) for five (5) years by establishing 2 new acres per year of filter strips per year to trap sediments before entering the stream.

Action 1: Target outreach and quality technical assistance to generate higher levels of filter strip implementation.
Action 2: Conduct personal interviews with farmers, survey questionnaire mailings, form farmer focus groups and conduct local informational meetings.

Objective 4: Reduce soil erosion from unprotected cropland by about 215 pounds per year (1640 pounds per acre per year) for five (5) years by establishing 0.13 new acres per year of grassed waterways to control sediment runoff.

Action 1: Evaluate areas of concentrated flow to determine need for combining additional best management practices, e.g. grassed waterway and filter strip.
Action 2: Target outreach and quality technical assistance to generate higher levels of grassed waterway implementation.
Action 3: Conduct personal interviews with farmers, survey questionnaire mailings, form farmer focus groups and conduct local informational meetings.

Objective 5: Reduce soil erosion from unprotected cropland by about 430 pounds per year (1640 pounds per acre per year) for five (5) years by establishing 0.26 new acres per year of critical area plantings to trap sediments before entering the stream.

Action 1: Target outreach and quality technical assistance to generate higher levels of critical area planting implementation.
Action 2: Conduct personal interviews with farmers, survey questionnaire mailings, form farmer focus groups and conduct local informational meetings.
Action 3: Evaluate areas of concentrated flow to determine need for combining additional best management practices, e.g. critical area planting and filter strip.

Problem Statement 2: Local stakeholder concern has identified the low head dam @ Mill Creek (2) RM 8.69 as a hazard and a potential cause of impairment for this section of stream. The low head dam, may be a potential source of the impairment due to habitat alteration and low flow.

Goal: Remove the low head dam @ Mill Creek (2) RM 8.69 to reconnect mill creek with the rest of the watershed and restore natural flow to the stream.

Objective 1: Remove the low head dam @ Mill Creek (2) RM 8.69 to reconnect mill creek with the rest of the watershed and restore natural flow to the stream.

Action 1: Obtain support and conduct feasibility study to determine the benefits, impacts and costs involved with removal of the low head dam @ Mill Creek (2) RM 8.69.
Action 2: Obtain support and develop an engineering plan based on the results of the dam removal feasibility study.
Action 3: Determine best funding options and obtain funds for removal of the low head dam @ Mill Creek (2) RM 8.69 from potential funding sources:

- U.S. Army Corps of Engineers (USCOE) - Aquatic Ecosystem Restoration, Section 206, Water Resources Development Act of 1996
- U.S. Fish and Wildlife Service (USFWS) - Fish Passage Program (Grant)
- Partners for Fish and Wildlife (Grant)
- Natural Resources Conservation Service (NRCS) - Wildlife Habitat Incentive Program (Grant)
- Ohio Environmental Protection Agency (OEPA) - Division of Surface Water
- Ohio Department of Natural Resources - Division of Natural Areas and Preserves or Division of Wildlife
- Ohio Department of Transportation (ODOT) - Office of Environmental Services
- State of Ohio Water Development Authority - Ohio Water Development Authority (OWDA)
- National Fish and Wildlife Foundation - General Matching Grant Program

Source: Funding Sources for Lowhead Dam Removal -
http://www.dnr.state.oh.us/water/tabid/3360/Default.aspx
Action 4: Obtain proper reviews, approvals, permits and certificates prior to removal of the low head dam @ Mill Creek (2) RM 8.69.
Action 5: Determine options for sediment removal (complete removal and relocation of all accumulated material from the inundated regions; removing sediment only from the anticipated channel of the river, or allowing the river to erode a new channel through the sediment) and proceed with sediment removal.
Action 6: Remove of the low head dam @ Mill Creek (2) RM 8.69 and stabilize site around former dam location.

Objective 2: Stabilize banks and restore floodplains and riparian zones following removal of the low head dam @ Mill Creek (2) RM 8.69. This project would encompass approximately 10 acres of floodplains and riparian zone and an estimated 3000 linear feet of stream bank.

Action 1: Obtain support and develop a restoration plan based on the results of the dam removal or modification feasibility study.
Action 3: Determine best funding options and obtain funds for removal of the low head dam @ Mill Creek (2) RM 8.69 from potential funding sources:

- Ohio Environmental Protection Agency (OEPA) - Surface Water Improvement Fund (SWIF) Grant
- Ohio Environmental Protection Agency (OEPA) - Division of Surface Water – Section 319(h) Grant

Action 2: Grade, add materials, native plants, shrubs and trees to stream banks, floodplains and riparian zones to return aquatic functions and natural physical habitat characteristics to a close approximation of its condition prior to alteration.
Action 3: Monitor before, during and after restoration to evaluate restoration efforts and determine if future restoration efforts are necessary.

Problem Statement 3: Local stakeholder concern has identified 1439 acres of land with high natural area conservation value (Map 95) under threat of conversion. It was assumed that for a single family housing development on the 1439 acres, 50% of the land would be preserved as open space. Of the remaining 719.5 acres developed as single-family residential, it was assumed that the development would use filter buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by impervious surfaces and residential land use (excess loading of nitrogen (N) - 2089 lbs/year, phosphorus (P) – 307 lbs/year, Biological Oxygen Demand (BOD) - 8461 lbs/year and Sediment – 23 tons/year) would push adjacent sections of Village of Jefferson - Mill Creek (2) to impairment (see table 268).

Goal: Protect 1439 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 1439 acres of land with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 268. Town of Jefferson-Mill Creek (2) Subwatershed Land Protection Load Estimates for land protection.

Current land use loading as 1439 acres of forest			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
472.2	230.7	1157.0	14.7
New land use loading following development of 719.5 acres as single-family housing with LID			
N Load lb/year	**P Load lb/year**	**BOD lb/year**	**Sediment Load t/year**
2561.3	538.1	9637.6	37.5
Net increase due to land use change			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
2089.1	**307.4**	**8480.6**	**22.8**

Problem Statement 4: Local stakeholder concern has identified 109 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 109 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 109 acres of wetlands with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified wetland protection properties.

Problem Statement 5: Local stakeholder concern has identified 18.66 miles or 98519 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant pollutants generated by channel erosion (excess loading of sediment – 1675 tons/year, N - 3350 lbs/year and P - 1675 lbs/year) would push adjacent sections of Peters Creek to impairment (see table 269).

Goal: Protect 18.66 miles or 98519 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 18.66 miles or 98519 linear feet of stream corridor with high natural area conservation value.

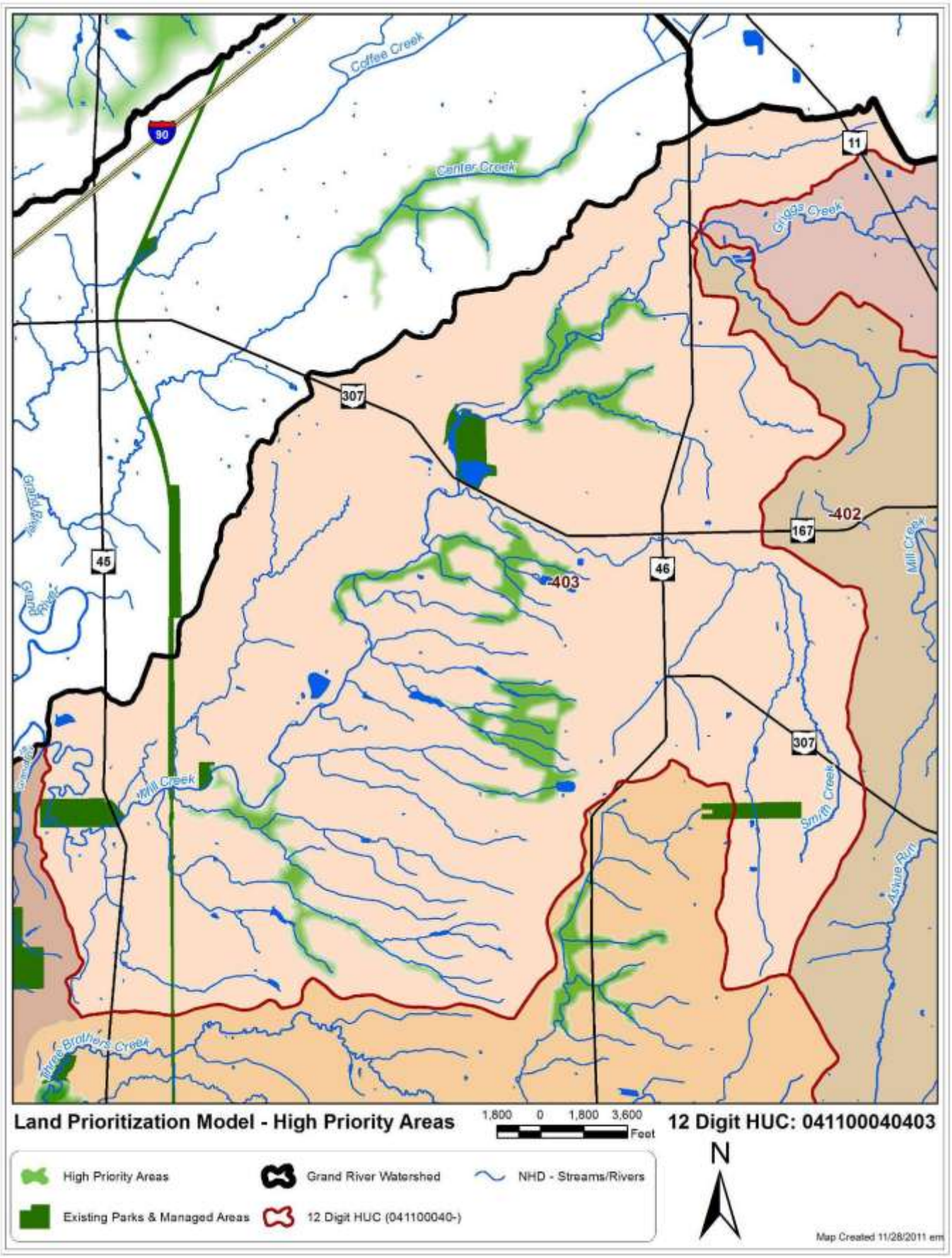
Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 269. Town of Jefferson-Mill Creek (2) Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	837.4	837.4
Phosphorus Load Reduction (lb/year)			837.4	837.4
Nitrogen Load Reduction (lb/yr)			1674.8	1674.8

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 95. Village of Jefferson - Mill Creek Land Protection Prioritization Model - High Priority Areas



This Page Intentionally left blank

R. Three Brothers Creek-Grand River Subwatershed

12 Digit HUC: 041100040501
Location: Grand River below Rock Cr. to below Three Brothers Cr.
Drainage Area: 21.68 miles^2, 13875 acres
Miles of stream: 72.79 miles
Average Sinuosity: 1.17
Average Impervious Cover: 0.78%

Photo 28. Grand River near Confluence with Three Brothers Creek *(Source: G. Warnock)*

Subwatershed Description
The Three Brothers Creek-Grand River 12-digit HUC subwatershed represents 38 percent of the two (2) subwatersheds in the Three Brothers Creek-Grand River 10-digit HUC subwatershed to the Grand River Watershed. This watershed drains mostly cultivated crops, forested and pasture/hay land in the Village of Rock Creek and Jefferson, Lenox, Morgan and Trumbull Township in Ashtabula County.

As of 2006, about 3 percent or 348 acres of land development (low & medium intensity, no high intensity) has occurred in the Three Brothers Creek-Grand River subwatershed, with 58 percent or 8022 acres of the land use as forested and 38 percent or 5283 as agricultural land use (Table 271, Map 76). Deciduous forest makes up of 55 percent of the forested land use, cultivated crops and pasture/hay makes up 97 percent of agricultural land use and corn & soybeans dominates the row crop production at 81 percent *(2009 USDA Cropland Cover)*.

Table 270. 041100040501 – Subwatershed Land Use
Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.

Description	Acres	Percent of Watershed
Developed, High Intensity	0	0.00
Developed, Medium Intensity	9	0.06
Developed, Low Intensity	339	2.44
Developed, Open Space	37	0.27
Cultivated Crops	3385	24.40
Pasture/Hay	1762	12.70
Grassland/Herbaceous	136	0.98
Deciduous Forest	4383	31.59
Evergreen Forest	70	0.50
Mixed Forest	28	0.20
Scrub/Shrub	1591	11.47
Palustrine Forested Wetland	1743	12.56
Palustrine Scrub/Shrub Wetland	207	1.49
Palustrine Emergent Wetland	102	0.74
Open Water	83	0.60
Total	**13875**	

Floodplain
Forest and pasture make up 83 percent of the land use in the Three Brothers Creek-Grand River subwatershed floodplain. Forest covers 71 percent or 1826 acres and pasture/hay covers 14 percent or 380 acres of the 2686 acres of flood plain. The next closest land use in the flood plain is open space at 123 acres or 15 percent. High, medium and low density development only composes 14 acres or just 0.51 percent of the floodplain (Table 272).

Table 271. 041100040501 – Subwatershed Land Use Within Floodplain
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

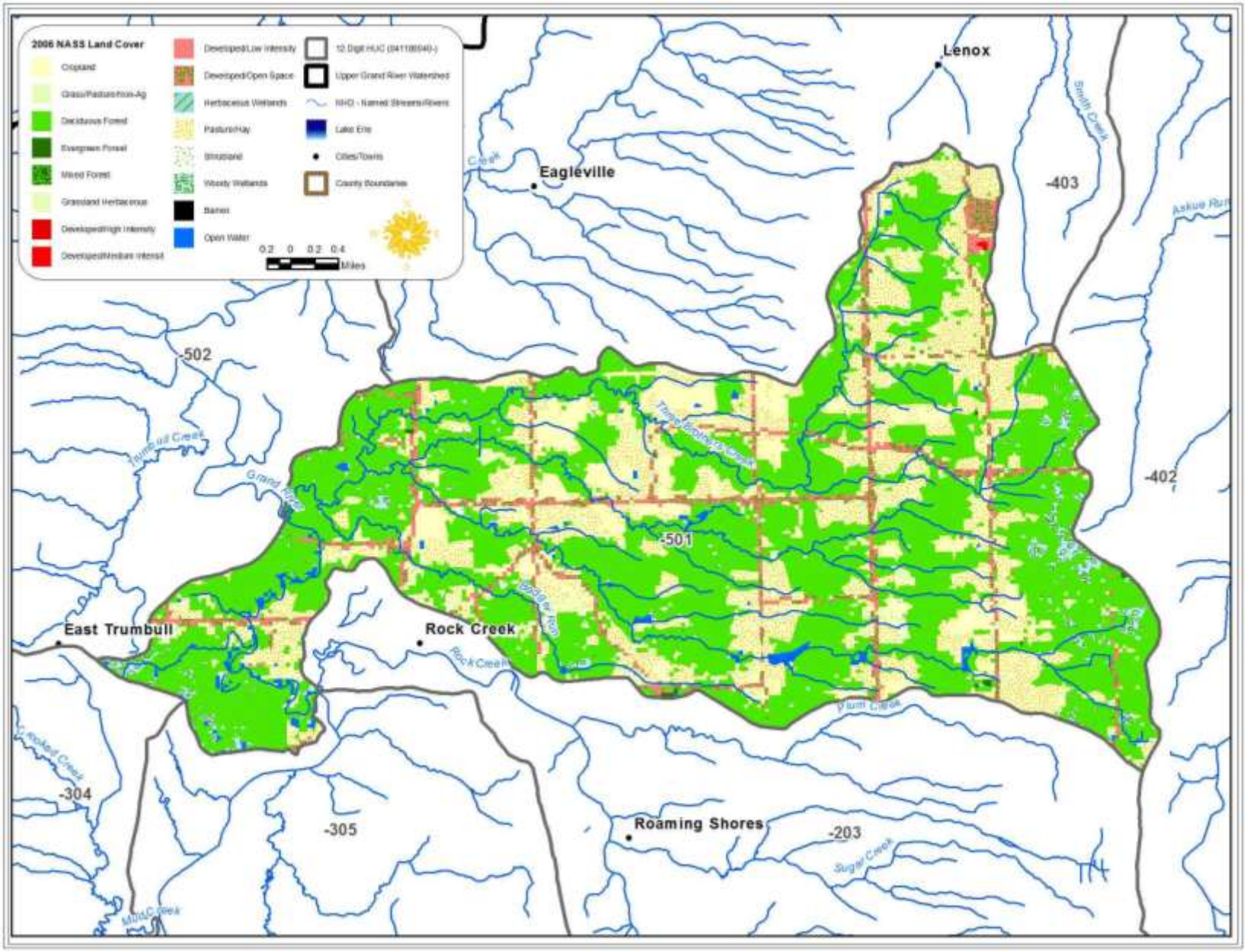
Description	Acres	Percent of Watershed
Agriculture	76	2.84
Grass/Pasture/Non-Ag	18	0.68
Barren	0	0.00
Deciduous Forest	1866	69.48
Developed/High Intensity	0	0.00
Developed/Low Intensity	14	0.51
Developed/Medium Intensity	0	0.00
Developed/Open Space	123	4.56
Evergreen Forest	0	0.02
Grassland Herbaceous	67	2.48
Herbaceous Wetlands	0	0.00
Open Water	83	3.08
Pasture/Hay	380	14.15
Shrubland	11	0.42
Woody Wetlands	48	1.78
Total	**2686**	

Table 272. 041100040501 – Subwatershed Wetland Types by Acres
Source: National Wetlands Inventory(NWI)

Emergent Wetland	Forested/Shrub Wetland	Pond	Grand Total
49	1387	152	1588

Map 96. 041100040501 – Subwatershed Land Use

Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.



This Page Intentionally left blank

Soils

The major soils of the Three Brothers Creek-Grand River subwatershed are the Fitchville-Haskins-Sebring Association, Caneadea-Canadice Association, and Holly-Orrville-Tioga Association. These are characterized by deep, nearly level to gently sloping areas that vary from very poorly drained to well drained in a few locations. In general these soils suffer from flooding and seasonal wetness and ponding, and have moderately slow to very slow permeability. Typically they have high seasonable water tables. All three associations consist of soils formed from fine texture lacustrine material, glacial outwash, or glacial till. The Holly-Orrville-Tioga Association is solely associated with flat flood plains and it is common to find it on valley floors associated with the basins of former glacial lakes. About 38 percent of the soils are considered potentially highly erodible. Tables 4 & 5 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Ashtabula and Trumbull County.

Table 273. 041100040501 – Subwatershed Highly Erodible Soil by Acres

(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
119	5020	8327	409

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Three Brothers Creek-Grand River Creek subwatershed is made up of 49% from Group C/D Hydrologic Soil. Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Some soils having clay, silty clay, or sandy clay textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.

Table 274. 041100040501 - Subwatershed Hydrologic Soil Groups by Acres
(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

A	B	C	D	A/D	B/D	C/D
119	0	94	4863	0	1876	6779

Water Quality
The physical habitat quality of streams in the Upper Grand River basin is largely influenced by topography, drainage area, and the juxtaposition of glacial till and lacustrine deposits. Essentially this creates three distinct stream types: lowland streams, upland headwaters, and the non-wadeable Grand River mainstem.

The Biological and Water Quality Study of the Upper Grand River 2007 lists The Grand River mainstem within hydrologic unit 0411000040 is bounded on the south by the confluence with Rock Creek (RM 50.59) and to the north by Mill Creek (RM 41.28). The river transitions from a verified WWH use to a verified EWH use at Fobes Road (RM 44.7). Fish and macroinvertebrate samples collected at Footville Richmond Road (RM 48.2), and a macroinvertebrate sample collected downstream from Riverdale Road at RM 45.9 fully supported the WWH use. A fish sample collected at Schweitzer Road (RM 42.4) partially met the EWH use. The partial attainment of the EWH was not related to pollution, it was due to natural limitations. The Grand River is unique in having populations of walleye, northern pike and muskellunge inhabiting the same reach. The reason these species co-occur is because the habitat is largely intact, and the water unpolluted.

On the northeastern side of the catchment, Three Brothers Creek has the drainage area, gradient, and substrates to form stream channels with features typical of headwater streams. Three Brothers Creek has an unverified WWH use. Results of fish and macroinvertebrate samples collected at Camp Beaumont (RM 1.99) and Stumpville Road (RM 6.68) suggest that a WWH use is suitable. Based on a WWH use, the fish community met at both sampling locations, but the macroinvertebrate community was rated as fair owing to intermittent flows. Subregional scoring expectations for small, bedrock streams subject to low or intermittent flows in the summer need to be derived.

Table 275. 041100040501 – Subwatershed Aquatic Life Use (ALU) Designation
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-001 Grand River			
49.45	WWH	Full	
03-015 Three Brothers Creek			
6.68	WWH	Partial	Natural – Low Flow/Salamander present
1.99	WWH	Partial	Natural - Low Flow

The quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

Fish Communities were sampled at nine locations along the Grand River mainstem. Fish communities met standards for WWH from West Farmington (RM 88.5) downstream to Footville Richmond Road (RM 48.6). Northern brook lamprey ammocoetes and sand darters were found in the Grand River near West Farmington. Downstream from Footville Richmond Road, starting at RM 44.5, the Grand River is designated Exceptional Warmwater Habitat (EWH). The fish community sampled at RM 42.4 (Schweitzer Road) did not meet EWH; however, the reach sampled did not have a riffle, and therefore is expected to be handicapped. Functionally, the fish community at the site represents one of the closest approximations Ohio has to an intact, lowland, large river fish fauna. No other river in Ohio has native, naturally reproducing populations of muskellunge, northern pike and walleye occurring together. Preservation of the bottomland forests and wetlands is essential for maintaining these populations.

