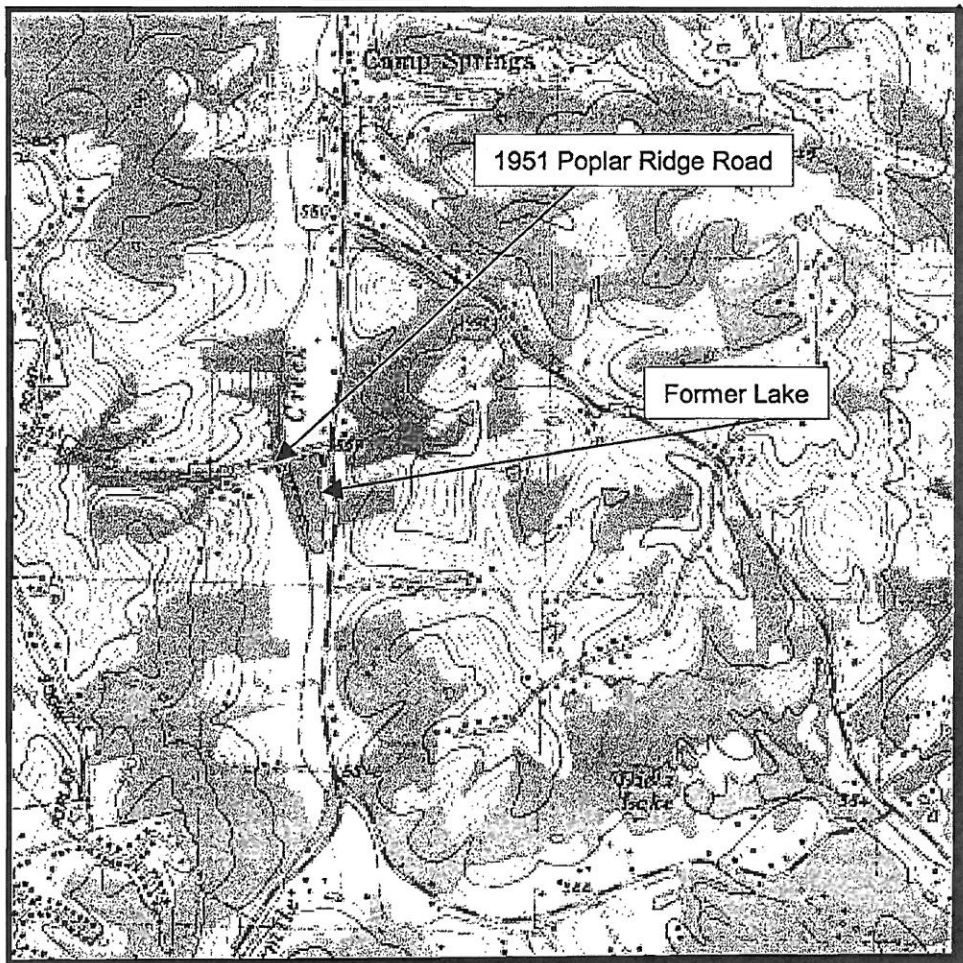
extent to the on-site property but that its daughter product plumes 1,1-DCE, 1,1-DCA, and chloroethane are migrating to the northeast from the source area. The 1,1-DCE and chloroethane plumes are the most far-reaching and have been detected off-site in concentrations exceeding the established criteria for the site (the United States Environmental Protection Agency [USEPA] Maximum Contaminant Level [MCL] for drinking water of 7 micrograms per liter (μg/L) for 1,1-DCE and the EPA Region 9 PRG of 4.6 μg/L for chloroethane) on the Campbell County Property to the east of, and across the creek from, the site.

Analysis of soil and groundwater samples from the monitoring wells installed on the property to the south and of soil samples from the property to the west indicate no detectable concentrations of contaminants.

Water level information collected at the Site indicates that groundwater flows under the creek during low groundwater stages and therefore, the creek does not always serve as a groundwater divide as previously thought.

The groundwater geochemical data indicate that organic substrate injection is an appropriate remedy to pilot test at the site. The higher concentrations of ethane, ethene, and methane in groundwater samples from MW-7 and MW-16 in and near the source area compared to the concentrations of the same gases in the groundwater samples further from the source area indicate that natural attenuation is already occurring.



N

Not to Scale
New Richmond Quadrangle
Revised 1992

QUADRANGLE LOCATION

Parsons Cincinnati, Ohio 45241 513-326-3040	**Figure 1:** **Site Location Map**	Rohm and Haas Company Melbourne Kentucky March 2002

SECTION 1.0
INTRODUCTION

This work plan provides a detailed discussion of tasks to be conducted as part of the Phase III Field Investigation at the Morton International, Inc. (Morton) leased property at 199C Poplar Ridge Road, Melbourne, Kentucky (Figure 1). Application guns containing a polymer sealant were cleaned at the site between 1982 and 2001. These guns were cleaned at the rear of the property using chlorinated solvents. Subsequent to the purchase of Morton by Rohm & Haas Company, Parsons conducted Phase I and limited Phase II environmental site assessments (ESAs) of the property to evaluate the potential effects of solvent use at the facility on soil and groundwater quality in the area.

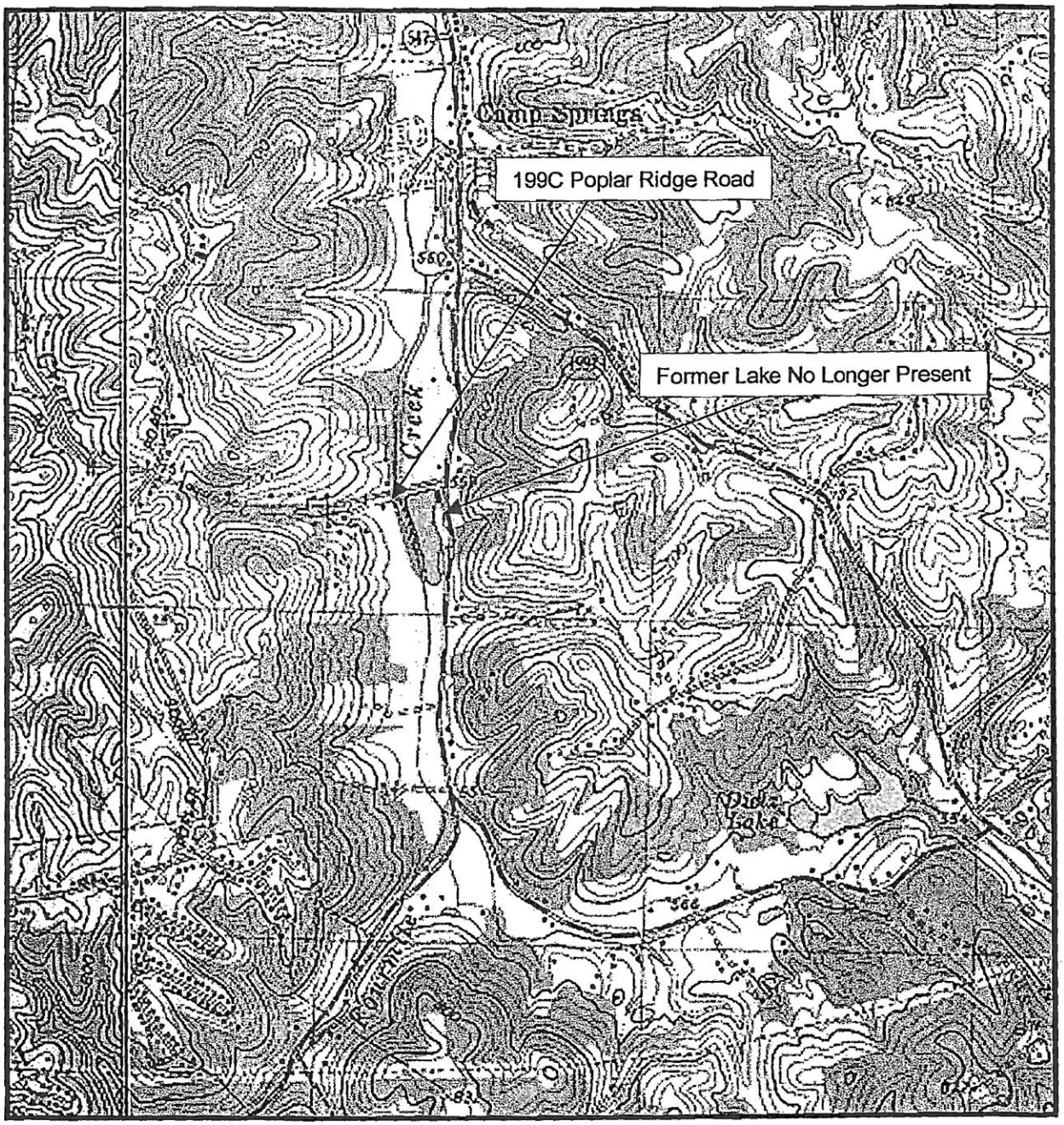
Volatile organic compounds (VOCs) were detected in groundwater samples collected during initial site assessment activities in September 2000. The results of the initial investigation were presented to Rohm and Haas in a report entitled: *Combined Phase I and Phase II Environmental Site Assessment* (November 2000). As a result of the initial investigation, a subsequent environmental site assessment was conducted in November and December 2001 to identify potential source areas for the VOCs detected in groundwater during the September 2000 investigation. In addition, as part of the 2001 study, groundwater samples were collected to evaluate the potential for migration of these compounds within the saturated zone. As part of this investigation, twenty-eight soil borings were advanced at the Facility. Ten of these were abandoned, nine were completed as temporary piezometers, and nine were completed as permanent monitoring wells. The results of the 2001 investigation were presented to Rohm and Haas in a report entitled: *Site Assessment, Morton International, Melbourne, Kentucky Facility* (March 2002).

Groundwater level information was collected during the 2001 investigation from both the temporary piezometers and the permanent monitoring wells. In general, groundwater flow is to the east-northeast at the Site toward Four Mile Creek. Based on water level data collected from Four Mile Creek, it appears that groundwater within the unconsolidated material discharges to the creek. In addition, groundwater flow east of

Four Mile Creek is to the northwest toward Four Mile Creek. As a result, the creek is a hydraulic divide in this area (Figure 2).

Analytical results from the 2001 investigation indicated that seven VOCs were present in soil, including 1,1,1-trichloroethane (1,1,1-TCA) and its daughter products 1,1 dichloroethene (1,1-DCE), and 1,1-dichloroethane (1,1-DCA). The largest concentrations of these compounds were detected in samples collected from under the concrete pad west of the maintenance portion of the barn.

