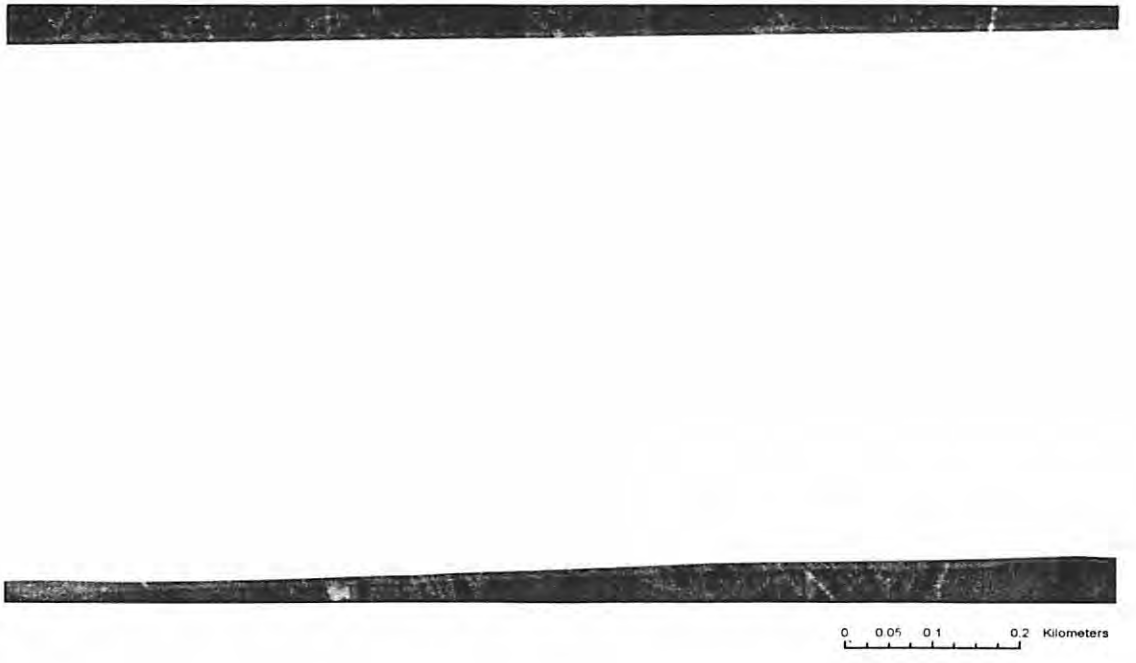
Trenching was conducted along the floodplain/terrace interface from the eastern project limits to a

Figure 3

Portion of French Lick Quadrangle Showing
Location of Phase Ic Trenches



point where the project parcel becomes constricted by the Lick Creek channel, two drainage ditches and an agricultural access lane. Due to the constraints imposed by these impediments, it was necessary to reduce intervals between trenches to 40 m in this particular segment of the project.

Backhoe trenching was conducted in accordance with DHPA Guidelines and OSHA standards. A 1.5 m toothless bucket was utilized to excavate trenches a minimum of 5 m in length and typically excavated to depths where ground water was encountered (Table 1).

Table 1. General trench dimensions.

Trench #	Length (m)	Maximum Depth (m)
1	6.4	2.7
2	8.0	2.3
3	6.75	2.25
4	8.0	1.6
5	7.0	1.6
6	6.0	2.5
7	6.3	2.0

Upon excavation, one trench wall was stepped for safety after initial inspection. Trench walls were scraped by Ingalls handpick or trowel and examined for the presence of cultural materials. Stratigraphic profiles were then mapped and formally described based on standard USDA soil terminology (Soil Survey Division Staff 1993). Trench locations were plotted using a Trimble GeoExplorer handheld GPS unit (NAD 83 datum) and differential correction software. All artifacts were collected and transported back to ISUAL for cleaning, accessioning, and permanent curation. The archaeological site was designated by a state-issued site number, plotted on a standard USGS 7.5' topographic quadrangle map, and a site form was completed.

Trench Descriptions

Trenches 1 and 2

Trench 1 (Figure 4) and Trench 2 (Figure 5) were excavated west of the main excavations to confirm generally poor drainage conditions as observed during an earlier geoarchaeological assessment for this project (Holycross, Cantin & Stafford 2003). Although, cambic B (Bw) horizons are thicker and solum depths are more extensive than descriptions (Soil Survey Staff 1984) for a typical Haymond silt loam pedon, trenches 1 and 2 display profiles that generally correlate with those of the Haymond silt loam, frequently flooded. Sedimentological differences exist between these two

trenches, but differences in the amount of sand and presence of loam and sandy loam strata are noted in the aforementioned descriptions. Bw horizons could be subdivided, but this was not practical in the field and they are represented in profile maps as a single entity. No cultural materials were identified in trenches 1 and 2. Formal descriptions are provided for these two trenches in Table 2 and Table 3.

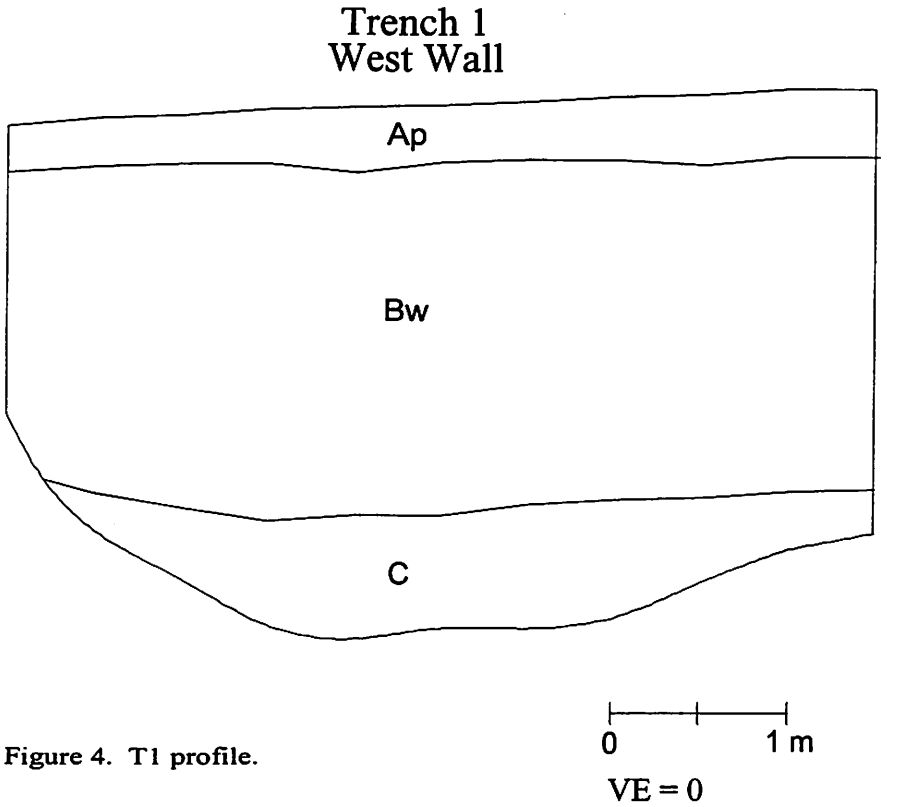


Figure 4. T1 profile.

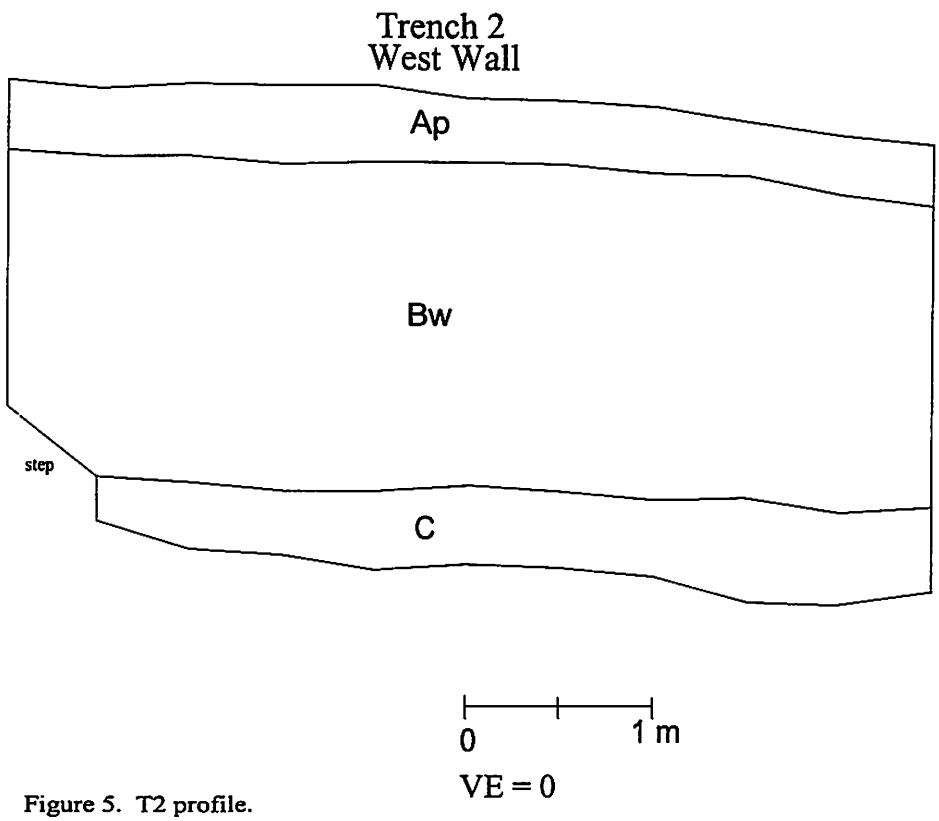


Figure 5. T2 profile.

Table 2. US 150 Trench 1 - Lick Creek Floodplain.

UTM North End: N4270461 E536227 UTM South End: N4270453 E536223

0-30 cm	10YR3/4 (dark yellowish brown) silt loam Moderate, medium granular structure Clear Boundary	Ap
30-200 cm bs	10YR4/4 (dark yellowish brown) silt loam to silty clay loam Moderate, fine subangular blocky structure Few, fine, distinct 10YR5/8 (yellowish brown) and 7.5YR4/6 (strong brown) mottles Few, fine 10YR2/1 manganese accumulations Many, 10YR6/1 krotivina Gradual Boundary	Bw
200-270 cm bs	7.5YR4/3 (brown) silty clay loam Massive structure Few, faint to distinct, fine to medium 7.5YR4/4 (brown) to 7.5YR4/6 (strong-brown) mottles Common, 10YR6/1 krotivina Few, fine 10YR2/1 manganese accumulations	C

Table 3. US 150 Trench 2 - Lick Creek Floodplain.

UTM North End: N4270276 E536748 UTM South End: N4270265 E536750

BFS Trench 2 Lick Creek Floodplain		
0-30 cm bs	10YR3/3 (dark brown) silt loam Moderate, medium granular structure Clear Boundary	Ap
30-190 cm bs	10YR4/4 (dark yellowish brown) silt loam to loam Moderate, fine subangular blocky structure Few, fine to medium, distinct 7.5YR4/6 (strong brown) mottles Few, fine 10YR2/1 manganese accumulations Many, 10YR6/1 krotivina Gradual Boundary	Bw

190-230 cm bs	7.5YR4/4 (brown) sandy loam Massive structure Few, distinct, medium 7.5YR4/6 (strong-brown) mottles Common, 10YR6/1 krotivina Few, fine 10YR2/1 manganese accumulations	2C

Trench 3

Trench 3 (Figure 6) was one of five trenches (T3-T7) excavated in the eastern portion of the project. The goal of work in this area was to better define an older Holocene alluvial unit (and any buried prehistoric remains that may be present) identified as a result of coring. In this area of the project, Lick Creek is entrenched within an approximately 0.35 km wide floodplain. Additional relief is provided by a terrace (upon which US 150 has been constructed) which quickly gives way to the uplands that rise about 30 m above the floodplain. Backhoe trenches were excavated along the floodplain/terrace interface (in front of the toe-slope), roughly perpendicular to both Lick Creek and the terrace. Trenching along the floodplain and terrace interface revealed soils with A-Bw-C profiles, but contact with ground water was made in three trenches before the C horizon was encountered. While all exposed soil profiles in this series of trenches revealed cumlic or over-thickened A horizons, Trench 3 is unique among the five excavated in this area and is discussed separately.

Trench 3 represents an anomaly within the group of five trenches excavated in this area due to the vertical extent of generally homogenous A horizon materials (1.5+ m). The extent of these deposits make this profile depart significantly from that of a typical Haymond silt loam, frequently flooded pedon (Soil Survey Staff 1984). No subdivision of A horizons, other than plowzone definition, was made in the field. The profile of Trench 3 differs from that identified during earlier coring nearer to the Lick Creek channel (Entisol overlying a buried solum) and that of Trench 4 (40 m east) which revealed A horizon materials that were of lesser thickness (ca. .5 m). The extent of these deposits may be attributable to both alluvial and colluvial deposition with its proximity to both the Lick Creek channel and the upland bluff line. However, the generally well-sorted nature of the deposits and distance from the bluff line suggest alluviation is the dominate mode of deposition. Although, some limited colluvial deposits are probably present as well. Other possible influences may include a depression which once existed in the area of the trench and served as a sump for organic material. Also, the construction of US150 and a reported earlier roadway (local landowner interview) may have been contributing factors to the extent of the A horizon. However, the lack of observed mixing of deposits would suggest that the impacts of these events were relatively minor.

A layer of moderate charcoal concentration was observed in the trench wall ranging from ca. 55 cm to 65 cm below ground surface and extending about 10 cm beyond these depths. No other inclusions (e.g., rock etc.) were associated with this zone, but due to limited artifact recovery from Trenches 4 and 7, an approximate 70 cm-75 cm sediment column was screened. This sediment column, extending to the base of the charcoal enriched zone, was removed from the south end of the

trench. No cultural materials were recovered associated with Trench 3. A formal description for Trench 3 is provided in Table 4.

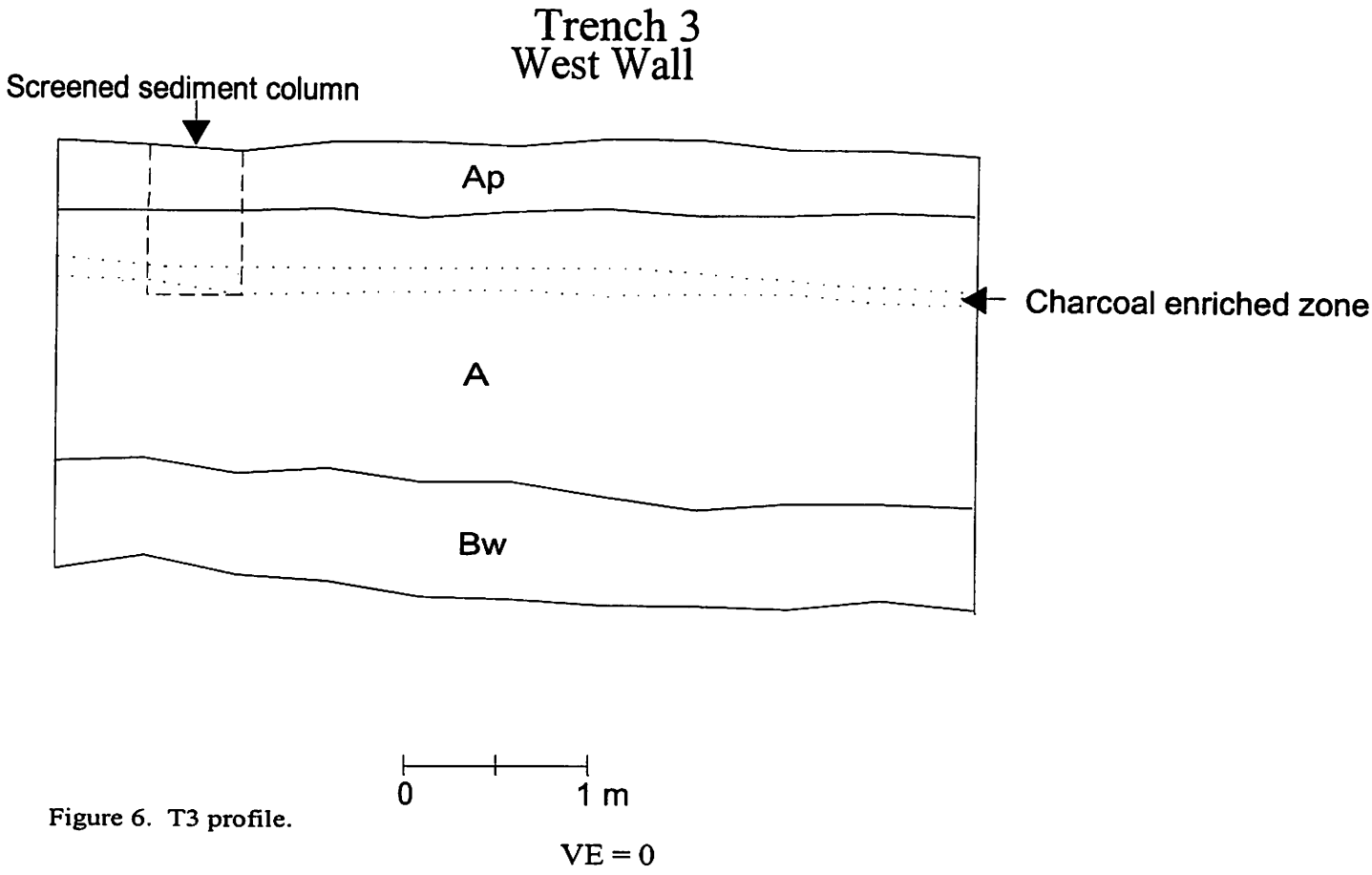


Figure 6. T3 profile.

Table 4. US 150 Trench 3 Lick Creek Floodplain/Terrace interface.

UTM North End: N4270246 E537396 UTM South End: N4270245 E537387

0-32 cm bs	10YR3/3 (dark brown) silt loam Moderate, medium granular structure Gradual Boundary	Ap
32-160 cm bs	10YR3/3 (dark brown) silt loam Moderate, medium granular structure Gradual Boundary	A
160-225 cm bs	7.5YR4/4 (brown) silt loam Moderate, fine subangular blocky structure Few, fine, faint 10YR4/3 (brown) mottles few to common 10YR6/1 krotivina	Bw

Trenches 4 and 5

Trench 4 (Figure 7) and Trench 5 (Figure 8) revealed similar silt loam dominated sediment assemblages and soil profiles. Also, ground water was encountered at shallower depths than other areas in this portion of the project (ca. 1.6 m). A difference between the profiles of these two trenches was that mottling was more pronounced within the Bw (cambic) horizon of Trench 5 than Trench 4. The extent of A horizons (ca. 40 cm-50 cm) also make these profiles depart somewhat from that of a typical Haymond silt loam pedon (Soil Survey Staff 1984).

A few, very fine pieces of wood charcoal were observed within these trench walls in the A and Bw horizons, but no discreet zones of enrichment were definable. Also, a small number of oxidized and deteriorating pieces of sandstone were noted in the walls and along the floor (Bw horizon) of these trenches (n=4). The clasts are not interpreted as cultural. This is due to a lack of any discernable patterning (concentrations or traceable zones), evidence of in-place burning and lack of association with other more definitive cultural materials. The sandstone has likely oxidized due to natural processes prior to deposition and burial.

Cultural material from these two trenches consist of a single Holland chert secondary flake recovered from Trench 4 during the stepping of the trench's east wall. While the flake was not recovered in-situ, it was recovered during mechanical excavation near the base of the plowzone. In an attempt to provide more definitive definition of the occupation associated with the recovered flake, 50 cm sediment columns were screened from the north end of both trenches. These columns penetrated beyond the base of the plowzone, but no additional cultural materials were recovered. Formal descriptions are provided for these two trenches in Table 5 and Table 6.

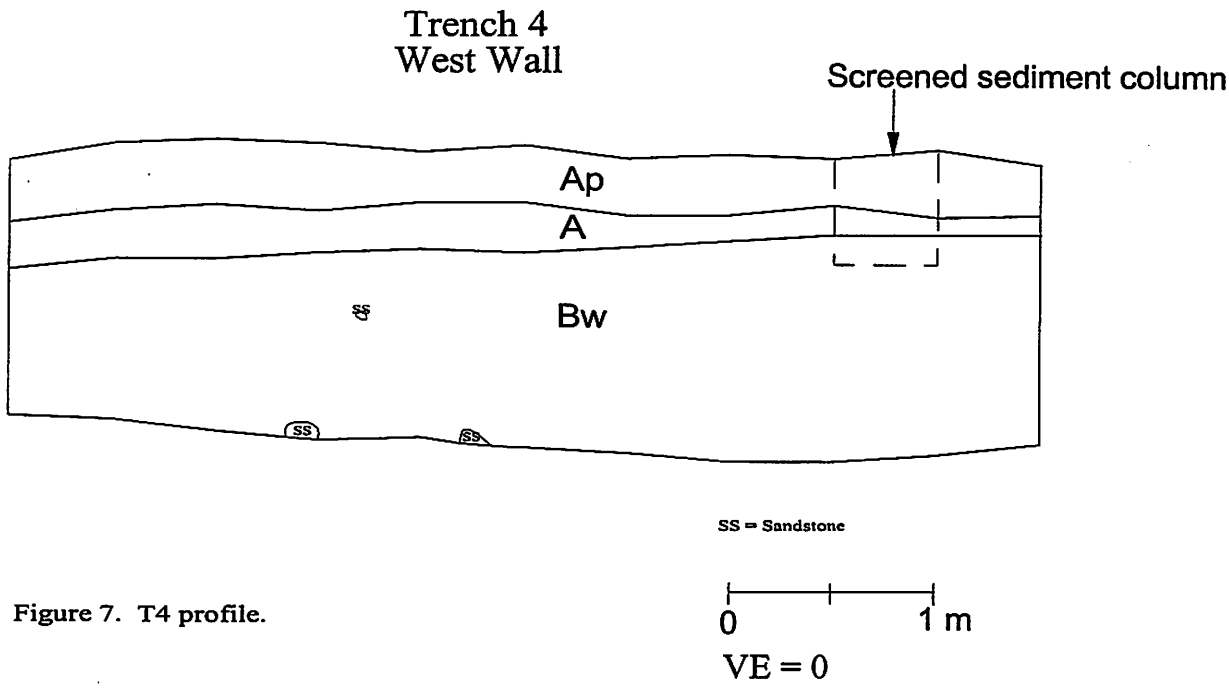


Figure 7. T4 profile.

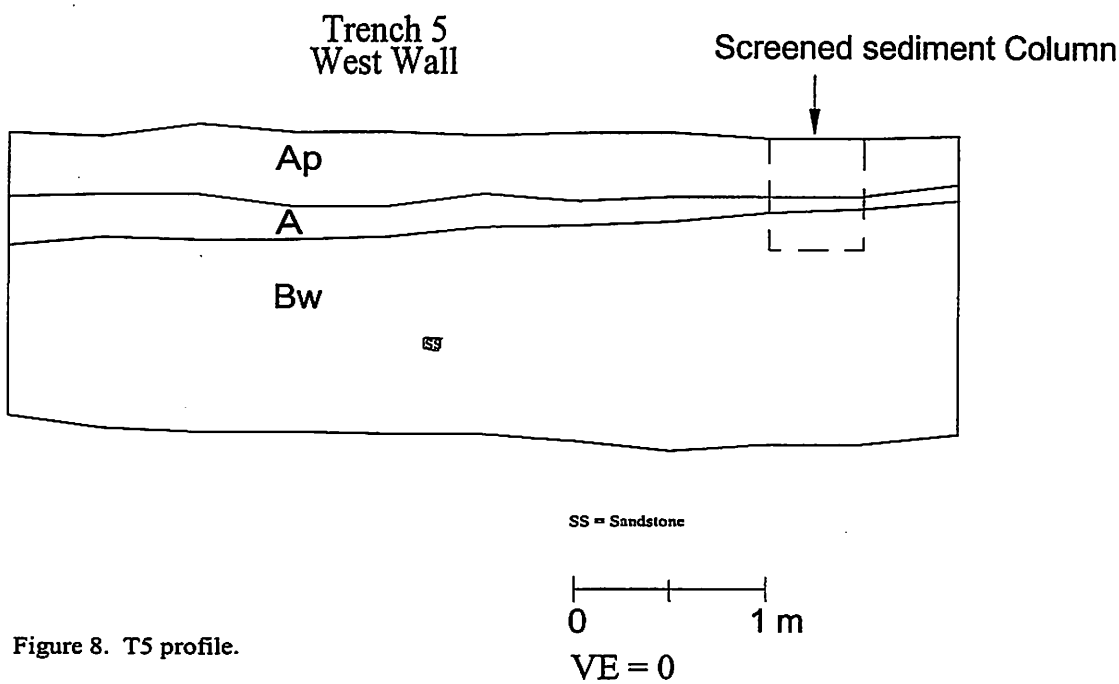


Figure 8. T5 profile.

Table 5. US 150 Trench 4 - Lick Creek Floodplain/Terrace interface.

UTM North End: N4270207 E537402 UTM South End: N4270205 E537393

0-30	10YR3/3 (dark brown) silt loam Moderate, medium granular structure Few, fine 10YR2/1 manganese accumulations Few, fine, distinct 7.5YR5/8 (strong-brown) mottles Clear Boundary	Ap
30-50	10YR3/3 (dark brown) silt loam Moderate, medium granular structure Few, fine 10YR2/1 manganese accumulations Few, fine, distinct 7.5YR5/8 (strong-brown) mottles Clear Boundary	A
50-160	7.5YR4/4 (brown) silt loam Moderate, fine subangular blocky structure Few, fine, faint 10YR4/4 (dark yellowish brown) mottles Few, fine 10YR2/1 manganese accumulations Many, 10YR6/1 krotivina	Bw

Table 6. US 150 Trench 5 - Lick Creek Floodplain/Terrace interface.