Table 276. 041100040501 - Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIWb[a]	Narrative
03-001 Grand River - WWH										
G02K54	49.5	23	23	510	49	323	64.5	56	9.20	E/VG
03-015 Three Brothers Creek - unverified WWH - recommended										
300203	6.7	15	15.0	1066	0	5.8	66.5	44		Good
300208	2	16	16.0	673.9	0	8.4	72.5	44		Good

a - MIwb is not applicable to headwater streams with drainage areas < 20 mi2.
* - Indicates significant departure from applicable biocriteria (>4 IBI units or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

The Biological and Water Quality Study of the Upper Grand River 2007 lists natural limits as the cause of impairment and a major contribution to the segment of stream not meeting it's aquatic life use designation. The quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin (Table 278).

The Grand River mainstem downstream from West Farmington flows through a glacial lake-bed and consequently has low gradient, and fine sediment. However, because the catchment is highly dendritic, drainage area downstream from West Farmington increases rapidly, providing sufficient energy to create meanders, and sort sediments such that substrates in the thalweg are generally sand and gravel. Furthermore, because farms in the catchment tend to be small and isolated from the immediate riparian area, and because most of the headwaters are reasonably intact, the channel is not overwhelmed with silt and clay. Lastly, the wooded riparian zone supplies a generous quantity of large woody debris to the river, which, in-turn, creates variation in current velocity that further helps sort sediments (Table 278).

Localized impacts to water quality from anthropogenic sources, principally from organic enrichment, were noted in tributaries to the Grand River. The sources of enrichment were primarily on-site sewerage, livestock, and, in some cases, an unknown source. The organic enrichment was most apparent in Three Brothers Creek, as noted by consistently high concentrations of total Kjeldahl nitrogen (TKN) co-occurring with elevated concentrations of ammonia-nitrogen. For sites such as Three Brothers Creek RM 6.68, with high bacteria counts, but lacking both corroborating water quality data (i.e., elevated NH_3-N, TKN, TDS) and any anecdotal evidence pointing to a likely source, attainment is considered ambiguous, and the sources are listed as unknown. The bacteria counts in those cases may be from ubiquitous background contamination (Table 278).

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 277. 041100040501 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Three Brothers Creek-Grand River Creek Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	STORET	GEOMEAN	N	Class	Attainment	Sources
Grand River						
49.45	G02K54	100	2.0	A	Full	
Three Brothers Creek						
6.68	300203	516	2.0	B	Non	Unknown
1.99	300208	310	1.0	B	Full	

Macroinvertebrate communities evaluated in the Upper Grand River tributaries can be grouped, to a large part, based on the physical habitat, shaped by the typography of the landscape, they flow through. The Coffee Creek subwatershed Grand River stations were located in a lowland area with low gradient and substrates composed primarily of smaller sized particles and woody debris (glacial Grand River Lake lacustrine deposits). Macroinvertebrate communities at these stations were performing at good to exceptional levels, with generally lower diversity of EPT (9-23) and sensitive taxa (14-31). Fourteen species of freshwater mussels were collected at these lowland stations with the most diverse populations found upstream of Footville Richmond Road (RM 49.45), and at Camp Beaumont (RM 45.90).

Headwater stream stations that were limited by low to interstitial flow included Three Brothers Creek RMs 6.68 and 1.99. Macroinvertebrate communities evaluated at these stations had lower than expected EPT (3-7) and sensitive taxa (3-11) diversity, due to the loss of surface flow as the result of the water table dropping below the level of the riffle habitats.

Table 278. 041100040501 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Three Brothers Creek-Grand River Creek Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	Drain Area (mi2)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Grand River (03-001)										
49.45	361	-	64.0	23/24	31/36	L-M/1291	0	Hydropsychid caddisflies (F,MI), midges (MI,MT), riffle beetles (F)	52	
Three Brothers Creek (03-015)										
6.68	5.8	9	30	7	11	L	1.0	Midges (F,T,MI), heptageniid mayflies (F)	-	Fair
1.99	17.4	9	32	7	10	L	1.0	Red midges (T,MT,MI), crayfish (F), heptageniid mayflies (F)	-	Fair

- **12-digit HUC 041100040501 – Three Brothers Creek-Grand River Subwatershed Problem Statements, Goals, objectives and Action**

Summary of Impairments: The major causes of impairment for Three Brothers Creek–Grand River subwatershed, a 12-digit subwatershed of Three Brothers Creek–Grand River 10-digit subwatershed, include natural causes and pathogen loading (fecal coliform and E. coli) in excess of 355 colony forming units (cfu) per year. Those causes are primarily associated with unknown sources, failing HSTS, livestock and natural sources.

Problem Statement 1: The presence of about 355 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the most likely cause of recreational use designation non-attainment status for Three Brothers Creek around RM 6.68 due to pastures in close proximity upstream from the sampling location. The most likely source for roughly 50% of the excess pathogen loading (178 cfu) is livestock manure runoff in the Three Brothers Creek-Grand River Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 178 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 1 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 178 cfu.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Problem Statement 2: The presence of about 355 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the most likely cause of recreational use designation non-attainment status along 4 miles of Three Brothers Creek and it's tributaries upstream of RM 6.68. The most likely source for roughly 50% of the excess pathogen loading (178 cfu) is approximately 15 to 20 failing Home Sewage Treatment Systems (HSTS) in the Three Brothers Creek-Grand River Subwatershed.

Goal: Reduce pathogenic bacteria from failing HSTS discharge by about 36 cfu on average per year for five consecutive years, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Inspect the estimated 86 Home Sewage Treatment Systems (HSTS) for failure along 4 miles of Three Brothers Creek and it's tributaries upstream of RM 6.68.

Action1: Conduct annual inspections on 20 percent of off-lot discharging systems that directly outlet to a tributary.
Action 2: Document failed systems & develop comprehensive HSTS database as inspections are completed.
Action 3: Gather and enter data on type of system, geo-coded location, year of installation, date of last inspection, date of last pumping, and sampling results.

Objective 2: Upgrade, repair or replace a minimum of 20 failing Home Sewage Treatment Systems (HSTS) of along 4 miles of Three Brothers Creek and it's tributaries upstream of RM 6.68.
Action 1: Implement repair or replacement procedures to bring systems into compliance.
Action 2: Introduce new, proven technology such as Wisconsin mounds, drip irrigation, and shallow trench or at-grade systems and integrate into current regulations.
Action 2: Utilize private sector service industry permit inspection program to help assure proper operation and maintenance of discharging systems and/or soilbased treatment and disposal systems.

Objective 3: Use education and outreach along with other informational programs and services to assist the estimated 86 residents with Home Sewage Treatment Systems (HSTS) in the area along 4 miles of Three Brothers Creek and it's tributaries upstream of RM 6.68 on operation and maintenance of systems and assistance with corrective measures.
Action 1: Conduct annual homeowner septic system operation and maintenance workshop for residents with HSTS.
Action 2: Assist qualified homeowners in identifying financial assistance for repairs or replacements or conversion to central sewer.

Problem Statement 3: Local stakeholder concern has identified 1264 acres of land with high natural area conservation value (Map 97) under threat of conversion. It was assumed that for a single family housing development on the 1264 acres, 50% of the land would be preserved as open space. Of the remaining 627 acres developed as single-family residential, it was assumed that the development would use filter buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by

impervious surfaces and residential land use (excess loading of nitrogen (N) - 1834 lbs/year, phosphorus (P) - 270 lbs/year, Biological Oxygen Demand (BOD) - 7448 lbs/year and Sediment – 20 tons/year) would push adjacent sections of Three Brothers Creek to impairment (see table 279).

Goal: Protect 1264 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 1264 acres of land with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 279. Three Brothers Creek-Grand River Subwatershed Land Protection Load Estimates for land protection.

Current land use loading as 1254 acres of forest			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
415.9	203.1	1018.8	13.2
New land use loading following development of 627 acres as single-family housing with LID			
N Load lb/year	**P Load lb/year**	**BOD lb/year**	**Sediment Load t/year**
2250.3	472.9	8466.6	33.1
Net increase due to land use change			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
1834.4	**269.8**	**7447.8**	**19.9**

Problem Statement 4: Local stakeholder concern has identified 269 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 269 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 269 acres of wetlands with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding

sources and applying for appropriate private and public funding intended for specified wetland protection properties.
Problem Statement 5: Local stakeholder concern has identified 9.95 miles or 52523 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant pollutants generated by channel erosion (excess loading of sediment – 892 tons/year, N - 1784 lbs/year and P - 892 lbs/year) would push adjacent sections of Three Brothers Creek to impairment (see table 282).

Goal: Protect 9.95 miles or 52523 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 9.95 miles or 52523 linear feet of stream corridor with high natural area conservation value.

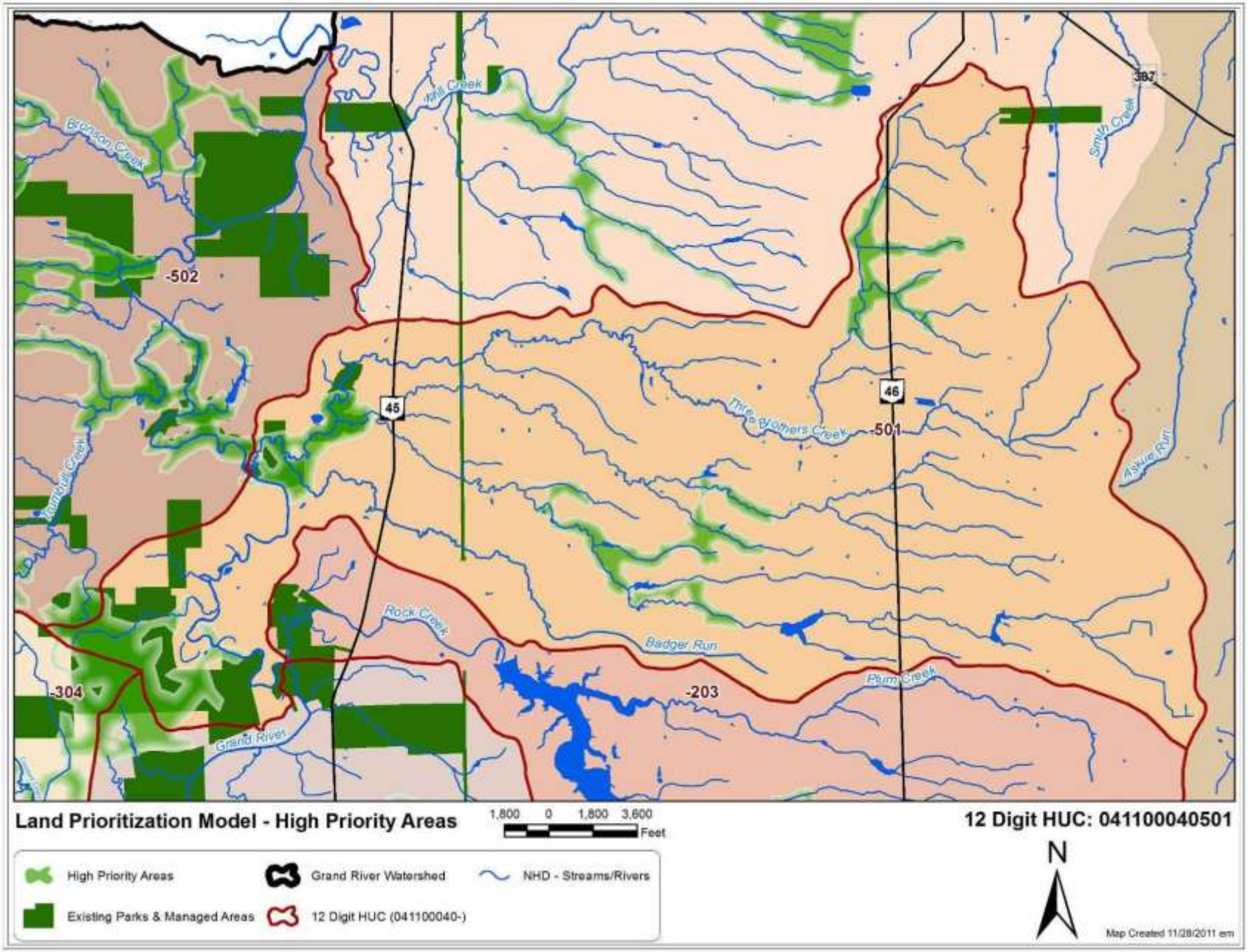
Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 280. Three Brothers Creek-Grand River Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	446.4	446.4
Phosphorus Load Reduction (lb/year)			446.4	446.4
Nitrogen Load Reduction (lb/yr)			892.9	892.9

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 97 – 041100040501 Three Brothers Creek-Grand River Land Protection Prioritization Model - High Priority Areas



S. Bronson Creek-Grand River Subwatershed

12 Digit HUC: 041100040502
Location: Grand River below Three Brothers Creek to above Mill Creek (2)
Drainage Area: 36.05 miles^2, 23075 acres
Miles of stream: 91.59 miles
Average Sinuosity: 1.26
Average Impervious Cover: 0.84%

Photo 29. Grand River near confluence with Bronson Creek *(Source: G. Warnock)*

Subwatershed Description
The Bronson Creek-Grand River Creek 12-digit HUC subwatershed represents 62 percent of the two (2) subwatersheds in the Three Brothers Creek-Grand River 10-digit HUC subwatershed to the Grand River Watershed. This watershed drains mostly cultivated crops, forested and pasture/hay land in the Austinburg, Harpersfield, Hartsgrove, Morgan and Trumbull Townships in Ashtabula County and Montville and Thompson Township in Geauga County.

As of 2006, about 3 percent or 624 acres of land development (low, medium & high intensity) has occurred in the Bronson Creek-Grand River Creek subwatershed, with 67 percent or 15378 acres of the land use as forested and 29 percent or 6648 as agricultural land use (Table 283, Map 78). Deciduous forest makes up of 68 percent of the forested land use, cultivated crops and pasture/hay makes up 96 percent of agricultural land use and corn & soybeans dominates the row crop production at 72 percent *(2009 USDA Cropland Cover)*.

Table 281. 041100040502 – Subwatershed Land Use
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

Description	Acres	Percent of Watershed
Developed, High Intensity	3	0.01
Developed, Medium Intensity	22	0.09
Developed, Low Intensity	599	2.60
Developed, Open Space	46	0.20
Cultivated Crops	3923	17.00
Pasture/Hay	2477	10.74
Grassland/Herbaceous	248	1.07
Deciduous Forest	10394	45.05
Evergreen Forest	106	0.46
Mixed Forest	67	0.29
Scrub/Shrub	2473	10.72
Palustrine Forested Wetland	2063	8.94
Palustrine Scrub/Shrub Wetland	277	1.20
Palustrine Emergent Wetland	121	0.52
Bare Land	25	0.11
Open Water	233	1.01
Total	**23074**	

Floodplain

Forest and pasture make up 62 percent of the land use in the Bronson Creek-Grand River Creek subwatershed floodplain. Forest covers 77 percent or 2377 acres and pasture/hay covers 9 percent or 282 acres of the 3099 acres of flood plain. The next closest land use in the flood plain is open space at 140 acres or 5 percent. High, medium and low density development only composes 19 acres or just 0.62 percent of the floodplain (Table 284).

Table 282. 041100040502 – Subwatershed Land Use Within Floodplain
(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)

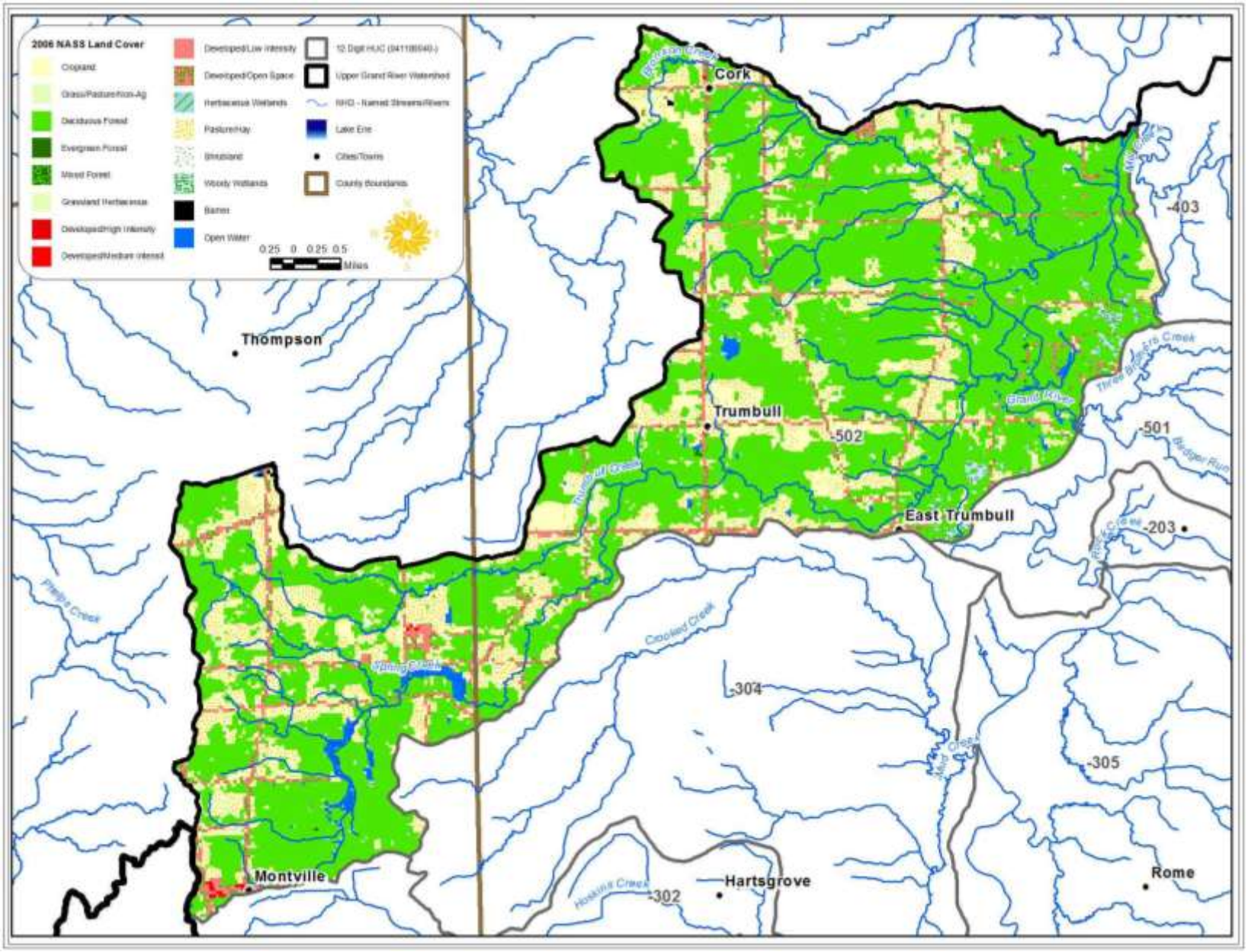
Description	Acres	Percent of Watershed
Agriculture	22	0.71
Grass/Pasture/Non-Ag	19	0.62
Barren	0	0.00
Deciduous Forest	2377	76.70
Developed/High Intensity	0	0.00
Developed/Low Intensity	19	0.62
Developed/Medium Intensity	0	0.00
Developed/Open Space	140	4.51
Evergreen Forest	1	0.03
Grassland Herbaceous	89	2.88
Herbaceous Wetlands	3	0.09
Open Water	107	3.44
Pasture/Hay	282	9.11
Shrubland	6	0.18
Woody Wetlands	34	1.10
Total	**3099**	

Table 283. 041100040502 – Subwatershed Wetland Types by Acres
(Source: National Wetlands Inventory(NWI))

Emergent Wetland	Forested/Shrub Wetland	Lake	Pond	Riverine	Grand Total
136	3317	55	181	13	3701

Map 98. 041100040502 – Subwatershed Land Use

(Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.)



This Page Intentionally left blank

Soils

The major soils of the Bronson Creek-Grand River Creek subwatershed are the Caneadea-Canadice Association, Platea-Pierpont Association, and Platea-Sheffield Association. The Caneadea-Canadice Association are characterized by deep, nearly level to gently sloping areas that vary from very poorly drained to well drained in a few locations. In general these soils suffer from flooding and seasonal wetness and ponding, and have moderately slow to very slow permeability. Typically they have high seasonable water tables. The Caneadea-Canadice Association consists of soils formed from fine texture lacustrine material, glacial outwash, or glacial till. In addition there are also the Platea-Pierpont Association, and the Platea-Sheffield Association. These are characterized by deep, nearly level to gently sloping soils that very from somewhat poorly drained to poorly drained silty soils situated on glaciated uplands. The Platea-Pierpont Association occurs in the northern part of the county on hummocky morainal deposits. About 45 percent of the soils are considered potentially highly erodible. Tables 4 & 5 provide acreages for highly erodible soil and hydrologic soil group classification. More detailed information about the soils is given in the soil surveys of Ashtabula County and Geauga County.

Table 284. 041100040502 – Subwatershed Highly Erodible Soil by Acres

(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC)(

Highly erodible land	Potentially highly erodible land	Not highly erodible land	Unknown
185	10365	11253	1267

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. Only the soils that in their natural condition are in group D are assigned to dual classes (NRCS National Cooperative Soil Survey 2008).

The soil of the Bronson Creek-Grand River Creek subwatershed is made up of 52% from Group C/D Hydrologic Soil. Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Some soils having clay, silty clay, or sandy clay textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments (Table 287).

Table 285. 041100040502 - Subwatershed Hydrologic Soil Groups by Acres
(Source: SSURGO (Soil Survey Geographic database) Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC))

A	B	C	D	A/D	B/D	C/D
149	70	1276	7593	4	1835	11837

Water Quality
The physical habitat quality of streams in the Upper Grand River basin is largely influenced by topography, drainage area, and the juxtaposition of glacial till and lacustrine deposits. Essentially this creates three distinct stream types: lowland streams, upland headwaters, and the non-wadeable Grand River mainstem. Where the topography is flat, and the substrates are composed primarily of lacustrine silts and clays, habitat quality is generally poor and not conducive to stream faunas typical of the ecoregion.