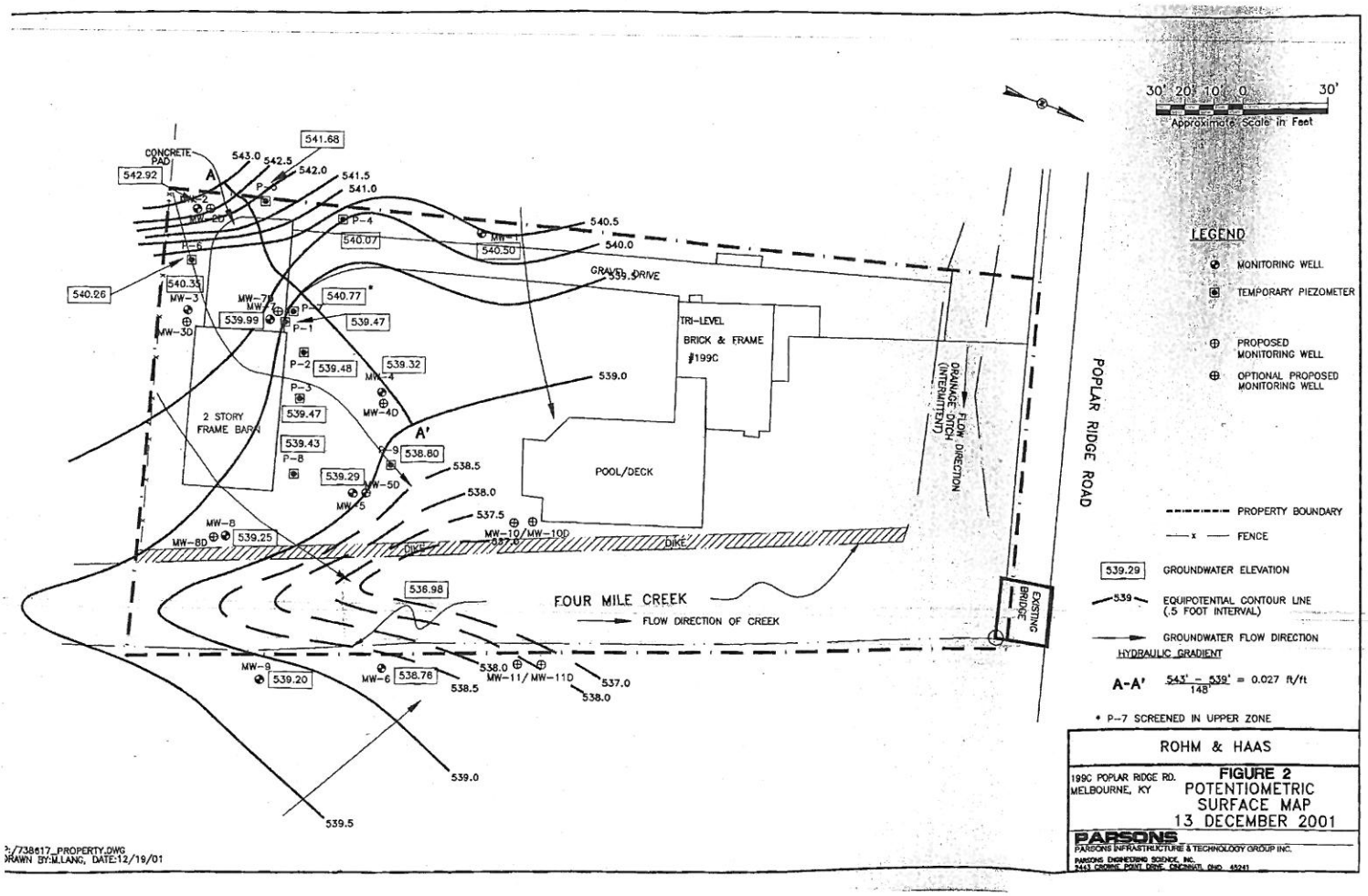
Groundwater sampling results from the 2001 investigation indicated that 1,1,1-TCA and its daughter products 1,1-DCE, 1,1-DCA, and chloroethane are present in groundwater, and a plume of VOCs migrating to the northeast is present at the site. Like the soil samples, the largest concentrations in groundwater were detected in samples collected from piezometers and monitoring wells installed through and near the concrete pad west of the barn. As a result, the source area for the VOCs in soil and groundwater appears to be under the concrete pad next to the barn.

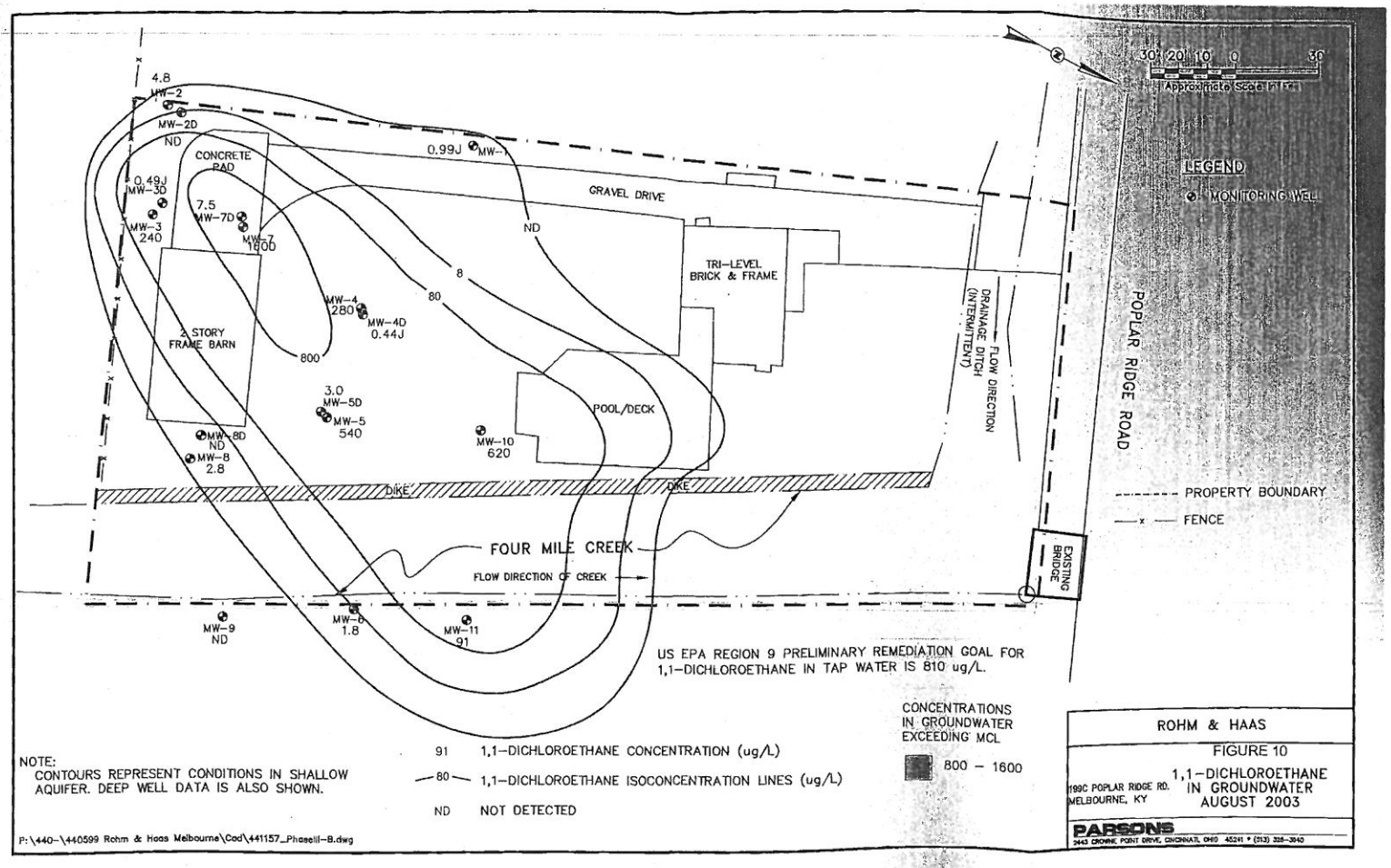


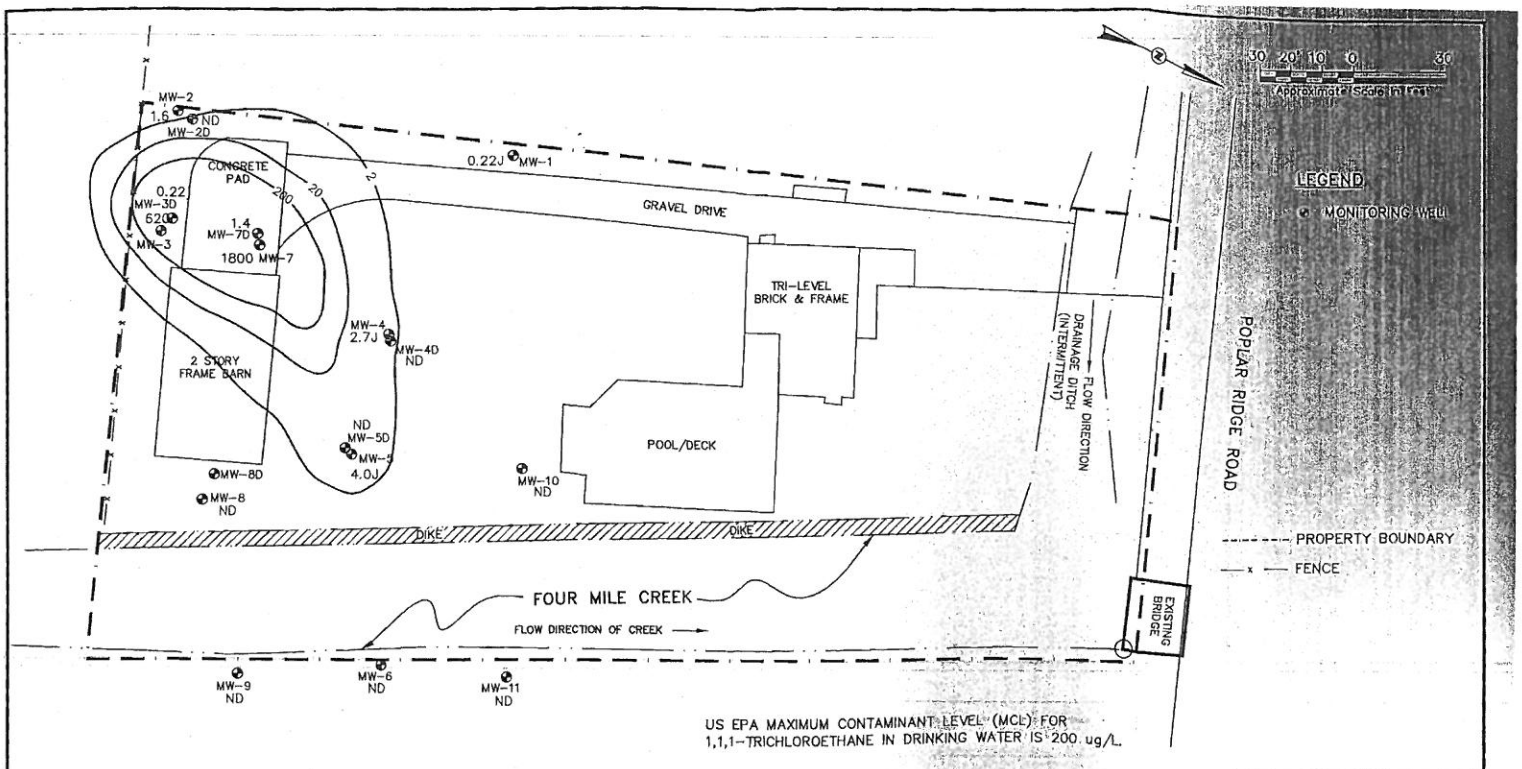
Not to Scale
New Richmond Quadrangle
Revised 1992