UTM North End: N4270170 E537413 UTM South End: N4270166 E537405

0-30	10YR3/3 (dark brown) silt loam Moderate, medium granular structure Few, fine 10YR2/1 manganese accumulations Few, fine, distinct, 7.5YR5/8 (strong-brown) mottles Clear Boundary	Ap
30-40	10YR3/3 (dark brown) silt loam Moderate, medium granular structure Few, fine 10YR2/1 manganese accumulations Few, fine, distinct, 7.5YR5/8 (strong-brown) mottles Clear Boundary	A
40-160	7.5YR4/4 (brown) silt loam Moderate, fine subangular blocky structure Common, fine to medium, distinct 7.5YR5/8 (strong-brown) mottles Few, fine 10YR2/1 manganese accumulations Many, 10YR6/1 krotivina	Bw

Trenches 6 and 7

Trench 6 (Figure 9) and Trench 7 (Figure 10) displayed similar fine-grained, overbank dominated sediment assemblages and soil profiles. Trench 6 was excavated to a depth where contact was made with ground water (ca. 240 cm-250 cm), but excavation was terminated at shallower depths with Trench 7, upon identification of C horizon material. A horizons approximately 50 cm in depth were overlying, thick Bw horizons which could likely be subdivided. C horizons were identified at depths of about 200 cm-215 cm.

As was the case with Trench 3, a layer of moderate charcoal concentration was observed in the wall of Trench 6. Occurring at depths of approximately 40 cm-45 cm below surface, this zone was 10 cm-20 cm in thickness and extended into the Bw horizon. No other inclusions were associated with this charcoal zone that is possibly contemporaneous with that encountered in Trench 3.

Cultural material recovered during excavating, scraping and mapping of Trenches 6 and 7 consisted of a single Indian Creek chert secondary flake. This artifact was recovered from Trench 7 during the stepping of the trench's east wall, near the base of the plowzone.

50 cm-60 cm sediment columns were screened from the north end of both trenches. These columns penetrated beyond the base of A horizons and the charcoal enriched strata of Trench 6. This screening resulted in the recovery of one Indian Creek chert tertiary flake from the plowzone of Trench 7 (ca. 15 cm below surface). Formal descriptions are provided for these two trenches in Table 7 and Table 8.

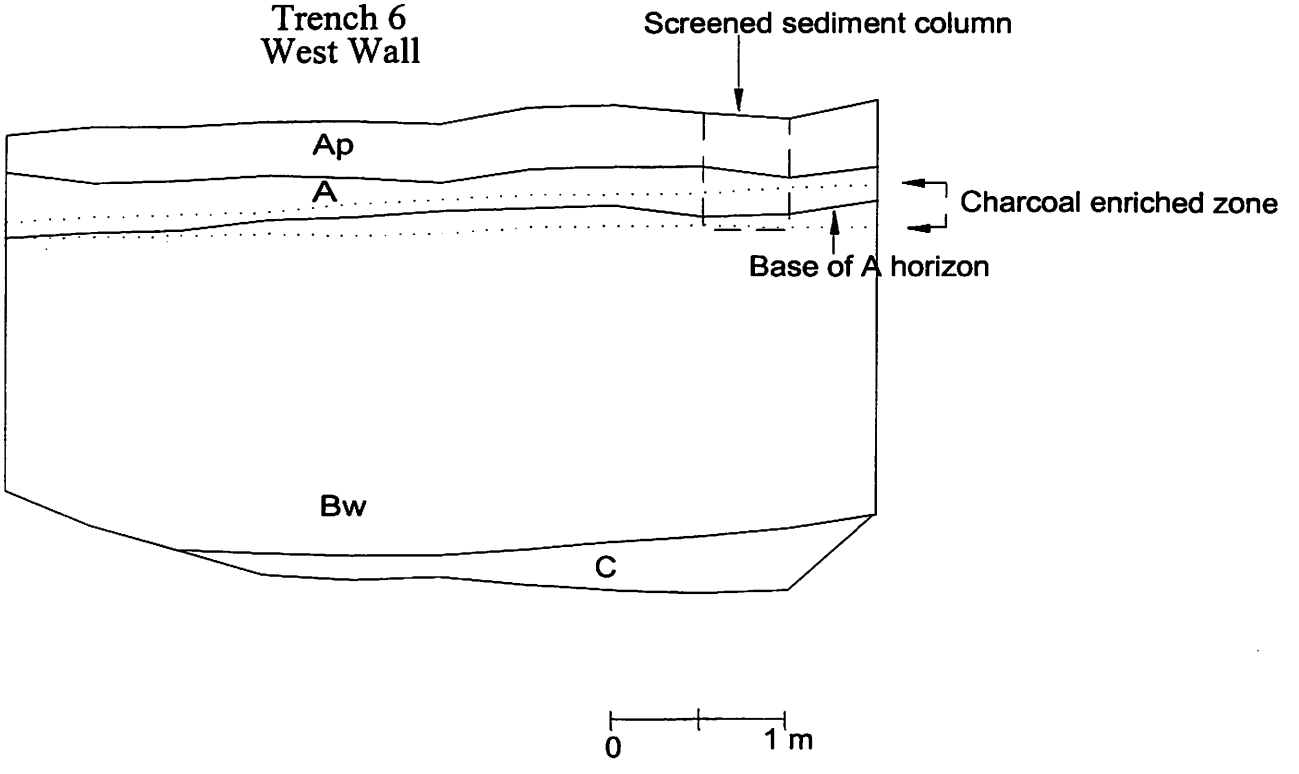


Figure 9. T6 profile.

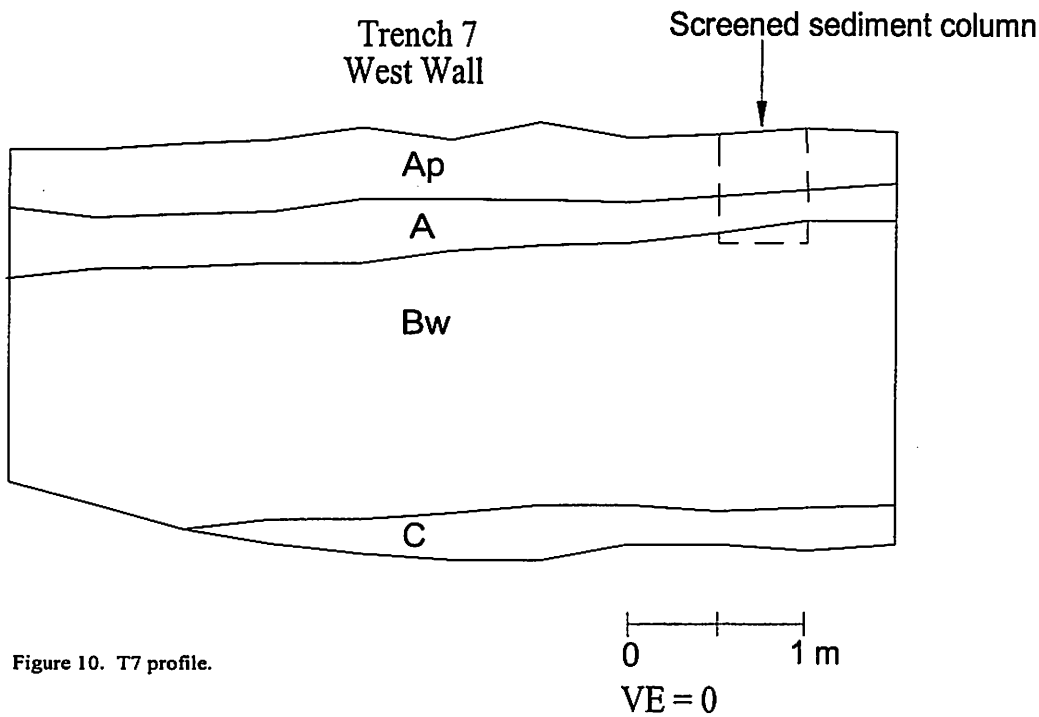


Figure 10. T7 profile.

Table 7. US 150 Trench 6 Lick Creek Floodplain/Terrace interface.

UTM North End: N4270134 E537428 UTM South End: N4270130 E537419

0-30	10YR3/3 (dark brown) silt loam Moderate, medium granular structure Few, fine, distinct 10YR5/8 (yellowish brown) mottles Few, fine 10YR2/1 manganese accumulations Gradual Boundary	Ap
30-50	10YR3/3 (dark brown) silt loam Moderate, medium granular structure Few, fine, distinct 10YR5/8 (yellowish brown) mottles Few, fine 10YR2/1 manganese accumulations Gradual Boundary	A
50-215	7.5YR3/4 (dark brown) silt loam Moderate, fine subangular blocky structure Few to common, fine to medium, distinct 7.5YR5/8 (strong brown) mottles Few, fine 10YR2/1 manganese accumulations Common 10YR6/1 krotivina Clear Boundary	Bw
215-250	5YR4/4 (reddish brown) silty clay loam Massive structure Common, 10YR6/1 krotivina Few, fine to medium 10YR2/1 manganese accumulations	C

Table 8. US 150 Trench 7 Lick Creek Floodplain/Terrace interface.

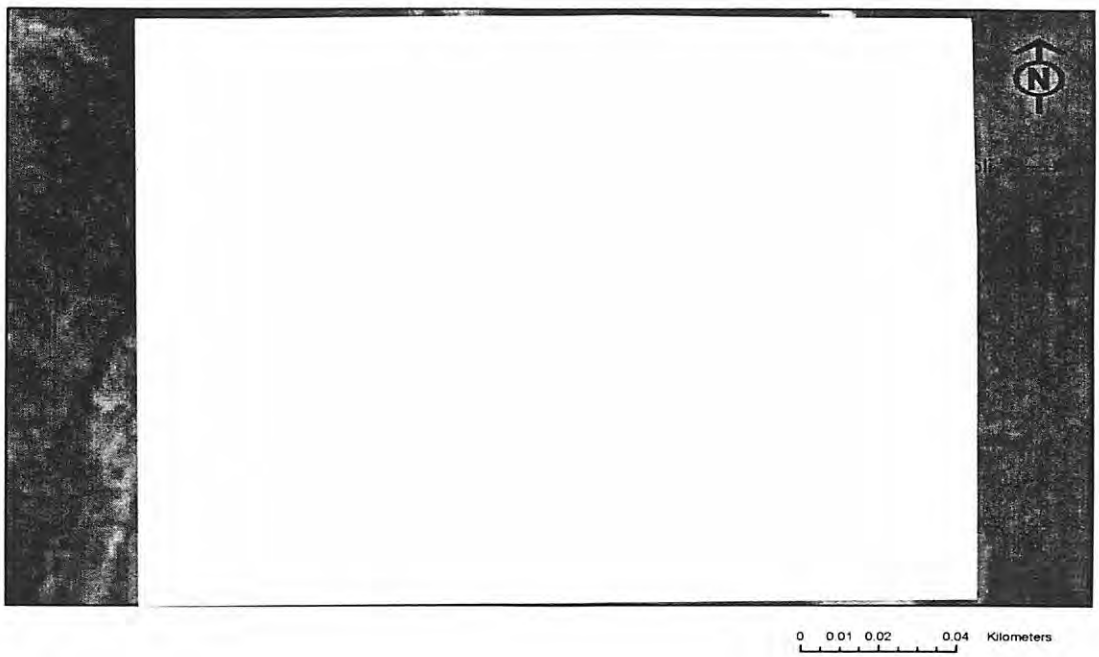
UTM North End: N4270101 E537446 UTM South End: N4270096 E5374

0-30	10YR3/3 (dark brown) silt loam Moderate, medium granular structure Few, fine, distinct 10YR5/8 (yellowish brown) mottles Few, fine 10YR2/1 manganese accumulations Gradual Boundary	Ap
30-50	10YR3/3 (dark brown) silt loam Moderate, medium granular structure Few, fine, distinct 10YR5/8 (yellowish brown) mottles Few, fine 10YR2/1 manganese accumulations Gradual Boundary	A
50-170	7.5YR3/4 (dark brown) silt loam Moderate, fine subangular blocky structure Few to common, fine to medium, distinct 7.5YR5/8 (strong brown) mottles Few, fine 10YR2/1 manganese accumulations Few to common 10YR6/1 krotivina Clear Boundary	Bw
170-200	5YR4/4 (reddish brown) silty clay loam Massive structure Common, 10YR6/1 krotivina Few, fine to medium 10YR2/1 manganese accumulations	C

Archaeological Subsurface Results

One previously unknown archaeological site (12Or757) was identified during this reconnaissance (Figure 11 and Figure 12). The site consisted of three pieces of lithic debitage as follows: 1 Holland secondary flake, 1 Indian Creek secondary flake, and 1 Indian Creek tertiary flake. These materials were recovered from two trenches (T4 and T7) within plowzone contexts. However, as two of the three (Holland secondary flake and Indian Creek secondary flake) were recovered during the stepping of trench walls, only a general provenance is known (near base of plowzone). The Indian Creek tertiary flake was recovered during sediment column screening from a depth of 15 cm below surface. Additional information is provided on this site in abstract form.

Figure 11
Portion of French Lick Quadrangle Showing
Site 12Or757 Boundaries as Defined During Phase Ic Trenching



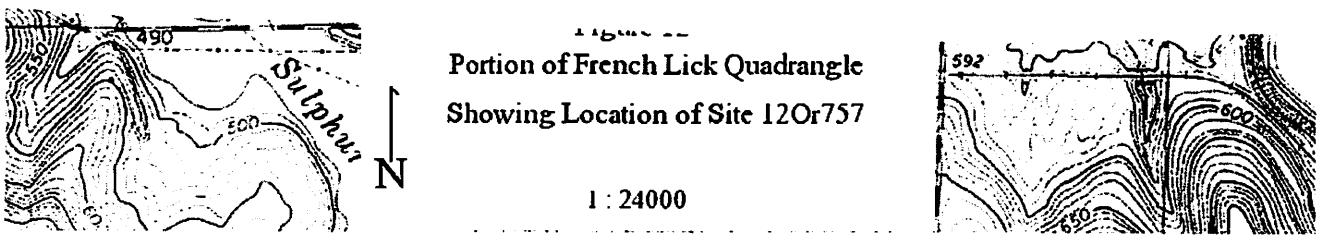


Figure 12
Portion of French Lick Quadrangle
Showing Location of Site 12Or757

1 : 24000

Site Abstract

Site #: 12Or757 **Accession #:** 043
Location: (Grid NW & SW) W1/2, SW1/4, SW1/4, NW1/4 Sec. 30, T2N R1W, French Lick Twp., Orange Co., IN
Quadrangle: French Lick **Elevation:** 490' amsl
Surveyor, Institution, and Date: Holycross, Pearman and Bays ISUAL, 3/26-4/16/04
Physiographic Zone: Crawford Upland
Physiography: Floodplain/terrace interface
Mapped Soil Type: Haymond silt loam **Slope:** E/W 1-2%
Watershed: Lower White, East Fork
Nearest Water: Lick Creek **Distance To:** 60 m **Direction To:** West
Surface Cover: Buried in plowzone **Surface Visibility:** 0% (buried)
Survey Method: Phase Ic trenching
Material Density: Low **Midden:** No **Features:** No
Concentrations: No **Buried Deposits:** Yes
Site Size: As defined during trenching, site size is approx.120 m x 8 m
Materials Recovered/Observed/Reported: 1 Holland chert secondary flake, 1 Indian Creek chert secondary flake, 1 Indian Creek chert tertiary flake
Cultural Affiliation: Unknown Prehistoric
Site Type: Prehistoric
Assessment: This previously undocumented site consisted of three pieces of non-diagnostic lithic debitage recovered during initial trenching and sediment column screening. Such low densities of artifacts suggest a short term, limited intensity occupation. No midden or pit features were encountered. The limited deposits and activities represented by the site would likely exclude it from consideration for the NRHP.

Conclusions and Recommendation

Trenching in the western portion of the project (Trench 1 and Trench 2) revealed weakly developed alluvial soil profiles (A-Bw-C). This alluvium is dominated by dark-colored, fine-grained sediments, indicating low-energy, overbank deposition (silt loam and silty clay loam) in Trench 1 and a low-energy unit (silt loam to loam) overlying higher-energy, lateral accretion deposits (sandy loam) in Trench 2. Identified cambic B horizons display moderately developed structural characteristics. These properties are generally consistent with the mapped Inceptisol, Haymond silt loam, frequently flooded.

Weathering characteristics such as oxidation and mottling were observed and are somewhat more pronounced than might be expected for late Holocene alluvium, according to models (Bettis 1992; Stafford and Creasman 1998) for larger drainage basins such as the Ohio River. However, mottling is also a characteristic that develops due to the influences of fluctuating but routinely high

water tables. The likelihood of these influences, resulting in the development of these characteristics can not be ignored with informant interviews, field observations, soils descriptions (Haymond silt loam, *frequently flooded*), low-lying topography and proximity to the Lick Creek channel indicating these areas are often inundated. Therefore, based on the presence of cambic horizons (Bw) and absence of fragic or albic horizons, low chroma and value Munsell colors (dark coloration) indicating a relatively high organic content (Bettis 1992; Stafford and Creasman 1998) these deposits are most likely dominated by late Holocene to historic alluvium. The absence of cultural materials, low-lying topographic situation, and evidence of routinely high water and associated poor drainage indicate conditions that were not conducive to intensive prehistoric occupation and cultural deposits of significance in this portion of the project.

Trenching in the eastern portion of the project (Trenches 3-7) also revealed A-Bw-C alluvial soil profiles. This alluvium is also dominated by dark-colored, fine-grained sediments that indicate low-energy, overbank deposition (silt loam and silty clay loam). However, A horizons are much more extensive and more closely resemble mollic (e.g. mollisol) rather than ochric epipedons (e.g. inceptisol). These are inconsistent with the mapped Inceptisol, Haymond silt loam, frequently flooded. Also, while cambic B horizons still only display moderately developed structural characteristics, a more weathered (reddish coloration) and somewhat more extensive and pronounced mottling suggest better development and somewhat older age than those observed in the western portion of the project. Finally, the presence of non-diagnostic, prehistoric cultural materials in a plowzone context further indicate a lack of substantial alluvial deposits. Based on the presence of prehistoric cultural materials, better developed cambic horizons (Bw) and absence of fragic or albic horizons, low chroma and value Munsell colors (Bettis 1992; Stafford and Creasman 1998) these deposits are most likely dominated by middle to late Holocene age alluvium.

During this reconnaissance, one previously unknown archaeological site was discovered. Site 12Or757 consisted of three pieces of non-diagnostic, lithic debitage, and no midden or pit features were encountered. The moderate density, wood charcoal-enriched zones (Trenches 3 and 6) do not appear to be associated with prehistoric occupations, as no other materials were encountered or recovered (column screening) associated with the material. Also, no evidence of in-place burning was observed. Wood charcoal is a common constituent of alluvial deposits, with natural sources being common (i.e. lightning fires) and one that is readily entrained and transported.

While the exact extent of the site is unknown, it appears that the occupation(s) represented are ephemeral, serving as short-term camp sites of limited significance. Site 12Or757 does not appear to meet requirements for state or national registers with little potential to contribute significantly to our knowledge of local, state, regional, or national history. Little would likely be gained by further investigation of site 12Or757, as it is anticipated that no significant data would likely be added beyond that which has already been recovered. Therefore, no further archaeological assessments of the project area are recommended. However, in the course of this project should any additional archaeological deposits be encountered, all activity in the local area should immediately cease, and a qualified archaeologist should then be notified for an on-site assessment. Such deposits

may take the form of, but are not limited to, artifact concentrations, midden, features, human burials, or buried/stratified deposits in alluvial/colluvial matrices.

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DNH/dnh
Attachments
Or04-14.RCN

Archaeological Testing
Sites 12-Or-740 and 12-Or-741
Orange County

Prepared for:
Butler, Fairman and Seufert
8540 Westfield Boulevard, Suite 300
Indianapolis, Indiana 46240-8302

Prepared by:
Mitchell Zoll

Mitchell Zoll
Principal Investigator

July 19, 2004

03IA1

Archaeological Resources Management Service
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Abstract

Archaeological testing of sites 12-Or-740 and 741 which will be impacted by the reconstruction of US Highway 150 near Paoli, Orange County, Indiana located no subsurface archaeological deposits and documented eroded soil at both sites. It was recommended that the project be allowed to proceed without additional archaeological assessment.

Introduction

In November of 2002, Archaeological Consultants of the Midwest conducted a reconnaissance level survey for the proposed rehabilitation of US Highway 150 / SR 56 between the towns of Prospect and Paoli in Orange County, Indiana (Figure 1). The project area was located in portions of Sections 1 and 2, Township 1 North, Range 1 West, Sections 35, 34, 33, 32, 30 and 29, Township 1 North, Range 2 West and Sections 25, 26 and 27, Township 2 North, Range 2 West as shown on the USGS 7.5' French Lick and Paoli, Indiana, Quadrangle (Figures 2 3 and 4). The project area measured approximately 14.5 km by 60 m and contained approximately 215 acres.

The archaeological field reconnaissance located 13 previously unrecorded archaeological sites (Jackson and Church 2002). One of the sites (12-Or-740) appeared to be potentially significant and avoidance or archaeological testing was recommended (Jackson and Church 2002). Additionally, site 12-Or-741 was determined to be potentially significant during a review of the field reconnaissance report by the IDNR; SHPO (Mohow 2001). The archaeological field reconnaissance also documented the presence of well drained, alluvial soil within the project area. Based on the presence of the alluvial soil, a subsurface reconnaissance was recommended for portions of the project area (Jackson and Church 2002).

This report addresses the archaeological testing of sites 12-Or-740 and 741. The goals of the archaeological testing were to sample site contents, determine the nature and extent of the site and to evaluate the site's integrity and significance (Zoll 2003).

Site 12-Or-740 measured approximately 90 meters by 40 meters and was located in a portion of the SW 1/4 of the NE 1/4 of the NW 1/4 of the NE 1/4 of Section 32, Township 2 North, Range 1 West as shown on the USGS 7.5' French Lick, Indiana, Quadrangle (Figure 5). The site contained 60 prehistoric artifacts. The soil at the site was Crider silt loam, 6-12% slopes, eroded (Wingard 1984: 17, Map Sheet 27).

Site 12-Or-741 measured approximately 40 meters by 10 meters and was located in a portion of the SE 1/4 of the SW 1/4 of the NE 1/4 of the SW 1/4 of Section 30, Township 2 North, Range 1 West as shown on the USGS 7.5' French Lick, Indiana, Quadrangle (Figure 5). The site contained 7 prehistoric artifacts. The soil at the site was Crider silt loam, 2-6% slopes (Wingard 1984: 17, Map Sheet 21).

The physiographic setting and archaeological and historical background of the project area

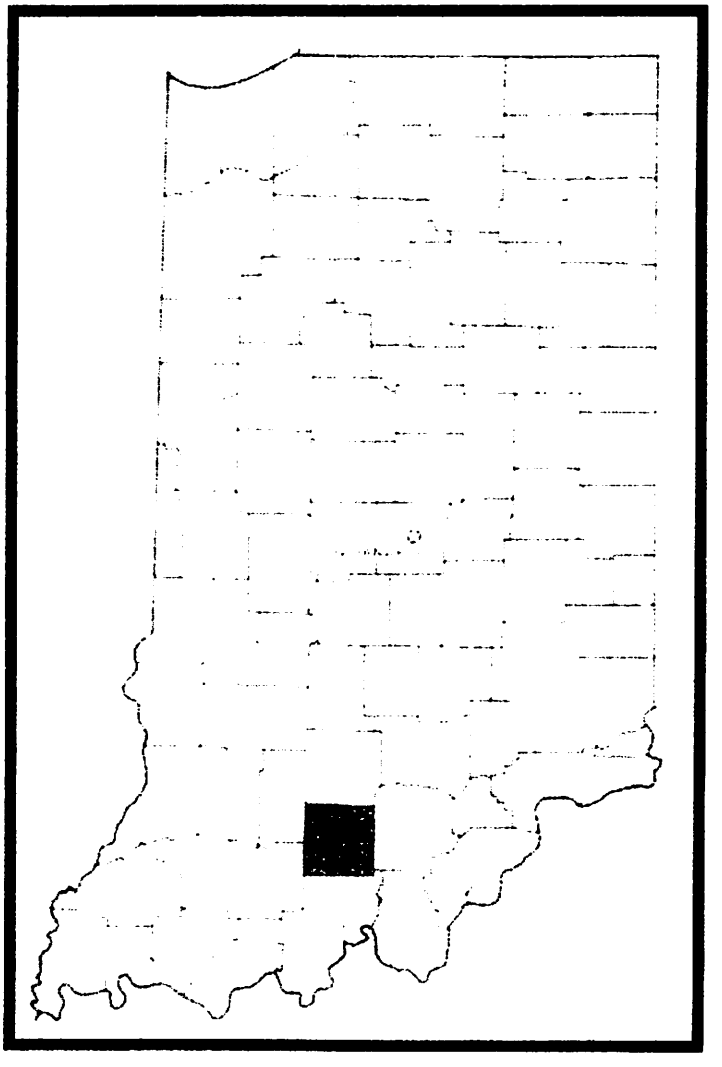

Figure 1. Location of Orange County within the State.