According to the Biological and Water Quality Study of the Upper Grand River 2007, the Ohio EPA reported fish and macroinvertebrate samples collected downstream from Riverdale Road at RM 45.9 fully supported the WWH use. A fish sample collected at Schweitzer Road (RM 42.4) partially met the EWH use. The partial attainment of the EWH was not related to pollution, it was due to natural limitations. The Grand River is unique in having populations of walleye, northern pike and muskellunge inhabiting the same reach. The reason these species co-occur is because the habitat is largely intact, and the water unpolluted (Table 288).

Bronson Creek has an unverified WWH use. Fish samples collected at Schweitzer Road (RM 0.82) and Windsor-Mechanicsville Road (RM 1.52) fully supported the WWH use. Qualitative macroinvertebrate samples collected at the same locations narrowly missed the WWH attainment due to interstitial flow. A WWH use for this stream is appropriate. Because Bronson Creek is a bedrock stream and experiences critically low flows during the summer, it is especially sensitive to disturbance and pollution (Table 288).

Trumbull Creek has a verified EWH use based on one fish sample collected at Windsor-Mechanicsville Road (RM 3.5). Results of biological samples and habitat assessments from three locations in 2007 demonstrate that a WWH use is best for the lowland reach downstream from Windsor-Mechanicsville Road, and a CWH use is appropriate from Windsor- Mechanicsville Road to the confluence with Spring Creek (RM 7.38). Upstream from Spring Creek, the creek transitions to primary headwater habitat. Considerable potential exists to augment the coldwater character of Trumbull Creek, predicated on habitat protection and restoration, and riparian restoration in the primary headwaters (Table 288).

Spring Creek, despite its namesake, has a default WWH use. Fish and macroinvertebrate samples collected at Callahan Road (RM 2.76) and Legget Road (RM 5.02) demonstrate a CWH use at Legget Road, and WWH use at Callahan Road. The creek probably transitions back to a coldwater stream at some point before joining Trumbull Creek. An impoundment on Spring Creek immediately upstream from Murphy Road (RM 4.1) is why the site at Callahan met criteria for a WWH use and not a CWH use (Table 288).

Table 286. 041100040502 – Subwatershed Aquatic Life Use (ALU) Designation
Source: Biological and Water Quality Study of the Upper Grand River 2007 - OEPA

RM	ALU Existing/Proposed	Attainment Status	Causes/Notes
03-001 Grand River			
45.90	EWH	Partial	Natural - Wetlands
03-012 Bronson Creek			
1.52	WWH	Partial	Natural - Low Flow
0.82	WWH	Partial	Natural - Low Flow
03-013 Trumbull Creek			
9.03	PHWH	Full	
6.23	EWH/CWH	Full	
2.05	WWH	Full	
03-014 Spring Creek			
5.02	WWH	Full	Has coldwater potential if restored
2.76	WWH	Full	Has coldwater potential if restored

The quality of fish communities in the headwaters of the Upper Grand River Watershed is strongly tied to habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

The Biological and Water Quality Study of the Upper Grand River 2007 indicates fish communities were sampled at multiple locations along the Grand River mainstem. Downstream from Footville Richmond Road, starting at RM 44.5, the Grand River is designated Exceptional Warmwater Habitat (EWH). The fish community sampled at RM 42.4 (Schweitzer Road) did not meet EWH; however, the reach sampled did not have a riffle, and therefore is expected to be handicapped. Functionally, the fish community at the site represents one of the closest approximations Ohio has to an intact, lowland, large river fish fauna. No other river in Ohio has native, naturally reproducing populations of muskellunge, northern pike and walleye occurring together. Preservation of the bottomland forests and wetlands is essential for maintaining these populations (Table 289).

Table 287. 041100040502 - Fish community attributes for study sites in the Upper Grand River basin, 2007. QHEI: Qualitative Habitat Evaluation Index, IBI: Index of Biotic Integrity, MIwb: Modified Index of Well-being.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

STORET	RM	Cumulative Species	Mean Species	Relative Number	Relative Weight	Drain Area	QHEI	IBI	MIWb[a]	Narrative
03-001 Grand River - WWH										
G02W16	45.90	26	20	298	58.70	417	59	46	8.60	VG/MG
03-012 Bronson Creek - unverified WWH - recommended										
300201	1.52	15	15.0	482.0	0.0	5	60.0	38		Good
G02K50	0.82	15	15.0	738.0	0.0	8	77.5	52		Excellent
03-013 Trumbull Creek										
300205	9.03					0.0	0.0	0		PHW
03-013 Trumbull Creek - EWH/CWH recommended										
300204	6.23	15	15	1032.0	0.0	13.1	69.0	40		Good
G02K51	2.05	20.00	20.00	274.0	0.0	19.6	70.5	44		Good
03-014 Spring Creek - unverified WWH - recommended										
300202	5.02	14	14.0	849.4	0.00	1.9	76.0	48		Very Good
300207	2.76	11	11.0	603.0	0.0	6.5	61.5	36[ns]		Marginally Good

a - MIwb is not applicable to headwater streams with drainage areas < 20 mi2.
ns - Nonsignificant departure from biocriteria (<4 IBI units or <0.5 MIwb units).

The Biological and Water Quality Study of the Upper Grand River 2007 lists natural limits as the cause of impairment and a major contribution to the segment of stream not meeting it's aquatic life use designation. The quality of fish communities in the headwaters of the Upper Grand River watershed is strongly tied to

habitat quality. Substrate quality and drainage area account for almost three-quarters of the variation in headwater IBI scores. The strength of substrate quality as an explanatory variable is directly related to the sharp differences in substrate size and origin imparted by the glacial and lacustrine history of the basin.

Localized impacts to water quality from anthropogenic sources, principally from organic enrichment, were noted in tributaries to the Grand River. The sources of enrichment were primarily on-site sewerage, livestock, and, in some cases, an unknown source. The organic enrichment was most apparent in Three Brothers Creek, as noted by consistently high concentrations of total Kjeldahl nitrogen (TKN) co-occurring with elevated concentrations of ammonia-nitrogen. For sites such as Trumbull Creek RM 9.03 and RM 2.05, with high bacteria counts, but lacking both corroborating water quality data (i.e., elevated NH_3-N, TKN, TDS) and any anecdotal evidence pointing to a likely source, attainment is considered ambiguous, and the sources are listed as unknown. The bacteria counts in those cases may be from ubiquitous background contamination (Table 8).

The specific waterbodies where high E. coli counts were associated with indicators of organic enrichment were Bronson Creek and Spring Creek. The ubiquity of high bacteria counts clearly suggests that the bacteria indicators are not serving exclusively as surrogates for pathogens of human origin. E. coli counts followed a log-normal distribution suggesting an origin from diffuse sources such as livestock and wildlife. Livestock was the suspected source for Bronson Creek and Spring Creek due to pastures in close proximity upstream from the sampling location (Table 8).

Standards based on E. coli for each class are as follows:
Class A – geometric mean shall not exceed 126 colonies/100ml, or a maximum of 298 colonies/100ml;
Class B – geometric mean shall not exceed 161 colonies/100ml, or a maximum of 523 colonies/100ml;
Class C – geometric mean shall not exceed 206 colonies/100ml, or a maximum of 940 colonies/100ml

Table 288. 041100040502 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Bronson Creek-Grand River Creek subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	STORET	GEOMEAN	N	Class	Attainment	Sources
Grand River						
1.23	G01K03	92	6	B	Full	
Bronson Creek						
1.52	300201.0	1200	1.0	B	Non	Livestock
0.82	G02K50	230	1.0	B	Full	
Trumbull Creek						
9.03	300205	790	1	B	Non	Unknown
6.23	300204	42	2	B	Full	
2.05	G02K51	462	6	B	Non	Unknown
Spring Creek						
5.02	300202	364	2	B	Non	Livestock
2.76	300207	416	2	B	Non	Livestock

Macroinvertebrate communities evaluated in the Upper Grand River tributaries can be grouped, to a large part, based on the physical habitat, shaped by the typography of the landscape, they flow through.

Headwater stream stations that were limited by low to interstitial flow included Trumbull Creek RM 9.03 and Bronson Creek RM 1.52. Macroinvertebrate communities evaluated at these stations had lower than expected EPT (3-7) and sensitive taxa (3-11) diversity, due to the loss of surface flow as the result of the water table dropping below the level of the riffle habitats (Table 9).

Many of the streams on the western part of the basin flow through high gradient channels that in places have cut down to sandstone bedrock and receive significant groundwater. These streams generally have high EPT (19-31) and sensitive taxa (23-41) diversity, presence of cold water taxa (4-9), and uncommonly

collected sensitive taxa (1-9). The stream station at Trumbull Creek RM 6.23 one of the stations that fell into this category. One of the stations with four or more cold water macroinvertebrate taxa, and therefore would qualify for the CWH Aquatic Live Use, was Bronson Creek RM 0.82 (Table 291).

Table 289. 041100040502 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Bronson Creek-Grand River Subwatershed in 2007.
(Source: Biological and Water Quality Study of the Upper Grand River 2007 – OEPA)

RM	Drain Area (mi2)	Data Codes	Qual. Taxa	EPT Ql. / Total	Sensitive Taxa Ql. / Total	Density Ql. / Qt.	CW Taxa	Predominant Organisms on the Natural Substrates With Tolerance Category(ies)	ICI	Narrative Evaluation
Grand River (03-001)										
45.90	382	-	60	15/18	29/32	L-M/625	0	Hydropsychid caddisflies (F), midges (MI,F), baetid mayflies (F,I)	48	
Bronson Creek (03-012)										
1.52	5.2	9	29	5	9	L	1	Midges (MI,F,MT)	-	Fair
0.82	7.6	-	43	8	18	L-M	5.0	Caddisflies (F,MI),midges (MI,F)	-	Fair
Trumbull Creek (03-013)										
9.03	2.7	-	19	4	3	L	0.0	Blackflies (F)	-	Poor
6.23	13.1	-	57	30	32	M	5.0	Caddisflies (MI,F), baetid mayflies (F,MI,I), midges (MI,F)	-	Exceptional
2.05	19.6	12	45	1	1	L/420	1	Hydropsychid caddisflies (F), midges (MI), baetid mayflies (I,F)	48	
Spring Creek (03-014)										
5.02	5.9	-	50	18	24	L-M	3	Caddisflies (F,MI), midges (MI), mayflies (I,F)	-	Very
2.76	6.5	-	63	13	20	M	0	Caddisflies (F,MI), midges (MI,F,MT), mayflies (F,MI)	-	Good

- **12-digit HUC 041100040502 – Bronson Creek-Grand River Subwatershed Problem Statements, Goals, objectives and Action**

Summary of Impairments: The major causes of impairment for Bronson Creek-Grand River subwatershed, a 12-digit subwatershed of Three Brothers Creek – Grand River 10-digit subwatershed, include natural causes and pathogen loading (fecal coliform and E. coli) in excess of 3057 colony forming units (cfu) per year. Those causes are primarily associated with unknown sources, failing HSTS, livestock and natural sources.

Problem Statement 1: The presence of about 1039 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the most likely cause of recreational use designation non-attainment status for Bronson Creek around RM 1.52 due to pastures in close proximity upstream from the sampling location. The most likely source is livestock manure runoff in the Bronson Creek-Grand River Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 1039 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Establish 1 new manure storage facility in the adjacent agricultural area, each resulting in an excess pathogen loading reduction of 445 cfu for a total of 890 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Objective 2: Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms (approximately 1000 feet of streambank), resulting in an excess pathogen loading reduction of 150 cfu.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 2: The presence of about 203 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Spring Creek around RM 5.02. The most likely source is livestock manure runoff in this section of the Bronson Creek - Grand River Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 203 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective: Establish 1 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 203 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Problem Statement 3: The presence of about 255 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Spring Creek around RM 2.76. The most likely source is livestock manure runoff in this section of the Bronson Creek - Grand River Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 255 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective: Establish 1 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 255 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Problem Statement 4: The presence of about 630 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Trumbull Creek around RM 9.03. The most likely source for roughly 50% of the excess pathogen loading (315 cfu) is livestock manure runoff in this section of the Bronson Creek - Grand River Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 315 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective: Establish 1 new manure storage facility in the adjacent agricultural area, resulting in an excess pathogen loading reduction of 315 cfu per year.

Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for Livestock Manure Management.
Action 3: Work with NRCS to implement EQIP cost share program for manure storage facilities in priority areas.
Action 4: Develop list of strategies to encourage stream protection, establish priorities, and discourage non-recommended grazing and livestock watering practices.

Problem Statement 5: The presence of about 630 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the most likely cause of recreational use designation non-attainment status for Trumbull Creek near RM 9.03 due to anecdotal evidence pointing to contamination from human origins. The most likely source for roughly 50% of the excess pathogen loading (315 cfu) is approximately 15 to 20 failing Home Sewage Treatment Systems (HSTS) in the Bronson Creek - Grand River Subwatershed.

Goal: Reduce pathogenic bacteria from failing HSTS discharge by about 63 cfu on average per year for five consecutive years, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Inspect the estimated 86 Home Sewage Treatment Systems (HSTS) for failure along 3 miles of Trumbull Creek and it's tributaries upstream of RM 9.03.
Action1: Conduct annual inspections on 20 percent of off-lot discharging systems that directly outlet to a tributary.
Action 2: Document failed systems & develop comprehensive HSTS database as inspections are completed.
Action 3: Gather and enter data on type of system, geo-coded location, year of installation, date of last inspection, date of last pumping, and sampling results.

Objective 2: Upgrade, repair or replace a minimum of 10 failing Home Sewage Treatment Systems (HSTS) of along 3 miles of Trumbull Creek and it's tributaries upstream of RM 9.03.
Action 1: Implement repair or replacement procedures to bring systems into compliance.
Action 2: Introduce new, proven technology such as Wisconsin mounds, drip irrigation, and shallow trench or at-grade systems and integrate into current regulations.
Action 2: Utilize private sector service industry permit inspection program to help assure proper operation and maintenance of discharging systems and/or soilbased treatment and disposal systems.

Objective 3: Use education and outreach along with other informational programs and services to assist the estimated 86 residents with Home Sewage Treatment Systems (HSTS) in the area along 3 miles of Trumbull Creek and it's tributaries upstream of RM 9.03 on operation and maintenance of systems and assistance with corrective measures.
Action 1: Conduct annual homeowner septic system operation and maintenance workshop for residents with HSTS.
Action 2: Assist qualified homeowners in identifying financial assistance for repairs or replacements or conversion to central sewer.

Problem Statement 6: The presence of about 300 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the cause of recreational use designation non-attainment status for Trumbull Creek around RM 2.05. The most likely source for roughly 50% of the excess pathogen loading (150 cfu) is livestock manure runoff in this section of the Bronson Creek - Grand River Subwatershed.

Goal: Reduce pathogenic bacteria from suspected livestock (cattle) manure runoff by about 150 cfu per year, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective: Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms (approximately 1000 feet of streambank), resulting in an excess pathogen loading reduction of 150 cfu.
Action 1: Develop contact list for landowners adjacent to impaired stream channel segments.
Action 2: Make available to all owners of land adjacent to impaired stream segments copies of the EQIP brochure providing financial incentives for livestock exclusion fencing and alternative watering structures.
Action 3: Work with NRCS to implement EQIP cost share program for livestock fencing and alternative watering structures in priority areas.

Problem Statement 7: The presence of about 300 colony forming units (cfu) per year of excess pathogen loading (fecal coliform and E. coli) is the most likely cause of recreational use designation non-attainment status for Trumbull Creek near RM 2.05 due to anecdotal evidence pointing to contamination from human origins. The most likely source for roughly 50% of the excess pathogen loading (150 cfu) is approximately 10 to 15 failing Home Sewage Treatment Systems (HSTS) in the Bronson Creek - Grand River Subwatershed.

Goal: Reduce pathogenic bacteria from failing HSTS discharge by about 30 cfu on average per year for five consecutive years, thus lowering pollutant levels and allowing the stream to reach full attainment.

Objective 1: Inspect the estimated 57 Home Sewage Treatment Systems (HSTS) for failure along 2 miles of Trumbull Creek and it's tributaries upstream of RM 2.05.
Action1: Conduct annual inspections on 20 percent of off-lot discharging systems that directly outlet to a tributary.
Action 2: Document failed systems & develop comprehensive HSTS database as inspections are completed.
Action 3: Gather and enter data on type of system, geo-coded location, year of installation, date of last inspection, date of last pumping, and sampling results.

Objective 2: Upgrade, repair or replace a minimum of 10 failing Home Sewage Treatment Systems (HSTS) of along 2 miles of Trumbull Creek and it's tributaries upstream of RM 2.05.
Action 1: Implement repair or replacement procedures to bring systems into compliance.
Action 2: Introduce new, proven technology such as Wisconsin mounds, drip irrigation, and shallow trench or at-grade systems and integrate into current regulations.
Action 2: Utilize private sector service industry permit inspection program to help assure proper operation and maintenance of discharging systems and/or soilbased treatment and disposal systems.

Objective 3: Use education and outreach along with other informational programs and services to assist the estimated 57 residents with Home Sewage Treatment Systems (HSTS) in the area along 2 miles of Trumbull Creek and it's tributaries upstream of RM 2.05 on operation and maintenance of systems and assistance with corrective measures.
Action 1: Conduct annual homeowner septic system operation and maintenance workshop for residents with HSTS.
Action 2: Assist qualified homeowners in identifying financial assistance for repairs or replacements or conversion to central sewer.

Problem Statement 8: Local stakeholder concern has identified 2665 acres of land with high natural area conservation value under threat of conversion. It was assumed that for a single family housing development on the 2665 acres, 50% of the land would be preserved as open space. Of the remaining 1332.5 acres developed as single-family residential, it was assumed that the development would use filter buffer strips as a Low Impact Development (LID) technique. Based on this the resultant pollutants generated by impervious surfaces and residential land use (excess loading of nitrogen (N) – 1834 lbs/year, phosphorus (P) - 270 lbs/year, Biological Oxygen Demand (BOD) - 7448 lbs/year and Sediment – 20 tons/year) would push adjacent sections of Bronson to impairment (Table 290).

Goal: Protect 2665 acres of land with high natural area conservation value under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use land protection methods such as conservation easements and fee-simple acquisitions to protect 2665 acres of land with high natural area conservation value.
Action 1: Identify and engage potential landowners for the purposes of acquiring land protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential land acquisition opportunities.
Action 3: Secure funding needed to support land protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified land protection properties.

Table 290. Bronson Creek-Grand River Subwatershed Land Protection Load Estimates for land protection.

Current land use loading as 2665 acres of forest			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
415.9	203.1	1018.8	13.2
New land use loading following development of 1332.5 acres as single-family housing with LID			
N Load lb/year	**P Load lb/year**	**BOD lb/year**	**Sediment Load t/year**
2250.3	472.9	8466.6	33.1
Net increase due to land use change			
N Load lb/year	**P Load lb/year**	**BOD Load lb/year**	**Sediment Load t/year**
1834.4	**269.8**	**7447.8**	**19.9**

Problem Statement 9: Local stakeholder concern has identified 280 acres of National Wetlands Inventory (NWI) wetlands under threat of conversion. The alternate development scenario is the filling of half (½) of the acreage and its conversion to impervious surface. Wetlands are well known for their "kidney-on-the-landscape" value; however, these services are rarely assessed quantitatively. Because of this, estimates of resultant pollutants generated by impervious surfaces and residential land use are not available at this time.

Goal: Protect 280 acres of wetlands under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use wetland protection methods such as conservation easements and fee-simple acquisitions to protect 280 acres of wetlands with high natural area conservation value.

Action 1: Identify and engage potential landowners for the purposes of acquiring wetland protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential wetland acquisition opportunities.
Action 3: Secure funding needed to support wetland protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified wetland protection properties.

Problem Statement 10: Local stakeholder concern has identified 25.81 miles or 136253 linear feet of stream corridor under threat of conversion. The conservative assumption is that land development will result in an exposed stream bank which would be impacted by erosional processes. Based on this the resultant pollutants generated by channel erosion (excess loading of sediment – 2316 tons/year, N - 4632 lbs/year and P - 2316 lbs/year) would push adjacent sections of Bronson Creek to impairment (see table 291).

Goal: Protect 25.81 miles or 136253 linear feet of stream corridor under threat of conversion. This practice will avoid the potential resultant pollutants generated by impervious surfaces and residential land use.

Objective: Use stream corridor protection methods such as conservation easements and fee-simple acquisitions to protect 25.81 miles or 136253 linear feet of stream corridor with high natural area conservation value.