QUADRANGLE LOCATION

Parsons Engineering Science Cincinnati, Ohio 45241 515-326-3040	**Figure 1:** **Site Location Map**	Rohm & Haas Company Melbourne, Kentucky July 2002


30' 20' 10' 0' 30'
Approximate Scale in Feet
LEGEND
MONITORING WELL
TEMPORARY PIEZOMETER
PROPOSED MONITORING WELL
OPTIONAL PROPOSED MONITORING WELL
PROPERTY BOUNDARY
FENCE
539.29 GROUNDWATER ELEVATION
539 EQUIPOTENTIAL CONTOUR LINE (.5 FOOT INTERVAL)
GROUNDWATER FLOW DIRECTION
HYDRAULIC GRADIENT
A-A' 543' - 539' / 148' = 0.027 ft/ft
* P-7 SCREENED IN UPPER ZONE
ROHM & HAAS
199C POPLAR RIDGE RD.
MELBOURNE, KY
FIGURE 2
POTENTIOMETRIC SURFACE MAP
13 DECEMBER 2001
PARSONS
PARSONS INFRASTRUCTURE & TECHNOLOGY GROUP INC.
PARSONS ENGINEERING SCIENCE, INC.
2443 CROSNE POINT DRIVE, CINCINNATI, OHIO 45241
POPLAR RIDGE ROAD
EXISTING BRIDGE
FOUR MILE CREEK
FLOW DIRECTION OF CREEK
DRAINAGE DITCH (INTERMITTENT)
FLOW DIRECTION
DIKE
POOL/DECK
TRI-LEVEL BRICK & FRAME #199C
GRAVEL DRIVE
2 STORY FRAME BARN
CONCRETE PAD
A
A'
541.68
542.92
543.0
542.5
542.0
541.5
541.0
540.5
540.0
540.07
540.50
540.26
540.33
540.77
539.99
539.47
539.48
539.32
539.0
539.47
539.43
538.80
538.5
538.0
537.5
539.29
539.25
536.98
539.20
536.76
537.0
539.5
MW-1
MW-2
MW-2D
MW-3
MW-3D
MW-4
MW-4D
MW-5
MW-5D
MW-6
MW-7
MW-8
MW-8D
MW-9
MW-10/MW-10D
MW-11/MW-11D
P-1
P-2
P-3
P-4
P-5
P-6
P-7
P-8
P-9
P:/738617_PROPERTY.DWG
DRAWN BY:M.LANG, DATE:12/19/01


30' 20' 10' 0 30'
(Approximate Scale in Ft.)
LEGEND
MONITORING WELL
PROPERTY BOUNDARY
FENCE
POPLAR RIDGE ROAD
EXISTING BRIDGE
DRAINAGE DITCH (INTERMITTENT)
FLOW DIRECTION
TRI-LEVEL BRICK & FRAME
POOL/DECK
GRAVEL DRIVE
CONCRETE PAD
2 STORY FRAME BARN
DIKE
FOUR MILE CREEK
FLOW DIRECTION OF CREEK
MW-2 4.8
MW-2D ND
MW-3D 0.49J
MW-3 240
MW-7D 7.5
MW-7 1600
MW-1 0.99J
MW-4 280
MW-4D 0.44J
MW-5D 3.0
MW-5 540
MW-8D ND
MW-8 2.8
MW-10 620
MW-9 ND
MW-6 1.8
MW-11 91
ND
8
80
800
US EPA REGION 9 PRELIMINARY REMEDIATION GOAL FOR 1,1-DICHLOROETHANE IN TAP WATER IS 810 ug/L.
CONCENTRATIONS IN GROUNDWATER EXCEEDING MCL
800 - 1600
91 1,1-DICHLOROETHANE CONCENTRATION (ug/L)
80 1,1-DICHLOROETHANE ISOCONCENTRATION LINES (ug/L)
ND NOT DETECTED
NOTE:
CONTOURS REPRESENT CONDITIONS IN SHALLOW AQUIFER. DEEP WELL DATA IS ALSO SHOWN.
P:\440-\440599 Rohm & Haas Melbourne\Cad\441157_Phaseiii-B.dwg
ROHM & HAAS
FIGURE 10
1,1-DICHLOROETHANE IN GROUNDWATER AUGUST 2003
1199C POPLAR RIDGE RD. MELBOURNE, KY
PARSONS
2443 CROWNE POINT DRIVE, CINCINNATI, OHIO 45241 • (513) 326-3940



US EPA MAXIMUM CONTAMINANT LEVEL (MCL) FOR 1,1,1-TRICHLOROETHANE IN DRINKING WATER IS 200 ug/L.

NOTE:
CONTOURS REPRESENT CONDITIONS IN SHALLOW AQUIFER. DEEP WELL DATA IS ALSO SHOWN.

5.5 1,1,1-TRICHLOROETHANE CONCENTRATION (ug/L)

200 1,1,1-TRICHLOROETHANE ISOCONCENTRATION LINES (ug/L)

ND NOT DETECTED

CONCENTRATIONS IN GROUNDWATER

200 – 1800

ROHM & HAAS

FIGURE 8

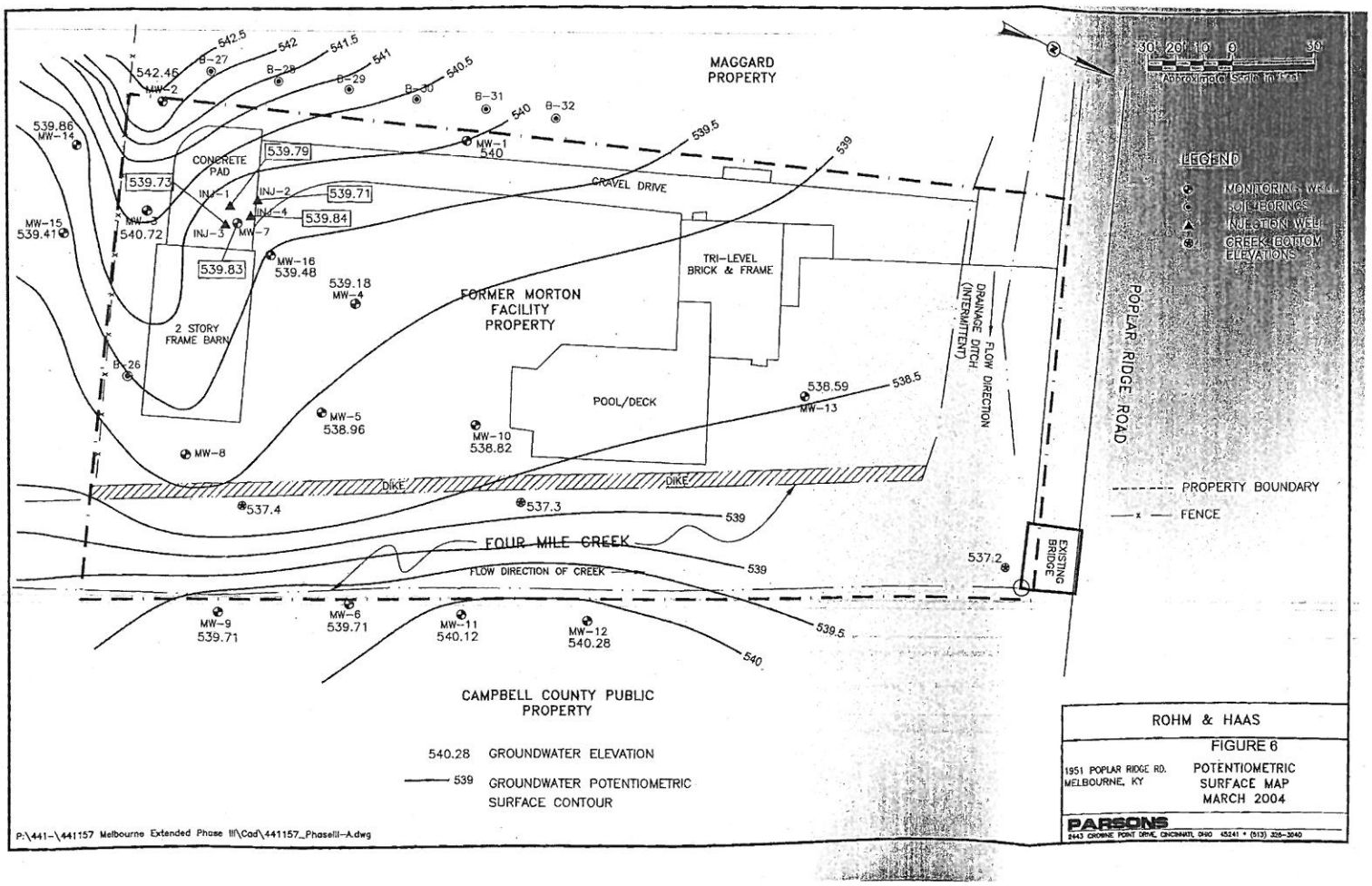
1,1,1-TRICHLOROETHANE IN GROUNDWATER

AUGUST 2003

1990 POPLAR RIDGE RD.
MELBOURNE, KY

PARSONS
2443 CROSNE POINT DRIVE, CINCINNATI, OHIO 45241 • (513) 326-3040

P:\440-\440599 Rohm & Haas Melbourne\Cad\441157_Phaseiii-B.dwg


MAGGARD PROPERTY
CONCRETE PAD
2 STORY FRAME BARN
GRAVEL DRIVE
FORMER MORTON FACILITY PROPERTY
TRI-LEVEL BRICK & FRAME
POOL/DECK
DRAINAGE DITCH (INTERMITTENT)
FLOW DIRECTION
POPLAR RIDGE ROAD
EXISTING BRIDGE
DIKE
FOUR MILE CREEK
FLOW DIRECTION OF CREEK
CAMPBELL COUNTY PUBLIC PROPERTY
MW-1 540
MW-2 542.46
MW-3 540.72
MW-4 539.18
MW-5 538.96
MW-6 539.71
MW-7
MW-8
MW-9 539.71
MW-10 538.82
MW-11 540.12
MW-12 540.28
MW-13 538.59
MW-14 539.86
MW-15 539.41
MW-16 539.48
INJ-1
INJ-2
INJ-3
INJ-4
B-26
B-27
B-28
B-29
B-30
B-31
B-32
537.4
537.3
537.2
539.79
539.73
539.71
539.84
539.83
542.5
542
541.5
541
540.5
540
539.5
539
538.5
30' 20' 10' 0' 30'
Approximate Scale in Feet
LEGEND
MONITORING WELL
SOIL BORINGS
INJECTION WELL
CREEK BOTTOM ELEVATIONS
PROPERTY BOUNDARY
FENCE
540.28 GROUNDWATER ELEVATION
539 GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR
P:\441-\441157 Melbourne Extended Phase III\Cad\441157_PhaseIII-A.dwg
ROHM & HAAS
FIGURE 6
1951 POPLAR RIDGE RD.
MELBOURNE, KY
POTENTIOMETRIC SURFACE MAP
MARCH 2004
PARSONS
2443 CROSSING POINT DRIVE, CINCINNATI, OHIO 45241 • (513) 326-3040

APPENDIX B

ARCHAEOLOGICAL SURVEY

CULTURAL RESOURCE SURVEY

CULTURAL HISTORIC BASELINE SURVEY

TREE IMPACT ASSESSMENT

Contract Publication Series 09-255

A CULTURAL RESOURCE SURVEY OF THE PROPOSED ASH STREET PUMP STATION AND FORCE MAIN PROJECT IN CAMPBELL COUNTY, KENTUCKY

by
Russell S. Quick, Ph.D.