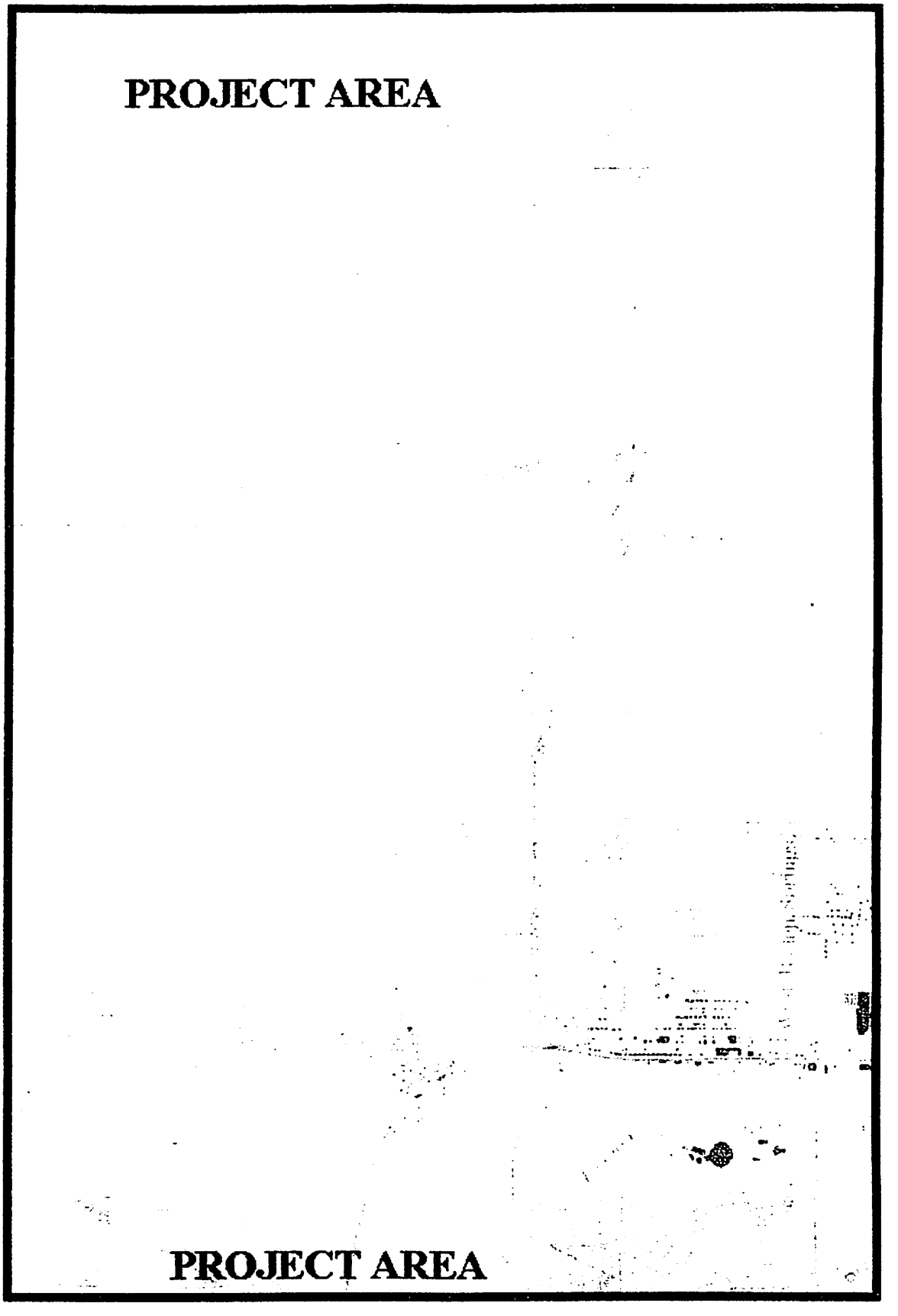

Figure 2. A portion of the USGS 7.5' French Lick, Indiana. Quadrangle showing the western portion of the project area.

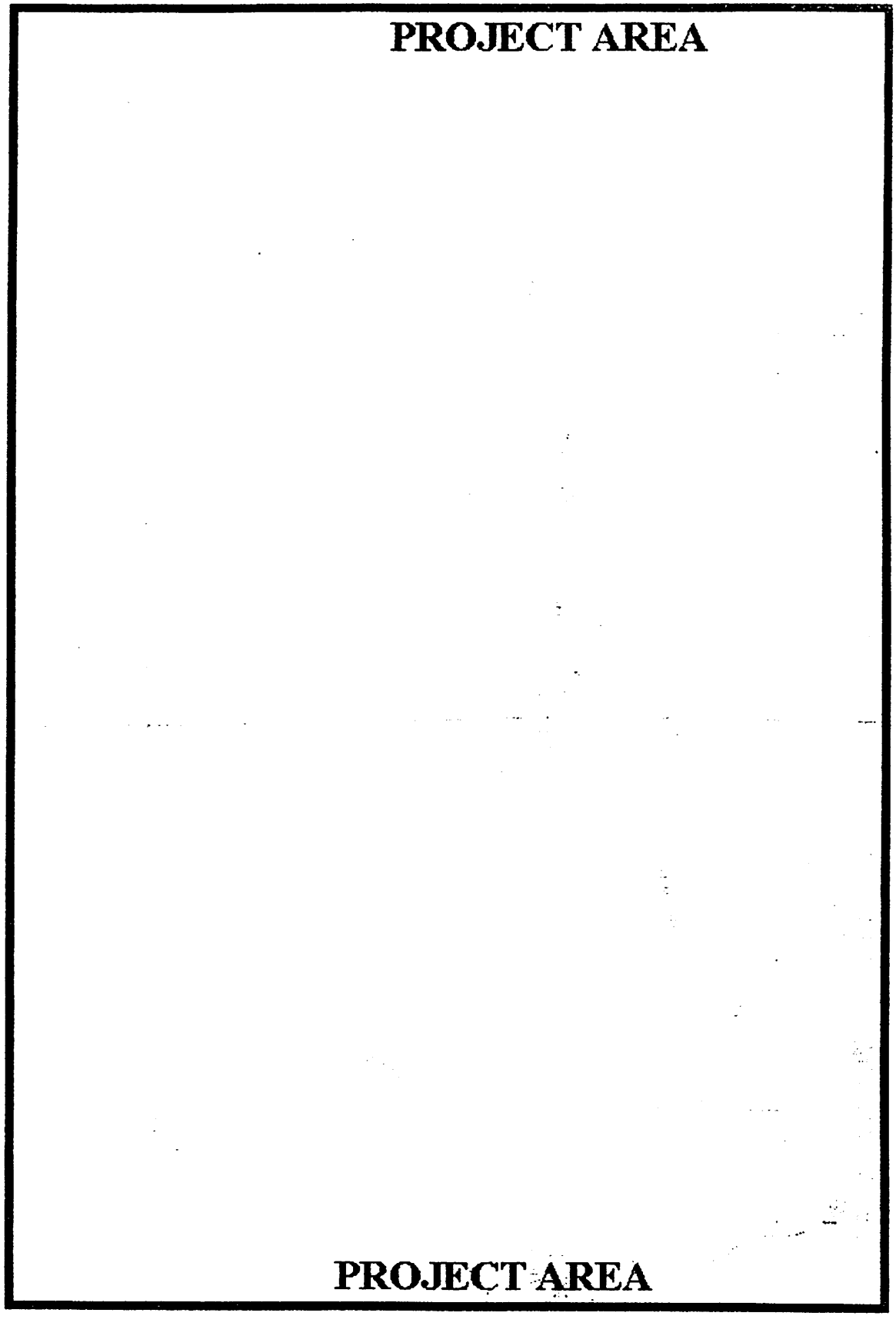

Figure 3. A portion of the USGS 7.5' French Lick, Indiana, Quadrangle showing the middle portion of the project area.

Figure 4. A portion of the USGS 7.5' Paoli, Indiana. Quadrangle showing the eastern portion of the project area

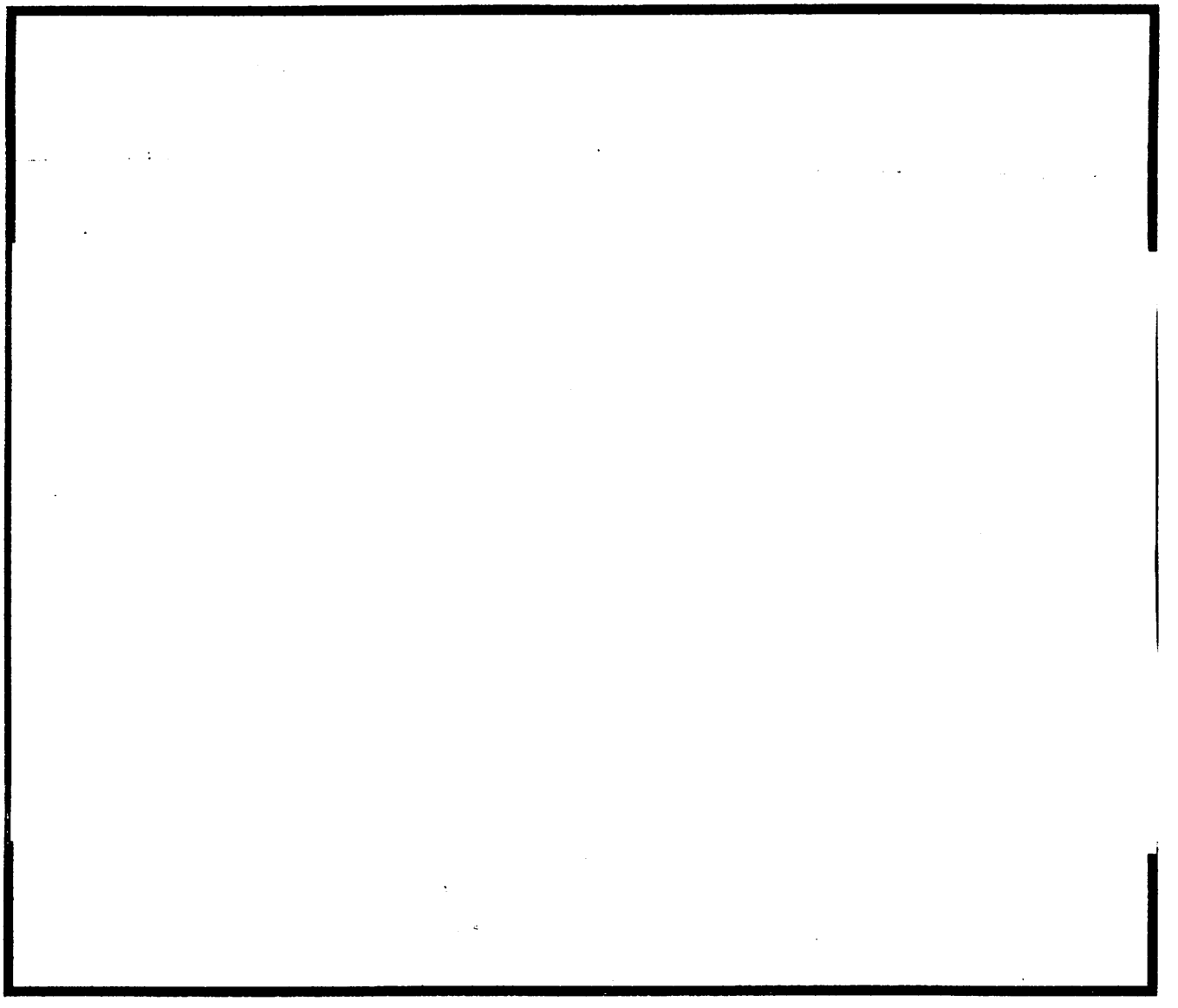

Figure 5. A portion of the USGS 7.5' French Lick, Indiana. Quadrangle showing the locations of archaeological sites 12-Or-740 and 741.

can be found in Jackson and Church 2002.

Archaeological Testing and Subsurface Reconnaissance

Methodology

The archaeological testing of sites 12-Or-740 and 741 was conducted on April 6, 2004 by the author and Don Cochran and on June 25, 2004 by the author and Louis Bubb.

Each site was examined by one backhoe trench. The trench at site 12-Or-740 measured 42 meters by 1 meter representing a 1% sample of the site and the trench at site 12-Or-741 measured 43 meters by 1 meter representing an 11% sample of the site. Based on the existence of severely eroded soil, the testing of site 12-Or-740 was halted after consultation with Mr. James Mohow of the Indiana Department of Natural Resources, Division of Historic Preservation and Archaeology.

The trenches were excavated to the base of the plowzone. All excavation was monitored by Archaeological Resources Management Service personnel. The floor of each trench was shovel and trowel cleaned to help in the identification of archaeological deposits. Soil samples were collected from each trench.

The locations of the trenches were recorded from a datum (Figure 6 and 7). Digital images were taken to document the excavation. All materials associated with the project were curated at Ball State University, Archaeological Resources Management Service under accession number 04.59.

Results

The archaeological testing of sites 12-Or-740 and 741 located no subsurface archaeological deposits and documented eroded soil at both sites.

A random surface collection of site 12-Or-740 recovered 22 unmodified flakes, 2 modified flakes, 2 cores, 1 biface fragment and 1 Stage 3 biface. All of the artifacts were manufactured from an unknown chert. Samples of the material examined by Mark Cantin of Indiana State University were identified as a potential variant of Indian Creek chert (Cantin: personal communication). The soil at site 12-Or-740 consisted of silt loam (10YR 4/4) to a depth of 8 to 11cm, followed by silt loam (10YR 5/4). The soil at the site was severely eroded.

Since site 12-Or-741 was grass covered, no surface collection was made. The soil at site 12-Or-741 consisted of silt loam (10YR 4/4) to a depth of 5 to 14cm, followed by silty clay loam (5YR 4/6). The soil at the site was also severely eroded.

Based on the severely eroded nature of the soil at both sites, it is the author's determination that any subplowzone archaeological deposits which might have been present would not have survived intact.

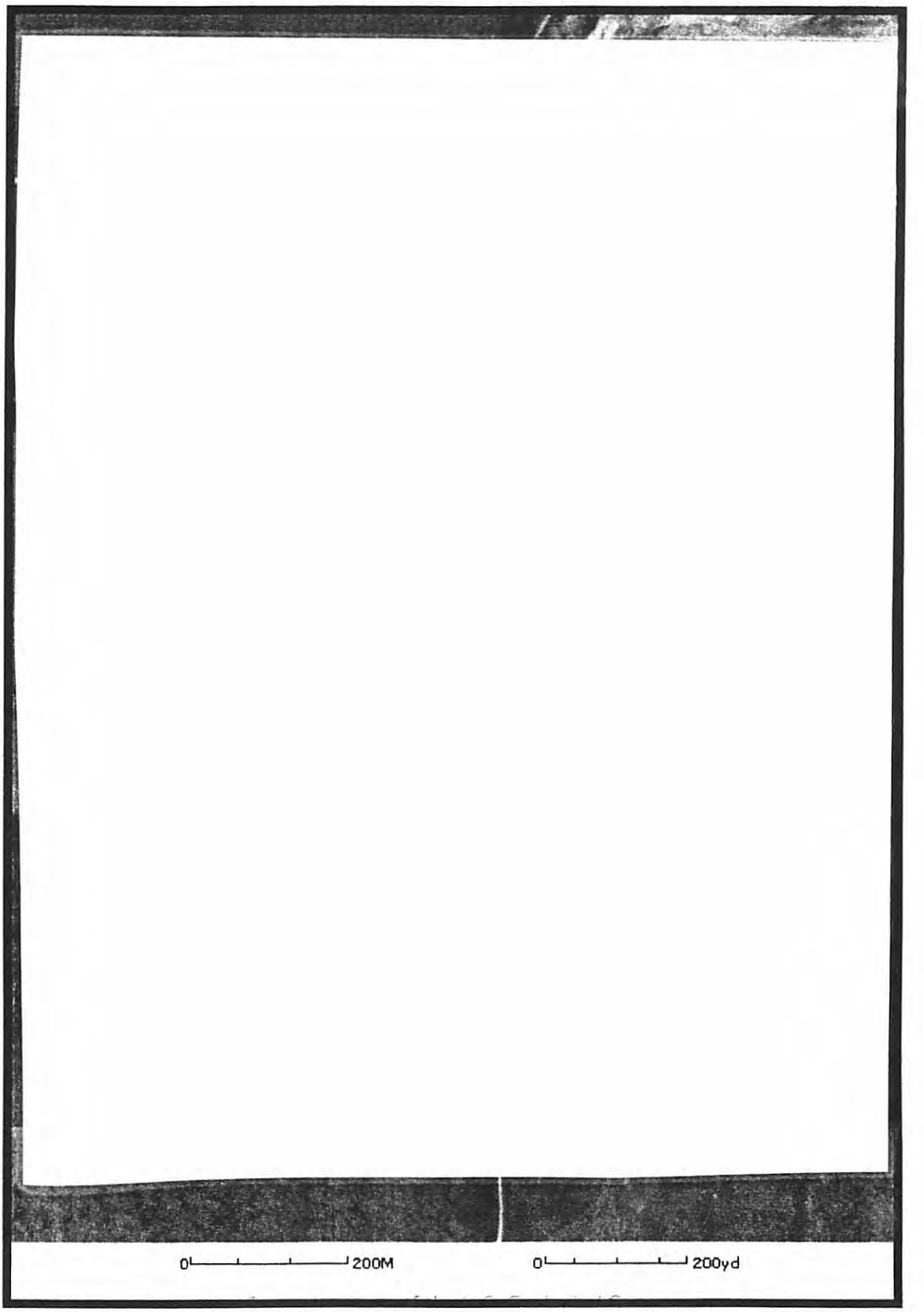

Figure 6. Aerial photograph of site 12-Or-740 showing the location of Trench 1.

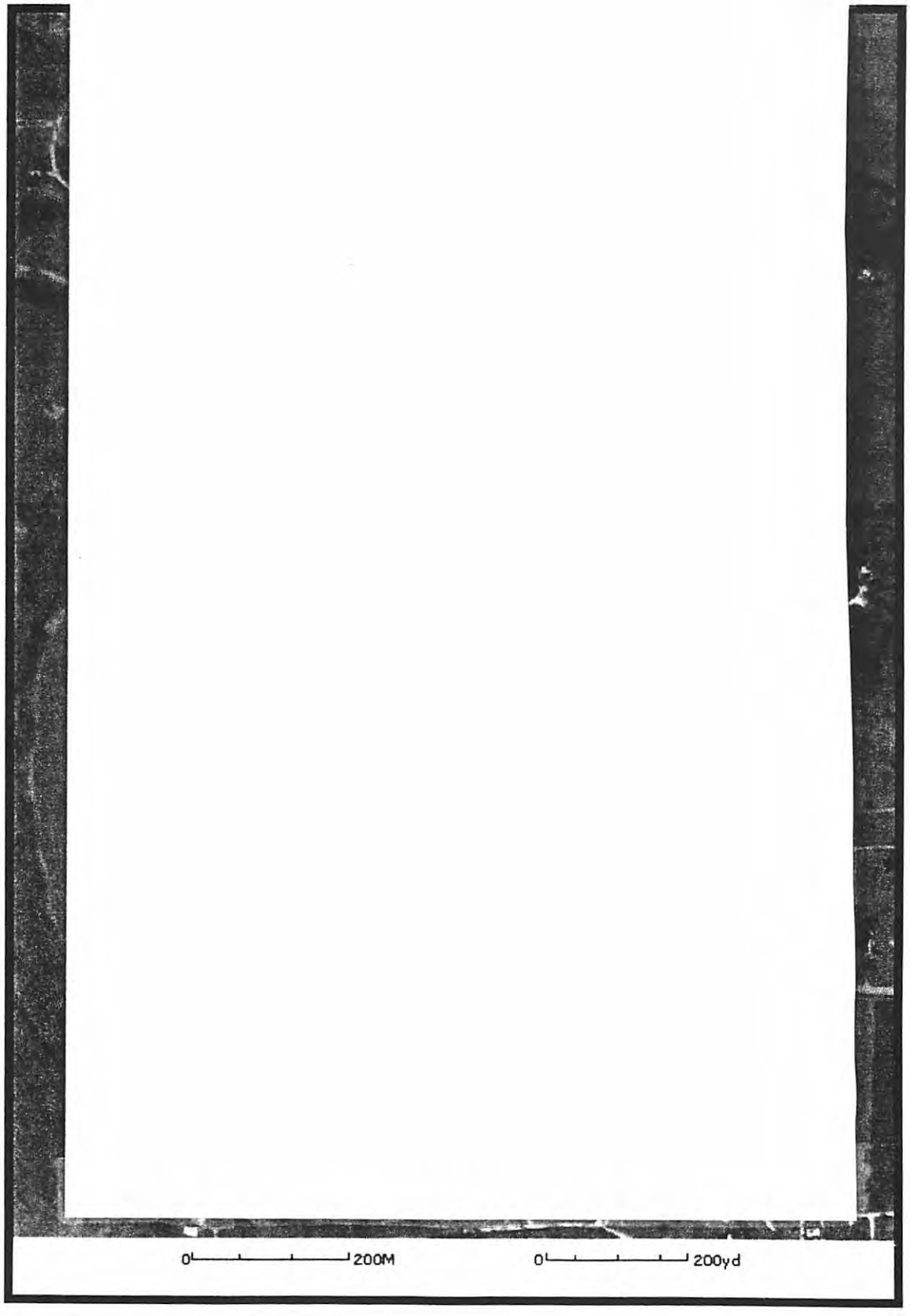

Figure 7. Aerial photograph of site 12-Or-741 showing the location of Trench 1.

Conclusions and Recommendations

Based on the results of the testing, sites 12-Or-740 and 741 are not significant. The soil at both sites was severely eroded and no subsurface archaeological deposits were found at either site.

It is therefore our recommendation that the project be allowed to proceed without additional archaeological assessment. However, should any unanticipated subsurface archaeological deposits be encountered during construction, the project must be halted and the Indiana Department of Natural Resources, Division of Historic Preservation ans Archaeology contacted for an evaluation.

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WETLAND DELINEATION
FOR THE

RECONSTRUCTION OF US 150/SR 56/SR 37
PROSPECT TO MITCHELL

ORANGE AND LAWRENCE COUNTIES, INDIANA

Prepared by:
Butler, Fairman and Seufert, Inc.
Consulting Engineers
8450 Westfield Boulevard, Suite 300
Indianapolis, Indiana 46240
(317) 713-4615

WETLAND DELINEATION REPORT
RECONSTRUCTION OF US 150/SR 56/SR 37
PROSPECT TO MITCHELL
ORANGE AND LAWRENCE COUNTIES, INDIANA

Purpose:

Butler, Fairman and Seufert, Inc., was contracted to perform a jurisdictional determination and delineation for the reconstruction of US 150/SR 56 and SR 37 from Prospect to Mitchell. The project begins in Prospect and extends east on US 150/SR 56 for 14.5 km (9 miles) to the Paoli Town Square. From this point the project extends north on SR 37, excluding the Paoli Town Square, for 18.5 km (11.5 miles) to the end of the project at the SR 37 intersection with CR 1000 at the southern end of the Town of Mitchell. More specifically, the project is located as follows:

Sections 25, 26, and 27, Township 2 North, Range 2 West, and Sections 29, 30, 32, 33, and 34, Township 2 North, Range 1 West on the U.S.G.S. French Lick, Indiana Quadrangle, all in French Lick and Paoli Townships, Orange County, Indiana.

Sections 12, 13, 24, 25, 35, and 36, Township 2 North, Range 1 West, Sections 1 and 2, Township 1 North, Range 1 West, and Sections 7, 18, 19, and 30, Township 2 North, Range 1 East, on the U.S.G.S. Paoli, Indiana Quadrangle, all in Paoli and Orleans Townships, Orange County, Indiana.

Sections 1 and 12, Township 2 North, Range 1 West, Sections 6 and 7, Township 2 North, Range 1 East, and Sections 19, 30, and 31, Township 3 North, Range 1 East, on the U.S.G.S. Mitchell, Indiana Quadrangle, all in Orleans Township, Orange County, Indiana.

Section 18, Township 3 North, Range 1 East, on the U.S.G.S. Mitchell, Indiana Quadrangle, all in Marion Township, Lawrence County, Indiana.

The purpose of this report is to determine whether any jurisdictional wetlands will be impacted by the proposed construction project.

Regulatory Definitions:

The 1987 Corps of Engineers Wetland Delineation Manual (1987) was used as a guideline for the identification and delineation of the wetlands on this property. This manual defines wetlands as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions".

Wetland Characteristics:

Wetlands have three major components. All three components must be present for an area to be considered a jurisdictional wetland. The components are:

Hydrophytic Vegetation – Any plant that grows in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water. For hydrophytic vegetation to be considered present, more than fifty percent (50%) of the dominant species must be able to grow in wetland conditions. Most plants have been classified as

to their occurrence in wetlands, and have been assigned an indicator status. This status is as follows:

Obligate Wetland (OBL) – Plants that occur almost always (estimated probability >99%) in wetlands under natural conditions, but which also occur rarely in non-wetlands.

Facultative Wetland (FACW) – Plants that occur usually (estimated probability >67-99%) in wetlands, but also occur in non-wetlands.

Facultative (FAC) – Plants with a similar likelihood (estimated probability 33-67%) of occurring in both wetlands and non-wetlands.

Facultative Upland (FACU) – Plants that occur sometimes (estimated probability 1-33%) in wetlands, but occur more often in non-wetlands.

Obligate Upland (UPL) – Plants that occur rarely (estimate probability <1%) in wetlands, but occur almost always in non-wetlands under natural conditions.

Plants that are OBL, FACW and FAC (except FAC-) are considered wetland species. Positive or negative signs indicate a tendency toward a higher (+) or lower (-) frequency of occurrence.

Hydric Soils – Hydric soils are soils which are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. The presence of hydric soils may be determined by comparing a profile against soil survey descriptions of listed hydric soils, or based on certain field characteristics.

The Munsell Soil Color Chart was used to determine the existing soil characteristics. The color criteria used for hydric soils is a matrix chroma of 2 or less in mottled soils or a matrix chroma of 1 or less in unmottled soils.

Wetland Hyrodology – Wetland hydrology is defined as inundation or saturation to the surface for at least five percent of the growing season in most years. Primary indicators of wetland hydrology include observation of inundation, soil saturation within the upper 12 inches, watermarks, drift lines, sediment deposits and drainage patterns.

Resources Used:

Resources used to aid in the identification of potential jurisdictional wetlands included the U.S. Fish and Wildlife Service's National Wetland Inventory (NWI) maps and the Natural Resources Conservation Service's (NRCS) *Soil Survey* for Orange and Lawrence Counties. The information contained on the NWI maps are not field verified and are used as a general guideline to locate potential wetland resources. The mapping units of the Soil Survey are generalized based upon topographical information and may contain inclusions of other soil types. Neither resource may solely be used to make a jurisdictional wetland determination. Additionally, the National List of Plant Species that Occur in Wetlands: North Central (Region 3) (U.S. Fish and Wildlife Region 3) manual was used to identify the indicator status of each dominant plant species.

Methodology:

The delineation method used for this project was based upon the 1987 Corps of Engineers Wetland Delineation Manual. The NWI map illustrated numerous potential wetlands along existing US 150/SR 56/SR 37 between Prospect and Mitchell. The construction site was walked to determine areas of potential concern. Prior to this site investigation, it was determined that the majority of the sites illustrated on the NWI maps were sinkholes. Basic data was collected to determine exact areas to be studied. Based upon the wetland reconnaissance and available resources, three sites were identified as potential jurisdictional wetlands within the proposed construction area and are referenced as Sites W-1 through W-3 (see NWI Maps in appendix for site locations).