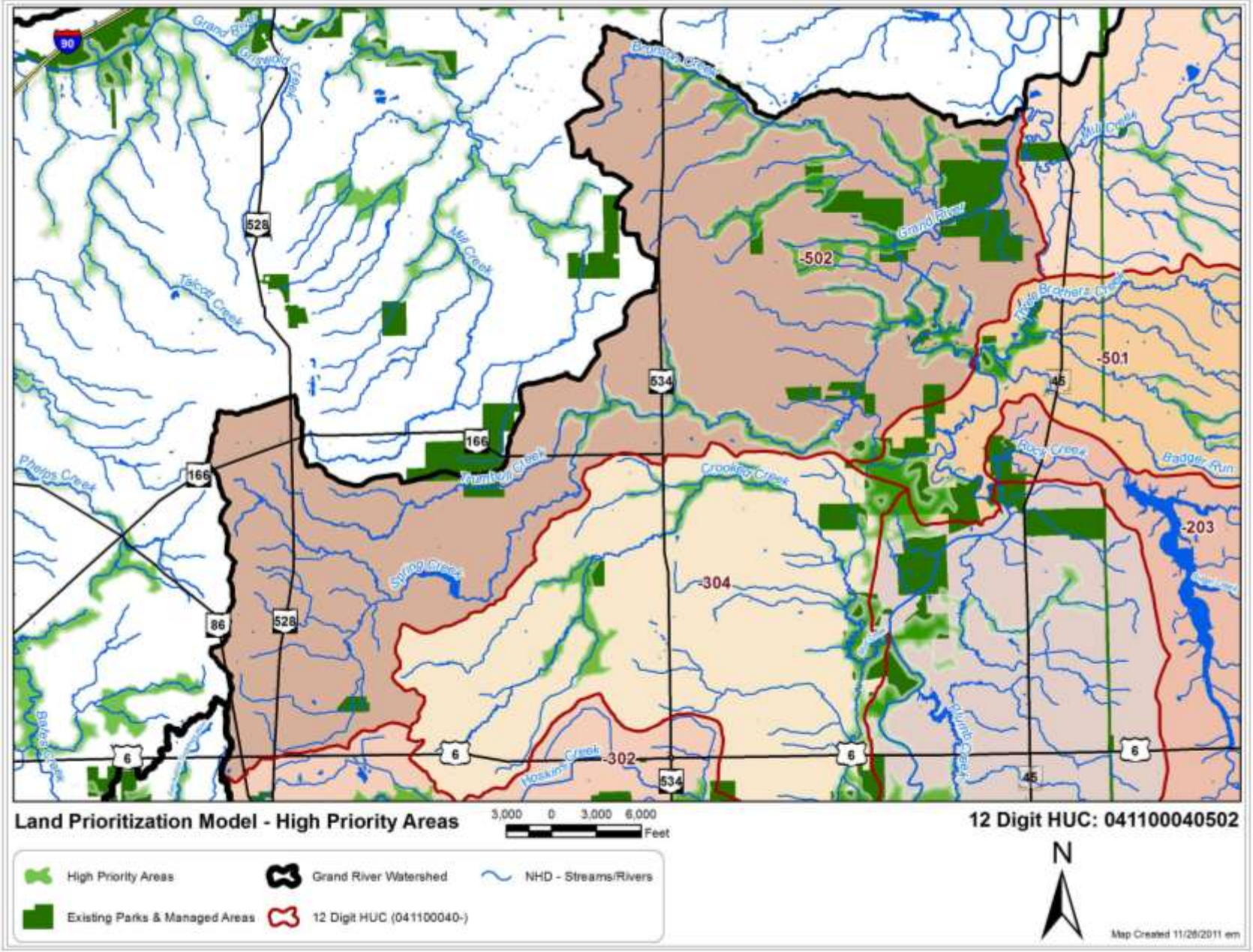
Action 1: Identify and engage potential landowners for the purposes of acquiring stream corridor protection property through conservation easement and fee-simple land acquisition.
Action 2: Connect conservation agencies, organizations and land trusts with identified landowners for potential stream corridor acquisition opportunities.
Action 3: Secure funding needed to support stream corridor protection efforts, by identifying and pursuing private and public funding sources, matching identified land protection properties with private and public funding sources and applying for appropriate private and public funding intended for specified stream corridor protection properties.

Table 291. Bronson Creek-Grand River Subwatershed Estimated Load Reductions for Stream Corridor Protection.

	BMP Efficiency* Bank #1	BMP Efficiency* Bank #2	Bank #1	Bank #2
Sediment Load Reduction (ton/year)	0.5	0.5	1158.2	1158.2
Phosphorus Load Reduction (lb/year)			1158.2	1158.2
Nitrogen Load Reduction (lb/yr)			2316.3	2316.3

* BMP efficiency values should be between 0 and 1, and 1 means 100% pollutant removal efficiency.

Map 99 – 041100040502 Bronson Creek-Grand River Creek Land Protection Prioritization Model - High Priority Areas



This Page Intentionally left blank

Table 292. Implementation Table for the Upper Grand River Watershed Action Plan

Stream/Project Name	12 Digit HUC	ALU	Attainment Status	Causes	Project Type	Sources	Pollutant Targeted	Action Item	Unit	Target	Estimated Cost	Comments	Status	Project Priority
Dead Branch Land Protection	041100040101	WWH	Full	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	721	$3,605,000	Protect 721 acres of Dead Branch Watershed land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Dead Branch Wetland Protection	041100040101	WWH	Full	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Wetland Conservation Easements	Acres	174	$870,000	Protect 174 acres of Dead Branch Watershed wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Dead Branch Riparian Protection	041100040101	WWH	Full	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	19620	$235,440	Protect 3.72 miles or 19620 linear feet (100' wide buffer) of Dead Branch stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Headwaters Excess Pathogen Control (Grand River RM 98.95)	041100040102	CWH EWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	2	$50,000	Establish 2 new manure storage facilites in the adjacent agricultural area near Grand River RM 98.95	No Plans - County Soil & Water Conservation District	5-10 Years
Headwaters Excess Pathogen Control (Grand River RM 98.95)	041100040102	CWH EWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	2000	$8,000	Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms near Grand River RM 98.95	No Plans - County Soil & Water Conservation District	5-10 Years
Headwaters Excess Pathogen Control (Grand River RM 95.38)	041100040102	CWH EWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	1	$25,000	Establish 1 new manure storage facility in the adjacent agricultural area near Grand River RM 95.38	No Plans - County Soil & Water Conservation District	5-10 Years
Headwaters Excess Pathogen Control (Grand River RM 94.27)	041100040102	CWH EWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	1	$25,000	Establish 1 new manure storage facility in the adjacent agricultural area near Grand River RM 94.27	No Plans - County Soil & Water Conservation District	5-10 Years
Headwaters Excess Pathogen Control (Grand River RM 88.50)	041100040102	EWH WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	2	$50,000	Establish 2 new manure storage facilites in the adjacent agricultural area near Grand River RM 88.50	No Plans - County Soil & Water Conservation District	5-10 Years
Headwaters Excess Pathogen Control (Grand River RM 88.50)	041100040102	EWH WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	2000	$8,000	Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms near Grand River RM 88.50	No Plans - County Soil & Water Conservation District	5-10 Years
Headwaters Land Protection	041100040102	CWH EWH WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	1663	$8,315,000	Protect 1663 acres of Grand River Headwaters Watershed land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Headwaters Wetland Protection	041100040102	CWH EWH WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Wetland Conservation Easements	Acres	320	$1,600,000	Protect 320 acres of Grand River Headwaters Watershed wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Headwaters Riparian Protection	041100040102	CWH EWH WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	86792	$1,041,504	Protect 16.44 miles or 86792 linear feet of Grand River Headwaters Watershed stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years

This Page Intentionally left blank

Table 292. Implementation Table for the Upper Grand River Watershed Action Plan (Cont'd)

Stream/Project Name	12 Digit HUC	ALU	Attainment Status	Causes	Project Type	Sources	Pollutant Targeted	Action Item	Unit	Target	Estimated Cost	Comments	Status	Project Priority
Baughman Creek Excess Pathogen Control (Baughman Creek RM 3.3)	041100040103	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	1	$25,000	Establish 1 new manure storage facility in the adjacent agricultural area near Baughman Creek RM 3.3	No Plans - County Soil & Water Conservation District	5-10 Years
Baughman Creek Excess Pathogen Control (Baughman Creek RM 3.3)	041100040103	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	2000	$8,000	Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms near Baughman Creek RM 3.3	No Plans - County Soil & Water Conservation District	5-10 Years
Baughman Creek Excess Pathogen Control (Deacon Creek RM 1.38)	041100040103	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	2	$50,000	Establish 2 new manure storage facilites in the adjacent agricultural area near Deacon Creek RM 1.38	No Plans - County Soil & Water Conservation District	5-10 Years
Baughman Creek Excess Pathogen Control (Deacon Creek RM 1.38)	041100040103	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	2000	$8,000	Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms near Deacon Creek RM 1.38	No Plans - County Soil & Water Conservation District	5-10 Years
Baughman Creek Land Protection	041100040103	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	105	$525,000	Protect 105 acres of Baughman Creek Watershed land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Baughman Creek Wetland Protection	041100040103	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Wetland Conservation Easements	Acres	88	$440,000	Protect 88 acres of Baughman Creek Watershed wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Baughman Creek Riparian Protection	041100040103	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	841	$10,092	Protect 0.16 miles or 841linear feet of Baughman Creek Watershed stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Center Creek-Grand River Excess Pathogen Control	041100040104	WWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Inspect Home Sewage Treatment Systems (HSTS) for Failure	Inspections	320	$64,000	Inspect the estimated 320 Home Sewage Treatment Systems (HSTS) for failure near Center Creek-Grand River	No Plans - County Health Department	5-10 Years
Center Creek-Grand River Excess Pathogen Control	041100040104	WWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Upgrade, repair or replace failing Home Sewage Treatment Systems (HSTS)	Systems	50	$750,000	Upgrade, repair or replace a minimum of 50 failing Home Sewage Treatment Systems (HSTS) near Center Creek-Grand River	No Plans - County Health Department	10+ Years
Center Creek-Grand River Excess Pathogen Control	041100040104	WWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Home Sewage Treatment Systems (HSTS) education & outreach	Residents	320	$3,200	Use education and outreach to assist the estimated 320 residents in operation and maintenance of systems near Center Creek-Grand River	No Plans - County Health Department	5-10 Years
Center Creek-Grand River Excess Pathogen Control (Mud Run RM 4.05)	041100040104	WWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Inspect Home Sewage Treatment Systems (HSTS) for Failure	Inspections	320	$64,000	Inspect the estimated 320 Home Sewage Treatment Systems (HSTS) for failure near Mud Run	No Plans - County Health Department	5-10 Years
Center Creek-Grand River Excess Pathogen Control (Mud Run RM 4.05)	041100040104	WWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Upgrade, repair or replace failing Home Sewage Treatment Systems (HSTS)	Systems	50	$750,000	Upgrade, repair or replace a minimum of 50 failing Home Sewage Treatment Systems (HSTS) near Mud Run	No Plans - County Health Department	10+ Years

This Page Intentionally left blank

Table 292. Implementation Table for the Upper Grand River Watershed Action Plan (Cont'd)

Stream/Project Name	12 Digit HUC	ALU	Attainment Status	Causes	Project Type	Sources	Pollutant Targeted	Action Item	Unit	Target	Estimated Cost	Comments	Status	Project Priority
Center Creek-Grand RiverExcess Pathogen Control(Mud Run RM 4.05)	041100040104	WWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform& E. Coli	Home Sewage Treatment Systems (HSTS) education & outreach	Residents	320	$3,200	Use education and outreach to assist the estimated 320 residents in operation and maintenance of systems near Mud Run	No Plans - County Health Department	5-10Years
Center Creek-Grand River Land Protection	041100040104	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	566	$2,830,000	Protect 566 acres of Center Creek-Grand River Watershed land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Center Creek-Grand River Wetland Protection	041100040104	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Wetland Conservation Easements	Acres	485	$2,425,000	Protect 485 acres of Center Creek-Grand River Watershed wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Center Creek-Grand River Riparian Protection	041100040104	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	4706	$56,472	Protect 0.89 miles or 4706 linear feet of Center Creek-Grand River Watershed stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Coffee Creek Excess Pathogen Control (Hoskins Creek RM 2.01)	041100040105	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	1000	$4,000	Establish 1000 lineal feet of livestock exclusion fencing along streams on 2 farms near Hoskins Creek RM 2.01	No Plans - County Soil & Water Conservation District	5-10 Years
Coffee Creek Land Protection	041100040105	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	2194	$10,970,000	Protect 2194 acres of Coffee Creek land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Coffee Creek Wetland Protection	041100040105	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Wetland Conservation Easements	Acres	1995	$9,975,000	Protect 1995 acres of Coffee Creek wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Coffee Creek Riparian Protection	041100040105	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	68746	$824,952	Protect 13.02 miles or 68746 linear feet of Coffee Creek stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Swine Creek Excess Pathogen Control	041100040106	CWH WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	2	$50,000	Establish 2 new manure storage facilites in the adjacent agricultural area on nearly the entire reach of Swine Creek	No Plans - County Soil & Water Conservation District	5-10 Years
Swine Creek Excess Pathogen Control	041100040106	CWH WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	2000	$8,000	Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms on nearly the entire reach of Swine Creek	No Plans - County Soil & Water Conservation District	5-10 Years

This Page Intentionally left blank

Table 292. Implementation Table for the Upper Grand River Watershed Action Plan (Cont'd)

Stream/Project Name	12 Digit HUC	ALU	Attainment Status	Causes	Project Type	Sources	Pollutant Targeted	Action Item	Unit	Target	Estimated Cost	Comments	Status	Project Priority
Swine Creek Excess Pathogen Control (Andrews Creek RM 3.62)	041100040106	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	1	$25,000	Establish 1 new manure storage facility in the adjacent agricultural area near Andrews Creek RM 3.62	No Plans - County Soil & Water Conservation District	5-10 Years
Swine Creek Excess Pathogen Control (Andrews Creek RM 3.62)	041100040106	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	2000	$8,000	Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms near Andrews Creek RM 3.62	No Plans - County Soil & Water Conservation District	5-10 Years
Swine Creek Excess Pathogen Control (Plum Creek RM 1.48)	041100040106	CWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	1	$25,000	Establish 1 new manure storage facility in the adjacent agricultural area near Plum Creek RM 1.48	No Plans - County Soil & Water Conservation District	5-10 Years
Swine Creek Excess Pathogen Control (Plum Creek RM 1.48)	041100040106	CWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	1000	$4,000	Establish 1000 lineal feet of livestock exclusion fencing along streams on 2 farms near Plum Creek RM 1.48	No Plans - County Soil & Water Conservation District	5-10 Years
Swine Creek Land Protection	041100040106	CWH WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	1779	$8,895,000	Protect 1779 acres of Swine Creek Watershed land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Swine Creek Wetland Protection	041100040106	CWH WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Wetland Conservation Easements	Acres	448	$2,240,000	Protect 448 acres of Swine Creek Watershed wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Swine Creek Riparian Protection	041100040106	CWH WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	85793	$1,029,516	Protect 16.25 miles or 85793 linear feet of Swine Creek Watershed stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Upper Rock Creek Stream Restoration & Habitat Restoration	041100040201	MWH	Full	Direct Habitat Alterations	Restoration	Drainage/Filling of Wetlands, Channelization - Development	Nutrients & Sediment	Restore non-attaining streams	Linear Feet	30102	$30,102,000	Restore 5.7 miles or 30102 linear feet of non-attaining streams, including restoration of in-stream habitat, riparian habitat restoration, re-connection to floodplain and enhancement and restoration of existing wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	5-10 Years
Upper Rock Creek Land Protection	041100040201	MWH	Full	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	1834	$9,170,000	Protect 1834 acres of Upper Rock Creek Watershed land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Upper Rock Creek Wetland Protection	041100040201	MWH	Full	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Wetland Conservation Easements	Acres	833	$4,165,000	Protect 833 acres of Upper Rock Creek Watershed wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years

This Page Intentionally left blank

Table 292. Implementation Table for the Upper Grand River Watershed Action Plan (Cont'd)

Stream/Project Name	12 Digit HUC	ALU	Attainment Status	Causes	Project Type	Sources	Pollutant Targeted	Action Item	Unit	Target	Estimated Cost	Comments	Status	Project Priority
Upper Rock Creek Riparian Protection	041100040201	MWH	Full	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	85011	$1,020,132	Protect 15.53 miles or 85011 linear feet of Upper Rock Creek stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Middle Rock Creek Excess Pathogen Control (Rock Creek RM 9.64)	041100040202	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	2000	$8,000	Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms near Rock Creek RM 9.64	No Plans - County Soil & Water Conservation District	5-10 Years
Middle Rock Creek Excess Pathogen Control (Lebanon Creek)	041100040202	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	1800	$7,200	Establish 1800 lineal feet of livestock exclusion fencing along streams on 2 farms near Lebanon Creek	No Plans - County Soil & Water Conservation District	5-10 Years
Middle Rock Creek Land Protection	041100040202	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	1229	$6,145,000	Protect 1229 acres of Middle Rock Creek Watershed land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Middle Rock Creek Wetland Protection	041100040202	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients &Sediment	Acquire Wetland Conservation Easements	Acres	247	$1,235,000	Protect 247 acres of Middle Rock Creek Watershed wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5Years
Middle Rock Creek Riparian Protection	041100040202	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	89232	$1,070,784	Protect 16.9 miles or 89232 linear feet of Middle Rock Creek Watershed stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Lower Rock Creek Excess Pathogen Control (Whetstone Creek)	041100040203	WWH	Non	Excess Pathogen Loading	Restoration	Spill or Illegal Dumping	Fecal Coliform & E. Coli	Sample upstream & downstream for presence of elevated levels of excess pathogenic bacteria	Survey	1	$5,000	Conduct 1 sample survey on Whetstone Creek to follow up results of Biological and Water Quality Study of the Upper Grand River 2007	No Plans - Ohio Environmental Protection	1-5 Years
Lower Rock Creek Land Protection	041100040203	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	481	$2,405,000	Protect 481 acres of Lower Rock Creek Watershed land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Lower Rock Creek Wetland Protection	041100040203	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Wetland Conservation Easements	Acres	51	$255,000	Protect 51 acres of Lower Rock Creek Watershed wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Lower Rock Creek Riparian Protection	041100040203	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	30738	$368,856	Protect 5.82 miles or 30738 linear feet of Lower Rock Creek Watershed stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years

This Page Intentionally left blank

Table 292. Implementation Table for the Upper Grand River Watershed Action Plan (Cont'd)

Stream/Project Name	12 Digit HUC	ALU	Attainment Status	Causes	Project Type	Sources	Pollutant Targeted	Action Item	Unit	Target	Estimated Cost	Comments	Status	Project Priority
North Branch Phelps Creek Excess Pathogen Control	041100040301	WWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Inspect Home Sewage Treatment Systems (HSTS) for Failure	Inspections	315	$63,000	Inspect the estimated 315 Home Sewage Treatment Systems (HSTS) for failure near North Branch Phelps Creek	No Plans - County Health Department	5-10 Years
North Branch Phelps Creek Excess Pathogen Control	041100040301	WWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Upgrade, repair or replace failing Home Sewage Treatment Systems (HSTS)	Systems	50	$750,000	Upgrade, repair or replace a minimum of 50 failing Home Sewage Treatment Systems (HSTS) near North Branch Phelps Creek	No Plans - County Health Department	10+ Years
North Branch Phelps Creek Excess Pathogen Control	041100040301	WWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Home Sewage Treatment Systems (HSTS) education & outreach	Residents	315	$3,150	Use education and outreach to assist the estimated 315 residents in operation and maintenance of systems near North Branch Phelps Creek	No Plans - County Health Department	5-10 Years
Phelps Creek Excess Pathogen Control (Phelps Creek RM 1.23)	041100040301	WWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Inspect Home Sewage Treatment Systems (HSTS) for Failure	Inspections	252	$50,400	Inspect the estimated 252 Home Sewage Treatment Systems (HSTS) for failure near Phelps Creek RM 1.23	No Plans - County Health Department	5-10 Years
Phelps Creek Excess Pathogen Control (Phelps Creek RM 1.23)	041100040301	WWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Upgrade, repair or replace failing Home Sewage Treatment Systems (HSTS)	Systems	50	$750,000	Upgrade, repair or replace a minimum of 50 failing Home Sewage Treatment Systems (HSTS) near Phelps Creek RM 1.23	No Plans - County Health Department	10+ Years
Phelps Creek Excess Pathogen Control (Phelps Creek RM 1.23)	041100040301	WWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Home Sewage Treatment Systems (HSTS) education & outreach	Residents	252	$2,520	Use education and outreach to assist the estimated 252 residents in operation and maintenance of systems near Phelps Creek RM 1.23	No Plans - County Health Department	5-10 Years
Phelps Creek Land Protection	041100040301	CWH WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	1747	$8,735,000	Protect 1747 acres of Phelps Creek Watershed land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Phelps Creek Wetland Protection	041100040301	CWH WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Wetland Conservation Easements	Acres	532	$2,660,000	Protect 532 acres of Phelps Creek Watershed wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Phelps Creek Riparian Protection	041100040301	CWH WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	88636	$1,063,632	Protect 16.79 miles or 88636 linear feet of Phelps Creek Watershed stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Hoskins Creek Excess Pathogen Control (Hoskins Creek RM 4.88)	041100040302	CWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	1	$25,000	Establish 1 new manure storage facility in the adjacent agricultural area near Hoskins Creek RM 4.88	No Plans - County Soil & Water Conservation District	5-10 Years
Hoskins Creek Excess Pathogen Control (Hoskins Creek RM 4.88)	041100040302	CWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	2000	$8,000	Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms near Hoskins Creek RM 4.88	No Plans - County Soil & Water Conservation District	5-10 Years
Hoskins Creek Excess Pathogen Control (Hoskins Creek RM 2.01)	041100040302	EWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	1	$25,000	Establish 1 new manure storage facility in the adjacent agricultural area near Hoskins Creek RM 2.01	No Plans - County Soil & Water Conservation District	5-10 Years

This Page Intentionally left blank

Table 292. Implementation Table for the Upper Grand River Watershed Action Plan (Cont'd)