With a contribution by Alan Higgins

Prepared for

and

Prepared by

cra
cultural resource analysts, inc

Kentucky | West Virginia | Ohio
Wyoming | Illinois | Indiana | Louisiana | Tennessee
New Mexico | Virginia | Colorado | Maryland

Contract Publication Series 09-255

A CULTURAL RESOURCE SURVEY OF THE PROPOSED ASH STREET PUMP STATION AND FORCE MAIN PROJECT IN CAMPBELL COUNTY, KENTUCKY

By Russell S. Quick, Ph.D.
With a contribution by Alan Higgins, MS

Prepared for

Joe Henry
GRW Engineers, Inc.
801 Corporate Drive
Lexington, Kentucky 40503
Phone: (859) 223-3999
Fax: (859) 223-8917

Prepared by

Cultural Resource Analysts, Inc.
151 Walton Avenue
Lexington, Kentucky 40508
Phone: (859) 252-4737
Fax: (859) 254-3747
Email: cmniquette@crai-ky.com
CRA Project No.: K09G003

Charles M. Niquette, RPA
Co-Principal Investigator

Andrew P. Bradbury, RPA
Co-Principal Investigator

August 8, 2011

Lead Agency: Kentucky Infrastructure Authority
OSA Project Registration No.: FY10_6237

ABSTRACT

On November 15–18, 2010, and May 2–4, 2011, Cultural Resource Analysts, Inc., personnel conducted a cultural resource survey of the proposed corridor for a force main sewer line in Campbell County, Kentucky. The survey was conducted at the request of Joe Henry of GRW Engineers, Inc., in Lexington, Kentucky, on behalf of Sanitation District No. 1 of Northern Kentucky. The project area begins at an existing pump station adjacent to Mary Ingles Highway in Silver Grove, Kentucky, encompasses the location of the proposed new pump station on Ash Street, and continues south-southeast, paralleling Four Mile Road through the community of Camp Springs to the existing Riley Road Pump Station northeast of the community of Alexandria. The proposed project area consisted of approximately 32 ha (79 acres). Prior to conducting the field research, a records review was conducted at the Office of State Archaeology. The review indicated that no archaeological sites and no investigations had been documented within the project area. Survey methods, which included intensive pedestrian survey supplemented by shovel testing and auger cores, varied according to topographic setting and past and current land use practices. Most of the proposed right-of-way crossed farmland and residential areas, but some portions passed through commercial properties. Some portions of the project area were extensively disturbed by previous construction or landscaping activities, confirmation of which only required visual inspection and randomly placed shovel tests.

No archaeological sites were documented during this survey; however, the proposed force main passes through several areas with standing structures over 50 years of age. These structures (Cultural Historic Sites 1–39) were documented as historic resources either individually or in groups. One of these sites (Site 36) is a contributing element of a site listed on the National Register of Historic Places. The force main in this area will be bored beneath the existing structures and, therefore, will not have any adverse visual or physical effect to this historic property. The other resources are recommended as not eligible for listing on the National Register of Historic Places. Therefore, cultural resource clearance for the proposed project is recommended.

TABLE OF CONTENTS

ABSTRACT i
LIST OF FIGURES iii
LIST OF TABLES iv
I. INTRODUCTION 1
II. ENVIRONMENTAL SETTING 2
III. PREVIOUS RESEARCH AND HISTORIC CONTEXT 17
IV. METHODS 29
V. CULTURAL HISTORIC RESOURCE DOCUMENTATION 31
VI. CONSULTING PARTIES 50
VII. CONCLUSIONS, RECOMMENDATIONS, AND TREATMENT 51
REFERENCES CITED 51
APPENDIX A. SCOPE OF WORK A-1

LIST OF FIGURES

Figure 1. Map of Kentucky showing the location of Campbell County. 1
Figure 2. Location of project area on topographic quadrangle. 3
Figure 3. Project area plan map. 7
Figure 4. Map of the Licking River drainage basin. 12
Figure 5. General overview of project area depicting commercial area, facing east. 18
Figure 6. General overview of project area depicting typical terrain and vegetation, facing south. 18
Figure 7. General overview of project area depicting utility disturbance, facing north. 19
Figure 8. General overview of typical ground surface disturbance associated with residential properties. 19
Figure 9. Topographic map indicating the locations of map structures. 23
Figure 10. North-northwesterly view of the south and east elevations of the pump house at Site 1 32
Figure 11. Easterly view of the west elevation of the pump house at Site 1. 32
Figure 12. Westerly view of the WPA plaque on the east elevation of the pump house. 33
Figure 13. Southeasterly view of 5052–54 and 5058 Mary Ingles Highway. 35
Figure 14. Southeasterly view of 5072 Mary Ingles Highway 35
Figure 15. Southwesterly view of 5084 Mary Ingles Highway, showing a representative bungalow. 36
Figure 16. Southwesterly view of 5024 Mary Ingles Highway, showing common alterations to properties. 36
Figure 17. Southerly view of the park across from the proposed pumping station. 37
Figure 18. Southerly view near 4999 Mary Ingles Highway showing the proposed line of the force main. 37
Figure 19. Northeasterly overview of West Second Street showing examples of bungalow forms in area. 39
Figure 20. West-northwesterly overview of West Second Street from Oak Street. 39
Figure 21. Southwesterly view of 202 West Second Street showing the range of typical alterations 40
Figure 22. Northeasterly view of 216 West Second Street showing typical bungalow forms. 40
Figure 23. Southeasterly view of the church located at West Second Street and Oak Street. 41
Figure 24. Westerly view of the smokehouse at Site 36. 44

Figure 25. NRHP Boundary of Reitman House Site. 45
Figure 26. Northwesterly view of the remnants of the rock fence at Site 037. 46
Figure 27. Northwesterly view of the remnants of the rock fence at Site 037. 47
Figure 28. North-northeasterly view of the rock fence at Site 38. 48
Figure 29. East-northeasterly view of the rock fence at Site 38. 48
Figure 30. West-southwesterly view of the house at Site 39. 49

LIST OF TABLES

Table 1. Summary of Soil Information for Project Area. 13
Table 2. Summary of Selected Information for Previously Recorded Arch Sites in Campbell County 21
Table 3. Historic Map Structures. 22

I. INTRODUCTION

On November 15–18, 2010, and May 2–4, 2011, Cultural Resource Analysts, Inc. (CRA), personnel conducted a cultural resource survey of the proposed corridor for a force main sewer line in Campbell County, Kentucky (Figure 1). The survey was conducted at the request of Joe Henry of GRW Engineers, Inc. (GRW), in Lexington, Kentucky, on behalf of Sanitation District No. 1 of Northern Kentucky. The project area begins at an existing pump station adjacent to Mary Ingles Highway in Silver Grove, Kentucky, encompasses the location of the proposed new pump station on Ash Street, and continues south-southeast, paralleling Four Mile Road through the community of Camp Springs to the existing Riley Road Pump Station northeast of the community of Alexandria. The proposed project area consisted of approximately 32 ha (79 acres). Russell Quick supervised the fieldwork and was assisted by Karen Taylor and Ken Case. Approximately 90 person hours were required to complete the fieldwork. Geographic Information Systems (GIS) data requested by CRA on November 10, 2009, was returned on November 17, 2009. The results were researched by Heather Barras of CRA at the OSA on November 18, 2009. The OSA project registration number is FY10_6237. The scope of work is included as Appendix A.

Project Description

Sanitation District No. 1 of Northern Kentucky proposes to construct a new pump station and force main sewer line between an existing pump station adjacent to Mary Ingles Highway in Silver Grove, Kentucky, continuing south-southeast and paralleling Four Mile Road through the community of Camp Springs to the existing Riley Road Pump Station northeast of the community of Alexandria (Figures 2 and 3). A total area of approximately 32 ha (79 acres) was surveyed.

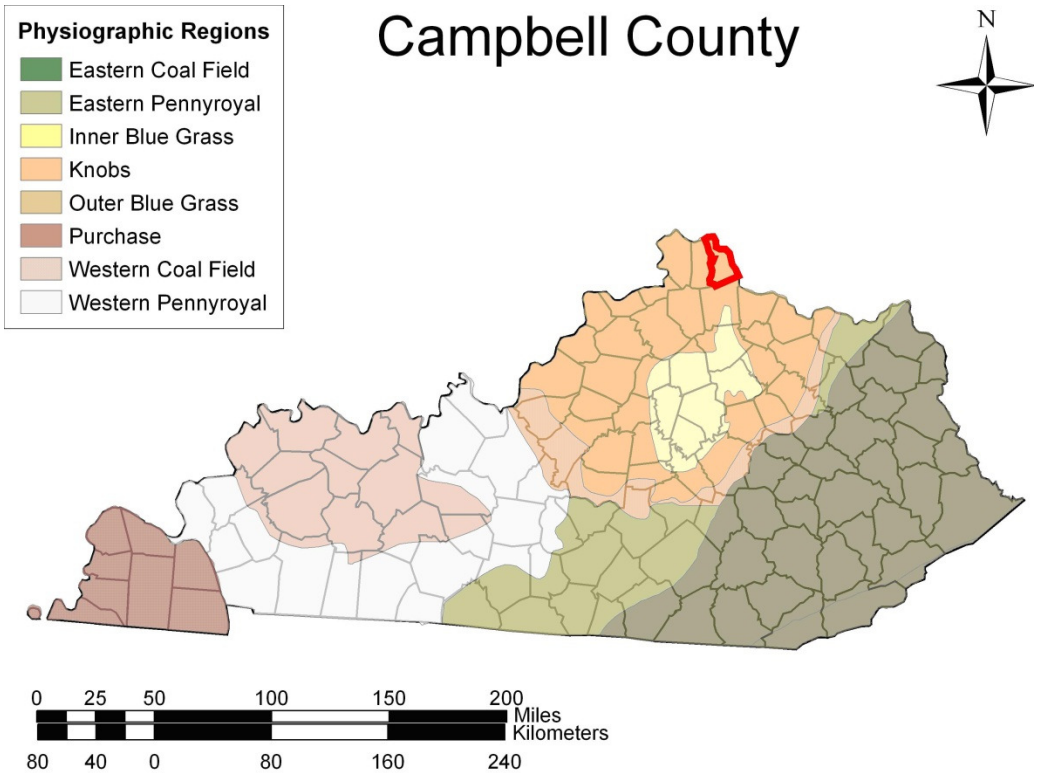


Figure 1. Map of Kentucky showing the location of Campbell County.