The maximum horizontal area of proposed fill for the construction project, east of the centerline of the existing roadway, was measured from proposed plans and marked in the field. Soils from each of the three sites were examined to an approximate depth of 15 inches to determine soil characteristics and site hydrology. Vegetation within each site was identified and recorded. A complete soil profile was not obtained. Information gathered was placed on Wetland Data Sheets that are attached to the Appendix. Photographs were taken of the proposed construction site during the field reconnaissance.

The Wetland Reconnaissance and the Wetland Delineation were conducted on October 1, 2002. The results are shown in the table.

Wetland Site	Wetland Criteria	Wetland Impact
W-1	No	--
W-2	No	--
W-3	Yes	0.02 ha (0.05 acre)
Total		0.02 ha (0.05 acre)

ANALYSIS:

Hydrophytic Vegetation

Site W-1: Site W-1 does not meet the criteria for hydrophytic vegetation due to only 50% of the dominant vegetation being OBL, FACW and/or FAC. Dominant species include Pennsylvania Smartweed (Polygonum pensylvanicum, FACW+) and Spiny Amaranth (Amaranthus spinosus, FACU).

Site W-2: Hydrophytic vegetation was present within the boundaries of W-2 of which the dominant vegetation was Panicled Aster (Aster simplex, FACW), Dogbane (Apocunum, FAC), Annual Ragweed (Ambrosia artemisiifolia, FACU) and Tufted Foxtail (Alopecurus carolinianus, FACW) and Eastern Cottonwood (Populus deltoids, FAC+). Hydrophytic vegetation criteria at this site has been met due to 80% of dominant species being OBL, FACW and/or FAC.

Site W-3: Hydrophytic vegetation was present within the wetland boundaries of W-3 of which the dominant vegetation was Black Willow (Salix nigra, OBL), Silver Maple (Acer saccharinum, FACW), Poison Ivy (Toxicodendron radicans, FAC+) and Panicled Aster (Aster simplex, FACW). Hydrophytic vegetation criteria at this site has been met due to 100% of dominant species being OBL, FACW and/or FAC.

Hydric Soils

Site W-1: Soil at this site is Crider-Frederick-Caneyville Silt Loam and is not on the hydric soils list. Soils are 10 yr 4/4 with mottles of 10 yr 5/6. The soil in site W-1 does not meet the criteria for hydric soils.

Site W-2: Soil at this site is Crider-Frederick-Caneyville Silt Loam and is not on the hydric soils list. Soils are 10 yr 4/3 with no mottles. The soil in site W-2 does not meet the criteria for hydric soils.

Site W-3: Soil at this site is Crider Silt Loam and is not on the hydric soils list. Soils are 10 yr 3/1 with no mottles. The soil in site W-3 does meet the criteria for hydric soils.

Hydrology

Site W-1: No inundation or saturation up to 12". The hydrology criterion has not been met.

Site W-2: No inundation or saturation up to 12". The hydrology criterion has not been met.

Site W-3: Inundation of 6-12". Soils saturated up to 12". The hydrology criterion has been met.

Conclusion:

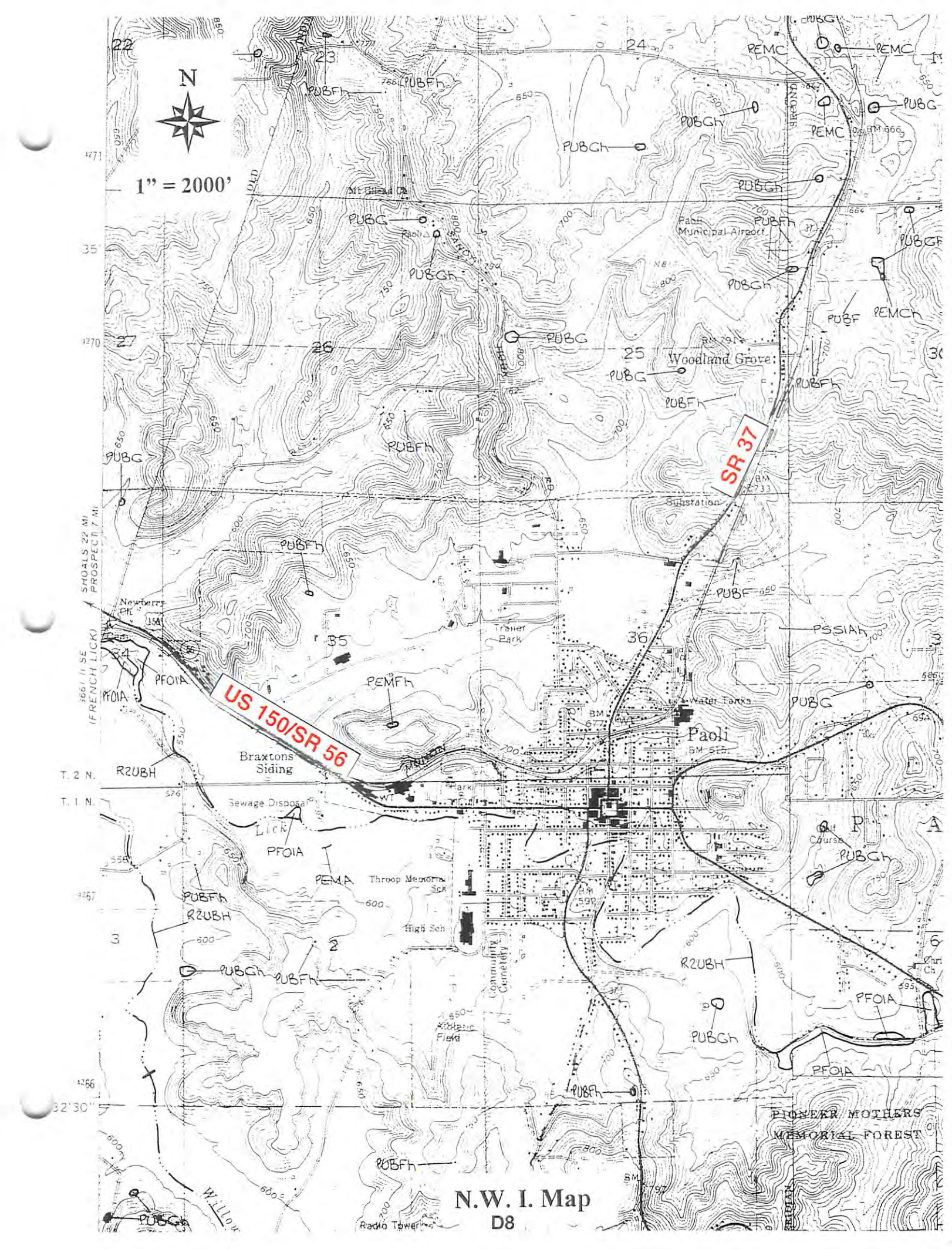
Sites W-1 and W-2 did not meet the three components necessary to be considered jurisdictional wetlands and appear to be sinkholes. Site W-3 did meet all three components and is considered a jurisdictional wetland. Although Site W-3 continues further to the east of the roadway, the only impacts are the changes in right-of-way where construction activities will occur.

Summary:

The proposed construction will impact approximately 0.02 ha (0.05 acre) of palustrine, emergent, semi-permanently flooded wetland (PEMF).

Wetland impacts listed are based on proposed construction information available at the time. If during design, the construction limits exceed that described in this report, additional wetland impacts will occur.

APPENDIX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N.W. I. Map

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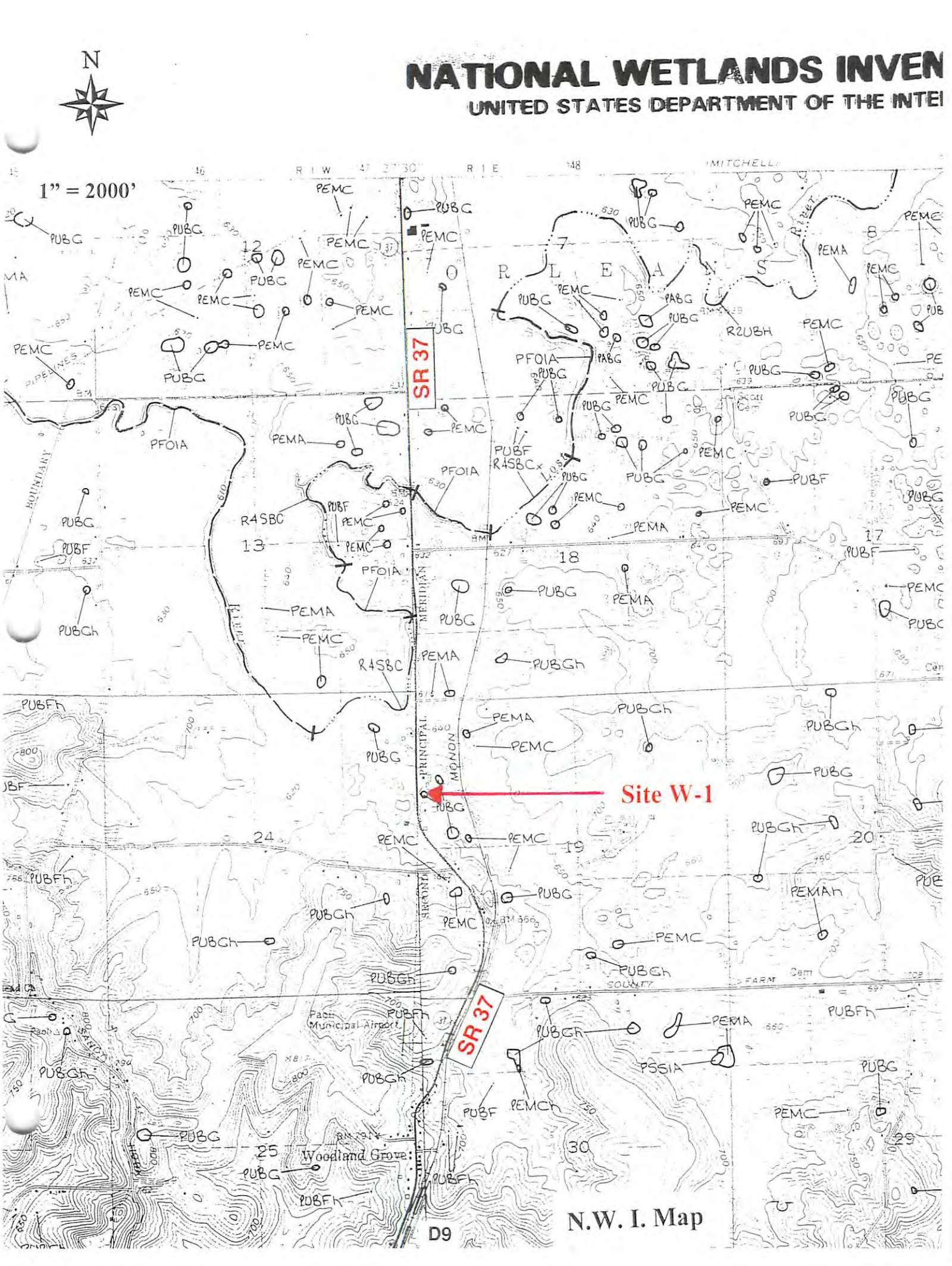
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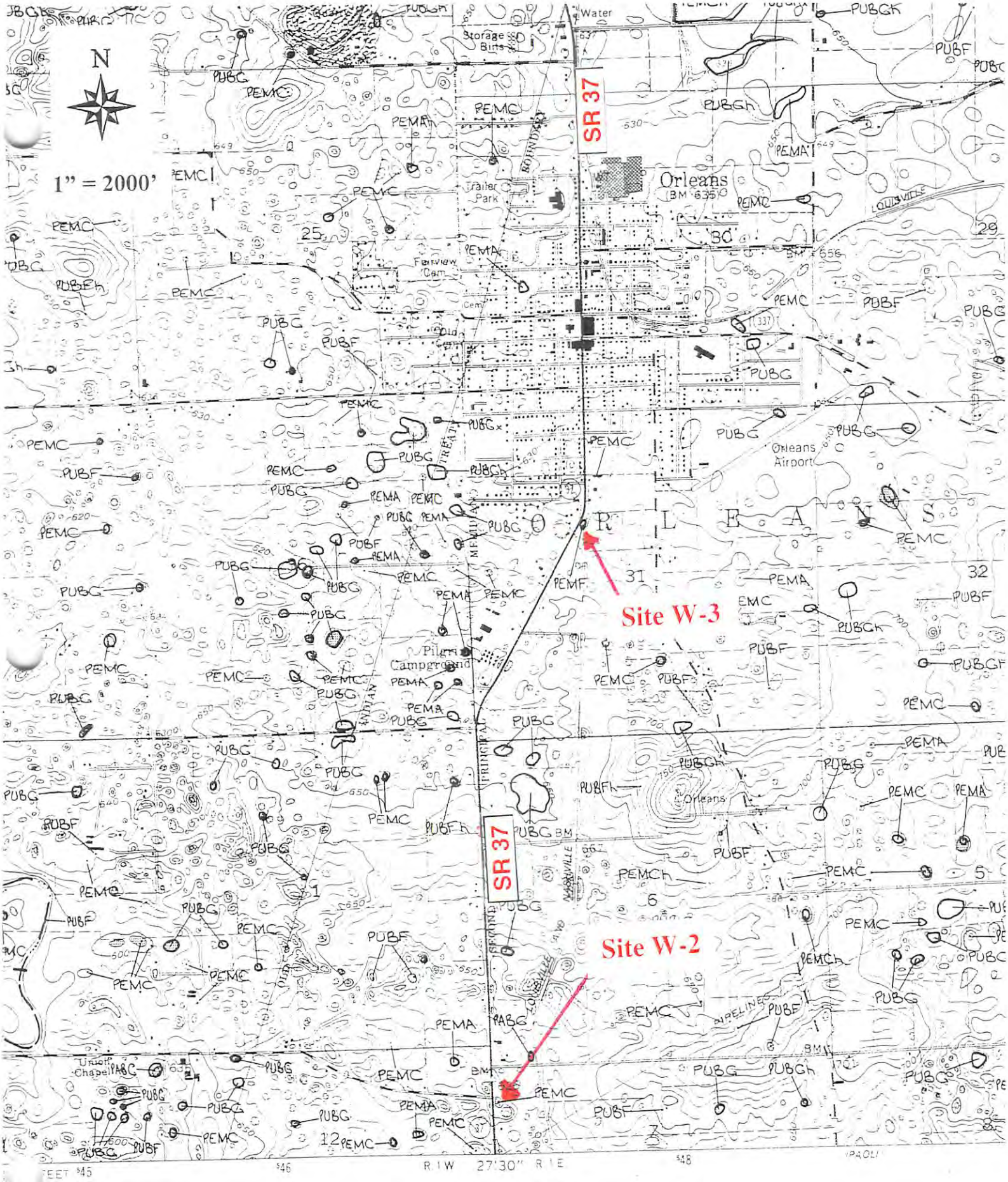

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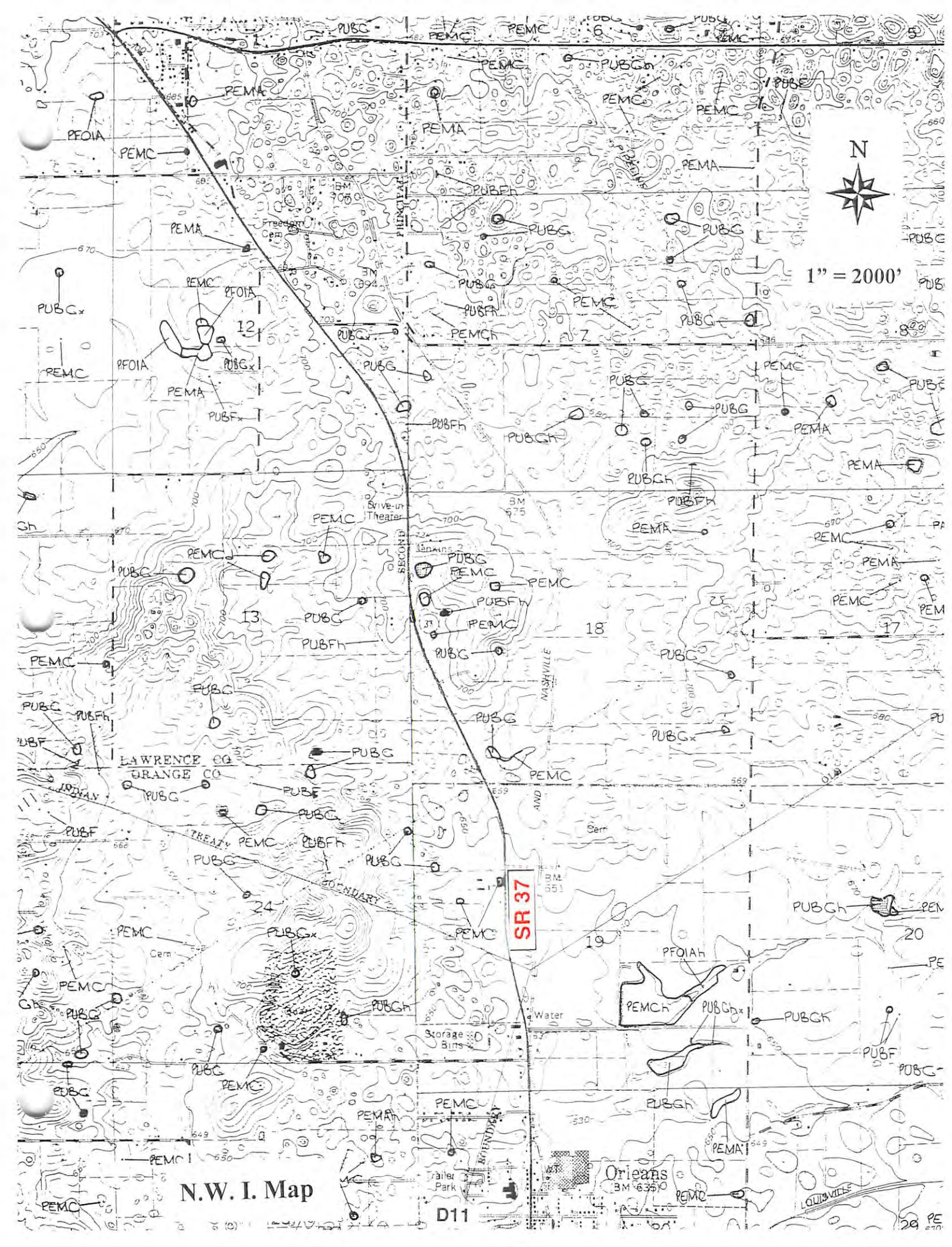
1 MILE

SPECIAL NOTE

This document was prepared primarily by stereoscopic analysis of high altitude aerial photographs. Wetlands were

SYMBOLOGY EXAMPLE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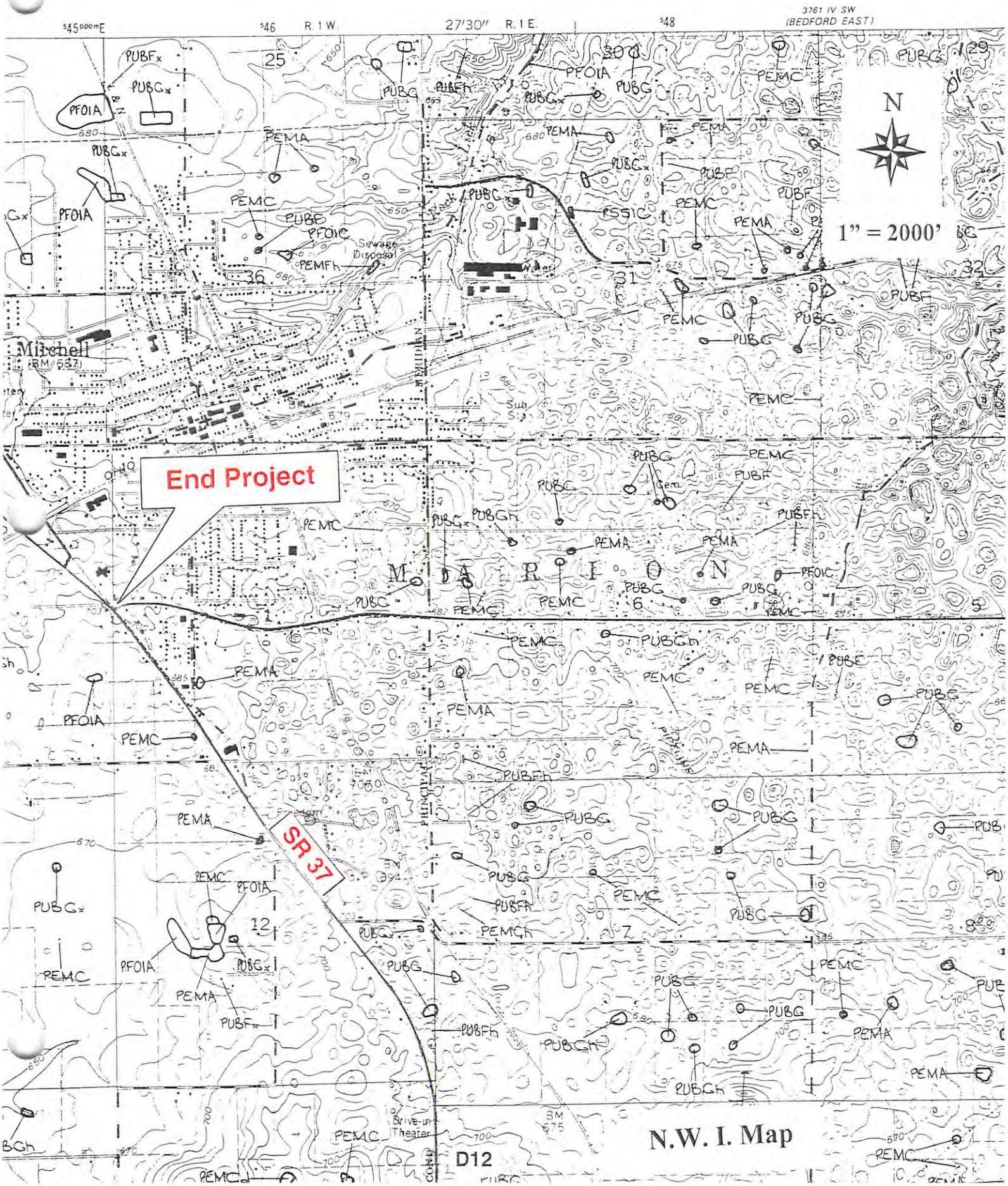
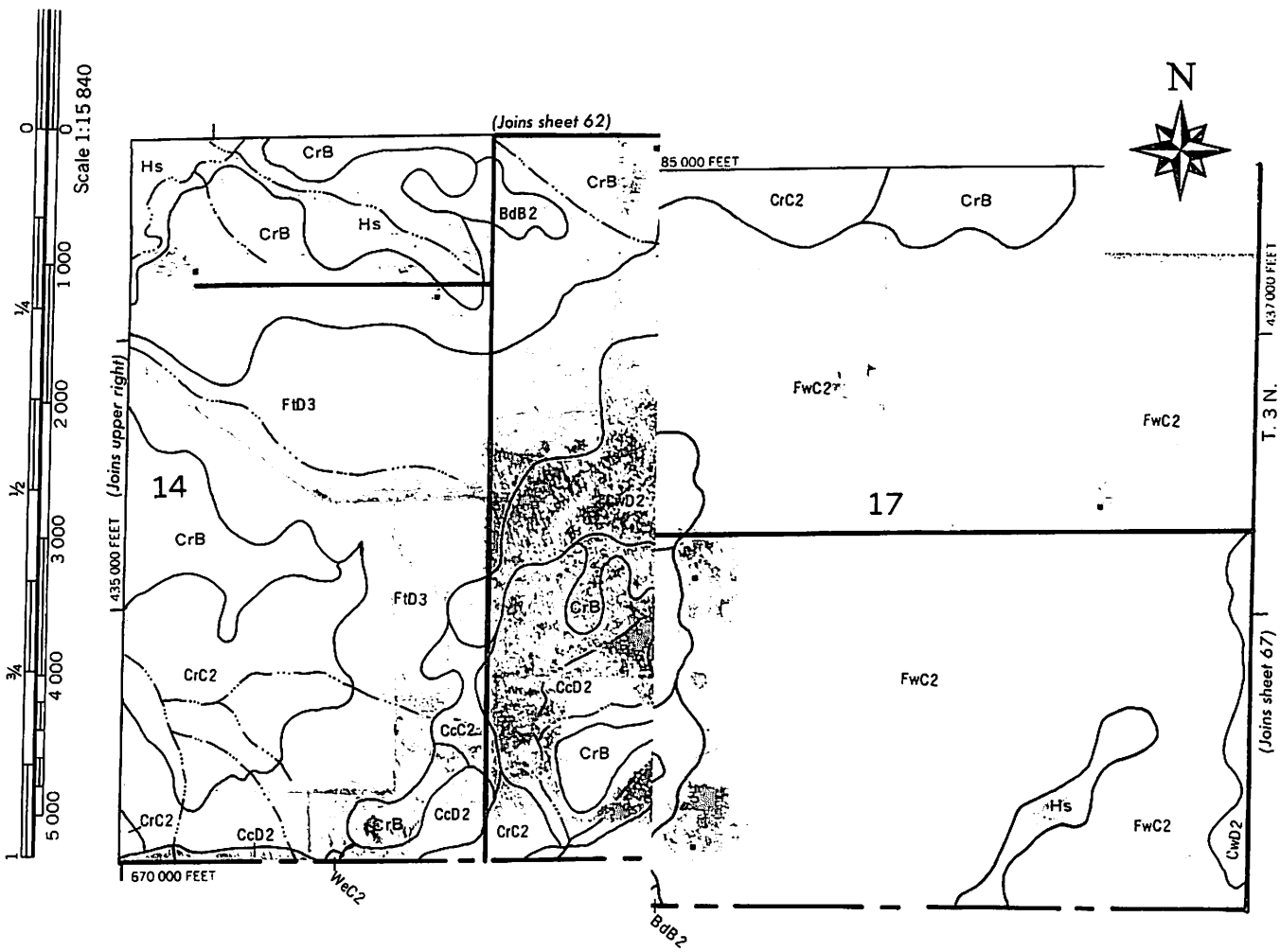


N.W. I. Map

SOIL LEGEND

Map symbols consist of a combination of letters or of letters and numbers. The first capital letter is the initial one of the map unit name. The lowercase letter that follows separates map units having names that begin with the same letter, except that it does not separate sloping or eroded phases. The second capital letter indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 indicates that the soil is eroded and 3 that it is severely eroded.