Stream/Project Name	12 Digit HUC	ALU	Attainment Status	Causes	Project Type	Sources	Pollutant Targeted	Action Item	Unit	Target	Estimated Cost	Comments	Status	Project Priority
Hoskins Creek Excess Pathogen Control (Hoskins Creek RM 2.01)	041100040302	EWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	1000	$4,000	Establish 1000 lineal feet of livestock exclusion fencing along streams on 2 farms near Hoskins Creek RM 2.01	No Plans - County Soil & Water Conservation District	5-10 Years
Indian Creek Excess Pathogen Control	041100040302	CWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	1	$25,000	Establish 1 new manure storage facility in the adjacent agricultural area near Indian Creek	No Plans - County Soil & Water Conservation District	5-10 Years
Indian Creek Excess Pathogen Control	041100040302	CWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	1000	$4,000	Establish 1000 lineal feet of livestock exclusion fencing along streams on 2 farms near Indian Creek	No Plans - County Soil & Water Conservation District	5-10 Years
unnamed tributary to Hoskins Creek Excess Pathogen Control	041100040302	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	4	$100,000	Establish 4 new manure storage facilites in the adjacent agricultural area on nearly the entire reach of unnamed tributary to Hoskins Creek	No Plans - County Soil & Water Conservation District	5-10 Years
unnamed tributary to Hoskins Creek Excess Pathogen Control	041100040302	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	4000	$16,000	Establish 4000 lineal feet of livestock exclusion fencing along streams on 2 farms on nearly the entire reach of unnamed tributary to Hoskins Creek	No Plans - County Soil & Water Conservation District	5-10 Years
Hoskins Creek Stream Restoration & Habitat Restoration	041100040302	WWH	Non	Direct Habitat Alterations	Restoration	Drainage/Filling of Wetlands, Channelization - Development	Nutrients & Sediment	Restore non-attaining streams	Linear Feet	2640	$2,640,000	Restore ½ mile or 2640 linear feet of non-attaining streams, including restoration of in-stream habitat, stabilization of eroding banks, and re-connection to floodplain using ditch retrofit techniques.	No Plans - County Soil & Water Conservation District	5-10 Years
Hoskins Creek Land Protection	041100040302	CWH EWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	2964	$14,820,000	Protect 2964 acres of Hoskins Creek Watershed land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Hoskins Creek Wetland Protection	041100040302	CWH EWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients &Sediment	Acquire Wetland Conservation Easements	Acres	790	$3,950,000	Protect 532 acres of Hoskins Creek Watershed wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5Years
Hoskins Creek Riparian Protection	041100040302	CWH EWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	88636	$1,063,632	Protect 27.64 miles or 145959 linear feet of Hoskins Creek Watershed stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Mill Creek (1) Excess Pathogen Control (Mill Creek (1) RM 4.94)	041100040303	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	1	$25,000	Establish 1 new manure storage facility in the adjacent agricultural area near Mill Creek (1) RM 4.94	No Plans - County Soil & Water Conservation District	5-10 Years
Mill Creek (1) Excess Pathogen Control (Mill Creek (1) RM 2.30)	041100040303	CWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	1	$25,000	Establish 1 new manure storage facility in the adjacent agricultural area near Mill Creek (1) RM 2.30	No Plans - County Soil & Water Conservation District	5-10 Years

This Page Intentionally left blank

Table 292. Implementation Table for the Upper Grand River Watershed Action Plan (Cont'd)

Stream/Project Name	12 Digit HUC	ALU	Attainment Status	Causes	Project Type	Sources	Pollutant Targeted	Action Item	Unit	Target	Estimated Cost	Comments	Status	Project Priority
Garden Creek Excess Pathogen Control	041100040303	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	1	$25,000	Establish 1 new manure storage facility in the adjacent agricultural area near Garden Creek	No Plans - County Soil & Water Conservation District	5-10 Years
Mill Creek (1) Stream Flow Restoration	041100040303	WWH	Partial	Direct Habitat Alterations	Restoration	Land Development/ Suburbanization	Nutrients & Sediment	Restore Streambank Using Bio-Engineering	Linear Feet	4000	$1,600,000	Remove or modify the Naji Lake Dam at Mill Creek (1) RM 5.71 to reconnect mill creek with the rest of the watershed and restore natural habitat & flow to about 4000 linear feet of stream .	No Plans - County Soil & Water Conservation District	10+ Years
Mill Creek (1) Land Protection	041100040303	CWH WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	4307	$21,535,000	Protect 4307 acres of Mill Creek (1) Watershed land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Mill Creek (1) Wetland Protection	041100040303	CWH WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Wetland Conservation Easements	Acres	1679	$8,395,000	Protect 1679 acres of Mill Creek (1) Watershed wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Mill Creek (1) Riparian Protection	041100040303	CWH WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	202017	$2,424,204	Protect 38.26 miles or 202017 linear feet of Mill Creek (1) Watershed stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Mud Creek Excess Pathogen Control (Mud Creek RM 3.78)	041100040304	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	2	$50,000	Establish 2 new manure storage facilites in the adjacent agricultural area near Mud Creek RM 3.78	No Plans - County Soil & Water Conservation District	5-10 Years
Mud Creek Excess Pathogen Control (Mud Creek RM 3.78)	041100040304	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	2000	$8,000	Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms near Mud Creek RM 3.78	No Plans - County Soil & Water Conservation District	5-10 Years
Mud Creek Excess Pathogen Control (Crooked Creek RM 1.62)	041100040304	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	2	$50,000	Establish 2 new manure storage facilites in the adjacent agricultural area near Crooked Creek RM 1.62	No Plans - County Soil & Water Conservation District	5-10 Years
Mud Creek Excess Pathogen Control (Crooked Creek RM 1.62)	041100040304	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	2000	$8,000	Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms near Crooked Creek RM 1.62	No Plans - County Soil & Water Conservation District	5-10 Years
Mud Creek Stream Restoration & Habitat Restoration (Crooked Creek RM 2.52)	041100040304	WWH	Non	Direct Habitat Alterations	Restoration	Drainage/Filling of Wetlands, Channelization - Development	Nutrients & Sediment	Restore non-attaining streams	Linear Feet	1000	$4,000	Restore 0.2 mile or 1000 linear feet of non-attaining streams, including restoration of in-stream habitat, stabilization of eroding banks, and re-connection to floodplain using ditch retrofit techniques.	No Plans - County Soil & Water Conservation District	5-10 Years
Mud Creek Land Protection	041100040304	CWH WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	1835	$9,175,000	Protect 1835 acres of Mud Creek Watershed land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years

This Page Intentionally left blank

Table 292. Implementation Table for the Upper Grand River Watershed Action Plan (Cont'd)

Stream/Project Name	12 Digit HUC	ALU	Attainment Status	Causes	Project Type	Sources	Pollutant Targeted	Action Item	Unit	Target	Estimated Cost	Comments	Status	Project Priority
Mud Creek Wetland Protection	041100040304	CWH WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Wetland Conservation Easements	Acres	532	$2,660,000	Protect 532 acres of Mud Creek Watershed wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Mud Creek Riparian Protection	041100040304	CWH WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	73673	$884,076	Protect 13.95 miles or 73673 linear feet of Mud Creek Watershed stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Plumb Creek-Grand River Excess Pathogen Control (Plumb Creek section of the Grand River Mainstem RM 55.62)	041100040305	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	1	$25,000	Establish 1 new manure storage facility in the adjacent agricultural area near Plumb Creek section of the Grand River Mainstem RM 55.62	No Plans - County Soil & Water Conservation District	5-10 Years
Plumb Creek-Grand River Land Protection	041100040305	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	2057	$10,285,000	Protect 2057 acres of Plumb Creek-Grand River Watershed land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Plumb Creek-Grand River Wetland Protection	041100040305	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Wetland Conservation Easements	Acres	754	$3,770,000	Protect 754 acres of Plumb Creek-Grand River Watershed wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Plumb Creek-Grand River Riparian Protection	041100040305	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	88636	$1,063,632	Protect 16.79 miles or 88636 linear feet of Plumb Creek-Grand River Watershed stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Mill Creek (2) Excess Pathogen Control (Griggs Creek)	041100040401	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	2	$50,000	Establish 2 new manure storage facilites in the adjacent agricultural area near Griggs Creek	No Plans - County Soil & Water Conservation District	5-10 Years
Mill Creek (2) Excess Pathogen Control (Griggs Creek)	041100040401	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	2000	$8,000	Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms near Griggs Creek	No Plans - County Soil & Water Conservation District	5-10 Years
Mill Creek (2) Land Protection (Griggs Creek)	041100040401	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	324	$1,620,000	Protect 324 acres of Griggs Creek Watershed land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Mill Creek (2) Wetland Protection(Griggs Creek)	041100040401	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients &Sediment	Acquire Wetland Conservation Easements	Acres	149	$745,000	Protect 149 acres of Griggs Creek Watershed wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5Years

This Page Intentionally left blank

Table 292. Implementation Table for the Upper Grand River Watershed Action Plan (Cont'd)

Stream/Project Name	12 Digit HUC	ALU	Attainment Status	Causes	Project Type	Sources	Pollutant Targeted	Action Item	Unit	Target	Estimated Cost	Comments	Status	Project Priority
Mill Creek (2) Riparian Protection (Griggs Creek)	041100040401	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	28059	$336,708	Protect 5.31 miles or 28059 linear feet of Griggs Creek Watershed stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Peters Creek – Mill Creek (2) Stream Restoration & Habitat Restoration (Mill Creek (2) RM 25.62)	041100040402	WWH	Non	Direct Habitat Alterations	Restoration	Physical habitat degradation (channel modifications)	Nutrients & Sediment	Reduce soil erosion	Acres	831	$1,662	Reduce soil erosion from unprotected cropland by establishing 831 new acres per year of cover crops, reduced tillage/residue management, filter strips and critical area plantings to avoid sediment runoff.	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Peters Creek – Mill Creek (2) Land Protection	041100040402	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	983	$4,915,000	Protect 983 acres of Peters Creek – Mill Creek (2) Watershed land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Peters Creek – Mill Creek (2) Wetland Protection	041100040402	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Wetland Conservation Easements	Acres	201	$1,005,000	Protect 201 acres of Peters Creek – Mill Creek (2) Watershed wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Peters Creek – Mill Creek (2) Riparian Protection	041100040402	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	62299	$747,588	Protect 11.80 miles or 62299 linear feet of Peters Creek – Mill Creek (2) Watershed stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Village of Jefferson – Mill Creek (2) Stream Restoration & Habitat Restoration (Cemetery Creek RM 2.4 & 2.1)	041100040403	WWH	Non	Direct Habitat Alterations	Restoration	Physical habitat degradation (channel modifications)	Nutrients & Sediment	Reduce soil erosion	Acres	547	$1,094	Reduce soil erosion from unprotected cropland by establishing 547 new acres per year of cover crops, reduced tillage/residue management, filter strips and critical area plantings to avoid sediment runoff.	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Village of Jefferson – Mill Creek (2) Stream Flow Restoration	041100040403	WWH	Non	Direct Habitat Alterations	Restoration	Land Development/ Suburbanization	Nutrients & Sediment	Restore Streambank Using Bio-Engineering	Linear Feet	3000	$1,000,000	Remove the Mill Creek (2) Dam at Village of Jefferson – Mill Creek (2) RM 8.69 to reconnect mill creek with the rest of the watershed and restore natural habitat & flow to about 3000 linear feet of stream .	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	10+ Years
Village of Jefferson – Mill Creek (2) Land Protection	041100040403	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	1439	$7,195,000	Protect 1439 acres of Village of Jefferson – Mill Creek (2) Watershed land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Village of Jefferson – Mill Creek (2) Wetland Protection	041100040403	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Wetland Conservation Easements	Acres	109	$545,000	Protect 109 acres of Village of Jefferson – Mill Creek (2) Watershed wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years

This Page Intentionally left blank

Table 292. Implementation Table for the Upper Grand River Watershed Action Plan (Cont'd)

Stream/Project Name	12 Digit HUC	ALU	Attainment Status	Causes	Project Type	Sources	Pollutant Targeted	Action Item	Unit	Target	Estimated Cost	Comments	Status	Project Priority
Village of Jefferson – Mill Creek (2) Riparian Protection	041100040403	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	98519	$1,182,228	Protect 18.66 miles or 98519 linear feet of Village of Jefferson – Mill Creek (2) Watershed stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Three Brothers Creek-Grand River Excess Pathogen Control (Three Brothers Creek RM 6.68)	041100040501	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	1	$25,000	Establish 1 new manure storage facility in the adjacent agricultural area near Three Brothers Creek RM 6.68	No Plans - County Soil & Water Conservation District	5-10 Years
Three Brothers Creek-Grand River Excess Pathogen Control (4 miles of Three Brothers Creek and it's tributaries upstream of RM 6.68)	041100040501	WWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Inspect Home Sewage Treatment Systems (HSTS) for Failure	Inspections	86	$17,200	Inspect the estimated 86 Home Sewage Treatment Systems (HSTS) for failure along 4 miles of Three Brothers Creek and it's tributaries upstream of RM 6.68	No Plans - County Health Department	5-10 Years
Three Brothers Creek-Grand River Excess Pathogen Control (4 miles of Three Brothers Creek and it's tributaries upstream of RM 6.68)	041100040501	WWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Upgrade, repair or replace failing Home Sewage Treatment Systems (HSTS)	Systems	20	$300,000	Upgrade, repair or replace a minimum of 20 failing Home Sewage Treatment Systems (HSTS) along 4 miles of Three Brothers Creek and it's tributaries upstream of RM 6.68	No Plans - County Health Department	10+ Years
Three Brothers Creek-Grand River Excess Pathogen Control (4 miles of Three Brothers Creek and it's tributaries upstream of RM 6.68)	041100040501	WWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Home Sewage Treatment Systems (HSTS) education & outreach	Residents	86	$860	Use education and outreach to assist the estimated 86 residents in operation and maintenance of systems along 4 miles of Three Brothers Creek and it's tributaries upstream of RM 6.68	No Plans - County Health Department	5-10 Years
Three Brothers Creek-Grand River Land Protection	041100040501	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	1264	$6,320,000	Protect 1264 acres of Three Brothers Creek-Grand River Watershed land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Three Brothers Creek-Grand River Wetland Protection	041100040501	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Wetland Conservation Easements	Acres	269	$1,345,000	Protect 269 acres of Three Brothers Creek-Grand River Watershed wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Three Brothers Creek-Grand River Riparian Protection	041100040501	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	52523	$630,276	Protect 9.95 miles or 52523 linear feet of Three Brothers Creek-Grand River Watershed stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Bronson Creek Excess Pathogen Control (Bronson Creek RM 1.52)	041100040502	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	1	$25,000	Establish 1 new manure storage facility in the adjacent agricultural area near Bronson Creek RM 1.52	No Plans - County Soil & Water Conservation District	5-10 Years
Bronson Creek Excess Pathogen Control (Bronson Creek RM 1.52)	041100040502	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	2000	$8,000	Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms near Bronson Creek RM 1.52	No Plans - County Soil & Water Conservation District	5-10 Years
Bronson Creek Excess Pathogen Control (Spring Creek RM 5.02)	041100040502	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	1	$25,000	Establish 1 new manure storage facility in the adjacent agricultural area near Spring Creek RM 5.02	No Plans - County Soil & Water Conservation District	5-10 Years

This Page Intentionally left blank

Table 292. Implementation Table for the Upper Grand River Watershed Action Plan (Cont'd)

Stream/Project Name	12 Digit HUC	ALU	Attainment Status	Causes	Project Type	Sources	Pollutant Targeted	Action Item	Unit	Target	Estimated Cost	Comments	Status	Project Priority
Bronson Creek Excess Pathogen Control (Spring Creek RM 2.76)	041100040502	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Construct Animal Waste Storage Structures	Structures	1	$25,000	Establish 1 new manure storage facility in the adjacent agricultural area near Spring Creek RM 2.76	No Plans - County Soil & Water Conservation District	5-10 Years
Bronson Creek Excess Pathogen Control(Trumbull Creek RM 9.03)	041100040502	CWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform& E. Coli	Construct Animal Waste Storage Structures	Structures	1	$25,000	Establish 1 new manure storage facility in the adjacent agricultural area near Trumbull Creek RM 9.03	No Plans - County Soil & Water Conservation District	5-10Years
Bronson Creek-Grand River Excess Pathogen Control (Trumbull Creek RM 9.03)	041100040502	CWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Inspect Home Sewage Treatment Systems (HSTS) for Failure	Inspections	86	$17,200	Inspect the estimated 86 Home Sewage Treatment Systems (HSTS) for failure near Trumbull Creek RM 9.03	No Plans - County Health Department	5-10 Years
Bronson Creek-Grand River Excess Pathogen Control (Trumbull Creek RM 9.03)	041100040502	CWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Upgrade, repair or replace failing Home Sewage Treatment Systems (HSTS)	Systems	10	$150,000	Upgrade, repair or replace a minimum of 10 failing Home Sewage Treatment Systems (HSTS) near Trumbull Creek RM 9.03	No Plans - County Health Department	10+ Years
Bronson Creek-Grand River Excess Pathogen Control (Trumbull Creek RM 9.03)	041100040502	CWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Home Sewage Treatment Systems (HSTS) education & outreach	Residents	86	$860	Use education and outreach to assist the estimated 86 residents in operation and maintenance of systems near Trumbull Creek RM 9.03	No Plans - County Health Department	5-10 Years
Bronson Creek-Grand River Excess Pathogen Control (Trumbull Creek RM 2.05)	041100040502	WWH	Non	Excess Pathogen Loading	Restoration	Livestock Manure Runoff	Fecal Coliform & E. Coli	Install Livestock Exclusion Fencing	Linear Feet	2000	$8,000	Establish 2000 lineal feet of livestock exclusion fencing along streams on 2 farms near Trumbull Creek RM 2.05	No Plans - County Soil & Water Conservation District	5-10 Years
Bronson Creek-Grand River Excess Pathogen Control (Trumbull Creek RM 9.03)	041100040502	WWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Inspect Home Sewage Treatment Systems (HSTS) for Failure	Inspections	57	$11,400	Inspect the estimated 57 Home Sewage Treatment Systems (HSTS) for failure near Trumbull Creek RM 2.05	No Plans - County Health Department	5-10 Years
Bronson Creek-Grand River Excess Pathogen Control (Trumbull Creek RM 2.05)	041100040502	WWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Upgrade, repair or replace failing Home Sewage Treatment Systems (HSTS)	Systems	10	$150,000	Upgrade, repair or replace a minimum of 10 failing Home Sewage Treatment Systems (HSTS) near Trumbull Creek RM 2.05	No Plans - County Health Department	10+ Years
Bronson Creek-Grand River Excess Pathogen Control (Trumbull Creek RM 2.05)	041100040502	WWH	Non	Excess Pathogen Loading	Restoration	Failing Home Sewage Treatment Systems (HSTS)	Fecal Coliform & E. Coli	Home Sewage Treatment Systems (HSTS) education & outreach	Residents	57	$570	Use education and outreach to assist the estimated 57 residents in operation and maintenance of systems near Trumbull Creek RM 2.05	No Plans - County Health Department	5-10 Years
Bronson Creek-Grand River Land Protection	041100040502	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Conservation Easements or Fee Title Purchases	Acres	2665	$13,325,000	Protect 2665 acres of Bronson Creek-Grand River Watershed land with high natural area conservation value	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Bronson Creek-Grand River Wetland Protection	041100040502	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Wetland Conservation Easements	Acres	280	$1,400,000	Protect 280 acres of Bronson Creek-Grand River Watershed wetlands	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years
Bronson Creek-Grand River Riparian Protection	041100040502	WWH	Non	Direct Habitat Alterations	Protection	Land Development/ Suburbanization	Nutrients & Sediment	Acquire Riparian Conservation Easements	Linear Feet	136253	$1,635,036	Protect 25.81 miles or 136253 linear feet of Bronson Creek-Grand River Watershed stream corridor	Continue to work with land protection partners (land trusts, parks districts, SWCD's, other Gov't & NGO's) and local landowners	1-5 Years

This Page Intentionally left blank

Part V.
IMPLEMENTATION OF OHIO COASTAL NONPOINT POLLUTION CONTROL PROGRAM MANAGEMENT MEASURES

V. IMPLEMENTATION OF OHIO COASTAL NONPOINT POLLUTION CONTROL PROGRAM MANAGEMENT MEASURES

This Page Intentionally left blank

V. IMPLEMENTATION OF OHIO COASTAL NONPOINT POLLUTION CONTROL PROGRAM MANAGEMENT MEASURES

Implementation of Coastal Non- Point Control Measures
The Upper Grand River Watershed lies within the Lake Erie Watershed boundary and therefore must incorporate management measures from the Coastal Nonpoint Plan into the Upper Grand River Watershed Action Plan. Many of the urban and hydromodification management measures addressed in the Coastal Nonpoint Plan are bolstered by the actions set forth within the implementation section of this plan.

Note: There are no Phase II NPDES communities in the Upper Grand River Watershed.

- **Introduction**

In recognition of the intense pressures facing our nation's coastal regions, Congress enacted the Coastal Zone Management Act (CZMA) which was signed into law on October 27, 1972. To address more specifically the impacts of nonpoint source pollution on coastal water quality, Congress enacted § 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) in November 1990. Section 6217 requires that each State with an approved coastal zone management program develop and submit for approval a Coastal Nonpoint Pollution Control Program (CNPCP) to the U.S. Environmental Protection Agency (USEPA) and the National Oceanic and Atmospheric Administration (NOAA). The purpose of the program "shall be to develop and implement management measures for nonpoint source pollution to restore and protect coastal waters, working in close conjunction with other State and local authorities." (www.dnr.state.oh.us/Portals/12/programs/coastalnonpoint/cnpcp/chapter%2001.pdf)

- **Program Specifics**

Guiding Principles

1. Local groups organized to protect or improve water resources are vital to the successful implementation of nonpoint source programs and projects.
2. The State of Ohio shares responsibility with local agencies and organizations in the implementation of watershed protection projects.
3. Protection and restoration of stream integrity (sinuosity, riparian habitat and flow) is one of the highest priorities of Ohio's nonpoint program.
4. Program priorities are set by involving multiple stakeholders including, but not limited to, government, academia, industry, environmental groups and local citizens.
5. Attention and funding is focused on local watershed and aquifer projects that directly improve water quality.
6. Water resources are prioritized and programs and projects targeted to priority areas.
7. Federal, state and locally funded best management practices have coordinated cost sharing amounts and requirements.
8. Existing regulations that target nonpoint sources are uniformly enforced.
9. Funding is available for nonpoint source research and evaluation of nonpoint source programs and best management practices.
10. Education and training are integral to the success of nonpoint source programs.