Purpose of Study

The study was conducted to comply with Section 106 of the National Historic Preservation Act. This project requires a Section 404 permit under the Clean Water Act from the United States Army Corps of Engineers (USACE) and is therefore considered an undertaking subject to Section 106 review.

The purpose of this survey was to assess any potential effects the proposed connector might have on identified cultural resources. To do this, we followed these objectives:

- identify prehistoric and historic archaeological sites located within the project area;
- determine, to the extent possible, the age and cultural affiliation of sites;
- establish the vertical and horizontal boundaries of sites;
- establish the degree of site integrity and potential for intact cultural deposits to be present; and
- identify aboveground resources 50 years of age or older located in the project easement and viewshed and evaluate their eligibility for listing in the NRHP.

For the purposes of this assessment, a site was defined as "any location where human behavior has resulted in the deposition of artifacts, or other evidence of purposive behavior at least 50 years of age" (Sanders 2006:2). Cultural deposits less than 50 years of age were not considered sites in accordance with "Archeology and Historic Preservation: the Secretary of the Interior's Standards and Guidelines" and were not assessed as part of this study (National Park Service 1983).

The following is a description of the project area, previous research and cultural history of the area, field and laboratory methods, materials recovered, and results of this study. It conforms to the *Specifications for Conducting Fieldwork and Preparing Cultural Resource Assessment Reports* (Sanders 2006). Cultural material, field notes, records, and site photographs will be curated with the William S. Webb Museum of Anthropology, University of Kentucky, in Lexington.

Summary of Findings

Prior to conducting the field research, a records review was conducted at OSA. The review indicated that no archaeological sites had previously been recorded and no archaeological surveys had previously taken place within the current project area.

No archaeological sites were documented during this survey; however, the proposed force main passes through several areas with standing structures over 50 years of age. These structures (Sites 1–39) were documented as historic resources either individually or in groups. One of these sites (Site 36) is a contributing element of a site listed on the National Register of Historic Places. The force main in this area will be bored beneath the existing structures and therefore will not have any adverse visual or physical effect on this historic property. The other resources are recommended as not eligible for listing on the National Register of Historic Places (NRHP); therefore, cultural resource clearance for the proposed project is recommended.

II. ENVIRONMENTAL SETTING

This section of the report provides a description of the modern and prehistoric environment and considers those aspects of the physical environment that may have influenced the location and methods for finding archaeological sites. The discussion of the modern environment specifically provides information regarding the topography, soils, vegetation, and climate. In addition, the general prehistoric environmental conditions are discussed to place the archaeological record of the region within a relative environmental context.

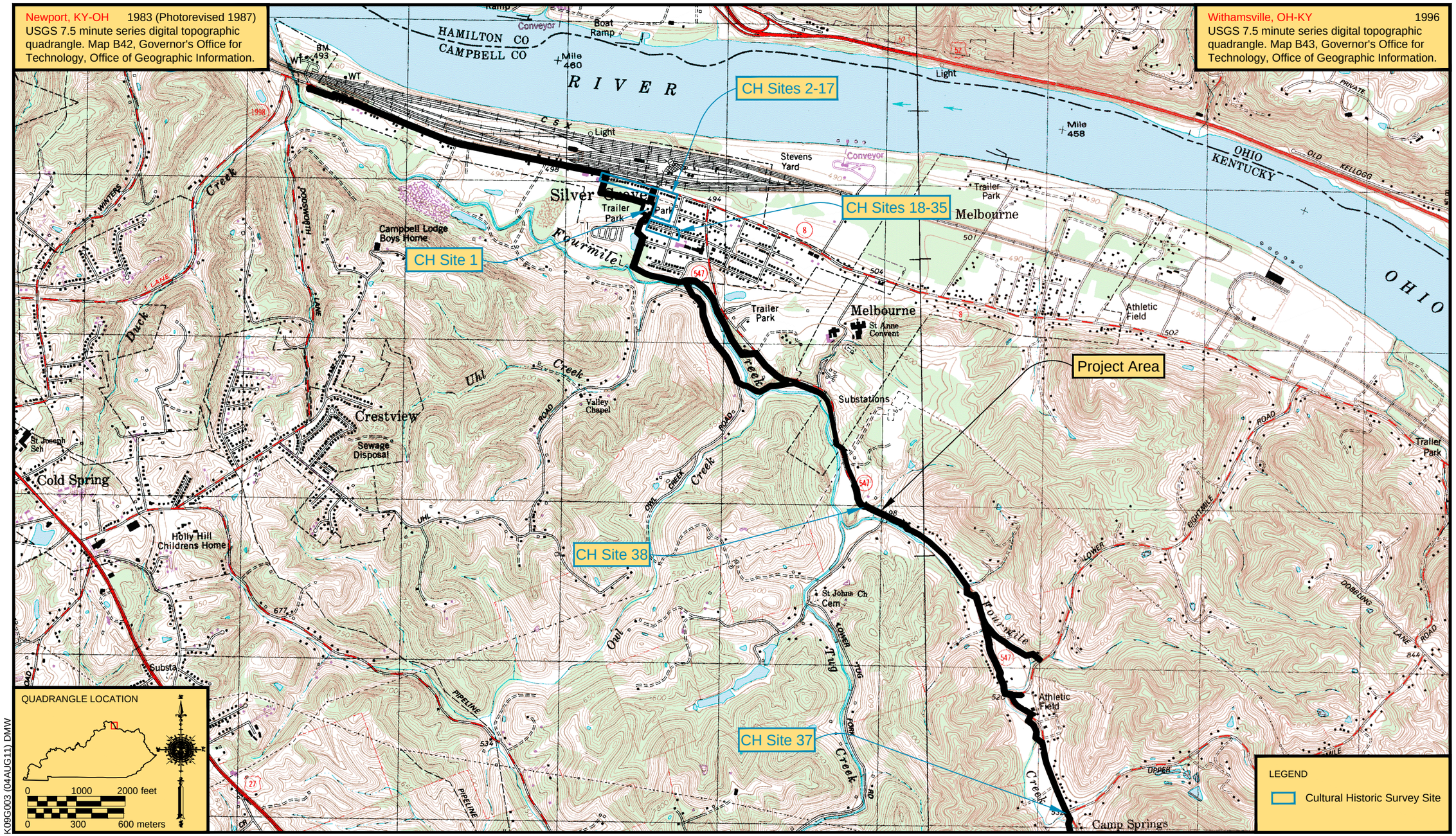


Figure 2a. Location of project area on topographic quadrangle.

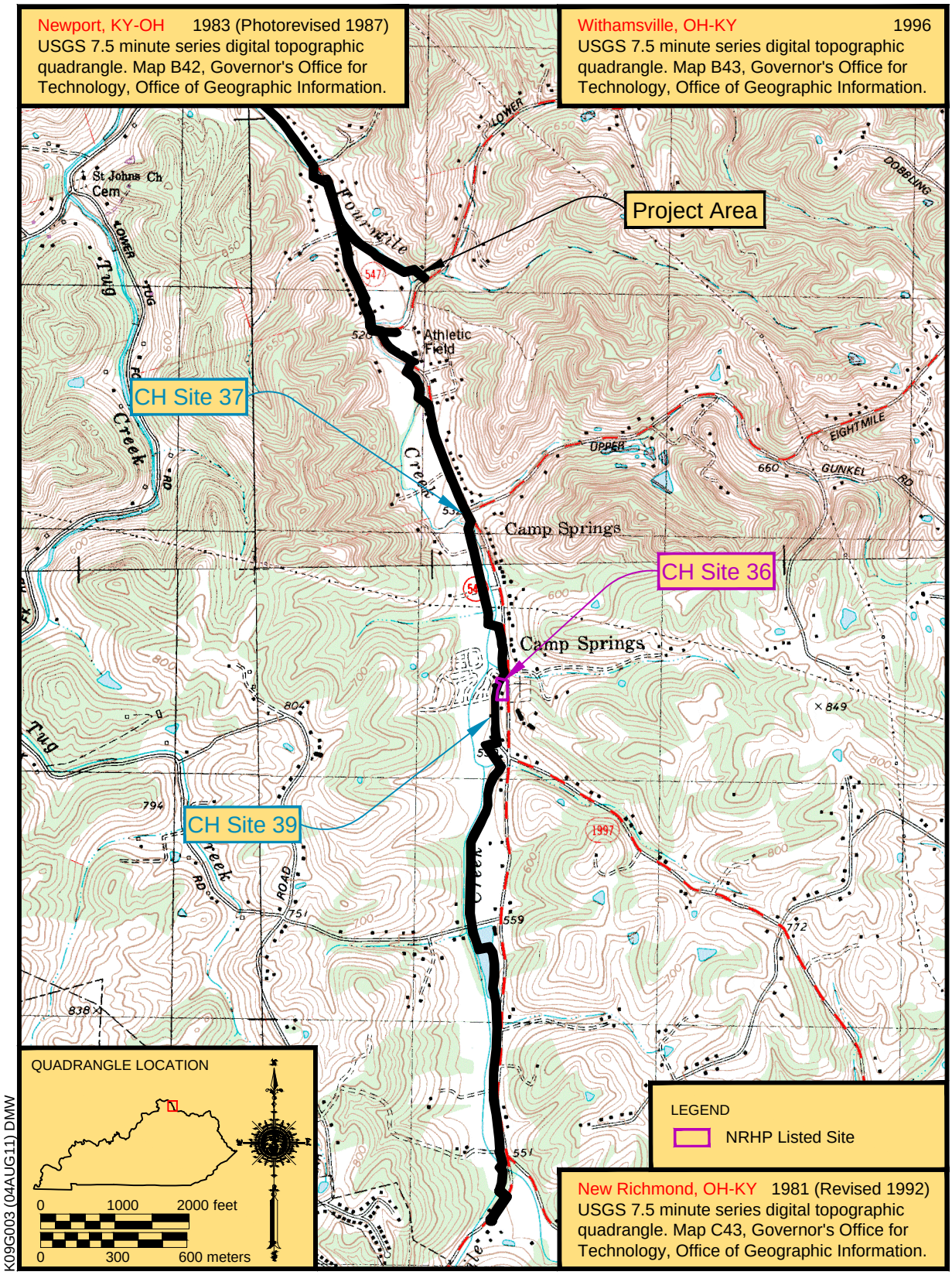


Figure 2b. Location of project area on topographic quadrangle.