SYMBOL	NAME
Ba	Bartle silt loam
BdA	Bedford silt loam, 0 to 2 percent slopes
BdB	Bedford silt loam, 2 to 6 percent slopes
Br	Bromer silt loam
Bu	Burnside silt loam, occasionally flooded
CaD3	Caneyville-Crider complex, 12 to 18 percent slopes, severely eroded
CaE	Caneyville-Crider silt loams, 18 to 25 percent slopes
CdF	Caneyville-Rock outcrop complex, 18 to 70 percent slopes
CrB	Crider silt loam, 2 to 6 percent slopes
CrC2	Crider silt loam, 6 to 12 percent slopes, eroded
CrC3	Crider silt loam, 6 to 12 percent slopes, severely eroded
CuD2	Crider-Caneyville silt loams, 12 to 18 percent slopes, eroded
CxC2	Crider-Frederick-Caneyville silt loams, karst, 2 to 12 percent slopes, eroded
ElA	Elkinsville silt loam, 0 to 2 percent slopes
ElB	Elkinsville silt loam, 2 to 6 percent slopes
ElC2	Elkinsville silt loam, 6 to 12 percent slopes, eroded
FrD2	Frederick silt loam, 12 to 18 percent slopes, eroded
FrF	Frederick silt loam, 18 to 50 percent slopes
GoF	Gilpin-Wellston silt loams, 18 to 50 percent slopes
Hd	Haymond silt loam, frequently flooded
Mo	Montgomery silty clay loam
PeB	Pekin silt loam, 2 to 6 percent slopes
PeC2	Pekin silt loam, 6 to 12 percent slopes, eroded
Po	Peoga silt loam, clayey substratum
Pt	Pits, quarry
Ud	Udorthents, loamy
Wa	Wakeland silt loam, frequently flooded
WeC2	Wellston silt loam, 6 to 12 percent slopes, eroded
WeC3	Wellston silt loam, 6 to 12 percent slopes, severely eroded
WfD3	Wellston-Ebal-Gilpin complex, 12 to 18 percent slopes, severely eroded
WgD2	Wellston-Gilpin-Ebal silt loams, 12 to 18 percent slopes, eroded
Wr	Wilbur silt loam, frequently flooded
ZaA	Zanesville silt loam, 0 to 2 percent slopes
ZaB	Zanesville silt loam, 2 to 6 percent slopes
ZaC2	Zanesville silt loam, 6 to 12 percent slopes, eroded
ZaC3	Zanesville silt loam, 6 to 12 percent slopes, severely eroded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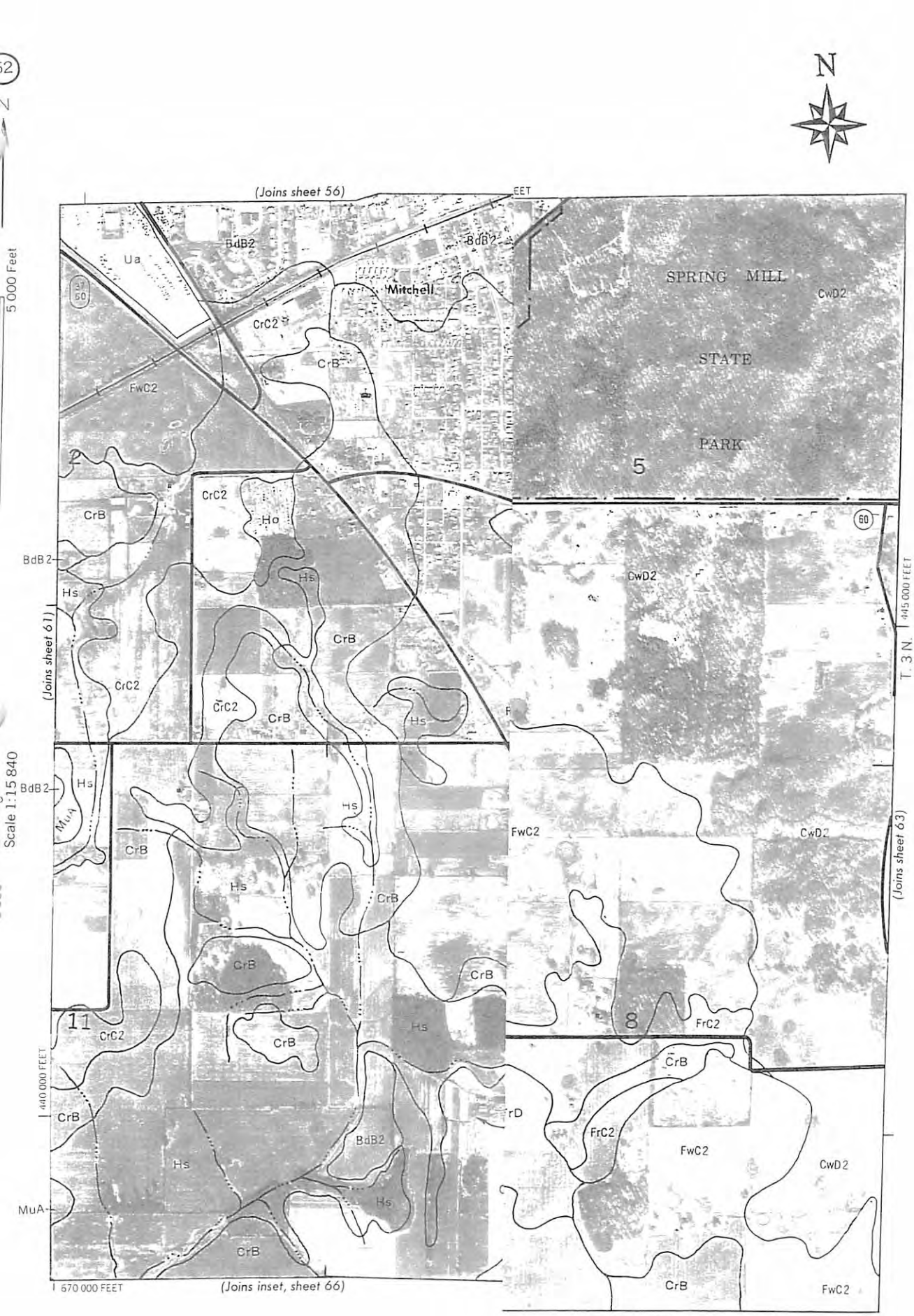
D22



This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and [illegible]
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL LEGEND

Map symbols consist of a combination of letters or of letters and a number. The first capital letter is the initial one of the map unit name. The lowercase letter that follows separates map units having names that begin with the same letter, except that it does not separate sloping or eroded phases. The second capital letter indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 indicates that the soil is eroded and 3 that it is severely eroded.

SYMBOL	NAME
Ab	Abscota sand, frequently flooded
AnD	Alvin sandy loam, 12 to 22 percent slopes
Ba	Bartle silt loam, rarely flooded
BdB2	Bedford silt loam, 2 to 6 percent slopes, eroded
BmC	Bloomfield loamy sand, 3 to 10 percent slopes
Bo	Bonnie silt loam, frequently flooded
Bu	Burnside silt loam, frequently flooded
CcC2	Caneyville silt loam, 6 to 12 percent slopes, eroded
CcD2	Caneyville silt loam, 12 to 20 percent slopes, eroded
CfF	Caneyville-Gilpin-Rock outcrop complex, 25 to 75 percent slopes
Cg	Chagrin loam, frequently flooded
CrB	Crider silt loam, 2 to 6 percent slopes
CrC2	Crider silt loam, 6 to 12 percent slopes, eroded
CrD2	Crider silt loam, 12 to 18 percent slopes, eroded
CsD2	Crider-Caneyville silt loams, 12 to 18 percent slopes, eroded
CwD2	Crider-Frederick silt loams, karst, 6 to 20 percent slopes, eroded
Dp	Dumps-Pits-Udorthents complex
EbC2	Ebal silt loam, 6 to 12 percent slopes, eroded
EdD	Ebal-Wellston silt loams, 12 to 24 percent slopes
EkB2	Elkinsville Variant loam, 2 to 6 percent slopes, eroded
FrC2	Frederick silt loam, 6 to 12 percent slopes, eroded
FrD	Frederick silt loam, 12 to 18 percent slopes
FtD3	Frederick silty clay loam, gullied, 10 to 18 percent slopes
FwC2	Frederick-Crider silt loams, karst, 2 to 12 percent slopes, eroded
GrC	Gilpin-Crider silt loams, 6 to 20 percent slopes
GwF	Gilpin-Weikert-Wellston complex, 18 to 50 percent slopes
Ho	Haymond silt loam, frequently flooded
HrA	Henshaw silt loam, rarely flooded, 1 to 3 percent slopes
Hs	Hoosierville silt loam
HxB2	Hosmer silt loam, 1 to 6 percent slopes, eroded
MdB2	Markland silty clay loam, 2 to 6 percent slopes, eroded
MhA	McGary silty clay loam, frequently flooded, 0 to 2 percent slopes
MuA	Muren silt loam, 1 to 3 percent slopes
Ne	Newark silt loam, frequently flooded
No	Nolin silt loam, frequently flooded
PeB	Pekin silt loam, 2 to 6 percent slopes
PeC2	Pekin silt loam, 6 to 12 percent slopes, eroded
Ph	Petrolia silty clay loam, frequently flooded
PnB	Princeton-Alvin complex, 2 to 6 percent slopes
St	Stendal silt loam, clayey substratum, frequently flooded
TyB	Tyner-Alvin loamy sands, 2 to 7 percent slopes
Ua	Udorthents, loamy
WbF	Weikert-Berks-Gilpin complex, 25 to 75 percent slopes
WeC2	Wellston silt loam, 6 to 12 percent slopes, eroded
WeD2	Wellston silt loam, 12 to 18 percent slopes, eroded
WfD3	Wellston silt loam, gullied, 10 to 18 percent slopes
WgD2	Wellston-Gilpin silt loams, 12 to 18 percent slopes, eroded
Wr	Wilbur silt loam, frequently flooded

DATA FORM 1

WETLAND DETERMINATION

Applicant Name: David Bourff

Application Number:

Project Name: US 150/SR 56/SR 37 Prospect to Mitchell in Orange and Lawrence Co.

State: *Indiana* County: Orange Legal Description: Township: Orleans Range: 1 E

Date: October 1, 2002 Plot No.: W-3 Section: 31

Vegetation [List the three dominant species in each vegetation layer (5 if only 1 or 2 layers)]. Indicate species with observed morphological or known physiological adaptations with an asterisk.

Species	Indicator Status	Species	Indicator Status
Trees		Herbs	
1. Salix nigra	OBL	7. Toxicodnedron radicans	FAC+
2. Acer saccharinum	FACW	8. Aster simplex	FACW
3.		9.	
		10.	
Saplings		Woody Vines	
4.		11.	
5.		12.	
6.			

% of Species that are OBL, FACW, and/or FAC: 100%. Other indicators .
Hydrophytic vegetation: Yes X No . Basis: Hydrophytic vegitation criteria met.

Soil

Series and phase: Crider Silt Loam On hydric soils list? Yes No X.
Mottled: Yes No X. Mottle color: ; Matrix color: 10 yr 3/1.
Gleyed: Yes No X. Other indicators:.
Hydric Soils: Yes X No ; Basis: Meets criteria for hydric soils.

Hydrology

Inundated: Yes X No . Depth of standing water: 6-12".
Saturated soils: Yes X No . Depth to saturated soil: Saturation up to 12".
Other indicators: .
Wetland Hydrology: Yes X No . Basis: Hydrology critera has been met.
Atypical situation: Yes No X,
Normal Circumstances?. Yes X No .
Wetland Determination: Wetland X Nonwetland.

Comments: Approximately 25 feet from edge of road. Dimensions are 117 feet (east side), 115 feet (south side), 98 feet (west side), and115 ft (north side).

Determined by: David Bourff

DATA FORM 1

WETLAND DETERMINATION

Applicant Name: David Bourff

Application Number:

Project Name: US 150/SR 56/SR 37 Prospect to Mitchell in Orange and Lawrence Co.

State: *Indiana* County: Orange Legal Description: Township: Orleans Range: 1 E

Date: October 1, 2002 Plot No.: W-2 Section: 7

Vegetation [List the three dominant species in each vegetation layer (5 if only 1 or 2 layers)]. Indicate species with observed morphological or known physiological adaptations with an asterisk.

Species	Indicator Status	Species	Indicator Status
Trees		Herbs	
1.		7. Aster simplex	FACW
2.		8. Apocunum	FAC
3.		9. Ambrosia artemisiifolia	FACU
		10. Alopecurus carolinianus	FACW
Saplings			
4. Populas deltoids	FAC+	Woody Vines	
5.		11.	
6.		12.	

% of Species that are OBL, FACW, and/or FAC: 80%. Other indicators .
Hydrophytic vegetation: Yes X No . Basis: Hydrophytic vegitation criteria met .

Soil

Series and phase: Crider-Frederick-Caneyville Silt Loam On hydric soils list? Yes No X .
Mottled: Yes No X . Mottle color: ; Matrix color: 10 yr 4/3 .
Gleyed: Yes No X . Other indicators: .
Hydric Soils: Yes No X ; Basis: Does not meet criteria for hydric soils .

Hydrology

Inundated: Yes No X . Depth of standing water: .
Saturated soils: Yes No X . Depth to saturated soil: No saturation up to 12" .
Other indicators: .
Wetland Hydrology: Yes No X . Basis: Hydrology critera has not been met .
Atypical situation: Yes No X ,
Normal Circumstances?. Yes X No .
Wetland Determination: Wetland Nonwetland X .

Comments: Site did not meet the requirements to be a wetland. Depression appears to be a possible sinkhole.

Determined by: David Bourff

DATA FORM 1

WETLAND DETERMINATION

Applicant Name: David Bourff
Application Number:
Project Name: US 150/SR 56/SR 37 Prospect to Mitchell in Orange and Lawrence Co.

State: *Indiana* County: Orange Legal Description: Township: Paoli Range: 1 E

Date: October 1, 2002 Plot No.: W-1 Section: 19

Vegetation [List the three dominant species in each vegetation layer (5 if only 1 or 2 layers)]. Indicate species with observed morphological or known physiological adaptations with an asterisk.

Species	Indicator Status	Species	Indicator Status
Trees		Herbs	
1.		7. Polygonum pensylvanicum	FACW+
2.		8. Amaranthus spinosus	FACU
3.		9.	
Saplings		Woody Vines	
4.		10.	
5.		11.	
6.		12.	

% of Species that are OBL, FACW, and/or FAC: 50%. Other indicators .
Hydrophytic vegetation: Yes ____ No X . Basis: Hydrophytic vegitation criteria not met .

Soil

Series and phase: Crider-Frederick-Caneyville Silt Loam On hydric soils list? Yes ____ No X .
Mottled: Yes X No ____ . Mottle color: 10 yr 5/6 ; Matrix color: 10 yr 4/4 .
Gleyed: Yes ____ No X . Other indicators: .
Hydric Soils: Yes ____ No X ; Basis: Does not meet criteria for hydric soils .

Hydrology

Inundated: Yes ____ No X . Depth of standing water: .
Saturated soils: Yes ____ No X . Depth to saturated soil: No saturation up to 12" .
Other indicators: .
Wetland Hydrology: Yes ____ No X . Basis: Hydrology critera has not been met .
Atypical situation: Yes ____ No X ,
Normal Circumstances?. Yes X No ____ .
Wetland Determination: Wetland ____ Nonwetland X .

Comments: Site did not meet the requirements to be a wetland. Depression appears to be a possible sinkhole.

Determined by: David Bourff

SITE PHOTOGRAPHS

Site W-1

Site W-2

Looking north along SR 37 at Site W-3

Looking south along SR 37 at Site W-3

Site W-3

Site W-3

MEMORANDUM OF UNDERSTANDING

THIS MEMORANDUM OF UNDERSTANDING IS MADE AND ENTERED INTO THIS THIRTEENTH DAY OF OCTOBER: 1993 BETWEEN THE INDIANA DEPARTMENT OF TRANSPORTATION (INDOT). THE INDIANA DEPARTMENT OF NATURAL RESOURCES (IDNR). THE INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT (IDEM) AND THE U. S. FISH AND WILDLIFE SERVICE (USFWS) FOR THE PURPOSE OF DELINEATING GUIDELINES FOR CONSTRUCTION OF TRANSPORTATION PROJECTS IN KARST REGIONS OF THE STATE.

WHEREAS. INDOT. IDNR. IDEM AND THE USFWS WISH TO COOPERATE IN THE IDENTIFICATION. STUDY AND TREATMENT OF DRAINAGE IN KARST REGIONS RELATED TO THE CONSTRUCTION OF TRANSPORTATION PROJECTS AND.

WHEREAS. INDOT. IDNR. IDEM AND THE USFWS ACCEPT RESPONSIBILITY TO ENSURE THE TRANSPORTATION NEEDS OF INDIANA ARE MET IN AN ENVIRONMENTALLY SENSITIVE MANNER THAT PROTECTS THE HABITAT OF ALL SPECIES AND.

WHEREAS. DESIGN AND CONSTRUCTION PRACTICES MUST PROTECT GROUND WATER QUALITY, PUBLIC HEALTH AND SAFETY. AND THE ENVIRONMENT.

WHEREAS. IDNR WILL CONFORM TO THE TERMS AND CONDITIONS OF THIS MOU ON THEIR TRANSPORTATION PROJECTS. LIKEWISE. IT WILL BE IDNR'S RESPONSIBILITY TO PROVIDE STANDARD BIOLOGICAL REVIEW FOR PROJECTS IN THE KARST REGION.

THEREFORE. IN CONSIDERATION OF THE TERMS AND CONDITIONS SET FORTH HEREIN THE INDOT, IDNR. IDEM. AND USFWS AGREE AS FOLLOWS:

1. INDOT IN COOPERATION WITH THE IDNR. IDEM AND USFWS SHALL DETERMINE THE LOCATION OF SINKHOLES. CAVES. UNDERGROUND STREAMS, AND OTHER RELATED KARST FEATURES AND THEIR RELATIONSHIP PRIOR TO PROPOSED ALTERATIONS OR CONSTRUCTION IN KARST REGIONS OF THE STATE. A CONSULTANT WITH EXPERTISE IN KARST GEOLOGY/HYDROLOGY MAY ASSIST IN THE IDENTIFICATION AND CHARACTERIZATION OF THE KARST FEATURES. THE CHOICE OF THE CONSULTANT RETAINED BY INDOT WILL BE SUBJECT TO THE REVIEW OF IDNR. USFWS AND IDEM.

2. TASKS TO ACCOMPLISH THIS WORK WILL INCLUDE:

RESEARCH AVAILABLE FROM PUBLIC AND PRIVATE SOURCES FOR INFORMATION RELATIVE TO KARST FEATURES.

FIELD CHECK KARST AND CAVE FEATURES THAT APPEAR FROM THE FIRST TASK AND IDENTIFY ANY ADDITIONAL KARST FEATURES.

PREPARE A DRAFT REPORT. WITH PHOTOGRAPHS AND MAPS. DRAINAGE AREAS. AND LAND USE OF THAT DRAINAGE AREA FOR EACH SINKHOLE OR KARST

FEATURE. DYE-TRACING AND/OR OTHER GEOTECHNICAL INFORMATION TO DETERMINE SUBSURFACE FLOW OF WATER IN THE PROJECT AREA AND SURFACE WATER DRAINAGE PATTERNS OF THE AREA. CALCULATIONS OF ESTIMATES OF ANNUAL POLLUTANT LOADS FROM THE HIGHWAY AND DRAINAGE WITHIN THE RIGHT-OF-WAY WILL BE MADE, INCLUDING PRIOR TO, DURING AND POST CONSTRUCTION ESTIMATES. THE DESIGN OF THE TREATMENT OF THE KARST FEATURES WILL TAKE INTO CONSIDERATION TREATMENTS NECESSARY TO MEET THE STANDARDS OF THE MONITORING AND MAINTENANCE PLAN.

THAT REPORT WILL BE USED AS A TOOL TO ASSIST IN DETERMINING THE PROPOSED HIGHWAY ALIGNMENT. THE INTENT OF INDOT IS TO AVOID KARST AREAS AND USE ALTERNATE DRAINAGE WHERE POSSIBLE.

3. IDNR, IDEM AND USFWS WILL BE REQUESTED TO REVIEW AND COMMENT ON THE FINDINGS AT THE EARLY COORDINATION PHASE OF PROJECT DEVELOPMENT.

4. INDOT, USING THE INPUT FROM IDNR, IDEM, AND USFWS WILL BEGIN TO FORMULATE APPROPRIATE MEASURES TO OFFSET UNAVOIDABLE IMPACTS TO THE KARST FEATURES. IT IS UNDERSTOOD BY ALL PARTIES THAT SOME OF THE METHODS PROPOSED AT THIS TIME WILL BE GENERIC AND COULD BE APPLIED THROUGHOUT THE LENGTH OF THE CORRIDOR. OTHER METHODS MAY BE SPECIFIC TO A PARTICULAR CAVE OR KARST FEATURE. SOME OF THE APPROACHES MAY REQUIRE ADDITIONAL INVESTIGATIONS TO DETERMINE THEIR NECESSITY AND/OR THEIR FEASIBILITY. A REVISED DRAFT REPORT WILL BE PREPARED BY INDOT'S CONSULTANT AND PROVIDED TO THE IDNR, IDEM, AND THE USFWS AS PART OF THE DESIGN REVIEW PROCESS.

5. DRAINAGE ENTERING FROM BEYOND THE RIGHT-OF-WAY WILL BE TREATED ACCORDING TO THE SAME PROCESS AS DRAINAGE GENERATED BY THE PROJECT.

6. AS THE PROJECT PROGRESSES FURTHER INTO THE DESIGN PHASE, THE IDNR, IDEM AND USFWS WILL BE INVITED AND WILL ATTEND FIELD CHECKS AND MEETINGS DEALING WITH EFFORTS TO NEGATE OR MINIMIZE ADVERSE IMPACTS.

7. HAZARDOUS MATERIALS TRAPS (HMT'S) WILL BE CONSTRUCTED AT STORMWATER OUTFALLS AND OTHER LOCATIONS THAT WILL PROTECT KARST FEATURES FROM SPILL CONTAMINATION.

8. INDOT AGREES TO DEVELOP A MONITORING AND MAINTENANCE PLAN FOR THE AFFECTED KARST FEATURES. IDNR, IDEM AND USFWS WILL BE PROVIDED AN OPPORTUNITY TO REVIEW THIS PLAN. THE ESTABLISHMENT OF WATER QUALITY AND A POINT AT WHICH A STANDARD IS ESTABLISHED FOR REMEDIATION WILL BE A PART OF EACH MONITORING PLAN. THE RESULTS OF THE MONITORING WILL BE SUBMITTED TO IDNR, USFWS, AND IDEM ON A REGULAR BASIS.

9. A LOW SALT, AND NO SPRAY STRATEGY WILL BE DEVELOPED FOR EACH FUTURE PROJECT. A SIGNING STRATEGY FOR THESE ITEMS WILL ALSO BE DEVELOPED FOR EACH PROJECT.

10. PRIOR TO ACCEPTANCE OF THE FINAL DESIGN PLANS AN AGREEMENT WILL BE DEVELOPED WHICH WILL SET OUT THE APPROPRIATE AND PRACTICABLE MEASURES TO OFFSET UNAVOIDABLE IMPACTS TO KARST FEATURES. THIS AGREEMENT WILL BE SIGNED BY THE DEPARTMENT DIRECTOR OF IDNR, THE COMMISSIONER OF THE IDEM, THE COMMISSIONER OF INDOT AND THE SUPERVISOR OF THE USFWS BLOOMINGTON INDIANA FIELD OFFICE. THE AGREEMENT WILL BECOME A PART OF THE CONTRACT DOCUMENTS FOR THE PROJECT. WILL BE

DISCUSSED AT THE PRE-CONSTRUCTION CONFERENCE AND WILL BE ON FILE AT THE OFFICE OF THE PROJECT ADMINISTRATOR.

11. INDOT WILL ASSURE THAT THE TERMS OF THE AGREEMENT WILL BE COMPLETED WITH ALL SAFEGUARDS GIVEN TO THE KARST AREA. SPECIAL PROVISIONS, WHICH ARE BINDING PROVISIONS THAT ARE A PART OF THE CONTRACT, WILL BE INCLUDED OUTLINING THE PRECAUTIONS TO BE TAKEN. CONSTRUCTION AND DESIGN STRATEGIES FOR HANDLING KARST FEATURES WILL BE DISCUSSED WITH THE CONTRACTOR(S) AND PROJECT ADMINISTRATOR DURING THE PRECONSTRUCTION CONFERENCE. PROJECT ADMINISTRATOR SHALL ENSURE THAT THE CONTRACTOR IS FOLLOWING THE NEW EROSION CONTROL STANDARDS THAT MEET RULE 5 OF 327 IAC 15 AND ANY SPECIAL PRECAUTIONS OUTLINED IN THE DESIGN PLANS THAT THE SINKHOLE TREATMENT IS BEING HANDLED CORRECTLY. THE EROSION CONTROL PLAN MUST BE AVAILABLE AT THE PROJECT ADMINISTRATOR'S OFFICE. AN EMERGENCY RESPONSE PLAN WILL BE MADE A PART OF THE CONTRACT DOCUMENTS. IN ADDITION, THE CONTRACT DOCUMENTS WILL CONTAIN A STRATEGY FOR SIGNING TO ALERT THE PUBLIC TO THE FACT THAT ALL TYPES OF SPILLS ARE POTENTIALLY HAZARDOUS TO THE KARST ENVIRONMENT. FOR INDOT, THIS PLAN WOULD BE PROCEDURE 20 OF THE FIELD OPERATIONS MANUAL DATED 6/24/92 (ATTACHED).

12. THE LOCATION AND NATURE OF THE SINKHOLES AND DRAINAGE SCHEMATIC WILL BE PROVIDED TO THE IDEM. THEY WILL PROVIDE THE INFORMATION TO THE APPROPRIATE LOCAL AUTHORITIES AND THE HAZMAT TEAMS. AN EMERGENCY RESPONSE PLAN WILL BE FOLLOWED. THIS CONSTITUTES PROCEDURE 20. INCLUDED IN THIS INFORMATION IS AN UNDERSTANDING THAT ALL TYPES OF SPILLS ARE POTENTIALLY HAZARDOUS TO KARST REGIONS.