In accordance with Appendix 8 of A Guide to Developing Local Watershed Action Plans in Ohio, the following identifies implementation strategies for the Management Measures of the Ohio Coastal Nonpoint Pollution Control Program (CNPCP) in the Upper Grand River Watershed. Management measures identified in the OCNP that are applicable to the Upper Grand River Ohio Lake Erie Watershed include:

- **Management Measures for Urban Areas**

http://www.dnr.state.oh.us/Portals/12/programs/coastalnonpoint/cnpcp/chapter%2005.pdf

V. IMPLEMENTATION OF OHIO COASTAL NONPOINT POLLUTION CONTROL PROGRAM MANAGEMENT MEASURES

(5.3.3) Site Development
(5.6.1) New On-Site Disposal Systems
(5.6.2) Operating On-Site Disposal Systems
(5.8.1) Planning, Siting, and Developing Roads and Highways (Local Roads & Highways Only)
(5.8.2) Bridges (Local Roads & Highways Only)

- **Management Measures for Hydromodification**

http://www.dnr.state.oh.us/Portals/12/programs/coastalnonpoint/cnpcp/chapter%2007.pdf
(7.4.1) Channelization and Channel Modification - Physical and Chemical Characteristics of Surface Waters
(7.4.2) Channelization and Channel Modification - Instream and Riparian Habitat Restoration
(7.5.1) Dams - Erosion and Sediment Control
(7.5.2) Dams - Chemical and Pollutant Control
(7.5.3) Dams - Protection of Surface Water Quality and Instream and Riparian Habitat
(7.6.1) Eroding Streambanks and Shorelines

- **Urban Areas:**

5.3.3 Site Development Management Measure
Plan, design, and develop sites to:

(1) Protect areas that provide important water quality benefits and/or are particularly susceptible to erosion and sediment loss;

(2) Limit increases of impervious areas, except where necessary;

(3) Limit land disturbance activities such as clearing and grading, and cut and fill to reduce erosion and sediment loss; and

(4) Limit disturbance of natural drainage features and vegetation.

Applicability
This management measure applies to all site development activities including those associated with roads, highways, and bridges. This management measure applies throughout Ohio's § 6217 management area.

Urbanization and development will continue with the watershed with certain areas becoming more urbanized and others becoming re-urbanized. As this trend continues, implementation of the Upper Grand River Watershed Land Use Management recommendations will assist in meeting the Coastal Nonpoint Management Measures.

The Upper Grand River Watershed communities will follow the County SWCD regulations regarding site development and erosion and sediment control. However, most communities will make decisions on a case-by-case basis and review the parameters of the proposed project in order to make a determination.

5.6.1 New On-Site Disposal Systems Management Measures

(1) Ensure that new On-Site Disposal Systems (OSDS) are located, designed, installed, operated, inspected, and maintained to prevent the discharge of pollutants to the surface of the ground and to the extent practicable reduce the discharge of pollutants into groundwaters that are closely hydrologically connected to surface waters.

Where necessary to meet these objectives:

(a) discourage the installation of garbage disposals to reduce hydraulic and nutrient loadings; and

(b) where low-volume plumbing fixtures have not been installed in new developments or redevelopments, reduce total hydraulic loading to the OSDS by 25 percent. Implement OSDS inspection schedules for preconstruction, construction, and post-construction.

(2) Direct the placement of OSDS away from unsuitable areas. Where OSDS placement in suitable areas is not practicable, insure that the OSDS is designed or sited at a density so as not to adversely affect surface waters or groundwater that is closely hydrologically connected to surface water.

Unsuitable areas include, but are not limited to, areas with poorly or excessively drained soils; areas with shallow water tables or areas with high seasonal water tables; areas overlaying fractured bedrock that drain directly to groundwater; areas within floodplains; or areas where nutrient and/or pathogen concentrations in the effluent cannot be sufficiently treated or reduced before the effluent reaches sensitive waterbodies.

(3) Establish protective setbacks from surface waters, wetlands, and floodplains for conventional as well as alternative OSDS. The lateral setbacks should be based on soil type, slope, hydrologic factors, and type of OSDS. Where uniform protective setbacks cannot be achieved, site development with OSDS so as not to adversely affect waterbodies and/or contribute to a public health nuisance.

(4) Establish protective separation distances between OSDS system components and groundwater that are closely, hydrologically connected to surface waters. The separation distances should be based on soil type, distance to groundwater, hydrologic factors, and type of OSDS.

(5) Where conditions indicate that nitrogen-limited surface waters may be adversely affected by excess nitrogen loadings from groundwater, require the installation of OSDS that reduce total nitrogen loadings by 50 percent to groundwater that is closely hydrologically connected to surface water.

Applicability

This management measure applies to all new OSDS including package plants and small-scale or regional treatment facilities not covered by NPDES regulations in order to manage the siting, design, installation, and operation and maintenance of all such OSDS. This management measure applies throughout Ohio's § 6217 management area.

The Upper Grand River Watershed communities will follow the County SWCD regulations regarding site development and erosion and sediment control. However, most communities will make decisions on a case-by-case basis and review the parameters of the proposed project in order to make a determination.

5.6.2 Operating On-Site Disposal Systems Management Measure

(1) Establish and implement policies and systems to ensure that existing OSDS are operated and maintained to prevent the discharge of pollutants to the surface of the ground and to the extent practicable reduce the discharge of pollutants into groundwaters that are closely hydrologically connected to surface waters. Where necessary to meet these objectives, encourage the reduced use of garbage disposals, encourage the use of low-volume plumbing fixtures, and reduce total phosphorus loadings to the OSDS by 15 percent (if the use of low-level phosphate detergents has not been required or widely adopted by OSDS users). Establish and implement policies that require an OSDS to be repaired, replaced, or modified where the OSDS fails, or threatens or impairs surface waters.

(2) Inspect OSDS at a frequency adequate to ascertain whether OSDS are failing.

(3) Consider replacing or upgrading OSDS to treat influent so that total nitrogen loadings in the effluent are reduced by 50 percent. This provision applies only:

(a) where conditions indicate that nitrogen-limited surface waters may be adversely affected by significant groundwater nitrogen loadings from OSDS, and

(b) where nitrogen loadings from OSDS are delivered to groundwater that is closely hydrologically connected to surface water.

Applicability

This management measure applies to all operating OSDS throughout Ohio's § 6217 management area. Nutrients, such as nitrogen and phosphorus, are prime constituents of domestic wastewater. Although these nutrients are essential to the health and continued functioning of aquatic ecosystems, excessive inputs of nutrients, organic matter, and sediments result in the excessive growth of macrophytes or phytoplankton leading to eutrophication. In most lakes, including Lake Erie, phosphorus is the limiting nutrient— lowering the input of phosphorus to the lake will limit excessive plant growth. Phosphorus has long been determined to be a critical pollutant in Lake Erie, and a discharge limit of 11,000 metric tons of phosphorus from all sources was set as the annual target load by the IJC in the Great Lakes Water Quality Agreement.

V. IMPLEMENTATION OF OHIO COASTAL NONPOINT POLLUTION CONTROL PROGRAM MANAGEMENT MEASURES

The Upper Grand River Watershed communities will follow the County SWCD regulations regarding site development and erosion and sediment control. However, most communities will make decisions on a case-by-case basis and review the parameters of the proposed project in order to make a determination.

5.8.1 Management Measure for Planning, Siting, and Developing Roads and Highways
Plan, site, and develop roads and highways to:

(1) Protect areas that provide important water quality benefits or are particularly susceptible to erosion or sediment loss;

(2) Limit land disturbance such as clearing and grading and cut and fill to reduce erosion and sediment loss; and

(3) Limit disturbance of natural drainage features and vegetation.

Applicability
This management measure applies to site development and land disturbing activities for new, relocated, and reconstructed (widened) roads (including residential streets) and highways in order to reduce the generation of nonpoint source pollutants and to mitigate the impacts of urban runoff and associated pollutants from such activities.

The Upper Grand River Watershed communities will follow the County SWCD regulations regarding site development and erosion and sediment control. However, most communities will make decisions on a case-by-case basis and review the parameters of the proposed project in order to make a determination.

On the Scenic River portion of the Grand River, the Scenic Rivers Act requires a citizens' advisory council, representing local officials, landowners and conservation organizations, to be appointed for each designated river. The council provides advice about local river protection and preservation concerns.

Public project review plays a major role in river preservation. The possible environmental impact of the construction of dams, bridges, roads or other publicly funded projects is carefully considered. ODNR has the authority to approve or disapprove all publicly funded projects on designated scenic rivers outside municipal corporation limits.

5.8.2 Management Measure for Bridges
Site, design, and maintain bridge structures so that sensitive and valuable aquatic ecosystems and areas providing important water quality benefits are protected from adverse effects.
Applicability
This management measure applies to new, relocated, and rehabilitated bridge structures in order to control erosion, streambed scouring, and surface runoff from such activities. This management measure applies throughout Ohio's § 6217 management area.

The Upper Grand River Watershed communities will follow the County SWCD regulations regarding site development and erosion and sediment control. However, most communities will make decisions on a case-by-case basis and review the parameters of the proposed project in order to make a determination.

On the Scenic River portion of the Grand River, the Scenic Rivers Act requires a citizens' advisory council, representing local officials, landowners and conservation organizations, to be appointed for each designated river. The council provides advice about local river protection and preservation concerns. Public project review plays a major role in river preservation. The possible environmental impact of the construction of dams, bridges, roads or other publicly funded projects is carefully considered. ODNR has the authority to approve or disapprove all publicly funded projects on designated scenic rivers outside municipal corporation limits.

- **Hydromodification Activities that Impact Coastal Waters**

7.4.1 Management Measure for Physical and Chemical Characteristics of Surface Waters

(1) Evaluate the potential effects of proposed channelization and channel modification on the physical and chemical characteristics of surface waters in coastal areas;

(2) Plan and design channelization and channel modification to reduce undesirable impacts; and

(3) Develop an operation and maintenance program for existing modified channels that includes identification and implementation of opportunities to improve physical and chemical characteristics of surface waters in those channels.

Applicability

This management measure applies to public and private channelization and channel modification activities in order to prevent the degradation of physical and chemical characteristics of surface waters from such activities in the § 6217 management area. This management measure applies to any proposed channelization or channel modification projects, including levees, to evaluate potential changes in surface water characteristics, as well as to existing modified channels that can be targeted for opportunities to improve the surface water characteristics necessary to support desired fish and wildlife. The purpose of this management measure is to ensure that the planning process for new Hydromodification projects addresses changes to physical and chemical characteristics of surface waters that may occur as a result of the proposed work. The three effects of channelization and channel modification that affect the physical and chemical characteristics of surface waters addressed in this management measure are: changed sediment supply, reduced freshwater availability, and accelerated delivery of pollutants.

7.4.2 Instream and Riparian Habitat Restoration Management Measure

(1) Evaluate the potential effects of proposed channelization and channel modification on instream and riparian habitat in coastal areas;

(2) Plan and design channelization and channel modification to reduce undesirable impacts; and

(3) Develop an operation and maintenance program with specific timetables for existing modified channels that includes identification of opportunities to restore instream and riparian habitat in those channels.

Applicability

This management measure pertains to surface waters where channelization and channel modification have altered or have the potential to alter instream and riparian habitat such that historically present fish or wildlife are adversely affected. This management measure applies in the § 6217 management area to any proposed channelization or channel modification project to determine changes in instream and riparian habitat and to existing modified channels to evaluate possible improvements to instream and riparian habitat.

The Upper Grand River Watershed communities will follow the County SWCD regulations regarding site development and erosion and sediment control. However, most communities will make decisions on a case-by-case basis and review the parameters of the proposed project in order to make a determination.

On the Scenic River portion of the Grand River, the Scenic Rivers Act requires a citizens' advisory council, representing local officials, landowners and conservation organizations, to be appointed for each designated river. The council provides advice about local river protection and preservation concerns.

Landowner assistance and education are vitally important components of river protection. ODNR scenic river staff advise landowners about streamside protection techniques and provide technical assistance in river corridor restoration. Scenic river designation does not affect private property rights.

Water resource protection balances the relationship between the streamside forest buffer, aquatic habitat and water quality. While the maintenance and improvement of responsibility of the Ohio Environmental Protection Agency (OEPA), the most effective watershed protection involves cooperation among OEPA, ODNR and local governments. A stream quality monitoring and biological survey project using volunteers has been developed by the Division of Natural Areas and Preserves to supplement this effort. Division staff

also work with federal, state and local agencies to reduce nonpoint source pollution, which causes serious environmental damage to rivers and streams.

- **Dams**

7.5.1 Management Measure for Erosion and Sediment Control
(1) Reduce erosion and, to the extent practicable, retain sediment on-site during and after construction, and
(2) Prior to land disturbance, prepare and implement an approved erosion and sediment control plan or similar administrative document that contains erosion and sediment control provisions.
Applicability
This management measure applies in the § 6217 management area to the construction of new dams, as well as to construction activities associated with the maintenance of dams. The purpose of this management measure is to prevent sediment from entering surface waters during the construction or maintenance of dams. This measure does not apply to projects that fall under NPDES jurisdiction.

ODNR's Division of Water has identified more than 50,000 dams in Ohio. Most dams in Ohio, however, are small and are constructed by farmers and other private individuals for water supply, recreation, swimming, and fishing purposes. Dams that fall under state jurisdiction are classified as follows:

- Class I—Dams having a storage volume >5,000 acre-feet or a height of >60 feet.
- Class II—Dams having a storage volume >500 acre-feet or a height of >40 feet.
- Class III—Dams having a storage volume >50 acre-feet, or a height of >25 feet.
- Class IV—Dams that are 25 feet or less in height and have a storage volume <50 acre-feet.

Of the over 50,000 dams identified by ODNR in Ohio, slightly over 1,000 statewide and 400 in the § 6217 management area meet the definition of a dam for the purposes of this plan.

7.5.2 Management Measure for Chemical and Pollutant Control
(1) Limit application, generation, and migration of toxic substances;
(2) Ensure the proper storage and disposal of toxic materials; and,
(3) Apply nutrients at rates necessary to establish and maintain vegetation without causing significant nutrient runoff to surface waters.
Applicability
This management measure applies in the § 6217 management area to the construction of new dams, as well as to construction activities associated with the maintenance of dams. The purpose of this management measure is to prevent downstream contamination from pollutants associated with dam construction activities. This measure addresses fuel and chemical spills associated with dam construction, as well as concrete washout and related construction activities. Since there are over 400 structures meeting the CZARA definition of "dam" in Ohio's § 6217 management area, this management measure is addressed as part of Ohio's CNPCP plan.

7.5.3 Management Measure for Protection of Surface Water Quality and Instream and Riparian Habitat
Develop and implement a program to manage the operation of dams in coastal areas that includes an assessment of:
(1) Surface water quality and instream and riparian habitat and potential for improvement; and
(2) Significant nonpoint source pollution problems that result from excessive surface water withdrawals.
Applicability
This management measure applies in the § 6217 management area to dam operations that result in the loss of desirable surface water quality, and of desirable instream and riparian habitat. The purpose of this management measure is to protect the quality of surface waters and aquatic habitat in reservoirs and in the downstream portions of rivers and streams that are influenced by the quality of water contained in the releases from reservoir impoundments.

V. IMPLEMENTATION OF OHIO COASTAL NONPOINT POLLUTION CONTROL PROGRAM MANAGEMENT MEASURES

The Upper Grand River Watershed communities will follow the County SWCD regulations regarding site development and erosion and sediment control. However, most communities will make decisions on a case-by-case basis and review the parameters of the proposed project in order to make a determination.

On the Scenic River portion of the Grand River, the Scenic Rivers Act requires a citizens' advisory council, representing local officials, landowners and conservation organizations, to be appointed for each designated river. The council provides advice about local river protection and preservation concerns.

Landowner assistance and education are vitally important components of river protection. ODNR scenic river staff advise landowners about streamside protection techniques and provide technical assistance in river corridor restoration. Scenic river designation does not affect private property rights.

Water resource protection balances the relationship between the streamside forest buffer, aquatic habitat and water quality. While the maintenance and improvement of responsibility of the Ohio Environmental Protection Agency (OEPA), the most effective watershed protection involves cooperation among OEPA, ODNR and local governments. A stream quality monitoring and biological survey project using volunteers has been developed by the Division of Natural Areas and Preserves to supplement this effort. Division staff also work with federal, state and local agencies to reduce nonpoint source pollution, which causes serious environmental damage to rivers and streams.

- **Streambank and Shoreline Erosion**

7.6.1 Management Measure for Eroding Streambanks and Shorelines

(1) Where streambank or shoreline erosion is a nonpoint source pollution problem, streambanks and shorelines should be stabilized. Vegetative methods are strongly preferred unless structural methods are more cost-effective, considering the severity of wave and wind erosion, offshore bathymetry, and the potential adverse impact on other streambanks, shorelines, and offshore areas.

(2) Protect streambank and shoreline features with the potential to reduce NPS pollution.

(3) Protect streambanks and shorelines from erosion due to uses of either the shorelands or adjacent surface waters.

Applicability

This management measure applies in the § 6217 management area to eroding shorelines in coastal bays and eroding streambanks in coastal rivers and creeks that constitute a nonpoint source pollution problem in surface waters in Ohio. The erosion of shorelines and streambanks can contribute significantly to nonpoint source pollution in surface waters. The intent of this measure is to promote the implementation of streambank and shoreline stabilization techniques that will be effective in controlling coastal erosion wherever it is a source of nonpoint pollution.

The Upper Grand River Watershed communities will follow the County SWCD regulations regarding site development and erosion and sediment control. However, most communities will make decisions on a case-by-case basis and review the parameters of the proposed project in order to make a determination.

On the Scenic River portion of the Grand River, the Scenic Rivers Act requires a citizens' advisory council, representing local officials, landowners and conservation organizations, to be appointed for each designated river. The council provides advice about local river protection and preservation concerns.

Landowner assistance and education are vitally important components of river protection. ODNR scenic river staff advise landowners about streamside protection techniques and provide technical assistance in river corridor restoration. Scenic river designation does not affect private property rights.

Water resource protection balances the relationship between the streamside forest buffer, aquatic habitat and water quality. While the maintenance and improvement of responsibility of the Ohio Environmental Protection Agency (OEPA), the most effective watershed protection involves cooperation among OEPA, ODNR and local governments. A stream quality monitoring and biological survey project using volunteers

has been developed by the Division of Natural Areas and Preserves to supplement this effort. Division staff also work with federal, state and local agencies to reduce nonpoint source pollution, which causes serious environmental damage to rivers and streams.

PART VI.
EVALUATION

VI. EVALUATION

Evaluation

The Upper Grand River Watershed Action Plan will be evaluated using 2 separate criteria; short term and long term goals.

Short Term Goals: Performance Based Measurement of Results throughout the implementation sections of this plan, will indicate whether goals, objectives and action items are successfully completed and if water quality standards have been achieved. Many of those items have associated timing requirements and can be evaluated using those measurements of success. Many short term tasks include formations of committees within the group structure, partnerships established, presentations presented, grants written, and additional credibility established within the watershed. These performance based measurements can be tracked through annual work plans and semi-annual technical reports.

Bringing the Upper Grand River into attainment is the end result of the measureable outcomes of short term goals. Water quality improvement on a scale of this magnitude will require cooperation from conservation groups and agencies, the Grand River Partnership, local communities and landowners. The Upper Grand River, like many other developing watersheds, face significant challenges in the future. Prioritization of projects, attainment of funding, and increased awareness of watershed issues through education and outreach are only a few of the actions required to restore this resource. Perseverance of actions and measuring their results will be essential to improving performance for future activities and rallying support from communities. This process is cumulative. One restoration project or protected property may only show minimal water quality improvement overall. However, 100 restoration projects or protected properties has potential to demonstrate substantial water quality improvement.

The establishing and sustaining local stakeholder partnerships will be essential to the success of these short term goals. The County SWCD's, Ohio EPA, local health departments, planning commissions, community leaders and members, will serve as stakeholders and technical partners assisting the Grand River Partnership with implementing the actions contained within this plan.

Long Term Goals: Water Quality Improvement, as stated earlier, the cumulative impact of the successes of short term goals provides the roadmap to achieving the targeted water quality goals of:

1. QHEI scores of > 60 throughout the entire watershed
2. ICI and IBI scores which meet Ohio water quality standards throughout the entire watershed
3. A reduction of sediment and nutrient loading into the watershed by implementation of BMP's and restoration of riparian corridors

The success of the long term goals will not only be a direct result of the success of the overall program, but through innovative strategies, persistence, the willingness of the partners to implement the actions outlined in this plan, and education and outreach. Most projects would benefit from a monitoring program to constantly evaluate the success of the program through on-the-ground monitoring. Through the establishment of a volunteer monitoring program, and continuation of the Scenic Rivers Program and OEPA stream monitoring, the success of the long term goals can be evaluated.

PART VII.
PLAN UPDATE / REVISION

VII. PLAN UPDATE / REVISION

Watershed Action Plan Update & Revision

The Upper Grand River Watershed Action Plan is a living document, created with the intent to update the plan as new information is made available and to revise the plan as the implementation process proceeds. Updates to the plan will occur on a regular basis and made available via electronic file upon request. The plan will be reviewed on an ongoing basis and will be revised within a minimum of two (2) years and a maximum of five (5) years from the date of state endorsement to update implementation priorities and acknowledge progress. This watershed action plan was written to aid stakeholders in meeting and exceeding water quality standards by guiding water quality restoration, preservation and protection efforts. Additions to the plan can be submitted to the Watershed Coordinator at any time.