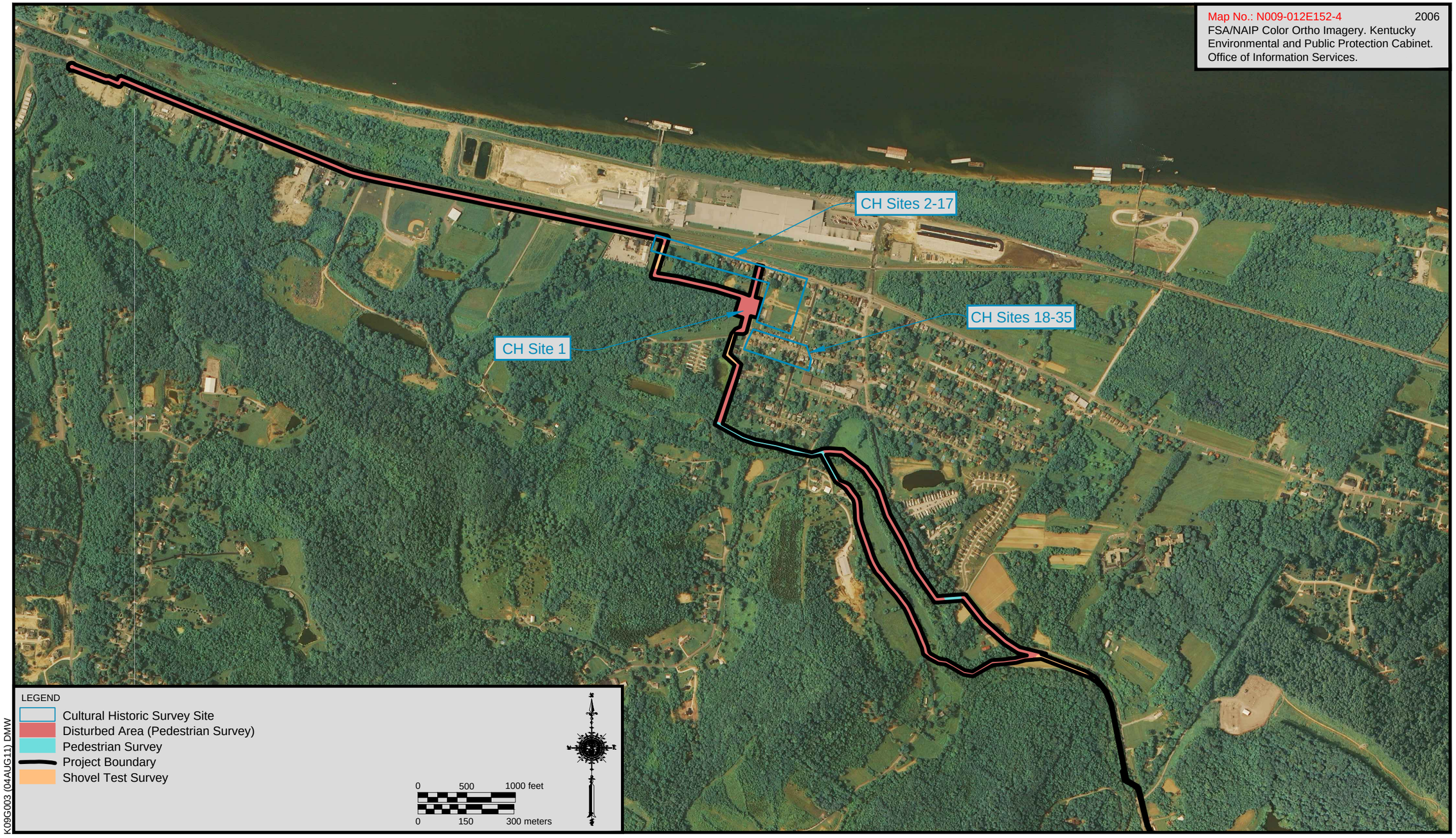


Figure 3a. Project area plan map.

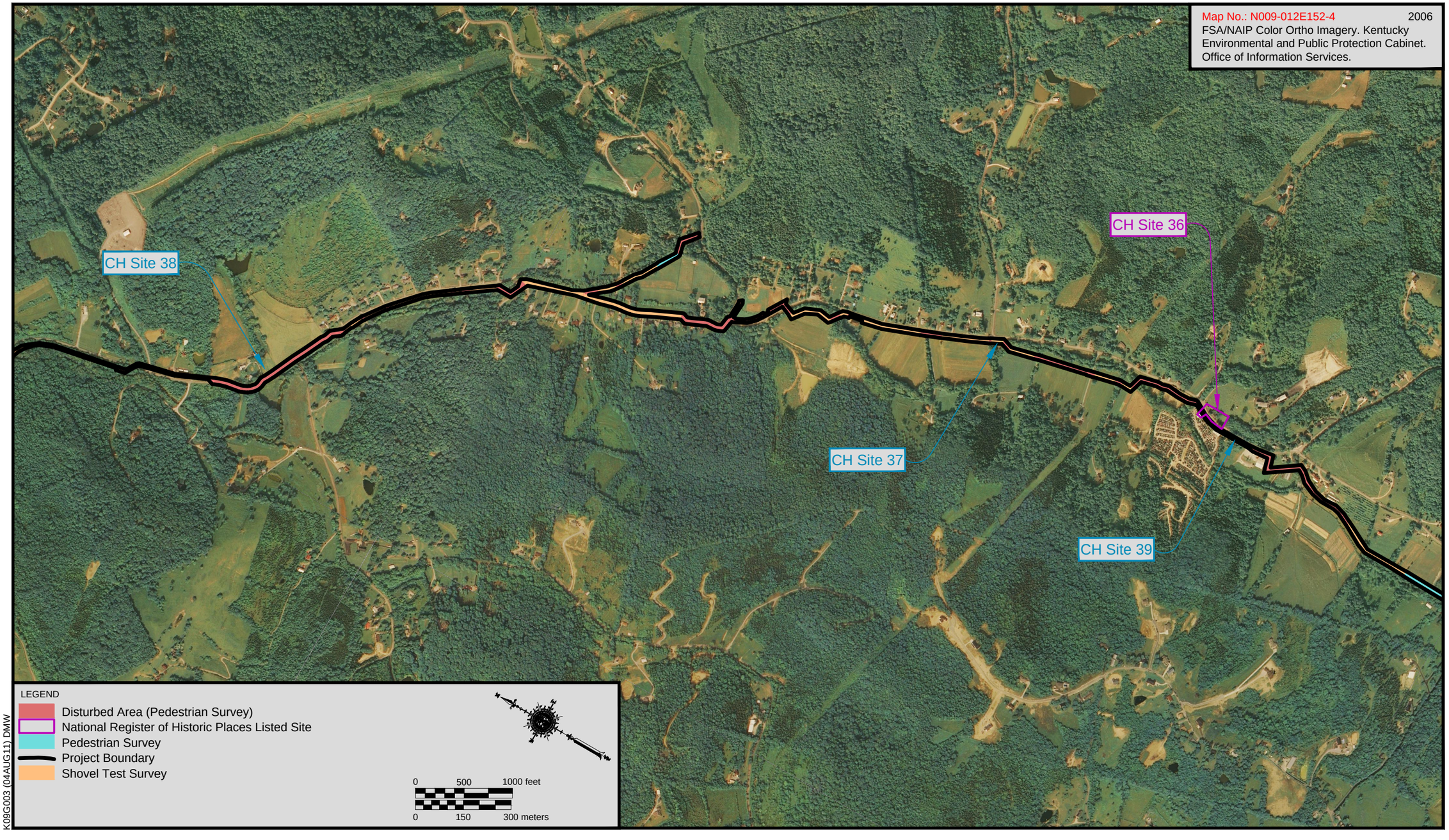


Figure 3b. Project area plan map.

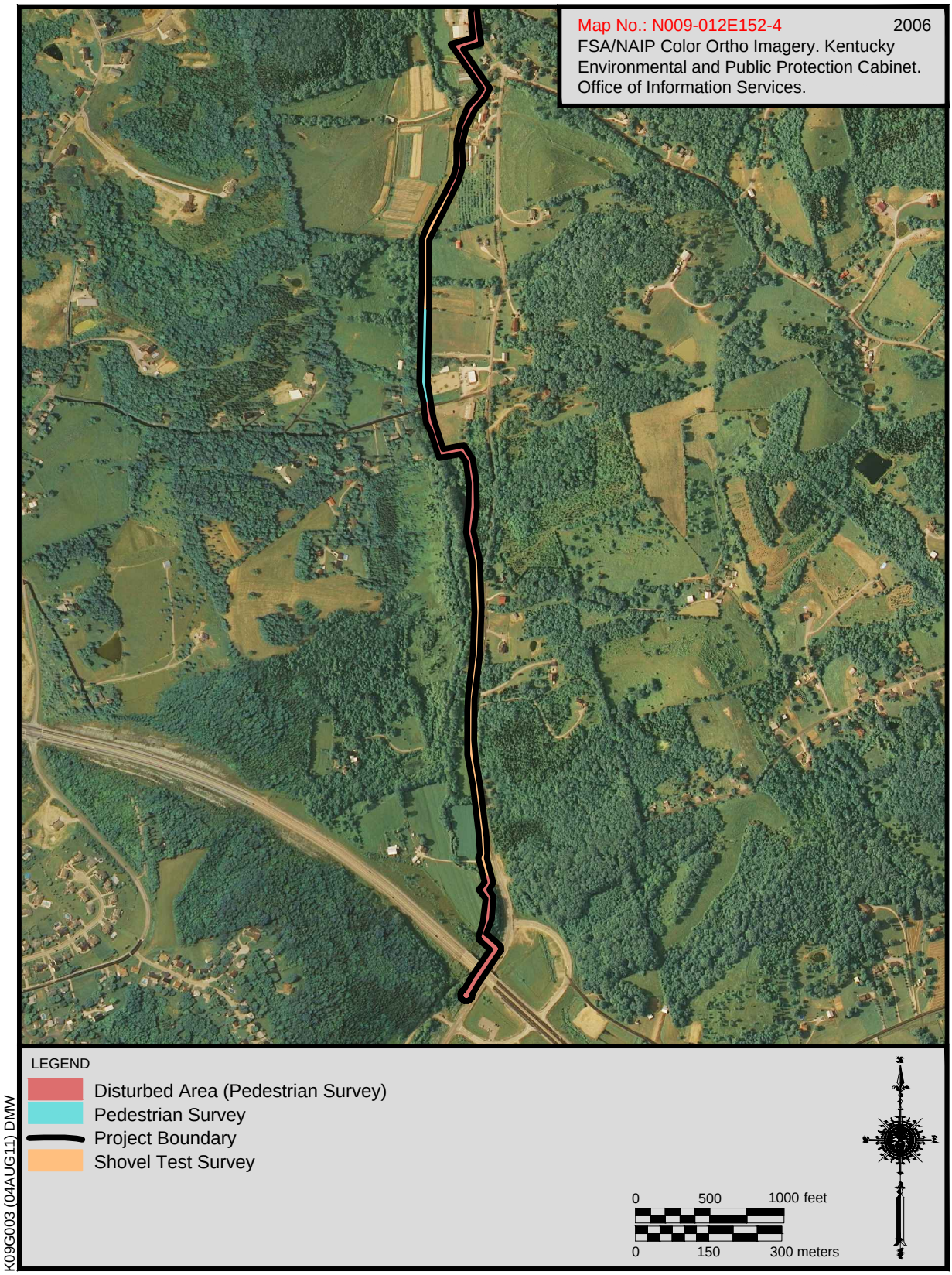


Figure 3c. Project area plan map.