13. IDNR, IDEM AND USFWS PERSONNEL WILL MONITOR CONSTRUCTION AND MAINTENANCE TO THE AGREED UPON TERMS, AS DEEMED NECESSARY.

14. IF DURING CONSTRUCTION IT IS FOUND THAT THE MITIGATION AGREEMENT MUST BE ALTERED, ALL OF THE AGENCIES WILL BE CONTACTED AND AGREEMENT REACHED PRIOR TO WORK CONTINUING IN THAT SPECIFIC AREA OF THE PROJECT. IN ORDER TO NOT UNDULY DELAY PROJECTS, A TWO WORKING DAYS RESPONSE TIME IS NEEDED FROM THE RESOURCE AGENCIES.

15. TREATMENTS WILL BE MAINTAINED DURING CONSTRUCTION BY MEANS OF A VISUAL INSPECTION ON A WEEKLY BASIS OR AFTER EVERY RAIN. CORRECTIVE ACTION WILL BE TAKEN AS NEEDED.

16. IF AFTER THE ABOVE PROCEDURE IS FOLLOWED AND A STATE/FEDERAL ENDANGERED/THREATENED SPECIES IS FOUND DURING CONSTRUCTION, WORK IN THAT AREA OF THE PROJECT WILL STOP. THE IDNR, AND USFWS WILL BE IMMEDIATELY NOTIFIED. THE IDNR AND USFWS WILL PROMPTLY INVESTIGATE THE SITUATION, ADVISE THE PROJECT ADMINISTRATOR AND ASSUME RESPONSIBILITY FOR PROTECTING THE ENDANGERED SPECIES AND TAKING THE APPROPRIATE ACTION.

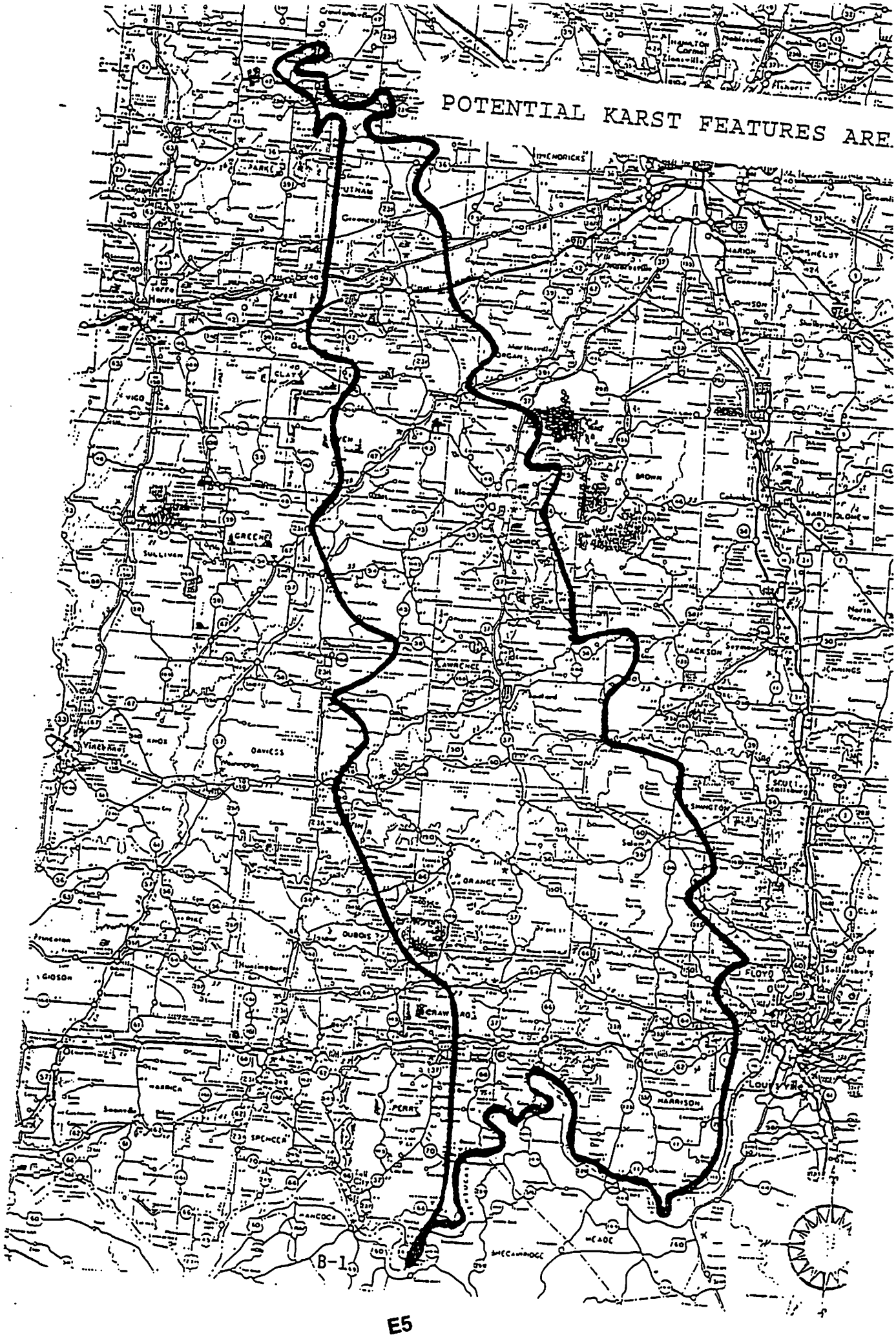
17. THIS DOCUMENT WILL BE REVIEWED ANNUALLY OR MORE FREQUENTLY AT THE REQUEST OF ANY OF THE FOREGOING AGENCIES.

MR. FREDERICK C. P POOL, COMMISSIONER
INDIANA DEPARTMENT OF TRANSPORTATION

MR. PATRICK R. RALSTON, DIRECTOR
INDIANA DEPARTMENT OF NATURAL RESOURCES

MS. KATHY PROSSER, COMMISSIONER
INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

MR. DAVID C HUDAK, FIELD SUPERVISOR, BLOOMINGTON FIELD OFFICE
U. S. FISH AND WILDLIFE SERVICE


POTENTIAL KARST FEATURES ARE
B-1

Indiana Karst Conservancy, Inc.

"PROTECTING CAVES THROUGH ACTIVE CONSERVATION"
PO BOX 2401 • INDIANAPOLIS, IN, 46206-2401 • (317) 882-5420
http://www.caves.org/conservancy/ikc/

November 28, 2002

David Bourff
Butler, Fairman, and Seufert
8450 Westfield Boulevard, Suite 300
Indianapolis, IN 46240

Dear Mr Bourff:

I have reviewed the EarthTech documents and it appears to be very complete with a few exceptions as noted below:

- I have a map of Just Off the Road Cave (15001) that EarthTech could not locate (ref page 10). They also stated on page 18 that this cave is not in the ICS database which is incorrect.
- In section 7.4.2 (Significant Features) under the Lost River System section (page 19), EarthTech omitted the discussion of Wesley Chapel Gulf, probably the most notable feature of the basin. The report does mention the Gulf while discussing Boiling Spring and Elrod caves, but does not discuss the Gulf in full detail, nor that it is National Natural Landmark.
- In addition to the Gulf, EarthTech did not discuss the Lost River Cave System just west of the Gulf (one of the three entrances is actually in the Gulf). This cave, now over 16 miles in length and when mapping is complete, it may turn out to be the longest cave in Indiana. The Lost River Cave System has already been documented to host 21 different troglobites, making it a significant and globally important cave system. Like many other features of the Lost River, there would be little direct impact due to the proposed SR 37 upgrade, but a spill or other catastrophic pollutant dumped into the sub-surface drainage system could cause significant biological damage.
- Also in section 7.4.2, under the discussion of Tolliver Swallowhole, the cave has been remapped to a length of approximately 1200 feet.

I would also like to reiterate EarthTech concerns that special attention is needed for the design work around feature 15007, the Lick Creek cut-off rise that is currently under a US 150 bridge. Also on SR 37, any work along the 1800' stretch of the Dry Bed of the Lost River needs to be carefully considered.

I would also strongly suggest the dye tracing suggested in the EarthTech report be completed to better understand the drainage divides and to be proactive about understanding the drainage system to better respond to a highway spill.

I do not fully understand the scope of the work your firm has been hired to perform. I would suggest that at the appropriate point in the design process, that the drainage traps and other preventative measures that EarthTech has suggested and has been utilized previously along SR 37 be incorporated into the design contract.

Please feel free to contact me at 317-280-6274 if you would like to discuss my comments further.

Sincerely,

Keith Dunlap
Indiana Karst Conservancy

engineering and technology tech for the planet.

Draft

DESCRIPTION AND DELINEATION OF KARST FEATURES IN THE VICINITY OF U.S. HIGHWAY 150/STATE ROAD 56 BETWEEN WEST BADEN SPRINGS AND PAOLI, ORANGE COUNTY, INDIANA, AND STATE ROAD 37 BETWEEN PAOLI AND MITCHELL, ORANGE AND LAWRENCE COUNTIES, INDIANA, AND RECOMMENDATIONS FOR THEIR PROTECTION

Prepared for:

Indiana Department of Transportation
100 North Senate Avenue, Room N848
Indianapolis, Indiana 46204-2249

Prepared by:

Earth Tech
5010 Stone Mill Road
Bloomington, Indiana 47408

January 1998

(revised January 12, 2001)

19705.07

CONTENTS

FIGURES

TABLES

SHEETS

APPENDIXES

1.0 INTRODUCTION

This report is prepared by Earth Tech for the Indiana Department of Transportation (INDOT) to assist the Department in complying with the terms and conditions of a 1993 Memorandum of Understanding (MOU) between INDOT, the Indiana Department of Natural Resources, the Indiana Department of Environmental Management, and the U. S. Fish and Wildlife Service regarding guidelines for construction of highway transportation projects in the karst areas of the State of Indiana. This report summarizes the results of field investigations of karst features within and near the existing right-of-ways of portions of U.S. Highway (US) 150/State Road (SR) 56, and SR 37 between West Baden Springs and Paoli in Orange County, Indiana, and SR 37 between Paoli, and Mitchell in Lawrence and Orange Counties, Indiana.

Karst features identified and evaluated in this report include features observed in the field that generally occurred within 200 feet of the existing right-of-way corridor of each highway, plus caves, springs, rises and other significant karst features that were located relative to the roadways in such a manner that runoff from highway construction activities or spills could possibly result in adverse impacts. Each feature near the existing the roadways is described and its drainage area estimated. For features receiving highway runoff, expected runoff from 2-, 5- and 10 year-24 hour design storms is calculated, and expected pollutant loadings are estimated for features with drainage areas greater than 10 acres. Recommendations for the protection of each feature are provided, and/or potential construction problems are noted.

A number of significant caves and karst features in the general area were identified and discussed by Ozark Underground Laboratory (OUL) in a report to INDOT dated September 27, 1994. Relevant caves and features identified in that report evaluated and discussed in this report as well. When appropriate, recommendations for the protection of these features are provided.

2.0 PROJECT DESCRIPTION

This report will provide INDOT with information that will be used for future highway planning efforts in these corridors. As of the date of this report, INDOT has no plans for highway construction or upgrading along any of the corridors, except for repaving SR 37 between Paoli and Mitchell, which is planned for 1998. This investigation begins on SR 56 in West Baden Springs, Indiana at the entrance to the West Baden Springs Hotel (station 92+40), and extends north approximately 0.8 miles to intersect with US 150 at Prospect, Indiana (station 136+60). The investigation continues east about 7.75 miles along US 150/SR 56 to the intersection with West Hospital Drive at the west edge of Paoli (station 545+00). Stationing on SR 56 and US 150 is based on highway construction plans dated 1927 and 1936, and all roadside features along US 150 and SR 56 are located with respect to this stationing.

At the intersection with West hospital Drive, the investigation continued along 1.7 miles of city streets that bypass downtown Paoli (West Hospital Drive, Longest Street, Sandy Hook Drive and East Hospital Drive) on the northwest site, and intersect with SR 37 on the north Side of Paoli. In preparation for resurfacing, metric station markers were marked at 20-m intervals on the road surface between the courthouse square at Paoli and the south side of Mitchell, and roadside features along SR 37 are located with respect to this stationing. The investigation continues north along SR 37 a distance of 11 miles (17.77 km) from station 2+580 in Paoli to Station 20+350 just south of Mitchell. The project ends at the intersection of SR 37 with CR 1000S. This intersection is also the southern terminus of the Southern Construction Segment, which was investigated by Earth Tech (then WW Engineering & Science) for INDOT in 1992-1995. The total roadway length investigated was approximately 21.25 miles.

3.0 DEFINITION OF TERMS USED IN THIS REPORT

Definitions of terms used in this report are based on a number of sources, including Lowe and Waltham (1995), Malott (1932) and Monroe (1970).

Blind Valley a valley that terminates abruptly at a point where its stream sinks, or once sank, underground

Cave a natural underground room, or series of rooms and passages large enough for human entry.

Conduit relatively large dissolutional void capable of transporting subsurface water. As used in this report, a conduit may not always be filled with water.

Detention Basin/Hazardous Materials Trap a basin of appropriate size to provide detention and settling of highway runoff prior to its entry into the subsurface. This is coupled with a trap for hazardous materials, which in most cases would consist of a siphon outfall to temporarily retain petroleum spills. As an option, this may be coupled with a secondary basin/sphagnum peat filter to remove dissolved metals and some dissolved organic compounds.

Estavelle an opening that can act as either a swallowhole or a resurgence, depending upon ground water conditions.

Eye an opening in a sinkhole at which water enters the subsurface.

Gulf a steep-walled or abruptly circumscribed depression which has an alluviated bottom in which an underground stream rises and sinks. Its development is dependent upon collapse of the rock overlying the stream, and the solution and removal of the fallen rock.

In-Sinkhole Treatment Structure a structure installed to treat runoff by a combination of settling and filtration, and to facilitate drainage to subsurface. These structures are installed in sinkholes that must be filled by construction to the extent that natural drainage is eliminated or greatly impeded. The structure typically consists of a vertical chimney installed in the excavated sinkhole throat. The chimney is surrounded by a graded stone filter, capped by a manhole or grate, and surrounded by a detention basin on the surface.

Mini-Basin an excavated basin in a highway ditch line designed to temporarily retain highway spills. The basins can be installed in series, and can range in capacity from several hundred to several thousand gallons.

Sinking Stream a stream that disappears underground, usually at a swallowhole or a swallet.

Sinkhole a closed depression in limestone, ranging in diameter from a few feet to several thousand feet, and in depth from a few feet to several hundred feet. Sinkholes may be formed in a number of ways, chiefly by solution of underlying limestone, or collapse over an underground passage. This report does not attempt to distinguish among the means of sinkhole formation since they cannot always be easily distinguished in the field. The term doline may also be used in the scientific literature.

Slump a small depression or opening in unconsolidated materials usually brought about by the removal of fine soil materials by water.

Stormwater Rise a point at which an underground stream emerges at the ground surface after the capacity of the subsurface drainage system has been exceeded.

Swallet (see Swallowhole)

Swallowhole the point at which a sinking stream enters the subsurface, usually in a sinkhole or blind valley. Swallet, as used in this report, refers to smaller sink points in sinking stream beds.

4.0 GEOLOGICAL SETTING

4.1 Physiography and Stratigraphy

Two physiographic units, the Mitchell Plain and the Crawford Upland occur in the study area (Figure 1) These units are related to the occurrence of different types of bedrock. Regional dip of the bedrock is about 30 feet per mile to the west-southwest, and the physiographic units are developed along the north-northwest strike of bedrock units. US 150/SR 56 between West Baden Springs and Paoli, and SR 37 north of Paoli to station 4+400 is located in the Crawford Upland physiographic unit. This area consists of a rugged, hilly upland that is deeply dissected by surface streams. These surface streams include the downstream portion of Lost River and Lick Creek, a major southern tributary of Lost River. Hilltops and ridges in the Crawford Upland are underlain by mixed sandstone, shale and thin limestone strata assigned to the West Baden and Stephensport Groups (Mississippian, Chesterian) (Figure 2).

From station 4+400 northward, SR 37 is located within the Mitchell Plain physiographic unit (Malott, 1922). This area is underlain by a thick sequence of limestones assigned to the Blue River and Sanders Groups (Mississippian, Valmeyeran and Chesterian) (Figure 2). These rocks occur stratigraphically below the West Baden and Stephensport Groups and dip beneath the overlying clastic units in eastern part of the Crawford Upland. The limestone units consist of (in descending order) the Paoli, Ste. Genevieve, St. Louis, Salem and Harrodsburg Limestones. Numerous karst features are developed on these limestones.

The Chester shales and sandstones of the Crawford Upland are more resistant to solutional weathering processes than the limestones of the Blue River Group. Therefore, the topography of the Crawford Upland is composed of a series of high upland ridges capped by clastic rocks, whereas adjacent parts of the Mitchell Plain to the north and east stand as a low sinkhole-pitted plateau. The boundary between the Crawford Upland and the Mitchell Plain is marked by the prominent east-facing Chester Escarpment. Karst features in the Crawford Upland portion of the project area generally occur only in the lower slopes of ridges and valley areas where the Blue River Group limestones are exposed beneath the West Baden and Stephensport clastics. The Blue River Group limestones are exposed along the valley walls of Lost River, and Lick Creek, a major tributary of Lost River, up to several miles west of the Chester Escarpment. The limestone units are exposed along the lower slopes of Lost River valley for a distance of a few miles northwest (downstream) of Prospect (Perry and Smith, 1958, Plate 2).

US 150/SR 56 west of Paoli runs roughly parallel with Lick Creek in the Crawford Upland. As the grade of Lick Creek is slightly less than the dip of the limestone strata, the limestones eventually dip beneath the valley floor, and karst features along the highway are uncommon at the west end of the study area. The short section of SR37 in the Crawford Upland (just north of Station 2+585 to Station 4+400), follows along a ridge top underlain by the West Baden Group. There are no significant karst features located along this stretch.

4.2 Hydrology

All of the Mitchell Plain and certain portions of the Crawford Upland in the project area are characterized by extensive development of surface and subsurface karst features. Karst features, including sinkholes, swallowholes, sinking streams, caves, estevelles, stormwater rises and

perennial springs are ubiquitous. Between Mitchell and Paoli, SR 37 traverses the Lost River drainage basin with its 22-mile long meandering "Dry Bed". The Lost River drainage basin is regarded as one of the classic karst areas of the United States (see Section 6.4.1), and has been extensively described by Malott (1932, 1949, 1952). Three of the major karst features in the Lost River basin are registered National Natural Landmarks, and/or Indiana Department of Natural Resources Nature Preserves (Tolliver Swallowhole, Wesley Chapel Gulf, and Orangeville Rise).

The Lost River area has been the subject of several hydrogeologic investigations (Malott, 1952; Murdock and Powell, 1968; Bassett, 1976; and Bayless and others, 1994). Subterranean drainage in the Mitchell Plain portion of the project area is tributary to the ground water basins of Hamer Cave in Spring Mill State Park, Orangeville Rise, or the Rise of Lost River (Sheet 1). Orangeville Rise and Rise of Lost River are the resurgence points for two, apparently independent, karst ground water basins. Their combined discharge of these two springs, located about 0.75 mile apart, in Sections 6 and 12, T2N, R1W, forms the headwaters of downstream Lost River below the Dry Bed section.

Ground water tracing investigations over a period of about 30 years have partially delineated the ground water basins of the Orangeville Rise and the Rise of Lost River (Sheet 1). Both drainage systems are hydrologically complex. Surface water flow and ground water flow are interrelated, and there are numerous instances of ground water flow crossing beneath apparent surface drainage divides. There is evidence that the subsurface conduits of both basins have only a limited capacity. Surface streams such as Lost River, Stampers Creek, Mt. Horeb Drain, and Flood Creek at Orleans sink at multiple swallowholes along their channels. When the subsurface conduits fill, the surface water bypasses upstream swallow holes and flows downstream in the dry bed to the next downstream swallow holes. After very large storm events, stormwater rises or overflow springs may discharge subsurface water into the lower reaches of the Dry Bed, bypassing the downstream portions of the conduit flow systems. Estevelles exist at a number of locations in the lower portion of the Dry Bed.

Ground water tracing results (Sheet 1) suggest that the area of the Orangeville Rise ground water basin is about 50 square miles. Mathers Stormwater Rises, and perhaps other stormwater rises in that general area (Sheet 1) appear to serve as major stormwater overflow points for the Orangeville Rise drainage system (Malott, 1952; Murdock and Powell, 1968; Bassett, 1976; Bayless and others, 1994; Earth Tech (1995) (see Section 6.4). The Orangeville Rise ground water basin is bounded to the north by the Blue Spring ground water basin, and to the northeast by the Hamer Cave ground water basin which discharges at Hamer Cave in Spring Mill State Park. The SR 37 project alignment from about station 17+500 northward follows along, or very close, to the probable location of the ground water divide between Hamer Cave and the Orangeville Rise. Southward, from Station 17+500, through the town of Orleans, to about Station 10+000, the project alignment is within the drainage basin of the Orangeville Rise. Treated wastewater injected into a sinkhole in the Orleans area has been documented to flow at velocities as great as 5.5 miles per day to the Orangeville Rise (Bassett, 1976).

Southward from about Station 10+000, the project alignment enters the drainage basin of the Lost River Rise. The Lost River Rise receives drainage from the Mitchell Plain in the project area as well as from a considerable surface catchment area in the upper portion of the Lost River watershed. This surface catchment area includes at least 52 square miles above the Principal Dry Weather Sinks of Lost River and 33 square miles above the Sinks of Stampers Creek and other smaller sinking streams in the eastern part of the Lost River Watershed (Sheet 1). Approximately 23 square miles of sinkhole plain and associated surface catchment area below the principal sinks are also drained by the Rise of Lost River.

From the Principal Sinks of Lost River to Lost River Rise. Lost River flows through subsurface solution conduits a distance of 7.0 miles. The flow route passes a short distance north of Tolliver Swallowhole (an overflow sink point) where a short section of the underground route was mapped by Malott (1952), and then through Wesley Chapel Gulf where dye injected at the Principal Sinks of Lost River was observed (Murdock and Powell, 1968) (Sheet 1). Scuba divers have followed a 10 foot high by 30 foot wide submerged conduit of Lost River 300 hundred feet around the north side of the Wesley Chapel Gulf, and have descended the actual Rise of Lost River to a depth of 160 feet. Several stormwater rises noted by Malott (1952) in the lower reaches of the Dry Bed channel (Sheet 1) may be overflow discharge points for the Rise of Lost River, but this has not been definitely established.

The project route probably leaves the Lost River Rise ground water basin near Station 4+600. South of this point, the route descends into the surface drainage basin of Lick Creek. Several springs draining small, isolated catchment areas in the Crawford Upland drain into Lick Creek along the route of us 150/SR 56. The largest of these are the spring at Kool Spring Cave and the spring at Clayton Conrad Cave (Sheet 1).

There is a documented subterranean cutoff (Malott, 1945) along Lick Creek south of US 150/SR 56 near Station 340+00. The cutoff, located beneath a meander spur of Lick Creek consists of: 1) a sink in the bed of Lick Creek on the southeast side of the meander core, 2) a spring and sink on the northwest side of the meander core, and 3) a rise directly beneath the highway bridge at Station 335+50. During low flow, the cutoff shunts much of the flow of Lick Creek into the sink. The stream rises in a pasture about 200 feet southeast of the highway, immediately sinks again, and rises directly beneath the SR 56 bridge in a deep mud-lined pool. The water then flows northwesterly via a surface channel to rejoin Lick Creek.

5.0 STUDY METHODS

5.1 Location and Identification of Karst Features

Earth Tech made a search of available literature and databases on area karst features. These included Indiana Cave Survey (ICS) list for the general area maintained by the Indiana Geological Survey, old highway plans, caving newsletters, cavers with knowledge of the areas, and the 1994 OUL report. Relevant karst feature locations were plotted on a 1:24,000 topographic base maps, which were digitized to form a map (Sheet 1) that encompassed the entire study area. The caves nearest the study segments were visited in the field to verify their locations.

In order to locate and describe karst features within and near the highway right-of-way, it was necessary to develop larger scale maps that could be used in the field to record the size and location of each feature. Copies of the original highway plans for US 150/SR 56, and SR 37 were provided by INDOT, and these were digitized by Earth Tech to construct preliminary line maps that included the roadway, station markers, public side roads, culverts and bridges, stream channels, and section lines and other government boundary lines. Line maps for the US 150/SR 56 segment were printed at a scale of 1"= 200', and comprised 3,000 foot highway segments that extended from the entrance of the West Baden Springs Hotel in West Baden Springs, to the west edge of Paoli.

State Road 37 between Paoli and Mitchell had recently been surveyed, and metric stations had been marked on the roadway at 60-meter intervals. To convert the SR 37 line maps to metric units, the locations of culverts, side roads, and other features appearing on the original highway

plans were measured in the field with respect to the new station markers. Line maps for the SR 37 segment were printed at a scale of 1"=70m (meters), and comprised 1 km (≅3,280 foot) highway segments that extended from the north edge of Paoli to CR 1000S, just south of Mitchell.

To describe karst features in the field, Earth Tech personnel walked the right-of-way of each line map segment. Each person had the following:

1. A copy of the line map
2. A 1"=400' air photo copy
3. A topographic map
4. A Karst Feature Survey Form to record
    - Feature designation
    - Station no., R/L
    - Area and depth of feature (if applicable)
    - Land use (row crop, pasture and hay, residential, commercial, wooded, paved)
    - Presence of an "eye" (sink point) or soil slumps
    - Whether the feature received highway runoff
    - Station nos. of highway runoff drainage breaks, R/L
    - Comments
5. An orange safety vest

When a feature was encountered, it was first located with respect to station numbers. Station numbers on SR 37 were read directly off the pavement, or a feature between two markers could be located by pacing and converting to metric. Station numbers on US 150 and SR 56 are estimated based on the distance from culverts, side roads or other features. The feature was marked on the line map in its approximate position, and marked on the air photo as well. The latter allowed the size and boundaries of the feature to be better visualized, and would be used to later refine the line map. Each feature was designated by the highway number (56, 150 or 37), the county (O or L), and a sequential number increasing from west to east on US 50/SR 56, and south to north on SR 37. Thus, the twenty-second feature noted on SR 37 was designated 37O22 as it was located in Orange County. The 150th feature on SR 37 was designated 37L150 as it was located in Lawrence County. If the feature was a sinkhole or swallowhole, an estimated depth was noted on the form.