Grand River Partnership is responsible to implement the Upper Grand River Watershed Action Plan as well as the continuous updates and revisions made to the Upper Grand River Watershed Action Plan. The Grand River Partnership meets quarterly to coordinate watershed action plan implementation activities, to share data and information and to discuss trends and changes in Grand River Watershed. Public Meetings will be held to inform and involve the public on matters occurring within the Upper Grand River Watershed as needed.

Once the Upper Grand River Watershed Action Plan is endorsed by the state, the plan implementation committee or watershed coordinator will work to disseminate the plan and its finding to all Grand River Partnership members and other key stakeholders.

Distribution List
Ashtabula County Commissioners
Ashtabula County Health District
Ashtabula County Metroparks
Ashtabula Soil & Water Conservation District
Ashtabula Soil & Water Conservation District
Cleveland Museum of Natural History
Ducks Unlimited
The Farmland Center
Geauga County Commissioners
Geauga Park District
Geauga County Planning Commission
Geauga Soil & Water Conservation District
Hiram College
Kent State University
Lake County Commissioners
Lake County Planning Commission
Lake County Health District
Lake Soil & Water Conservation District
Lake County Stormwater Management Dept.
Lake Metroparks
The Land Trust Alliance
The Nature Conservancy
Ohio Department of Transportation
Ohio Environmental Protection Agency
Ohio Department of Natural Resources - Division of Forestry
Ohio Department of Natural Resources - Watercraft - Scenic Rivers Program
Ohio Department of Natural Resources - Soil and Water Resources
Ohio Department of Natural Resources - Wildlife
Ohio Wetlands Foundation
Portage County Commissioners
Portage Park District
The Ohio State University Extension/Sea Grant

VII. PLAN UPDATE / REVISION

Distribution List (Cont'd)
Trumbull County Commissioners
Trumbull County Health Department
Trumbull Soil & Water Conservation District
Trust for Public Land
U.S. Army Corps of Engineers
U.S.F.W.S. – Partners of Fish & Wildlife
USDA Farm Service Agency
USDA Natural Resources Conservation Service
Western Reserve Resource Conservation & Development
Western Reserve Land Conservancy

The plan implementation committee or watershed coordinator will assume the primary responsibility for publicizing the watershed action plan, providing interpretative assistance and seeking local stakeholder endorsement of the Upper Grand River Watershed Action Plan.

Grand River Watershed Program

Grand River Partnership is responsible for the structure, funding and sustainability of the Grand River Watershed Program. An implementation committee or watershed coordinator be responsible for coordination of implementation of the Upper Grand River Watershed Action Plan. The Grand River Partnership is currently re-organizing in preparation for the implementation phase of the watershed program and will begin to set goals and objectives in the first quarter 2013. During the re-organization process the plan implementation committee is investigating possible funding opportunities to hire a watershed coordinator. In the meantime, the plan implementation committee will act to begin implementing the Upper Grand River Watershed Action Plan, once goals and objectives have been established.

Contact Person:
George Warnock, Upper Grand River Watershed Coordinator
Western Reserve land Conservancy
Grand River Chapter Office
70 South Park Place,
Painesville, Ohio 44077
Phone: (440) 357-4837
Fax: (440)357-1020

http://www.wrlandconservancy.org/

Record Keeping Organization:
Grand River Partnership

PART VIII.
APPENDICES

APPENDIX A – Table of Tables

VIII. APPENDICIES

Table of Tables

Table 1. Square Miles of Land in the Grand River Watershed and subwatersheds. 6
Table 2. Percentage of Land in the Grand River Watershed and subwatersheds. 6
Table 3. Percentage of County in the Grand River Watershed. 6
Table 4. Incorporated areas of the Grand River Watershed. 7
Table 5. Unincorporated areas of the Grand River Watershed. 8
Table 6. Population Density in the Grand River Watershed. 14
Table 7. Racial Diversity in the Grand River Watershed. 14
Table 8. Median Age of Population in the Grand River Watershed. 14
Table 9. Change in Housing Levels 1990 to 2000 in the Primary Townships of Grand River Watershed. 19
Table 10. Percentage of Housing Built Prior to 1950 in the Primary Townships of Grand River Watershed. 20
Table 11. Average daily commute (in minutes) for residents in the Grand River Watershed. 20
Table 12. Housing Units in the Grand River Watershed by 10-digit HUC. 21
Table 13. Education Attainment of Adult Population in the Grand River Watershed. 24
Table 14. Education Attainment of Adult Population in the Upper Grand River Watershed. 25
Table 15. Education Attainment of Adult Population in the Lower Grand River Watershed. 26
Table 16. Average per Capita Income in the Grand River Watershed by 10-digit HUC 28
Table 17. Earnings by Educational Attainment in the Counties of the Grand River Watershed. 30
Table 18. Contact List for Townships of the Upper Grand River Watershed. 34
Table 19. Contact List for Villages of the Upper Grand River Watershed. 35
Table 20. Contact List for County Seats of the Upper Grand River Watershed. 35
Table 21. NPDES Permits in the Upper Grand River Watershed. 36
Table 22. NPDES Permits in the Lower Grand River Watershed. 37
Table 23. The 10-digit HUC's for The Grand River subwatersheds. 40
Table 24. The 12-digit HUC's for The Grand River subwatersheds. 48
Table 25. State 305(b) Identification Number for Grand River Watershed 49
Table 26. Latitude, Longitude & Elevations of Key Features of the Grand River Watershed. 50
Table 27. Conservation Targets for the Grand River Watershed. 52
Table 28. Composition of tills in the Grand River Watershed (modified from White, 1982) 78
Table 29. Chronology of the glacial history in the Grand River Watershed 82
Table 30. Metadata for map of Glacial Geology of the Grand River Watershed. 84
Table 31. Bedrock Geological Type of the Grand River Watershed. 85
Table 32. Description of map units for Bedrock Geology. 87
Table 33. Ohio State Listed Fish Species in the Upper Grand River Watershed. 88
Table 34. Ohio State Listed Mussel Species in the Upper Grand River Watershed. 88
Table 35. Ohio State Listed Invertebrate Species in the Upper Grand River Watershed. 89
Table 36. Ohio State Listed Mammal Species in the Upper Grand River Watershed. 89
Table 37. Ohio State Listed Bird Species in the Upper Grand River Watershed. 89
Table 38. Ohio State Listed Reptile & Amphibian Species in the Upper Grand River Watershed. 90
Table 39. Ohio State Listed Plant Species in the Upper Grand River Watershed. 90
Table 40. Ohio State Listed Plant Species in the Upper Grand River Watershed. Cont'd 91
Table 41. Wetland Acres by 12-Digit Subwatershed for the Grand River Watershed. 98
Table 42. Tributary Names, Segment Lengths, Average Sinuosity of the Grand River Watershed. 102
Table 43. Surface Water Discharge in feet3/second at USGS Gage Stations in Grand River Watershed. 104
Table 44. 100 Year Floodplain in Grand River Watershed. 104
Table 45. 100 Year Floodplain in Subwatersheds of the Grand River Watershed. 104
Table 46. (cont'd) 100 Year Floodplain in Subwatersheds of the Grand River Watershed. 105
Table 47. Use designations for water bodies in the Upper Grand River drainage basin. 108
Table 48. DRASTIC Summary of the Grand River Watershed. 114
Table 49. Average Impervious Cover in the Grand River Watershed. 126
Table 50. Septic Systems Upper Grand River Watershed. 127
Table 51. Septic Tank Watershed Loading Upper Grand River Watershed. 127
Table 52. 2006 NLCD Forest Cover in the Grand River Watershed. 128
Table 53. Crop Types of the Grand River Watershed. 130

VIII. APPENDICIES

Table 54. Agricultural Animals of the Upper Grand River Watershed. 132
Table 55. Open Water Land Cover of the Grand River Watershed. 133
Table 56. Non-forested Wetlands in the Grand River Watershed. 134
Table 57. Barren Land in the Grand River Watershed. 135
Table 58. Parks and Protected Land in the Grand River Watershed. 136
Table 59. Protected Wetland Acres in the Grand River Watershed. 137
Table 60. City, County, District, State Protected Property in the Grand River Watershed. 139
Table 61. Private Foundation and Land Trust Protected Property in the Grand River Watershed. 139
Table 62. Historic Sites in the Grand River Watershed. 141
Table 63. Land Cover at the Time of the Earliest Surveys in the Grand River Watershed. 143
Table 64. Forested Riparian Corridor in the Grand River Watershed. (in acres) 147
Table 65. Forested Riparian Corridor in the Grand River Watershed. (in miles) 147
Table 66. Permanent Protection of Streams in the Grand RIver Watershed. 148
Table 67. Dams & Impoundments in the Grand River Watershed 148
Table 68. Ohio 2012 Integrated Report – Causes & Sources of Impairments for the Upper Grand River 152
Table 69. 2012 Integrated Report - Water Quality Assessment and Monitoring Schedule for the Upper Grand River 153
Table 70. Permitted Discharges (NPDES) by 12-digit Subwatershed in the Upper Grand River Watershed 178
Table 71. Septic Systems Upper Grand River Watershed 180
Table 72. Septic Tank Watershed Loading 181
Table 73. Total load by subwatershed(s) 182
Table 74. Total load by land use 182
Table 75. Highly Erodible Land in the Upper Grand River Watershed 183
Table 76. 041100040101 – Subwatershed Land Use 189
Table 77. 041100040101 – Subwatershed Land Use Within Floodplain 189
Table 78. 041100040101 – Subwatershed Wetland Types by Acres 189
Table 79. 041100040101 – Subwatershed Highly Erodible Soil by Acres 192
Table 80. 041100040101 - Subwatershed Hydrologic Soil Groups by Acres 192
Table 81. 041100040101 – Subwatershed Aquatic Life Use (ALU) Designation 193
Table 82. 041100040101 - Fish community attributes for study sites in the Upper Grand River basin, 2007. 193
Table 83. 041100040101 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Dead Branch Subwatershed in 2007. 194
Table 84. 041100040101 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Dead Branch Subwatershed in 2007. 194
Table 85. Dead Branch Subwatershed Land Protection Load Estimates for land protection 195
Table 86. Dead Branch Subwatershed Estimated Load Reductions for Stream Corridor Protection. 196
Table 87. 041100040102 – Subwatershed Land Use 199
Table 88. 041100040402 – Subwatershed Land Use Within Floodplain 199
Table 89. 041100040402 – Subwatershed Wetland Types by Acres 199
Table 90. 041100040102 – Subwatershed Highly Erodible Soil by Acres 202
Table 91. 041100040102 - Subwatershed Hydrologic Soil Groups by Acres 203
Table 92. 041100040102 – Subwatershed Aquatic Life Use (ALU) Designation 203
Table 93. 041100040102 - Fish community attributes for study sites in the Upper Grand River basin, 2007. 204
Table 94. 041100040102 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Headwaters Subwatershed in 2007. 204
Table 95. 041100040102 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Headwaters Subwatershed in 2007. 205
Table 96. Headwaters Subwatershed Land Protection Load Estimates for land protection. 207
Table 97. Headwaters Subwatershed Estimated Load Reductions for Stream Corridor Protection. 208
Table 98. 041100040103 – Subwatershed Land Use 210
Table 99. 041100040103 – Subwatershed Land Use Within Floodplain 211
Table 100. 041100040103 – Subwatershed Wetland Types by Acres 211
Table 101. 041100040103 – Subwatershed Highly Erodible Soil by Acres 214
Table 102. 041100040103 - Subwatershed Hydrologic Soil Groups by Acres 215

VIII. APPENDICIES

Table 103. 041100040103 – Subwatershed Aquatic Life Use (ALU) Designation 216
Table 104. 041100040103 - Fish community attributes for study sites in the Upper Grand River basin, 2007... 216
Table 105. 041100040103 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Baughman Creek Subwatershed in 2007. 217
Table 106. 041100040103 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Baughman Creek Subwatershed in 2007. 217
Table 107. Baughman Creek Subwatershed Land Protection Load Estimates for land protection. 219
Table 108. Baughman Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection. ... 220
Table 109. 041100040104 – Subwatershed Land Use 223
Table 110. 041100040104 – Subwatershed Land Use Within Floodplain 223
Table 111. 041100040104 – Subwatershed Wetland Types by Acres 223
Table 112. 041100040104 – Subwatershed Highly Erodible Soil by Acres 225
Table 113. 041100040104 - Subwatershed Hydrologic Soil Groups by Acres 226
Table 114. 041100040104 – Subwatershed Aquatic Life Use (ALU) Designation 226
Table 115. 041100040104 - Fish community attributes for study sites in the Upper Grand River basin, 2007... 227
Table 116. 041100040104 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Center Creek Subwatershed in 2007. 227
Table 117. 041100040104 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Center Creek Subwatershed in 2007. 228
Table 118. Center Creek Subwatershed Land Protection Load Estimates for land protection. 230
Table 119. Center Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection. 231
Table 120. 041100040105 – Subwatershed Land Use 235
Table 121. 041100040105 – Subwatershed Land Use Within Floodplain 235
Table 122. 041100040105 – Subwatershed Wetland Types by Acres 235
Table 123. 041100040105 – Subwatershed Highly Erodible Soil by Acres 237
Table 124. 041100040105 - Subwatershed Hydrologic Soil Groups by Acres 238
Table 125. 041100040105 – Subwatershed Aquatic Life Use (ALU) Designation 238
Table 126. 041100040105 - Fish community attributes for study sites in the Upper Grand River basin, 2007... 239
Table 127. 041100040105 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Swine Creek Subwatershed in 2007. 239
Table 128. 041100040105 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Coffee Creek Subwatershed in 2007. 239
Table 129. Coffee Creek Subwatershed Land Protection Load Estimates for land protection. 241
Table 130. Center Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection. 242
Table 131. 041100040106 – Subwatershed Land Use 244
Table 132. 041100040106 – Subwatershed Land Use Within Floodplain 245
Table 133. 041100040106 – Subwatershed Wetland Types by Acres 245
Table 134. 041100040106 – Subwatershed Highly Erodible Soil by Acres 248
Table 135. 041100040106 - Subwatershed Hydrologic Soil Groups 249
Table 136. 041100040106 – Subwatershed Aquatic Life Use (ALU) Designation 249
Table 137. 041100040106 - Fish community attributes for study sites in the Upper Grand River basin, 2007... 250
Table 138. 041100040106 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Swine Creek Subwatershed in 2007. 250
Table 139. 041100040106 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Swine Creek Subwatershed in 2007. 251
Table 140. Swine Creek Subwatershed Land Protection Load Estimates for land protection. 253
Table 141. Swine Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection. 254
Table 142. 041100040201 – Subwatershed Land Use 257
Table 143. 041100040201 – Subwatershed Land Use Within Floodplain 257
Table 144. 041100040201 – Subwatershed Wetland Types by Acres 257
Table 145. 041100040201 – Subwatershed Highly Erodible Soil by Acres 260
Table 146. 041100040201 - Subwatershed Hydrologic Soil Groups by Acres 261

VIII. APPENDICIES

Table 147. 041100040201 – Subwatershed Aquatic Life Use (ALU) Designation 261
Table 148. 041100040201 - Fish community attributes for study sites in the Upper Grand River basin, 2007. .. 261
Table 149. 041100040201 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Upper Rock Creek Creek Subwatershed in 2007. 262
Table 150. 041100040201 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Upper Rock Creek Creek Subwatershed in 2007. 262
Table 151. Upper Rock Creek Subwatershed Land Protection Load Estimates for land protection. 263
Table 152. Upper Rock Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection. .. 264
Table 153. 041100040202– Subwatershed Land Use 267
Table 154. 041100040202– Subwatershed Land Use Within Floodplain 267
Table 155. 041100040202– Subwatershed Wetland Types by Acres 267
Table 156. 041100040202– Subwatershed Highly Erodible Soil by Acres 270
Table 157. 041100040202- Subwatershed Hydrologic Soil Groups by Acres 271
Table 158. 041100040202– Subwatershed Aquatic Life Use (ALU) Designation 271
Table 159. 041100040202- Fish community attributes for study sites in the Upper Grand River basin, 2007. ... 272
Table 160. 041100040202– Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Middle Rock Creek Subwatershed in 2007. 272
Table 161. 041100040202– Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Middle Rock Creek Subwatershed in 2007. 273
Table 162. Middle Rock Creek Subwatershed Land Protection Load Estimates for land protection. 274
Table 163. Middle Rock Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection. . 275
Table 164. 041100040203 – Subwatershed Land Use 279
Table 165. 041100040203 – Subwatershed Land Use Within Floodplain 279
Table 166. 041100040203 – Subwatershed Wetland Types by Acres 279
Table 167. 041100040203 – Subwatershed Highly Erodible Soil by Acres 282
Table 168. 041100040203 - Subwatershed Hydrologic Soil Groups by Acres 283
Table 169. 041100040203 – Subwatershed Aquatic Life Use (ALU) Designation 283
Table 170. 041100040203 - Fish community attributes for study sites in the Upper Grand River basin, 2007. .. 284
Table 171. 041100040203 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Lower Rock Creek Subwatershed in 2007. 284
Table 172. 041100040203 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Lower Rock Creek Subwatershed in 2007. 285
Table 173. Lower Rock Creek Subwatershed Land Protection Load Estimates for land protection. 286
Table 174. Lower Rock Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection. .. 287
Table 175. 041100040301 – Subwatershed Land Use 290
Table 176. 041100040301 – Subwatershed Land Use Within Floodplain 291
Table 177. 041100040301 – Subwatershed Wetland Types by Acres 291
Table 178. 041100040301 – Subwatershed Land Use Within Floodplain 294
Table 179. 041100040301 – Subwatershed Wetland Types by Acres 294
Table 180. 041100040301 – Subwatershed Highly Erodible Soil by Acres 294
Table 181. 041100040301 - Subwatershed Hydrologic Soil Groups by Acres 295
Table 182. 041100040301 – Subwatershed Aquatic Life Use (ALU) Designation 296
Table 183. 041100040301 - Fish community attributes for study sites in the Upper Grand River basin, 2007. .. 296
Table 184. 041100040301 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Headwaters Subwatershed in 2007. 297
Table 185. 041100040301 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Headwaters Subwatershed in 2007 297
Table 186. Phelps Creek Subwatershed Land Protection Load Estimates for land protection. 299
Table 187. Phelps Creek Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection. 300
Table 188. 041100040302 – Subwatershed Land Use 302
Table 189. 041100040302 – Subwatershed Land Use Within Floodplain 303
Table 190. 041100040302 – Subwatershed Wetland Types by Acres 303

VIII. APPENDICIES

Table 191. 041100040302 – Subwatershed Highly Erodible Soil by Acres 306
Table 192. 041100040302 - Subwatershed Hydrologic Soil Groups by Acres 307
Table 193. 041100040302 – Subwatershed Aquatic Life Use (ALU) Designation 307
Table 194. 041100040302 - Fish community attributes for study sites in the Upper Grand River basin, 2007... 308
Table 195. 041100040302 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Headwaters Subwatershed in 2007. 308
Table 196. 041100040302 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Headwaters Subwatershed in 2007. 309
Table 197. Hoskins Creek Subwatershed Land Protection Load Estimates for land protection. 312
Table 198. Hoskins Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection. 313
Table 199. 041100040303 – Subwatershed Land Use 316
Table 200. 041100040303 – Subwatershed Land Use Within Floodplain 317
Table 201. 041100040303 – Subwatershed Wetland Types by Acres 317
Table 202. 041100040303 – Subwatershed Highly Erodible Soil by Acres 320
Table 203. 041100040303 - Subwatershed Hydrologic Soil Groups by Acres 321
Table 204. 041100040303 – Subwatershed Aquatic Life Use (ALU) Designation 321
Table 205. 041100040303 - Fish community attributes for study sites in the Upper Grand River basin, 2007... 322
Table 206. 041100040303 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Headwaters Subwatershed in 2007. 322
Table 207. 041100040303 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Headwaters Subwatershed in 2007. 323
Table 208. Mill Creek (1)-Grand River Subwatershed Land Protection Load Estimates for land protection. . 328
Table 209. Mill Creek (1)-Grand River Subwatershed Estimated Load Reductions for Stream Corridor Protection. 329
Table 210. 041100040304 – Subwatershed Land Use 333
Table 211. 041100040304 – Subwatershed Land Use Within Floodplain 333
Table 212. 041100040304 – Subwatershed Wetland Types by Acres 333
Table 213. 041100040304 – Subwatershed Land Use Within Floodplain 335
Table 214. 041100040304 – Subwatershed Wetland Types by Acres 336
Table 215. 041100040304 – Subwatershed Highly Erodible Soil by Acres 336
Table 216. 041100040304 - Subwatershed Hydrologic Soil Groups by Acres 337
Table 217. 041100040304 – Subwatershed Aquatic Life Use (ALU) Designation 338
Table 218. 041100040304 - Fish community attributes for study sites in the Upper Grand River basin, 2007... 338
Table 219. 041100040304 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Headwaters Subwatershed in 2007. 339
Table 220. 041100040304 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Headwaters Subwatershed in 2007. 339
Table 221. Mud Creek Subwatershed Land Protection Load Estimates for land protection..... 342
Table 222. Mud Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection. 343
Table 223. 041100040305 – Subwatershed Land Use 347
Table 224. 041100040305 – Subwatershed Land Use Within Floodplain 347
Table 225. 041100040305 – Subwatershed Wetland Types by Acres 347
Table 226. 041100040305 – Subwatershed Highly Erodible Soil by Acres 350
Table 227. 041100040305 - Subwatershed Hydrologic Soil Groups by Acres 351
Table 228. 041100040305 – Subwatershed Aquatic Life Use (ALU) Designation 351
Table 229. 041100040305 - Fish community attributes for study sites in the Upper Grand River basin, 2007... 352
Table 230. 041100040305 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Headwaters Subwatershed in 2007. 352
Table 231. 041100040305 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Headwaters Subwatershed in 2007. 353
Table 232. Plumb Creek - Grand River Subwatershed Land Protection Load Estimates for land protection. 354