Topography

The project area is located in the eastern portion of Campbell County in the Outer Bluegrass region of Kentucky (McGrain and Currens 1978). The topography of the Outer Bluegrass is characterized by rolling, high-grade limestone uplands that are slightly to moderately dissected (McGrain and Currens 1978). The majority of the project area consisted of floodplains and terraces with a few ridgetop, hillside, and dissected upland settings. Slopes ranged from nearly level to moderate. Elevations within the project area ranged between approximately 162 and 190 m (530 and 623 ft) above mean sea level (AMSL) (see Figures 2 and 3). The project area lies within the Licking River drainage (Figure 4).

Soils

Five soil associations are mapped within Campbell County: the Eden-Cynthiana, Faywood-Nicholson, Rossmoyne-Jessup, Licking-Captina, and Wheeling-Huntington-Alluvial land, steep (Weisenberger et al. 1973). Each soil association is comprised of one or more soil series. Every soil association and soil series represented within the project area is described in more detail below.

The proposed project area was located primarily within the Licking-Captina and Wheeling-Huntington-Alluvial land soil associations. The Licking-Captina association is found on stream terraces and is comprised of gently sloping soils with a clayey to loamy subsoil. Wheeling-Huntington-Alluvial land soils are found on stream terraces and bottoms along the Ohio River and some of its tributaries. These soils have loamy subsoil (Weisenberger et al. 1973:5–6).

Fourteen soil series were mapped for the project area (Table 1) and include Ashton, Avonburg, Brashear, Captina, Eden, Egam, Huntington, Lakin, Licking, Lindside, Newark, Nolin, Rossmoyne, and Wheeling (Weisenberger et al. 1973).

The Ashton series (Mollic Hapludalfs) consists of silt loam that is very deep, well drained, and moderately permeable. These soils formed in loamy alluvium on low stream terraces and alluvial fans, and slopes range from 0 to 15 percent. A typical soil profile consists of a dark brown (10YR 3/3) silt loam Ap horizon to a depth of 23 cm (9 in) over a brown (7.5YR 4/4) silt loam BA horizon to a depth of 38 cm (15 in) over a brown (7.5YR 4/4) silt loam Bt horizon. A C horizon extends between 102 and 203 cm (40 and 80 in) (Soil Survey Staff 2011).

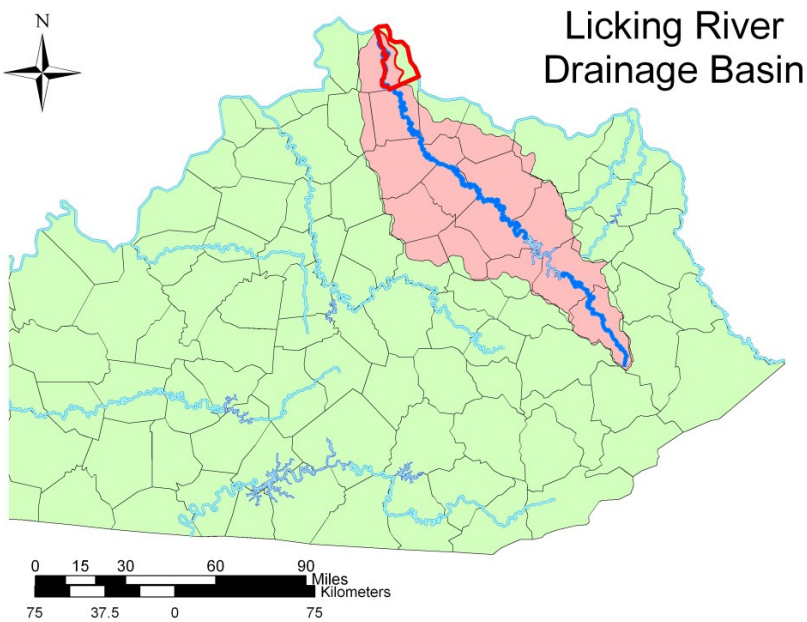


Figure 4. Map of the Licking River drainage basin.

Table 1. Summary of Soil Information for Project Area.

Symbol	Series Name	geomdesc	Taxonomic Order	Age
AsA	Ashton silt loam, 0 to 2 percent slopes (occasionally flooded)	stream terraces on river valleys	Alfisols	late Pleistocene deposits or surfaces
Av	Avonburg silt loam (0 to 4 percent slopes)	flats on uplands	Alfisols	late Pleistocene deposits or surfaces
BrC	Brashear silty clay loam, 6 to 12 percent slopes	ridges on uplands	Alfisols	late Pleistocene deposits or surfaces
BsD3	Brashear silty clay, 12 to 20 percent slopes, severely eroded	hills on uplands	Alfisols	late Pleistocene deposits or surfaces
CaB	Captina silt loam, 2 to 6 percent slopes	stream terraces on river valleys	Ultisols	Pleistocene to late Pliocene or older
EdE2	Eden silty clay loam, 20 to 35 percent slopes, eroded	hills on uplands	Alfisols	late Pleistocene deposits or surfaces
Eg	Egam silty clay loam, (woolper 0 to 4 percent slopes)	flood plains on valleys	Mollisols	late Wisconsin age deposits or surfaces
Hu	Huntington silt loam (0 to 4 percent slopes, occasionally flooded)	flood plains on river valleys	Mollisols	Holocene or late Pleistocene deposits
LaC	Lakin loamy fine sand, 2 to 12 percent slopes	stream terraces on river valleys	Entisols	on surfaces of any age from recent Historic to Pliocene (Udipsamments are generally on late Pleistocene or younger age)
LkA	Licking silt loam, 0 to 2 percent slopes	stream terraces on valleys	Alfisols	late Pleistocene deposits or surfaces
LkB	Licking silt loam, 2 to 6 percent slopes	stream terraces on valleys	Alfisols	late Pleistocene deposits or surfaces
LlD	Licking silty clay loam, 12 to 20 percent slopes	stream terraces on valleys	Alfisols	late Pleistocene deposits or surfaces
LlC	Licking silty clay loam, 6 to 12 percent slopes	stream terraces on valleys	Alfisols	late Pleistocene deposits or surfaces
Ln	Lindside silt loam (0 to 3 percent slopes, occasionally flooded)	flood plains on valleys	Inceptisols	developed in Holocene or late Pleistocene age deposits
Nk	Newark silt loam (0 to 2 percent slopes, occasionally flooded)	flood plains on river valleys	Inceptisols	developed in late Pleistocene or younger deposits
No	Nolin silt loam (0 to 3 percent slopes, occasionally flooded)	flood plains on river valleys	Inceptisols	Holocene or late Pleistocene deposits
RsB	Rossmoyne silt loam, 0 to 6 percent slopes	ridges on uplands	Alfisols	late Pleistocene age deposits
AlD	Wheeling (Alluvial land, steep, 25 to 30 percent slopes, rarely flooded)	stream terraces on river valleys	Alfisols	late Pleistocene deposits or surfaces
WhA	Wheeling silt loam, 0 to 2 percent slopes	stream terraces on river valleys	Alfisols	late Pleistocene deposits or surfaces
WhB	Wheeling silt loam, 2 to 6 percent slopes	stream terraces on river valleys	Alfisols	late Pleistocene deposits or surfaces

Avonburg series (Fragic Glossaqualfs) soils consist of very deep, somewhat poorly drained silt loams. These soils are found on the summits of loess-covered till plains and were formed in loess and the underlying paleosol and till. A typical profile consists of a yellowish brown (10YR 5/4) silt loam Ap horizon to a depth of 28 cm (11 in) over a brownish yellow (10YR 6/6) silt loam BE horizon to a depth of 53 cm (21 in). These surface soils overlie a complex series of four Bt horizons to a total depth of 229 cm (90 in) (Soil Survey Staff 2011).

The Brashear series (Typic Hapludalfs) consists of deep, well drained and moderately well drained soils that are moderately permeable and were formed in the residuum or colluvium of interbedded shale, siltstone, and limestone. These soils are typically found on footslopes and benches but can be found on upslopes with slopes ranging from 2 to 20 percent (Soil Survey Staff 2011). A typical profile consists of an Ap horizon between 0 and 18 cm (0 and 7 in) consisting of brown (10YR 4/3) silt loam over two Bt horizons: a yellowish brown (10YR 5/4) silty clay loam Bt1 and a yellowish brown (10YR 5/6) silty clay Bt2 to a total depth of 86 cm (34 in). These Bt horizons are followed by a Bc horizon of yellowish brown (10YR 5/4) silty clay to a depth of 114 cm (45 in) and a light olive brown (2.5Y 5/4) clay C horizon to a depth of 254 cm (100 in) (Soil Survey Staff 2011; Weisenberger et al. 1973:9–10).

Captina series (Typic Fragiudults) consist of very deep, moderately well drained silt loams. They are found on nearly level to moderately sloping uplands and formed in a thin mantle of silt, colluvium, and residuum weathered from limestone, cherty limestone and dolomite, or siltstone. Slopes range from 1 to 15 percent. A typical profile consists of a brown (10YR 4/3) silt loam Ap horizon to a depth of 23 cm (9 in) over a yellowish brown (10YR 5/4) silt loam BE horizon to a depth of 36 cm (14 in). These are followed by a complex series of five Bt horizons to a total depth of 203 cm (80 in) (Soil Survey Staff 2011).

The Eden series (Typic Hapludalfs) consists of moderately deep, well-drained soils that are slowly permeable and that were formed in residuum from interbedded calcareous shale, siltstone, and limestone. These soils are usually found on hillsides and narrow ridgetops with slopes ranging from 2 to 70 percent but are predominantly found on slopes of 20 and 30 percent (Soil Survey Staff 2011). A typical profile contains an Ap horizon between 0 and 15 cm (0 and 6 in) consisting of brown (10YR 4/3) silty clay loam over a Bt horizon characterized by light olive brown (2.5Y 5/4) silty clay with a few fine faint yellowish brown (10YR 5/6) mottles between 15 and 46 cm (6 and 18 in). The Bt horizon also contains 15 percent weathered shale and siltstone fragments. A BC horizon of light olive brown (2.5Y 5/4) flaggy silty clay with common fine faint olive brown (2.5Y 4/4) light yellowish brown (2.5Y 6/4) and olive (5Y 5/3) mottles can be found between 46 and 61 cm (18 and 24 in). The BC horizon also contains 25 percent weathered shale and siltstone fragments. The last two zones of the Eden series profile are a Cr1 horizon of olive gray (5Y 5/2) slightly weathered interbedded calcareous shale and siltstone with some strata of fractured limestone found between 61 and 127 cm (24 and 50 in) over a Cr2 horizon found between 127 and 203 cm (50 and 80 in) characterized by interbedded soft gray (N 5/0) calcareous shales and siltstones and thin-bedded gray hard fossiliferous limestone (Soil Survey Staff 2011; Weisenberger et al. 1973:13–14).