The presence of an "eye" or sink point for water was important to note, as it gives an indication of the drainage characteristics of the feature, and suggests the need for additional runoff protection and control should highway construction occur. Features with sink points are also those which can readily be dye traced. Some effort was made to distinguish between sink points for water and soil slumps, though that was not always possible. While sink points actively direct runoff to the subsurface, slumps are areas of soil subsidence are not necessarily directly related to the drainage of the feature, and are more likely to indicate instability. For instance, they commonly form in highway embankments through the settling of fill, or may result from failed attempts to fill karst features.

For features that receive highway runoff, the drainage divides were located on both sides of the road, and marked on the survey form. This information was used to estimate the drainage area and calculate expected runoff.

Earth Tech investigators also located bedrock outcrops, private driveways and commercial areas to the line maps as they were encountered in the field.

Karst Feature Survey Form results are summarized in Tables 1, 2 and 3. Those line maps showing karst features or drainage to karst features are shown in Appendix A.

5.2 Calculation of Expected Runoff

Expected runoff was calculated only for those features currently receiving highway runoff. Surface watershed boundaries for each feature were estimated in the field and outlined on the air photos (or 7.5' topographic maps for very large drainage areas). Boundaries and present land uses were spot checked in the field, and paved areas were determined from the line maps. Watershed boundaries and land uses and soil types were plotted and measured with a polar planimeter. These were used to calculate runoff volumes to each feature using SCS (Soil Conservation Service) methodology. Total runoff from 2 year-24 hour (3.1 inches); 5 year-24 hour (3.9 inches) and 10 year-24 hour (4.4 inches) was estimated.

Land use types are:

pave - paved area

crop - row crop

wood - wooded land

P&H - pasture and hay

res - residential

comm - commercial.

The runoff volume estimates are reported in acre-feet. Runoff estimates are provided in Table 4. Runoff work sheets are shown in Appendix B.

5.3 Pollutant Loading Estimates

Estimated Annual loadings of chloride, TSS and selected metals for features with watersheds ten or more acres in size are provided in worksheets in Appendix C. Loadings are calculated by multiplying anticipated pollutant concentrations in runoff by average annual runoff estimated from Exhibit 2-8 of the SCS Engineering Field Manual (Soil Conservation Service, 1971).

Table 5 presents estimated concentration ranges in runoff for chloride, TSS, total metals (total chromium, copper, lead, nickel and zinc) and dissolved metals (copper, lead and zinc) that will be received by karst features. These estimated ranges are based upon 5 rounds of storm water sampling conducted along SR 37 near Mitchell from March, 1993 through March, 1995. Concentrations in Table 5 are listed for summer and winter precipitation events during construction, and for post-construction precipitation events year round. Pollutant loading estimates are provided for both summer and winter runoff. Statistical summaries of the SR 37 data are provided in Appendix D. To provide conservative ranges, the low concentration estimates were based on calculated averages and high concentration estimates are based on the 90 percent Upper Confidence Limit (UCL - one-tailed t-test) for each parameter. Parameter concentrations in runoff from storm events have a 90 percent probability of falling between the average and the UCL. There was an insufficient number of positive results from the SR 37

results for total arsenic, cadmium, mercury and selenium, or for dissolved arsenic, cadmium, chromium, mercury, nickel and selenium to establish concentration estimates. These parameters are not expected to be present to any great extent.

Estimated pollutant loadings are expected to be most affected by changes in land use rather than changes in highway use and construction, as most of the area of each watershed is in land uses that are not highway related. These pollutant loading estimates can be useful in assessing relative impacts from runoff among the features.

6.0 CONSTRUCTION AND POST-CONSTRUCTION PROTECTION OF FEATURES

6.1 Protection During Highway Construction

Because no construction is planned at this time, no specific recommendations for erosion control measures a given in this report. Erosion controls referred to in the above table would consist of installing straw bales, silt fences, erosion control blankets and geotextiles, and sodding and seeding. The use of gabions may also be appropriate in some situations.

6.2 Management of Post-Construction Runoff

Long term post-construction runoff management methods considered include establishing low-salt and no-spray corridors along the highway, and constructing ditch line mini-basins, runoff detention basins/hazardous materials traps, and in-sinkhole treatment structures. The purpose of these constructed methods is to remove as much runoff contamination as possible before it enters the subsurface, and/or to retain highway spills of hazardous materials before they can enter the subsurface. These runoff management methods are defined in Section 3.0.

The purpose of mini-basins is to temporarily retain highway spills of hazardous materials before they can enter a feature and be directed to the subsurface. The spill can be retained long enough to be removed by an emergency response team, and the chances of fouling any other installed runoff management systems are greatly reduced. Mini-basins should be installed in series in **all** ditch lines that drain to karst features, but would be particularly important at intersections and curves where the chance of an accident or spill is greater. The aggregate storage volume of a series of mini-basins in a ditch line should be sufficient to retain 10-12,000 gallons, the volume of most gasoline tank trucks. For features that receive highway runoff but have no eye or sink point, mini-basins should offer sufficient protection.

Features that possess an eye or an active slump, and that receive highway runoff, provide a direct route for runoff to the subsurface without the benefit of natural soil filtering or settling of particulates. The use of detention basin/hazardous materials traps (Figure 3) should be considered if the feature will not be significantly filled as a result of highway construction, a detention basin/hazardous materials trap should be installed upslope of the feature to intercept all runoff, provide for settling of particulates, provide additional retention of highway spills, and provide a measure of filtration/adsorption of dissolved contaminants.

For features with an eye that will be entirely or mostly filled as a result of highway construction, there are two options that can be provided for runoff: The first is to direct runoff to the next available feature (which may not be possible or desirable), or to install an in-sinkhole treatment structure similar to those used along SR 37 between US 50 and Mitchell. These structures provide drainage to the subsurface, plus detention and filtration for the runoff (Figure 4). They are recommended in this report when there is an eye or active slump in or at the base of the embankment.

Runoff management methods are recommended assuming no major changes in highway alignment, and only minor widening of the highway and shoulders (i.e., no additional travel lanes).

7.0 DISCUSSION OF INDIVIDUAL FEATURES

7.1 West Baden Springs to Paoli - US 150/SR 56 Corridor

This highway segment is located entirely within the Crawford Upland. It roughly parallels Lick Creek for most of the distance between Paoli and Prospect. Lick Creek joins Lost River just east of Prospect. Land use is mostly agricultural and wooded, with occasional residences along the highway. At the west end, in and around West Baden Springs, there are few karst features, since most of the limestones associated with significant karst development (e.g., Salem, St. Louis, Ste. Genevieve) are below the valley floor of Lick Creek. Karst features become more prevalent at the eastern end of this segment, but still consist mainly of isolated sinkholes with small drainage areas.

7.1.1 Significant Features

See Table 1. Twenty karst features were identified in the vicinity of SR 56 and US 150 between West Baden Springs and Paoli. These are as follows:

- Flowing well - 1 (56O1)
- Caves/springs/rises - 5
  - Just Off the Road Cave (150O1)
  - Clayton Conrad Cave (150O2)
  - Seep or wet weather spring at end of culvert (150O5)
  - Buttermilk Spring/Cave (150O6)
  - Rise pit under highway (150O7)
- Sinkholes receiving highway runoff
  - With eye - 6
  - No eye - 1
- Sinkholes not receiving highway runoff
  - With eye - 1
  - No eye - 5
- Slump in ditch line - 1

Feature 56O1 is a flowing sulfur well within the right-of-way at the base of the south abutment of the highway bridge over Lost River. A flow of about 15 gpm issues from a three-inch iron well casing and flows downslope into Lost River. Historic information (Indiana Supreme Court, 1905) indicates that this was probably a well drilled by Dr. John A. Ritter in 1898. When the well was completed, there was a strong artesian flow of water. Shortly thereafter, the flow of the sulfur springs at nearby French Lick Springs and West Baden Springs Hotel greatly diminished, and again resumed when Dr. Ritter capped the well. The Ritter property was later transferred to the West Baden Springs Hotel. Though not a karst feature, the well is a significant hydrogeological feature immediately adjacent to the highway, and is therefore addressed in this report.

The well is situated on a steep embankment. The casing is severely corroded and protrudes about a foot above ground. The casing appears to end about 2 feet from ground level, apparently in bedrock. Water flows from the top of the casing, as well as from a split in the casing about a foot down, and perhaps from joints and cracks in the bedrock. In addition, there is a partial obstruction in the well at a depth of about 31 feet, which may have been the result of an early capping or plugging attempt, so the water flow from the well probably exceeds 16 gpm. The well would probably have to be grouted from the bottom up to stop all flow. See Appendix A, Sheet 1.

Feature 150O1 is Just Off the Road Cave, which is discussed in the 1994 OUL report. The cave entrance is located in the north wall of an abandoned rock quarry immediately north of US 150/SR 56, about 15 feet above road level. The cave passage is about 3-4 feet high and about 15-20 feet wide with a dirt floor. The cave passage generally extends northeasterly from the entrance, and is reported to be about 874 feet long. A map of the cave is reported to exist (Fee, personal communication), but could not be obtained by Earth Tech. No water was noted in the cave, nor was any noted in the OUL report. Highway runoff enters the quarry and sinks near the east end of the quarry in rock rubble. This water most likely drains to Lick Creek, located immediately south of the highway and quarry. A map of the cave has not been located. See Appendix A, Sheet 2

Feature 150O2 is Clayton Conrad Cave which is discussed in the 1994 OUL report. It was described in detail by Fee (1991). The cave entrance is located about 1,000 feet southwest of the highway, and consists of a spring outlet that discharges to a drainageway that flows to nearby Lick Creek. The elevation of the entrance is about 490 feet MSL. The cave is reported to be 4,162 feet long, with a stream running most of the length, and the passage extends southeasterly from the entrance and away from US 150/SR 56. It does not appear likely that Clayton Conrad Cave receives runoff from the present highway alignment. However, two small sinkholes, **150O3** and **150O4** (Appendix A, Sheet 3) receive runoff from a shallow swale that heads near the highway alignment to the east, and these most likely drain to Clayton Conrad Cave. Any shift of the highway alignment to the south in this area could result in highway runoff entering these features, and thus Clayton Conrad Cave. Features 150O3 and 150O4 are not discussed in the OUL report.

Feature 150O5 is a possible small seep or spring that is evidenced by minor discharge from the downstream end of a drainage culvert, but no discharge entering the culvert. It is not discussed in the OUL report. The feature is located in the vicinity of a rock outcrop along Lick Creek, and just northwest of Buttermilk Spring/Cave, and may be associated with the latter. The location of the outlet is unknown and the feature is quite small. See Appendix A, Sheet 4.

Feature 150O6 is Buttermilk Spring Cave, identified from the ICS cave list for Orange County. It is not discussed in the OUL report. The entrance is located in the west face of a small abandoned limestone quarry near Lick Creek, about 250 feet south of the highway. The original 4 foot x4 foot spring entrance was modified by cement blocks and wood to make a small spring house, which has mostly disintegrated. The passage is small and mud-filled, and was followed for a distance of about 35 feet. No map of the cave exists. See Appendix A, Sheet 4.

Feature 150O7 is a rise for a subterranean cutoff of Lick Creek. The feature was described by Malott (1945). A portion of the waters of Lick Creek sink in the stream bed southeast of Feature 150O7, and on the opposite side of the ridge. The water then flows underground to the northwest a distance of about 700 feet to rise as a small pond in a cattle pasture about 200 feet southeast of the highway. The outflow from the pond quickly disappears in a series of sinks, then rises again in a pool directly beneath the roadway. This enters a wooded drainageway and flows 500 feet

northeasterly to re-enter Lick Creek. From the sink point, Lick Creek flows approximately 2 miles in a large meander first northeasterly then southwesterly to the re-entry confluence. No enterable cave is known to exist. Highway runoff can enter the feature via Lick Creek but under all but low flow conditions, most of the stream water is expected to bypass the sink in the stream bed. Any construction activities involving bridge replacement and/or highway widening at the rise could significantly affect this feature. See Appendix A, Sheet 4.

There are seven additional karst features that presently receive highway runoff:

- 150O8 (Appendix A, Sheet 5)
- 150O9 (Appendix A, Sheet 5)
- 150O11 (Appendix A, Sheet 6)
- 150O12 (Appendix A, Sheet 6)
- 150O13 (Appendix A, Sheet 7)
- 150O15 (Appendix A, Sheet 7)
- 150O16 (Appendix A, Sheet 8)

All of the above features are located near Lick Creek, and have very small drainage areas. None are discussed in the OUL report. It is likely that they discharge to small seeps or springs in drainageways leading to Lick Creek, or along the creek itself. No springs are known from this reach of Lick Creek.

All of these features would be affected by any construction activities that involved highway widening or significant earthmoving. Feature 150O9 is located in a ditch line along the south side of the highway. The original highway plans show a significant sinkhole (several feet across, depth unknown) at this location. The feature has obviously been backfilled with rubble and pieces of blacktop until it is at grade with the rest of the ditch line. This feature would have to be excavated backfilled with rip rap, and capped with reinforced concrete if the roadway was widened.

There are five additional karst features that presently receive no highway runoff:

- 150O10 (Appendix A, Sheet 5)
- 150O14 (Appendix A, Sheet 7)
- 150O17 (Appendix A, Sheet 8)
- 150O18 (Appendix A, Sheet 8)
- 150O19 (Appendix A, Sheet 8)

All of these are upgradient from this highway, and none are likely to affected by future construction activities, unless the right-of-way is widened significantly. None are discussed in the OUL report.

7.1.2 Drainage Area and Runoff Estimates

See Table 4 and the appropriate feature number.

7.1.3 Pollutant Loading Estimates

See Appendix C and the appropriate feature number.

7.1.4 Potential Impacts to Features and Recommendations for Protection

See Table 6 and appropriate feature number.

7.1.5 Recommended Dye Tracing

It is recommended that either Feature 15003 or 15004 be dye traced to determine if runoff entering these features discharges into Clayton Conrad Cave.

7.2 Paoli to Orleans - SR 37 Corridor

The south end of this segment is in the Crawford Upland. Much of the land use here is wooded; however there is also considerable residential (and some commercial) development owing to the proximity to Paoli. About 2 km north of Paoli, the highway descends to the Mitchell Plain. Most of the land use in this portion of the Mitchell Plain is row crop and pasture and hay, with small residential and commercial areas along the highway.

7.2.1 Significant Features

See Table 2. Ninety-five karst features were identified in the vicinity SR 37 between Paoli and the south side of Orleans. These are summarized as follows:

- Sinkholes receiving highway runoff
  - With eye - 8
  - No eye - 35
- Sinkholes not receiving highway runoff
  - With eye - 10
  - No eye - 31
- Sinkhole ponds - 6
- Sinking streams and associated features - 3
- Slumps in ditches - 2

Because of the large number of features, this section discusses only selected features in detail. Features are selected for discussion based on size, natural and/or hydrological significance, possible instability, and/or the potential for construction problems, either for the feature or for the highway.

Feature 3704 is a large swallow hole located about 1,100 feet east of the highway in a mobile home subdivision. It receives runoff from over a kilometer of roadway, plus about 475 acres of wooded and residential land. It is situated at the base of the Crawford Upland at the upstream end of a karst valley that extends northwesterly into the Mitchell Plain in the direction of the Dry Bed of Lost River. **Feature 37020** is near the downstream end of this same karst valley. The fate of water sinking at 3704 is unknown. If it flows northwesterly toward Lost River, Robbin's Roaring Resurgence (Sheet 1) may be a stormwater overflow for this feature. A definite sewage odor was noted at the resurgence by those who discovered it (Fee, personal communication).

Feature 3708 is a broad, shallow 6.4-acre sinkhole just west of the highway and south of CR 250N. There are two large eyes at the bottom of the depression.

Features 37011, 37013 and 37014 are at a low point on the highway. Runoff from the east side of the highway flows to 37011, which was formerly a pond. According to the landowner's father, INDOT dug out an open joint on the east side of the pond in the past to improve drainage and alleviate road flooding during large storm events. Runoff from the west side of the highway flows to a culvert that also drains to 37011. However, some of this runoff drains into 37013, a

slump in the ditch line at the culvert inlet. During large storm events, some runoff may cross a shallow drainage divide and enter 37O14, which usually does not receive highway runoff.

Features 37O16 and 37O17 are probably the same sinkhole divided by the highway. There is an active slump at the base of the highway embankment at 37O16.

Feature 37O20 appears to be an excavated area at the outfall of a culvert with a rocky bottom. Water may sink at this point.

Features 37O23 and 37O24 are located on the east side of the Dry Bed of Lost River which runs parallel to the highway for about 1,800 feet in this stretch. Feature 37O23 is a depression located at the outfall of a highway culvert that drains a fairly large area to the east. It appears to be a small swallet. Feature 37O24 is located further upstream and is a larger swallet. Both would receive highway runoff during storm events.

Feature 37O28 is a small sinkhole east of the highway. There is a rip rapped depression at a culvert outfall draining the west side of the highway that may be a filled eye. There is also a slump in the highway embankment at the south end of the feature.

Feature 37O30 is the bridge crossing at the Lost River Dry Bed. Highway runoff drains to this feature from the north and south. The Turner Swallowholes (see Section 6.4.1) are located in an alcove off the Dry Bed approximately 2,500 feet downstream from this point, and would likely receive highway runoff when the Dry Bed is flowing. There are probably other smaller swallow holes in the Turner Swallowhole area that are closer to the highway and would receive highway runoff more often. A dye trace performed by Murdock and Powell (1968) at the Principal Sinks of Lost River upstream from the highway bridge was traced to the Rise of Lost River.

Feature 37O45 is a small sinkhole east of, and mostly within the highway right-of-way. There are signs that the water ponds in this feature, suggesting that it does not drain well.

Feature 37O47 is a broad sinkhole in a farm field west of the highway. There is a slump on the west slope of the feature that is at the approximate elevation of the road surface. It is not expected to receive highway runoff. There is a filled active slump in the right-of-way at the southeast corner of the feature.

Feature 37O56 is a shallow sinkhole located west of the highway. Immediately east of the highway is commercial property that has obviously been filled, and may have covered the eastward extension of this feature. Runoff from this commercial property flows via culvert to 37O56.

Feature 37O58 is a sinkhole pond used to water stock. It receives highway runoff.

Features 37O62 and 37O63 are probably the same sinkhole divided by the highway. Feature 37O62 drains to 37O63 via culvert, and there is a wet spot in the latter feature suggesting that it does not drain well.

Features 37O66 and 37O67 are probably the same sinkhole divided by the highway, but do not appear to be connected by culvert. Feature 37O66 is the larger of the two, and a wet area in the bottom suggests that it does drain well. There is an old rock quarry in the east wall of this feature. Feature 37O67 appears to have a filled eye near its center, and there is an active slump in the road embankment at the base of utility pole.

Features 37O68 and 37O69 are probably the same sinkhole divided by the highway, but are not connected by culvert. Runoff bypasses 37O69 and continues to 37O66 on the east side. On the west side, 37O68 appears to have a filled eye at the base of the highway embankment.

Features 37O71 and 37O72 are probably the same sinkhole divided by the highway and connected by culvert. Runoff drains from 37O71 to 37O72, and sinks at what appears to be a filled eye in 37O72.

Features 37O74, 37O75 and 37O76 are three closely spaced features located mostly within the right-of-way on both sides of the highway. Features 37O75 and 37O76 are connected by culvert. However most runoff to 37O75 appears to bypass the culvert and sink in a possible filled eye near the south end of the feature. Features 37O74 and 37O76 are located side-by-side, but are separated by a saddle, so one does not drain to the other. Feature 37O76 has a rubble-filled eye.

Features 37O77 and 37O78 are probably the same sinkhole divided by the highway and connected by culvert. Feature 37O78 drains to 37O77, and there is a sinkhole pond at the east end of the latter feature.

Feature 37O80 is a shallow sinkhole that receives highway runoff. However, runoff flows over a low saddle to a large, poorly drained sinkhole to the east.

Feature 37O81 is a low spot in the ditch line at which water sinks.

Feature 37O83 is a poorly drained, brushy sinkhole with some standing water partly within the right-of-way. It may be a wetland.

Features 37O86 and 37O87 are probably the same sinkhole divided by the highway. Old highway plans show the features connected by culvert, but this could not be located in the field. There is a slump in the highway embankment in 37O87.

Feature 37O86-A is a broad, shallow sinkhole located a the junction of SR 37 and Martin Street. This feature was inadvertently omitted from the original draft report. Land use is agricultural.

Feature 37O88 is a broad, grassed sinkhole in the Wesleyan Church Camp. A concrete pad in the center appears to cover the eye. The camp manager explained that the pad was installed in 1954 as a stage for a small amphitheater, and does not cover an opening in the sinkhole.

Feature 37O90 is a shallow swale that leads to a small pond on the Farm Bureau property. The pond may be in part the result of filling and development activities on the property.

Feature 37O91 is a broad, grassed sinkhole located just south of the Orleans Wastewater Treatment Plant. A dye trace was conducted by Bassett (1974) on the plant property immediately north of the feature. Drainage was traced to Orangeville Rise.

Feature 37O93 is included because it is shown as a sinkhole on old highway maps. The feature has been almost entirely filled and developed.

Feature 37O94 is a small sinkhole pond with a heavily vegetated margin. Parts of the feature have been filled at the south end, and by the highway embankment.

7.2.2 Drainage Area and Runoff Estimates

See Table 4 and the appropriate feature number.

7.2.3 Pollutant Loading Estimates

See Appendix C and the appropriate feature number.

7.2.4 Potential Impacts to Features and Recommendations for Protection

See Table 7 and appropriate feature number. For the purposes of brevity in Table 7. sinkholes with drainage to eyes are termed "open basins" and sinkholes without drainage to eyes are termed "closed basins".

7.2.5 Recommended Dye Tracing

Feature 37O4 should be dye traced. It is a swallowhole with a large drainage area located in the Mitchell Plain at the base of the Crawford Upland. Although it most likely drains northwesterly to the Rise of Lost River, it could possibly drain southerly into the Lick Creek drainage basin.

As a result of past dye tracing work, (Bassett, 1974; Bayless and others, 1994; Murdock and Powell, 1968), we can be reasonably certain that the other sinkholes on the Mitchell Plain in this highway segment drain either to the Rise of Lost River in the vicinity of the Dry Bed, or to Orangeville Rise in the vicinity of Orleans. However, the ground water divide between the two basins has not been determined in this area. For this purpose, dye traces are recommended at Features 37O28, 37O47, 37O67, 37O74 (or 37O76), and 37O81

7.3 Orleans to Mitchell- SR 37 Corridor

7.3.1 Significant Features

See Table 3. Sixty-seven karst features were identified in the vicinity SR 37 between the south side of Orleans and the south side of Mitchell. These are summarized as follows:

- Sinkholes receiving highway runoff
  - With eye - 6
  - No eye - 18
- Sinkholes not receiving highway runoff
  - With eye - 7
  - No eye - 21
- Sinkhole ponds - 1
- Sinking streams and associated features - 1
- Slumps in ditches - 13

Because of the large number of features, this section discusses only selected features in detail. Features are selected for discussion based on size, natural and/or hydrological significance, possible instability, and/or the potential for construction problems, either for the feature or for the highway.

Feature 37O99 is the sink point for Flood Creek (also named Ben's Creek locally, and "Old Sulphur" in Malott (1952)), which has an overall drainage area of approximately 1,760 acres. However, during most rain events, Flood Creek receives runoff mainly from 80 acres of city yards and streets and a small area of farmland, and the majority of the Flood Creek flow upstream of Orleans enters **Feature 37O102**. After larger events, Feature 37O102 overflows and drains overland south to the Essex Corp. property a distance of about 750 feet. The runoff enters two 72-inch culverts and drains westerly about 300 feet to discharge into the Flood Creek channel that crosses beneath SR 37 in Orleans.

Feature 37O101 shows as a sinkhole on both sides of the road in the old plans. The portion west of the highway has been filled. Water sinks at the east end of a culvert within the right-of-way.

Feature 37O103 and 37O104 are low spots adjacent to the roadway water stands, then sinks slowly.

Feature 37O106 is a low spot in the ditch line where water sinks at the west end of a culvert.

Feature 37L113 is a broad shallow sinkhole that lays across the Orange-Lawrence county line. There is a eye near the north end that is at or near the point where Bayless and others (1994) injected Rhodamine WT dye in February 1994 (Test 5). The dye was recovered at Orangeville Rise.

Features 37L114 and 37L115 are probably the same sinkhole divided by the highway. There is no connecting culvert. Feature 37L114 has no eye. Feature 37L115 has an eye.

Features 37L117 and 37L118 are probably the same feature divided by the highway. Runoff drains from 37L117 to 37L118 via culvert. There is an eye in 37L118 on the north slope of the feature. It is to one side of the sinkhole bottom and may receive runoff only after heavy rains.

Features 37L122 and 37L123 comprise a flat-bottomed sinkhole at the base of a hill slope, and divided by the highway. Runoff drains from 37L123 to 37L122 via culvert, and sinks at an eye in the floor of 37L122.

Feature 37L133 is broad flat-bottomed sinkhole that has had a trench excavated near the west end to receive and drain highway runoff.

Feature 37O134 is a low spot in the ditch line where water stands and sinks.

Feature 37L136 is a broad sinkhole that has been partly filled at the north end. It appears that excess runoff is directed to **Feature 37L135,** a sinkhole pond, via a shallow excavated ditch. This suggests that 37L136 does not drain well.

Features 37L140, 37L141, 37L142, 37L148, 37L149, 37L150, 37L151, 37L159 and 37L160 are rubble-filled slumps in the ditch line.

7.3.2 Drainage Area and Runoff Estimates

See Table 4 and the appropriate feature number.

7.3.3 Pollutant Loading Estimates

See Appendix C and the appropriate feature number.

7.3.4 Potential Impacts to Features and Recommendations for Protection

See Table 8 and appropriate feature number. For the purposes of brevity in Table 7, sinkholes with drainage to eyes are termed "open basins" and sinkholes without drainage to eyes are termed "closed basins".