VIII. APPENDICIES

Table 233. Plumb Creek - Grand River Subwatershed Estimated Load Reductions for Stream Corridor Protection. 355
Table 234. 041100040401 – Subwatershed Land Use 359
Table 235. 041100040401 – Subwatershed Land Use Within Floodplain 359
Table 236. 041100040401 – Subwatershed Wetland Types by Acres 359
Table 237. 041100040401 – Subwatershed Highly Erodible Soil by Acres 362
Table 238. 041100040401 - Subwatershed Hydrologic Soil Groups by Acres 362
According to the Biological and Water Quality Study of the Lower Grand River 2003 – 2004, the Ohio EPA reported there are 13.5 miles of stream with Warmwater Habitat (WWH) Aquatic Life Use Designation in the Griggs Creek Subwatershed. That use designation remains unconfirmed. The Griggs Creek reaches of the subwatershed are in partial attainment of WWH aquatic life use designation due to natural limits of a wetland at RM 2.0. The creek should be resampled in a reach not flowing through a wetland (Table 239). 363
Table 240. 041100040401 – Subwatershed Aquatic Life Use Designation (ALU) 363
Table 241. 041100040401 - Fish community attributes for study sites in the Upper Grand River basin, 2007. .. 363
Table 242. 041100040401 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Griggs Creek subwatershed in 2007. 364
Table 243. 041100040401 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Griggs Creek subwatershed in 2007. 364
Table 244. Griggs Creek Subwatershed Land Protection Load Estimates for land protection. 365
Table 245. Griggs Creek Subwatershed Estimated Load Reductions for Stream Corridor Protection. 366
Table 246. 041100040402 – Subwatershed Land Use 369
Table 247. 041100040402 – Subwatershed Land Use Within Floodplain 369
Table 248. 041100040402 – Subwatershed Wetland Types by Acres 369
Table 249. 041100040402 – Subwatershed Land Use Within Floodplain 372
Table 250. 041100040402 – Subwatershed Wetland Types by Acres 372
Table 251. 041100040402 – Subwatershed Highly Erodible Soil by Acres 372
Table 252. 041100040402 – Subwatershed Hydrologic Soil Groups by Acres 373
Table 253. 041100040402 – Subwatershed Aquatic Life Use Designation 373
Table 254. 041100040402 - Fish community attributes for study sites in the Upper Grand River basin, 2007. .. 374
Table 255. 041100040402 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Peters Creek - Mill Creek subwatershed in 2007. 375
Table 256. 041100040402 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Peters Creek-Mill Creek Subwatershed in 2007. 375
Table 257. Peters Creek-Mill Creek (2) Subwatershed Land Protection Load Estimates for land protection. 377
Table 258. Peters Creek-Mill Creek (2) Subwatershed Estimated Load Reductions for Stream Corridor Protection. 378
Table 259. 041100040403 – Subwatershed Land Use 381
Table 260. 041100040403 – Subwatershed Land Use Within Floodplain 381
Table 261. 041100040403 – Subwatershed Wetland Types by Acres 381
Table 262. 041100040403 – Subwatershed Highly Erodible Soil by Acres 384
Table 263. 041100040403 – Subwatershed Hydrologic Soil Groups by Acres 384
Table 264. 041100040403 – Subwatershed Aquatic Life Use Designation (ALU) 385
Table 265. 041100040403 - Fish community attributes for study sites in the Upper Grand River basin, 2007. .. 386
Table 266. 041100040403 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Village of Jefferson - Mill Creek subwatershed in 2007. 386
Table 267. 041100040403 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Village of Jefferson–Mill Creek Subwatershed in 2007. 387
Table 268. Town of Jefferson-Mill Creek (2) Subwatershed Land Protection Load Estimates for land protection. 390
Table 269. Town of Jefferson-Mill Creek (2) Subwatershed Estimated Load Reductions for Stream Corridor Protection. 391
Table 270. 041100040501 – Subwatershed Land Use 395

VIII. APPENDICIES

Table 271. 041100040501 – Subwatershed Land Use Within Floodplain 395
Table 272. 041100040501 – Subwatershed Wetland Types by Acres 395
Table 273. 041100040501 – Subwatershed Highly Erodible Soil by Acres 398
Table 274. 041100040501 - Subwatershed Hydrologic Soil Groups by Acres 399
Table 275. 041100040501 – Subwatershed Aquatic Life Use (ALU) Designation 399
Table 276. 041100040501 - Fish community attributes for study sites in the Upper Grand River basin, 2007... 400
Table 277. 041100040501 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Three Brothers Creek-Grand River Creek Subwatershed in 2007. 401
Table 278. 041100040501 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Three Brothers Creek-Grand River Creek Subwatershed in 2007. 401
Table 279. Three Brothers Creek-Grand River Subwatershed Land Protection Load Estimates for land protection. 403
Table 280. Three Brothers Creek-Grand River Subwatershed Estimated Load Reductions for Stream Corridor Protection. 404
Table 281. 041100040502 – Subwatershed Land Use 407
Table 282. 041100040502 – Subwatershed Land Use Within Floodplain 407
Table 283. 041100040502 – Subwatershed Wetland Types by Acres 407
Table 284. 041100040502 – Subwatershed Highly Erodible Soil by Acres 410
Table 285. 041100040502 - Subwatershed Hydrologic Soil Groups by Acres 411
Table 286. 041100040502 – Subwatershed Aquatic Life Use (ALU) Designation 412
Table 287. 041100040502 - Fish community attributes for study sites in the Upper Grand River basin, 2007... 412
Table 288. 041100040502 – Recreational use assessments based on E. coli bacteria counts from water quality samples collected in the Bronson Creek-Grand River Creek subwatershed in 2007. 413
Table 289. 041100040502 – Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Bronson Creek-Grand River Subwatershed in 2007. 414
Table 290. Bronson Creek-Grand River Subwatershed Land Protection Load Estimates for land protection. 418
Table 291. Bronson Creek-Grand River Subwatershed Estimated Load Reductions for Stream Corridor Protection. 419

APPENDIX B – Table of Maps

VIII. APPENDICIES

Table of Maps

Map 1. Location of Grand River Watershed. 4
Map 2. Communities of the Grand River Watershed. 9
Map 3. Grand River Wild and Scenic Designation Areas. 13
Map 4. Population Density in the Grand River Watershed. 15
Map 5. Racial Diversity in the Grand River Watershed. 16
Map 6. Median Age of Population in the Grand River Watershed. 17
Map 7. Housing Units in Grand River Watershed by 10 Digit HUC. 22
Map 8. Income per Capita in Grand River Watershed. 29
Map 9. NPDES Individual Permit Locations in the Grand River. 38
Map 10. 04110004 - Grand River Watershed. 41
Map 11. 0411000401 - Grand River Headwaters Subwatershed. 42
Map 12. 0411000402 - Rock Creek Subwatershed. 43
Map 13. 0411000403 - Phelps Creek-Grand River Subwatershed. 44
Map 14. 0411000404 - Griggs-Mill Creek Subwatershed. 45
Map 15. 0411000405 - Brothers Creek - Grand River Subwatershed. 46
Map 16. 0411000406 - Big Creek - Grand River Subwatershed. 47
Map 17. Pre-glacial (Teays Stage) drainage in Northeast Ohio (after Stout et al., 1943). The line of x's indicate the drainage divide. 65
Map 18. Elevation Graphic of the Grand River Watershed. 66
Map 19. River Reaches of the Grand River Watershed. 67
Map 20. River Regions of the Grand River Watershed. 71
Map 21. Hydric Soils in the Grand River Watershed. 74
Map 22. Highly Erodible Soils in the Grand River Watershed. 75
Map 23. Prime Farmland Soils in the Grand River Watershed. 76
Map 24. Glacial lakes in the Grand River Watershed. 1. Rock Creek Lake (elevation 820±ft); 2. Grand River Lake (elevation 820±ft) (From White, 1982) 80
Map 25. End Moraines in the Grand River Watershed. 81
Map 26. Glacial Geology of the Grand River Watershed. 83
Map 27. Bedrock Geology of the Grand River Watershed. 86
Map 28. Mean Snowfall for Winter Season, 1936-1965 – State of Ohio 95
Map 29. Mean Annual Snowfall (cm) in Ohio, the location of Chardon (41.6°N, 81.2°W), and the Lake Erie Snowbelt. The snowbelt is approximately the area with over 200 cm mean annual snowfall. 96
Map 30. National Wetland Inventory of the Grand River Watershed. 99
Map 31. Use Designations for the Grand River Watershed. 106
Map 32. Aquifer Types in Ohio modified from ODNR glacial and bedrock Aquifer Maps (ODNR, 2000). 111
Map 33. DRASTIC Ground Water Pollution Potential in the Grand River Watershed. 116
Map 34. Drastic Ground Water Pollution Potential - 0411000401 Headwaters Grand River Subwatershed... 117
Map 35. Drastic Pollution Potential - 0411000402 Rock Creek Subwatershed. 118
Map 36. Drastic Pollution Potential - 0411000403 Phelps Creek Subwatershed. 119
Map 37. Drastic Pollution Potential - 0411000404 Griggs - Mill Creek Subwatershed. 120
Map 38. Drastic Pollution Potential - 0411000404 Three Brothers Creek Subwatershed. 122
Map 39. Drastic Pollution Potential - 0411000406 Big Creek Grand River Subwatershed (lower Grand). 123
Map 40. Modern Land Cover in the Grand River Watershed. 124
Map 41. Parks and Protected Properties in the Grand River Watershed. 138
Map 42. Vegetation at the Time of Earliest Surveys in the Grand River Watershed. 144
Map 43. 041100040101 - Dead Branch Potential Contaminant Source Inventory 158
Map 44. 041100040102 – Headwaters Potential Contaminant Source Inventory 159
Map 45. 041100040103 – Baughman Creek Potential Contaminant Source Inventory 160
Map 46. 041100040104 – Center Creek Potential Contaminant Source Inventory 161
Map 47. 041100040105 – Coffee Creek Potential Contaminant Source Inventory 162
Map 48. 041100040106 – Swine Creek Potential Contaminant Source Inventory 163
Map 49. 041100040201 – Upper Rock Creek Potential Contaminant Source Inventory 164
Map 50. 041100040202 – Middle Rock Creek Potential Contaminant Source Inventory 165
Map 51. 041100040203 – Lower Rock Creek Potential Contaminant Source Inventory 166

VIII. APPENDICIES

Map 52. 041100040301 – Phelps Creek Potential Contaminant Source Inventory 167
Map 53. 041100040302 – Hoskins Creek Potential Contaminant Source Inventory 168
Map 54. 041100040303– Mill Creek (1) Creek Potential Contaminant Source Inventory 169
Map 55. 041100040304 – Mud Creek Potential Contaminant Source Inventory 170
Map 56. 041100040305 – Plumb Creek Potential Contaminant Source Inventory 171
Map 57. 041100040401 – Griggs Creek Potential Contaminant Source Inventory 172
Map 58. 041100040402 – Peters Creek Potential Contaminant Source Inventory 173
Map 59. 041100040403 – Mill Creek (2) Creek Potential Contaminant Source Inventory 174
Map 60. 041100040501 – Three Brothers Creek Potential Contaminant Source Inventory 175
Map 61. Map 53. 041100040502 – Bronson Creek Potential Contaminant Source Inventory 176
Map 62. 041100040101 – Subwatershed Land Use 190
Map 63. 041100040101 Dead Branch Land Protection Prioritization Model - High Priority Areas 197
Map 64. 041100040102 – Subwatershed Land Use (Source: 2006 National Land Cover Data (NLCD 2006) - a land-cover mapping program.) 200
Map 65 – 041100040102 Headwaters Subwatershed Land Protection Prioritization Model - High Priority Areas 209
Map 66. 041100040103 – Subwatershed Land Use 211
Map 67 – 041100040103 Baughman Creek Land Protection Prioritization Model - High Priority Areas 221
Map 68. 041100040104 – Subwatershed Land Use 224
Map 69 – 041100040104 Center Creek Land Protection Prioritization Model - High Priority Areas 232
Map 70. 041100040105 – Subwatershed Land Use 236
Map 71 – 041100040105 Coffee Creek Subwatershed Land Protection Prioritization Model - High Priority Areas 243
Map 72. 041100040106 – Subwatershed Land Use 246
Map 73 – 041100040106 Swine Creek Land Protection Prioritization Model - High Priority Areas 255
Map 74. 041100040201 – Subwatershed Land Use 257
Map 75 – 041100040201 Upper Rock Creek Land Protection Prioritization Model - High Priority Areas 265
Map 76. 041100040202– Subwatershed Land Use 268
Map 77 – 041100040201 Middle Rock Creek Land Protection Prioritization Model - High Priority Areas 276
Map 78. 041100040203 – Subwatershed Land Use 280
Map 79 – 041100040203 Lower Rock Creek Land Protection Prioritization Model - High Priority Areas 288
Map 80. 041100040301 – Subwatershed Land Use 291
Map 81 – 041100040301 Phelps Creek Land Protection Prioritization Model - High Priority Areas 301
Map 82. 041100040302 – Subwatershed Land Use 304
Map 83 – 041100040302 Hoskins Creek Land Protection Prioritization Model - High Priority Areas 314
Map 84. 041100040303 – Subwatershed Land Use 318
Map 85 – 041100040303 Mill Creek (1)-Grand River Land Protection Prioritization Model - High Priority Areas 330
Map 86. 041100040304 – Subwatershed Land Use 334
Map 87 – 041100040304 Mud Creek Land Protection Prioritization Model - High Priority Areas 344
Map 88. 041100040305 – Subwatershed Land Use 348
Map 89 – 041100040305 Plumb Creek – Grand River Land Protection Prioritization Model - High Priority Areas 356
Map 90. 041100040401 – Subwatershed Land Use 360
Map 91 - Griggs Creek Land Protection Prioritization Model - High Priority Areas 367
Map 92. 041100040402 – Subwatershed Land Use 370
Map 93. Peters Creek - Mill Creek Land Protection Prioritization Model - High Priority Areas 379
Map 94. Table 1. 041100040403 – Subwatershed Land Use 382
Map 95. Village of Jefferson - Mill Creek Land Protection Prioritization Model - High Priority Areas 392
Map 96. 041100040501 – Subwatershed Land Use 396
Map 97 – 041100040501 Three Brothers Creek-Grand River Land Protection Prioritization Model - High Priority Areas 405
Map 98. 041100040502 – Subwatershed Land Use 408
Map 99 – 041100040502 Bronson Creek-Grand River Creek Land Protection Prioritization Model - High Priority Areas 420

APPENDIX C – Table of Photos

VIII. APPENDICIES

Table of Photos

Photo 1. Grand River at Mechanicsville Road – view south (Source: GRPI) 2
Photo 2. Grand River Headwaters (Source: GRPI) 3
Photo 3. Grand Wild & Scenic River (Source: Grand River Partners, Inc.) 12
Photo 4. Grand River Headwaters (Source: GRPI) 68
Photo 5. Grand River Lowlands (Source: GRPI) 69
Photo 6. Grand River Tributaries - Phelps Creek (Source: Grand River Partner, Inc.) 70
Photo 7. Grand River in Winter (Source:GRPI) 94
Photo 8. Abandoned Grand River Channel (Source: GRPI) 100
Photo 9. Grand River Lowlands (Source: GRPI) 105
Photo 10. Grand River Unnamed Tributary (Source: GRPI) 112
Photo 11. Dead Branch near confluence with Grand River (Source: GRPI) 188
Photo 12. Mud Run near confluence with Grand River (Source: G. Warnock) 198
Photo 13. Grand River near confluence with Baughman Creek (Source: G. Warnock) 210
Photo 14. Center Creek near confluence with Grand River (Source: G. Warnock) 234
Photo 15. Grand River at the Confluence of Swine Creek (Source: G. Warnock) 244
Photo 16. Rock Creek at Falls near confluence with Grand River (Source: G. Warnock) 256
Photo 17. Rock Creek @ Dodgeville Road near confluence with Lebanon Creek (Source: G. Warnock) 266
Photo 18. Rock Creek (Snyder Ditch) @ US 322 (Source: G. Warnock) 278
Photo 19. Phelps Creek near confluence with Grand River (Source: G. Warnock) 290
Photo 20. Hoskins Creek at Conjunction with Grand River (source: G. Warnock) 302
Photo 21. Grand River near confluence with Mill Creek (1) (Source: G. Warnock) 316
Photo 22. Grand River near confluence with Mud Creek (Source: G. Warnock) 332
Photo 23. Grand River near confluence with Plumb Creek (Source: G. Warnock) 346
Photo 24. Mill Creek (2) at confluence with Griggs Creek (Source: G. Warnock) 358
Photo 25. Mill Creek @ Confluence of Griggs Creek (Source: GRPI) 368
Photo 26. Grand River @ Cork Cold Springs Road - North of Confluence with Mill Creek (2) (Source: GRPI) 380
Photo 27. Grand River near Confluence with Three Brothers Creek (Source: G. Warnock) 394
Photo 28. Grand River near confluence with Bronson Creek (Source: G. Warnock) 406

APPENDIX D – Abbreviations and Acronyms

VIII. APPENDICIES

Abbreviations and Acronyms

305(b) - Ohio Environmental Protection Agency Water Quality Report

319 - Section 319 of the Clean Water Act

a.k.a. – also known as

AOC - Area of Concern

ALU - Aquatic Life Use

AWS - Agricultural water supply

BGI - Balanced Growth Initiative

BMP - Best Management Practice

BOD - Biochemical Oxygen Demand

CAFO - Concentrated Animal Feeding Operation

CD - Conservation District

CFS - Cubic Feet per Second

COE - Corps of Engineers

CNPCP - Coastal Nonpoint Pollution Control Program

CREP - Conservation Reserve Enhancement Program

CRP - Conservation Reserve Program

CWA - Clean Water Act

CWH - Coldwater Habitat

DC - District Conservationist

DO - Dissolved Oxygen

DNAP - Division of Natural Areas and Preserves (Within ODNR)

DSW - Division of Surface Water (OEPA)

EOLP - Erie Ontario Lake Plain

EQIP - Environmental Quality Incentives Program

EWH - Exceptional Warmwater Habitat

FEMA - Federal Emergency Management Agency

FS - Forest Service

FWS - Fish and Wildlife Service

GIS - Geographic Information System

GLC - Great Lakes Commission

GLNPO - Great Lakes National Program Office

GLPF - Great Lakes Protection Fund

GPD – Gallons Per Day

GPM - Gallons Per Minute

GRPI – Grand River Partners, Inc.

GPS – Geographic Positioning System

Abbreviations and Acronyms (Cont'd)

GSCP - Clean Ohio Green Space Conservation Program

HEL - Highly Erodible Land

HHEI- Headwater Habitat Evaluation Index

HSTS - Home Sewage Treatment System

HUC - Hydrologic Unit Code

IBI - Index of Biotic Integrity

ICI - Invertebrate Community Index

IJC - International Joint Commission

IWS - Industrial water supply

LEPF - Lake Erie Protection Fund

LRW - Limited Resource Water

LSF – Line Start & Finish - the distance between the start and finish locations

Lt – Length total - the total length of the line

MGD – Million Gallons Per Day

MIwb - Modified Index of Well Being

MRCC - Midwestern Regional Climate Center

MS4 - Municipal Separate Storm Sewer Systems

MWH - Modified Warmwater Habitat

NEPA - National Environmental Policy Act

NLCD - National Land Cover Dataset

NOAA - National Oceanographic and Atmospheric Administration

NPDES - National Pollutant Discharge Elimination System

NPS - Nonpoint Source (Pollution)

NRCS - Natural Resources Conservation Service

OAC - Ohio Administrative Code

OARDC - Ohio Agricultural Research and Development Center

ODA - Ohio Department of Agriculture

ODH - Ohio Department of Health

ODNR - Ohio Department of Natural Resources

ODOT – Ohio Department of Transportation

OEEF - Ohio Environmental Education Fund

OEMA - Ohio Emergency Management Agency

OEPA - Ohio Environmental Protection Agency

OGRIP - Ohio Geographically Referenced Information Program

OLEC - Ohio Lake Erie Commission

Abbreviations and Acronyms (Cont'd)

ORC - Ohio Revised Code

OKI - Ohio-Kentucky-Indiana Regional Council of Governments

OSU - The Ohio State University

OWI - Ohio Wetlands Inventory

PCR - Primary contact recreation

PWS - Public water supply

QHEI- Qualitative Habitat Evaluation Index

RAP - Remedial Action Plan

RC&D - Resource Conservation and Development Areas

RFP - Request For Proposal

RM - River Mile

SSH - Seasonal Salmonid Habitat

STEPL - Spreadsheet Tool for Estimating Pollutant Loading

SWAP - Source Water Assessment Program

SWCD - Soil And Water Conservation District

SWPP - Source Water Protection Plan

TMDL - Total Maximum Daily Load

TSD - Technical Support Document

TSS - Total Suspended Solids

USACE – United States Army Corps of Engineers

USBGN - United States Board on Geographic Names

USDA - United States Department of Agriculture

USEPA - United States Environmental Protection Agency

USFWS - United States Fish and Wildlife Service

USGS - United States Geological Survey

WAP – Watershed Action Plan

WHP - Wellhead Protection

WQS - Water Quality Standards

WRLC – Western Reserve Land Conservancy

WRP - Wetland Reserve Program

WRRSP – Water Resource Restoration Sponsor Program

WTP - Water Treatment Plant

W.Wh. – Winter Wheat

WWH - Warmwater Habitat

WWTP - Wastewater Treatment Plant