The Egam series (Cumulic Hapludolls) consists of silty clay loam soils that are “very deep, well drained or moderately well drained soils that formed in clayey alluvium on flood plains and in depressions” (Soil Survey Staff 2011). Slopes are typically less than 2 percent but can be as high as 5 percent. A typical profile consists of a dark brown (10YR 3/3) silty clay loam Ap horizon to a depth of 18 cm (7 in) followed by a very dark grayish brown (10YR 3/2) silty clay loam A horizon to a depth of approximately 56 cm (22 in). The subsoil consists of three very dark grayish brown (10YR 3/2) to brown (10YR 4/3) silty

clay Bw horizons to a total depth of 190 cm (75 in) (Soil Survey Staff 2011).

Huntington series soils consist of deep, well drained soils that are on first bottoms along rivers and small creeks. These Hapludoll soils, which are located along the Ohio River, formed in mixed sediment of Holocene or late Pleistocene age that washed from the upper part of the Ohio River basin. Those along the creeks formed in sediment that washed mostly from soils of limestone origin (Soil Survey Staff 2011).

The Lakin series soils (Lamellic Udipsamments) are excessively-drained soils formed from sandy materials deposited by wind or water and are generally found in hummocky areas on stream terraces and uplands along the Ohio River. These soils typically have a dark brown (10YR 3/3) loamy sand Ap-horizon overlying a brown (10Y 4/3) loamy sand A-horizon followed by a dark yellowish brown (10YR 4/4) loamy sand B-horizon (Weisenberger et al. 1973:6, 18; Soil Survey Staff 2011).

Licking series soils (Aquic Hapludalfs) consist of very deep, moderately well drained silt loams. They formed in a silty mantle over clayey lacustrine deposits on terraces and slopes ranging between 0 and 25 percent. A typical profile consists of a brown (10YR 4/3) silt loam Ap horizon to a depth of 18 cm (7 in) over a yellowish brown (10YR 5/6) silt loam BE horizon to a depth of 28 cm (11 in). These near-surface soils overlie a series of 3 Bt horizons to a depth of 91 cm (36 in) over a series of three C horizons to a total depth of 213 cm (84 in) (Soil Survey Staff 2011).

Lindside series (Fluventic Endoaquepts) consists of very deep, moderately well drained soils formed in alluvium washed mainly from lime-influenced soils on uplands. These soils occur on nearly level floodplains. They typically have a dark grayish brown (10YR 4/2) silt loam A-horizon overlying a brown (10YR 4/3) silt loam BA horizon to approximately 43 cm (17 in). A brown (10YR 4/3) silty clay loam Bw-horizon with many fine and medium distinct yellowish red (5YR 4/6) masses of oxidized iron and few fine and medium distinct grayish brown (10YR 5/2) iron depletions commonly underlies these surface soils (Soil Survey Staff 2011).

The Newark series (Fluventic Endoaquepts) soils consist of very deep, somewhat poorly drained soils formed in mixed alluvium from limestone, shale, siltstone, sandstone, and loess (Whitaker and Waters 1986:94). The soil is on nearly level floodplains and in depressions. These soils are widely scattered throughout creek and river valleys and developed in late Pleistocene or younger deposits. Those soils along small creeks formed in sediment that washed mostly from soils of limestone origin, and those in the Ohio Valley formed in mixed sediment that washed from the upper part of the Ohio River basin. These soils typically have a brown (10YR 4/3) silt loam A-horizon over a brown (10YR 5/3) silt loam Bw-horizon that has many fine and medium faint light brownish gray (10YR 6/2) iron depletions. Commonly, the sediments are gleyed below 15 inches in these soils as a result of a high water table (Soil Survey Staff 2011).

Nolin series (Fluventic Eutrudepts) soils consist of very deep, well drained soils formed in alluvium derived from limestones, sandstones, siltstones, shales, and loess (Whitaker and Waters 1986:95–96). These nearly level to moderately steep soils are on floodplains, in depressions which receive runoff from surrounding slopes, or on natural levees of major streams and rivers. Nolin soils are weakly developed and typically have a brown (10YR 4/3) silt loam A-horizon over a brown (10YR 4/3) silt loam Bw-horizon with few, medium faint yellowish brown (10YR 5/4) mottles of highly weathered siltstone (Soil Survey Staff 2011).

The Rossmoyne soil series consists of "deep, moderately well drained soils that contain a fragipan" (Weisenberger et al. 1973:3). These soils were formed in either loess or glacial till and occur mostly on the broad glaciated ridges in the region. This soil series has been classified as a fine-silty, mixed, super active, mesic Aquic Fragiudalfs (Soil Survey Staff 2011). In a representative

profile, the topsoil is a dark brown silt loam to a depth of 18 cm (7 in) and is underlain by a dark brown silt loam to a depth of 28 cm (11 in). These soil horizons are then underlain by yellowish brown silty clay loam to a depth of 53 cm (21 in) (Weisenberger et al. 1973:24–25).

The Wheeling series (Ultic Hapludalfs) is comprised of deep and well drained soils that formed in loamy material underlain by sand or sand and gravel. Wheeling soils are associated with the Nolin soils on nearby floodplains. Slopes range from 0 to 55 percent. A typical Wheeling soil profile consists of a brown (10YR 4/3) silt loam Ap horizon to 23 cm. This is underlain by a strong brown (7.5YR 5/6) silty clay loam subsoil (Soil Survey Staff 2011).

Observed Soils

The soil profiles revealed in shovel test probes (STPs) within the project area varied depending on the topographic situation. Soils observed were generally associated with their mapped soil series. The typical profile for agricultural pastures that had been subjected to plowing revealed a dark brown (10YR 3/3) sandy loam topsoil that ranged in depth from 0 to 20 cm (0 to 8 in) below ground surface (bgs). The underlying subsoil generally consisted of yellowish brown (10YR 5/6) or brownish yellow (10YR 6/6) sandy loam or sandy clay loam. On hillsides and slopes, the topsoil had been extensively eroded. The profile typically consisted of a thin yellowish brown (10YR 5/6) clayey silt loam extending to approximately 5–7 cm (2–3 in) bgs. The underlying subsoil was characterized by brownish yellow (10YR 6/8) clay loam or clay. Soils situated within drainages and in floodplains usually indicated brown (10YR 4/3) silty clay loam topsoil extending to approximately 5–10 cm (2–4 in) bgs with an underlying gray (10YR 6/1) clay subsoil. Soils noted within previously disturbed areas that included mostly commercial and residential yards contained mixtures of strong brown (7.5YR 4/6), gray (10YR 5/1), and yellowish brown (10YR 5/8) clay subsoil that was mixed with gravel or rock.

Vegetation

The Outer Bluegrass physiographic province is located within the Western Mesophytic Forest (Braun 1950:146). The major vegetation types in this region form a complex mosaic strongly influenced by underlying geologic strata. This is in strong contrast to the situation in the Mixed Mesophytic Forest to the east. Forests in the Inner Bluegrass are generally less luxuriant than those in the Appalachian Plateau and have a greater tendency toward dominance of a few species (Braun 1950:122-123).

The transition from extensive, mixed Mesophytic communities in the far eastern part of the state to extensive oak and oak-hickory communities in central and western Kentucky is well marked despite the more generalized mosaic pattern and the presence of large prairie areas (Braun 1950:123). While old forest trees remain on large estates, there are no extensive areas of original vegetation outside of the river gorges in the Bluegrass and it is impossible to reconstruct a picture of the original forest conditions (Braun 1950:125). Beech trees are not represented naturally in the Inner Bluegrass forest however; beech trees are part of the forested areas in the Outer Bluegrass. The western Mesophytic forest is dominated by oak and hickory, but a wide variety of other species are represented.

Oak, oak-hickory, and oak-chestnut communities occupy many of the drier slopes and uplands while an oak-tuliptree type is represented in areas of low relief. Pine woods, more extensive in secondary than in primary growth, cover many of the Devonian age shale slopes (Braun 1950:137–138; Niquette and Henderson 1984).

Modern Climate

The climate of Kentucky is continental in character. As a result, temperature and precipitation levels throughout the state fluctuate widely. The prevailing surface winds originate in the Gulf of Mexico and are southerly and weak, allowing upper-level

westerly winds to steer weather systems across the state. These factors result in warm, moist air coming from the south, while cooler and drier air is derived from the north. Mean annual temperatures across the state range from 53 degrees Fahrenheit in the northeast to 59 degrees Fahrenheit in the southwest. Overall, there is significant seasonal variation in temperature, with approximately 20 degree differences possible during summer and winter months, as well as up to 25 degree shifts in the spring and fall. Average annual precipitation across the state ranges from 106.68 cm (42 in) in the north to 132.08 cm (52 in) in the south. Warm, moist tropical air masses derived from the Gulf of Mexico are most common during the summer months and contribute to the high humidity levels experienced in the state. During the spring and fall, storm systems tend to be less severe and less frequent, resulting in less radical climate extremes (Foster and Conner 2008).

In Campbell County, Kentucky, the average daily maximum temperature in January is 36 degrees Fahrenheit. July is the warmest month with an average daily maximum temperature of 85 degrees Fahrenheit. The total annual precipitation in the Kenton, Campbell, and Boone County area is 41.5 in (Weisenberger et al. 1973).

Description of the Project Area

The current project area begins at an existing pumping station in the community of Silver Grove on the north end, passes through the community of Camp Springs in the center, and terminates at another existing pump station 2.7 km (1.7 mi) northeast of the community of Alexandria on the south end. For most of its length, the proposed force main parallels the Mary Ingles Highway and Four Mile Road (KY 547) (see Figures 2 and 3).

Terrain within the current project area consisted of floodplains and terraces with a few small dissected upland ridges. Elevations ranged between 162 m (530 ft) AMSL along the Mary Ingles Highway in the northern portion of the project area and approximately 190 m (623 ft) AMSL along upland ridges in the southern portion of the project area along Four Mile Road.

Land within the project area was used for agricultural, commercial, and residential purposes (Figures 5–8). The agricultural areas included pastures that typically held short grass and weeds, as well as occasional stands of deciduous trees. The majority of commercial and residential properties had extensive ground surface disturbance due to landscaping and access roads.

III. PREVIOUS RESEARCH AND HISTORIC CONTEXT

Prior to initiating fieldwork, a search of records maintained by the OSA (Registration Number FY10_6237) was conducted to: 1) determine if the project area had been previously surveyed for archaeological resources; 2) identify any previously recorded archaeological sites that were situated within the project area; 3) provide information concerning what archaeological resources could be expected within the project area; and 4) provide a context for any archaeological resources recovered within the project area. The work at OSA consisted of a review of professional survey reports and records of archaeological sites for an area encompassing a 2 km radius of the project footprint. To characterize the archaeological resources in the general area further, the OSA archaeological site database for the county was reviewed and synthesized. The review of professional survey reports and archaeological site data for the county provided basic information on the types of archaeological resources that were likely to occur within the project area and the landforms that were most likely to contain these resources. The results are discussed below.

Figure 5. General overview of project area depicting commercial area, facing east.

Figure 6. General overview of project area depicting typical terrain and vegetation, facing south.

Figure 7. General overview of project area depicting utility disturbance, facing north.

Figure 8. General overview of typical ground surface disturbance associated with residential properties, facing north.