7.3.5 Recommended Dye Tracing

As a result of the dye tracing work by Bayless and others (1994) we know that the subsurface basin of Orangeville Rise extends at least as far north as the Orange-Lawrence County line. Previous dye tracing work by Earth Tech (then WW Engineering & science) for INDOT in 1993

along SR 37 indicates that sinkhole S-1, immediately north of 37L161, drains to Hamer Cave in Spring Mill State Park. Bayless and others (1994) placed the ground water divide between Hamer Cave and Orangeville Rise to the east of SR 37, but they had plotted the location of S-1 about 1,500 northeast of its actual location, so the actual divide is probably nearer the highway. In order to locate the divide, dye traces are recommended at Features 37L122, 37L133, 37L140 (or 37L141 or 37L142), 37L153 and 37L159 (or 37L160).

7.4 Significant Area Caves and Karst Features

7.4.1 OUL Report

This section primarily addresses certain caves and karst features discussed in the 1994 OUL report. The OUL report evaluated the potential for impacts on karst features for six proposed route alternatives for SR 145 between French Lick and Mitchell, Indiana. The study began on SR 145 at the edge of the Hoosier National Forest Patoka Purchase Unit, about 5 miles south of French Lick, and ended at the junction of SR 37 and SR 60 in Mitchell. One of the six route alternatives noted in the OUL report, Line E, corresponds with the study alignment for this report.

The stated purposes of the OUL report were to:

- Provide a broad overview of the study area and its significant karst features.
- Identify those features within the study that should be avoided by new construction.
- Identify the impacts on the environment of the proposed route alternatives.
- To justify why some proposed route alternatives are not feasible.

For each feature listed the report provides:

1. A brief site description.
2. The entrance location and land area underlain by passages.
3. Natural significance category (local, regional, state, national).
4. Association with route alternatives.
5. Assessment of environmental impact as a function of feature significance and vulnerability, and length of road corridor potentially affecting the feature.
6. Recommendations relative to avoidance or mitigation

Those karst features associated, or downgradient from, with Line E in the OUL report, plus features identified by Earth Tech for this report will be discussed in this section. All features are located on Sheet 1.

7.4.2 Significant Features

Barnett Cave, located just north of Paoli and about 4,500 feet west of SR 37, is noted by OUL to be a dry cave with a swallowhole entrance at an approximate elevation of 690 feet MSL. The cave was noted in the OUL report as having local significance and no environmental impact as a result of highway construction along Line E. The ICS file entry noted that this small cave has a length of 42 feet, depth of 40 feet, and floods. Earth Tech agrees with the OUL assessment of significance and environmental impact.

Buttermilk Spring Cave was identified and located by Earth Tech from the ICS files. It is discussed as Feature 15006 in Section 6.1.1. Based on size it has only local significance. Potential impacts and remedies were discussed in Section 6.1.4 and Table 6.

Cave Street Cave is located in Paoli about 750 feet north of US 150/SR 56, and adjacent to a city park. It consists of a small stream passage about 1,250 feet long. The cave is noted in the OUL report as having local significance, and no environmental impact as a result of construction along line E. The ICS file entry noted that the cave floods, and smells of sewage. It also notes the cave's alternate name is Tomato Factory Cave. Earth Tech agrees with the OUL assessment of significance and environmental impact.

Clayton Conrad Cave was discussed as Feature 15002 in Section 6.1.1. It is located about 1,000 feet southwest of US 150/SR 56, and has a spring entrance that discharges into nearby Lick Creek. Information in the ICS file entry is essentially the same. The OUL report assigns the cave state significance based upon length (4,162 feet) and the display of formations. Earth Tech concurs with this assessment of significance. The OUL report assumes the possibility that approximately 1,000 feet of the present highway alignment may lie within the recharge area of the cave. There is no field evidence that suggests that highway runoff might enter the cave (i.e., sink points at or above the entrance elevation that would receive highway runoff), but there are two sinkholes (15003 and 15004) in a nearby swale that does not receive highway runoff. Potential impacts and remedies were discussed in Section 6.1.4 and Table 6.

Hamer Cave (Spring Mill State Park) has been dye traced to feature S-1 on SR 37, immediately north of the terminus of this project. The Cave contains northern cavefish (*Amblyopsis spelaea*), and water from the entrance powers the old mill at the park. Some sinkholes south of S-1 in the study corridor may also be connected with Hamer Cave, or other caves within the park. Recommended locations for dye tracing discussed in Section 6.3.5 will address this issue.

Hobo Cave is located about 500 feet east of SR 37 on the north side of Paoli, and is located upgradient of the highway. The entrance consists of a seven foot vertical entrance in a hillside that leads to a sloping room about 40 feet long. The cave is listed as an ICS file entry, but was not mentioned in the OUL report. Highway construction activities should not affect this cave.

Just Off the Road Cave was discussed as Feature 15001 in Section 6.1.1. It is located just north of US 150/ SR 56 in the face of an abandoned rock quarry. It is not listed as an ICS entry. Fee (personal communication) believes that he saw a few bats in the cave, but were probably pipistrelles. The passage is dry. The OUL report assigns the cave regional significance based on passage length (874 feet) and size. It seems unlikely that this cave would have more than local significance. This cave would be adversely impacted only if the highway alignment was shifted northward into the ridge. Potential impacts and remedies were discussed in Section 6.1.4 and Table 6.

Kids Cave is located about 1,000 feet east of Barnett Cave, and about 3,500 feet west of SR 37. It is not listed as an ICS file entry. The cave was noted in the OUL report as having local significance and no environmental impact as a result of highway construction along Line E. Earth Tech agrees with the OUL assessment of significance and environmental impact.

Kool Spring Cave is a cave reported to contain about 1.5 miles of passage by Fee (OUL), and about 4,500 feet of passage in the ICS files. The passage trends northerly and discharges at a spring entrance on the south side of Lick Creek, about 2,000 feet south of SR 37. The cave is noteworthy for its population of northern cavefish reported to Keith by Ash (Keith, 1988). The OUL report assigns the cave state significance owing to the cavefish population and size and

beauty of the cave; and assigned zero environmental impact as a result of any construction on SR 37, so long as the highway corridor is not shifted south toward the cave. Earth Tech concurs with both findings.

Lost River System contains a number of associated caves and surface karst features. The underground section of the Lost River System begins at the Principal Dry Weather Sinks, which are located in the SW1/4 of Section 8, T2N, R1E, about 3 miles east of SR 37 (Sheet 1). During low flow conditions, the entire drainage for a 52 square mile drainage area enters the Principal Sinks. The downstream end of the Lost River System is the Rise of Lost River (True Rise), located in the SW1/4 NE1/4 Section 7, T2N R1W. The straight line distance between the Sinks and Rise is about seven miles. The total drainage area above the Rise of Lost River is approximately 108 square miles, which includes (in addition to the 52 square miles above the Principal Sinks) 33 square miles of drainage that is tributary to Stampers Creek and other small sinking streams in the eastern part of the watershed, and about 23 square miles of sinkhole plain drainage between the Principal Sinks and the Rise.

Malott (1952) states that the Dry Bed is flooded throughout an average of three times a year, though periods of a year or more may occur when the entire Dry Bed is not flooded at all. Flooding of the Dry Bed is described by Malott as occurring as a surge, or series of surges, of storm water that quickly fills the channel to a considerable depth. He attributes the sudden surges to the fact that upstream swallowholes will initially accept large volumes of runoff and slow the downstream advance of the storm water in the Dry Bed. When each swallowhole and its conduit becomes filled to capacity, inflow rapidly slows or ceases, and great volumes of excess runoff are suddenly shunted downstream in the Dry Bed. Thus it is likely that during very large precipitation events, much of the storm water in the Dry Bed will never be directed underground after the underground portion has filled with storm water, and the runoff will be heavily diluted. Conversely, runoff from small to moderate precipitation events is more likely to affect the underground portions of Lost River, as it will be directed entirely underground with less dilution.

Features discussed in the section that are within the Lost River System are generally located a significant distance downgradient from SR 37, and should not be affected by SR 56 or US 150 (Sheet 1). In the discussions below, it is assumed that the more readily a feature can receive highway runoff, and the less that runoff is diluted when it reaches the feature, the more potential there is for adverse impacts. For instance, features that receive inflow only during floods when the Dry Bed is flowing and there is significant dilution of runoff, are less vulnerable than features that have perennial flow, and can receive highway runoff more readily.

- **Boiling Spring Cave** is located along the south wall of Wesley Chapel Gulf (about 3.3 miles west of SR 37), about 25-30 feet above a conical, mud-lined, rise pit of Lost River. During floods, water can overflow the rise pit and enter the cave. The overflow water flows southerly and southwesterly in the cave, and probably enters known passages of Wesley Chapel Gulf Cave to the southwest. Boiling Spring Cave functions as a short stormwater overflow route for Lost River. It is not known to possess its own fauna, or other significant feature, and should not be affected by any highway-related disturbance from SR 37.

- **Cul de Sac** is described in Malott (1952) as follows:

"A short distance south of the westerly bend is a low alluviated cul de sac connected with the dry-bed, which contains several small swallow-holes as low or lower than the dry-bed . . . This cul de sac has the appearance of a partly filled swallow-hole complex into which water from the dry-bed entered in considerable volumes. It is probably a nearly abandoned swallow-hole terminal through which waters were once directed north-west through the Peacher caves underground route an on to the resurgence on the former Mathers farm.

This feature is located about 2.2 miles west of SR 37, and probably represents an ancient swallowhole when storm waters fill the Dry Bed of Lost River. The OUL report assigns Cul de Sac national significance because of its inclusion in the Lost River. Earth Tech believes that the site merits state significance. Little or no adverse impacts are expected from SR 37. Earth Tech agrees with this conclusion.

- **Dry Bed of Lost River** is the principal surface expression of the Lost River System, and consists of a largely abandoned, meandering surface channel about 22.5 miles in length between the Principal Dry Weather Sinks of Lost River and the Orangeville Rise. The Dry Bed channel is 12 to 16 feet in depth, and in many places, the bed is occupied by trees or heavy herbaceous vegetation. Throughout its length, the Dry Bed contains numerous openings through which storm waters may sink or rise, depending upon surface and subsurface flow conditions. A number of these features are comparatively insignificant in size, and have never been precisely located or described. For instance, Features 37O23 and 37O24, identified by this study are quite small, but because of their proximity to SR 37, offer a direct route for highway runoff to the subsurface. Other karst features directly associated with the Dry Bed of Lost River are **Cul de Sac, Mathers Storm Water Rises, Orangeville Rise, Stein Swallowhole, Turner Swallowholes,** and **Tolliver Swallowhole.** Orangeville Rise and Tolliver Swallowhole are National Natural Landmarks. These are discussed elsewhere in this section.

A dye injection performed at the Principal Sinks of Lost River (Sheet 1), just upstream from Stein Swallowhole (Murdock and Powell, 1968) was traced to the Rise of Lost River. A visual detection of the dye was also made at the rise pit of Lost River in Wesley Chapel Gulf. No other dye traces have been made in association with the Lost River Dry Bed with the exception of a trace from the Sinks of Stampers Creek to the Rise of Lost River (Murdock and Powell, 1968). Portions of the downstream Dry Bed between Mathers Stormwater Rises and Orangeville Rise have been shown by Earth Tech (1995) to be hydrologically connected with the Orangeville Rise ground water basin, at least during high ground water flow conditions.

The Dry Bed area most vulnerable to highway-related impacts from SR 37 is a 1.3-mile long segment that begins at the Lost River Bridge at Station 7+580 (Feature 37O30). Highway runoff enters the Dry Bed at this point from as far north as Station 7+960. The segment continues westerly to the Turner Swallowholes, turns southeasterly back to SR 37, runs parallel to the highway for about 2,500 feet, then turns west away from the highway. The segment ends at the confluence with a drainageway that receives flow from 37O20 at Station 6+150. The use of extensive erosion controls, ditch line mini-basins and/or detention basins/hazardous materials traps along this 1.8-km (1.1 mile) highway corridor will be necessary to protect this segment of the Dry Bed and associated features.

- **Elrod Cave** is located just west of Wesley Chapel Gulf. It has no direct connection with Lost River except that flood waters will rise into the cave through a mud-lined pit in the bottom of the cave. There are no aquatic fauna present in the cave, with the exception of amphipods and isopods in drip pools, or left behind in pools left by flood waters. The cave is noteworthy for being the type locality for mud stalagmites (Malott and Schrock, 1933). It is about 3.3 miles west of SR 37, and should not be affected by any highway-related disturbance.

- **Hudelson Cavern** is about 1.5 miles west of SR 37, and about 1,700 feet south of the Dry Bed. It is an accessible subsurface storm water overflow route of Lost River. Approximately 3,200 feet was initially mapped and described by Malott (1948), who had hoped to find a

direct connection to the low-water route of the main channel of underground Lost River. He concluded that the underground channel was somewhere north of the accessible cave passage, and south of the Dry Bed at an approximate elevation of 650 feet MSL, but further exploration did not yield a connection Additional mapping by others has extended the overall length of the cave to about 5,400 feet, but no connection was ever made with underground Lost River. Malott reported three cavefish in the cave stream.

Malott believed that the source of most of the muddy storm water that at times fills Hudelson Cavern is the Turner Swallowholes, located about 3,500 feet to the east. Apparently storm water enters the cave quickly, even during very early periods of flow, and he associated this with the period when large volumes of storm waters are filling the Turner Swallowholes. When the cave passages are filled, inflow from Turner is reduced and excess storm water continues downstream in the Dry Bed, bypassing Turner.

Hudelson Cavern was assigned national significance in the OUL report based on its relationship with underground Lost River, the presence of cavefish, and its citation in scientific literature. Earth Tech believes that Hudelson Cavern merits state significance for these reasons, but not national significance, as there are a number of other features in the Lost River system that have demonstrated and recognized national significance. Nevertheless, the cave system appears to be directly connected with the portion of the Dry Bed most vulnerable to disturbance from SR 37 (see previous section). The use of extensive erosion controls, ditch line mini-basins and/or detention basins/hazardous materials traps along the 1.8-km (1.1 mile) highway corridor closely associated the Lost River Dry Bed will be necessary to protect Hudelson Cavern.

- **L. Baker Cave** is a 300-foot long cave located just southwest of the Mathers Stormwater Rises in a bluff above the Dry Bed of Lost River. The passage is mainly dry. The OUL report assigned the cave regional significance owing to the presence of historic signatures, and impacts from runoff derived from SR 37 are not expected. Earth Tech concurs with these findings.

- **Mathers Stormwater Rises** are another feature directly associated with the Lost River Dry Bed. The feature consists of large resurgence pit in the bottom of a flat-floored east-west trending valley, and eight smaller resurgences along the drainageway connecting the main resurgence with the Dry Bed to the west. The Mathers Stormwater Rises are located in the downstream 11 miles of the Lost River Dry Bed. This lower segment of the Dry Bed has a much higher gradient (about 8 feet/mile) than the upstream portions of the Dry Bed (about 4 feet/mile), and has become deeply entrenched below the level of the sinkhole plain.

Malott (1952) noted that only stormwaters are discharged from Mathers, rising in the resurgences and flowing to the Dry Bed. He believed that some of this storm water was derived from a series of small swallow holes located in the Dry Bed about one mile to the east. However, most of the storm water, he believed, was derived from sinking streams tributary to Lost River and located northeast of Mathers. He specifically named "Old Sulfur" (Feature 37O99, Flood Creek and Ben's Creek elsewhere in this report) which sinks at Orleans, and sinks along Pearson Creek (Mt. Horeb Drain) as likely contributors. Both were subsequently traced to Orangeville Rise; the former by Murdock and Powell (1968), and the latter by Bassett (1974). To the authors' knowledge, detectors were not placed at Mathers during these traces. Any connection with Mathers will be impossible to establish unless dye detectors are placed at the resurgences and high ground water flow conditions are in effect during the trace.

A dye trace was conducted by Earth Tech (1995) during high ground water flow conditions from a small sinking stream southwest of Mitchell. Water was traced to Orangeville Rise, but was also found in the Dry Bed upstream of Orangeville. A similar result occurred during Trace 1 conducted by Bayless and others from a swallowhole northeast of Orleans. The water was traced both to Orangeville Rise and to the Dry Bed during high ground water flow conditions. Malott (1952) describes a series of storm water rises in the Dry Bed about 0.75 miles downstream from Mathers (See Sheet 1). These resurgences are lower in elevation than Mathers, and are the probable source of the dye in the Dry Bed during the referenced traces.

The OUL report assigns the feature national significance based on its inclusion in the Lost River system. No significant impacts are expected from SR 37 owing to distance. Earth Tech believes that Mathers Stormwater Rises have state significance, as there are other features in the Lost River System of demonstrated national significance. The source of the stormwaters issuing from the Mathers Stormwater Rises has not been determined. Earth Tech believes a hydrologic connection with SR 37 is likely via either subsurface flow to the Rise of Lost River or Orangeville Rise, though the effects of runoff are likely to be diminished both by distance from the source and/or dilution from other stormwaters. Construction and stormwater management measures recommended for features along SR 37 should provide protection for this feature.

- **Nichols Cave** is a short cave located on a hill slope about 3,000 feet west of Tolliver Swallowhole. It was mapped by Koeneman (1972), and is about 200 feet in total length. The cave contains a pit near the terminus into which flood waters from Lost River rise as much as 20 feet after heavy rains. Malott (1952) believed that the underground course of Lost River passes beneath or close to Nichols Cave as it flows from Tolliver Swallowhole to Wesley Chapel Gulf. A colony of bats was reported by Koeneman. This colony was later determined to consist of Indiana bats (*Myotis sodalis*), a federally endangered species. Cavefish are reported from a stream located at the bottom of the pit. The OUL report assigned the cave national significance for its fauna and its inclusion in the Lost River System. Earth Tech believes that the cave may merit national significance for its endangered bats, but not its association with Lost River. The OUL report predicted little or no significant impact from SR 37 runoff owing to distance. Earth Tech concurs and notes that there is probably no hydrologic connection between SR 37 and Nichols except during large floods.

- **Peachers Caves** are two short cave segments located just south of Mathers Stormwater Rises. They consist of a segment of trunk passage bisected into two caves by a collapse opening. Malott (1952) believed that the Peachers Caves were formerly a high-level subterranean channel that once conveyed Lost River waters in a short course from its Dry Bed channel to Mathers. According to Black (1992) flood waters in the cave emerge at Mathers, while regular subsurface flow emerges at Orangeville Rise. Black also reports cavefish from the South Peachers Cave. The OUL report assign South Peachers Cave regional significance owing to the unusually large passage size for the area. South Peachers Cave was assigned state significance because of the presence of cavefish. Little or no impact is expected to those caves from SR 37 runoff. Earth Tech concurs with these findings.

- **Orangeville Rise** is the resurgence of a large subsurface drainage basin of approximately 50 square miles that is tributary to Lost River. A portion of the drainage basin lies outside the surface basin of Lost River (see below). Water rises at the base of a vertical limestone wall in a circular basin approximately 100 feet in diameter. The water flows southwesterly about 500 feet southwesterly and joins the Lost River channel, at which point, the Lost River Dry

Bed ends. Highway runoff in the vicinity of Orleans has been demonstrated by dye tracing to drain to the Orangeville Rise (Bayless and others, 1994; Murdock and Powell, 1968), as has much of the runoff in the upstream end of the Beaver Creek Karst Valley to the north (Earth Tech, 1995). The divide between the drainage to Orangeville Rise and the Rise of Lost River has not as yet been determined. Orangeville Rise is a National Natural landmark and a State Nature Preserve, and has National Significance. The OUL report predicts little or no impact to the feature from SR 37 runoff owing to distance. Earth Tech concurs with this finding.

- **Rise of Lost River** (True Rise of Lost River in the OUL report) is the terminus of the underground course of Lost River. It is located approximately 0.75 miles southwest of Orangeville Rise in a rise pool immediately east of the now-flowing channel of Lost River. The pool is about 100 feet long and 30 feet wide. It is about 11 feet deep and contains several underwater pits, one of which was descended by divers to a depth of 160-165 feet, at which point what may be a horizontal passage was encountered. Water has been dye traced to the Rise of Lost River from the Sinks of Stampers Creek and the principal sinks of Lost River. Powell (1987) estimates that about 85 square miles of surface drainage flows to the Rise of Lost River. Water emerging at the Rise of Lost River is assumed to flow first beneath Wesley Chapel Gulf. The OUL report indicates that the Rise of Lost River has national significance, and that there should be little or no impact to the feature from SR 37 runoff owing to distance. Earth Tech concurs with these findings.

- **Stein Swallowhole** is located about 1,500 feet east, and upgradient, of SR 37. There does not appear to be any possibility that runoff or any other highway-related disturbance could reach this feature.

- **Tolliver Swallowhole** is a large swallowhole located just west of the Dry Bed, and is connected with the Dry Bed by a short sloping channel. It is located about 2 miles west of SR 37 in a straight line, and about 3 miles downstream from SR 37 via the Dry Bed. The feature is one of three major swallowholes (Stein and Turner are the others) situated along the Dry Bed of Lost River, and is the only one consisting of a single opening. It is one of the few features to provide access to a portion of the Lost River underground channel. Malott (1952) entered a passage at the base of a timber raft choking the swallowhole, and surveyed a passage northward for a distance of 565 feet to a large room containing a 300-foot segment of underground Lost River.

After filling Stein and Turner Swallowholes, excess water sinks at Tolliver. During very large storm events, Tolliver Swallowhole may become filled, and excess storm waters overtop a sill and proceed downstream in the Dry Bed (Quarterman and Powell, 1978). However, Malott (1952) noted that long before Dry Bed flow reaches Tolliver Swallowhole, the feature is in the process of filling from storm waters entering via other channels. He believed that the source of these waters was probably the Turner Swallowholes.

Tolliver Swallowhole is a National Natural Landmark and is therefore of national significance. The OUL report indicates that there would be little or no impact to the feature from SR 37 runoff owing to distance. However, Tolliver Swallowhole may be directly connected with the portion of the Dry Bed most vulnerable to disturbance from SR 37 (see previous section). The use of extensive erosion controls, ditch line mini-basins and/or detention basins/hazardous materials traps along the 1.8-km (1.1 mile) highway corridor closely associated the Lost River Dry Bed will be necessary to protect Tolliver Swallowhole.

- **Turner Swallowholes** are described by Malott (1952) as a complex of more than 40 individual holes along and near the Dry Bed of Lost River. The principal Turner sinks are located in an alcove west of the Dry Bed about 2,000 feet west of SR 37 and about 2,500 feet

downstream from SR 37 via the Dry Bed. Malott noted that the swallowholes have a larger capacity than that of Stein Swallowhole to the Northeast, but that once the underground conduits become filled with storm waters, excess water flows down the Dry Bed. There are no openings among the Stein Swallowholes large enough to enter and explore.

The OUL report assigns the Turner Swallowholes national The OUL report assigned the feature national significance for its inclusion in the Lost River System. Earth Tech believes that the feature merits state significance. The OUL report indicated the possibility of high environmental impact to the feature from SR 37 runoff. Earth Tech concurs. The use of extensive erosion controls, ditch line mini-basins and/or detention basins/hazardous materials traps along the 1.8-km (1.1 mile) highway corridor closely associated the Lost River Dry Bed will be necessary to protect the Turner Swallowholes.

- **Wesley Chapel Gulf** is regarded as the most significant and spectacular feature in the Lost River watershed. It is a large collapse sinkhole about 8.3 acres in area. The flat floor of the feature occupies an area of about 6.1 acres. Malott (1952) states that the gulf was formed as the result of multiple collapse sinkholes occurring over a broad area of weakened underground passages. Subsequent dissolution by the waters of Lost River have removed most of the collapse, and progressive collapses along the perimeter of the feature have contributed to its continued growth.

The gulf contains a conical rise pit at the south end in which water stands 25 to 30 feet below the floor of the gulf during low flow periods. After storm events, water rises in the pit. Initially, rising water enters Boiling Spring Cave, just south of the rise pit, and flows southwesterly to Wesley Chapel Gulf Cave. Additional storm waters enter two high water channels in the alluvial floor of the gulf and flow westerly and northwesterly to enter Wesley Chapel Gulf Cave through a series of swallowholes along the western margin of the gulf. Dye injected at the Sinks of Lost River was noted visually in the rise pit by Murdock and Powell (1968). The dye was recovered ion a detector at the Rise of Lost River and Powell, 1978).

Wesley Chapel Gulf Cave can be entered along the west wall of Wesley Chapel Gulf, and is a segment of underground Lost River. It was mapped and described by Malott (1932), who indicated that the length of the cave was 5,175 feet. The streams in the cave contain cavefish (Keith, 1988).

Wesley Chapel Gulf is a National Natural Landmark and is therefore of national significance. The OUL report indicates that there would be little or no impact to the feature from SR 37 runoff owing to distance. Earth Tech concurs with these findings.

Murray Spring Cave is a cave with a spring outlet located on the Paoli Golf Course about 3,500 feet east of SR 37. The cave has about 1,600 feet of stream passage (portions of which flood), and contains a variety of cave life, including troglobitic beetles, millipedes, spiders, crayfish and cavefish. The OUL report assigns the cave state significance owing to the cavefish population; and assigned zero environmental impact as a result of any construction on SR 37. Earth Tech concurs with both findings.

Robbin's Roaring Resurgence Cave is located about 2,200 feet west of SR 37, and about 1,200 feet south of the Dry Bed of Lost River in a surface tributary channel. It is not listed in the OUL report, but is listed in the ICS files. The cave is only 45 feet in length, but apparently can carry significant volumes of storm water overflow. A strong sewage odor has been noted in the cave, suggesting a hydrologic connection with nearby developed areas. The cave possesses no fauna or other features of significance, and is unlikely to be adversely affected by runoff from SR 37.

It is of interest in that it is situated between Feature 3704 and Hudelson Cavern and Tolliver Swallowhole, and may be monitored for dye in the event that 3704 is dye traced.

A small **Sinkhole** was located by Earth Tech about 300 feet northwest of the bypass route around downtown Paoli. The sinkhole is in a grassed field and is filled with rubble. It is upgradient from the road, and would not be affected by highway construction or runoff.

Tomato Cave is located on a hill slope north of US 150/SR 56 in Paoli. It is reported to be 200 feet long with a 40 foot pit. The cave is noted in the OUL report as having local significance, and no environmental impact as a result of construction along line E. Earth Tech agrees with the OUL assessment of significance and environmental impact.

7.4.3 Potential Impacts to Features and Recommendations for Protection

See Table 9.

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FIGURES

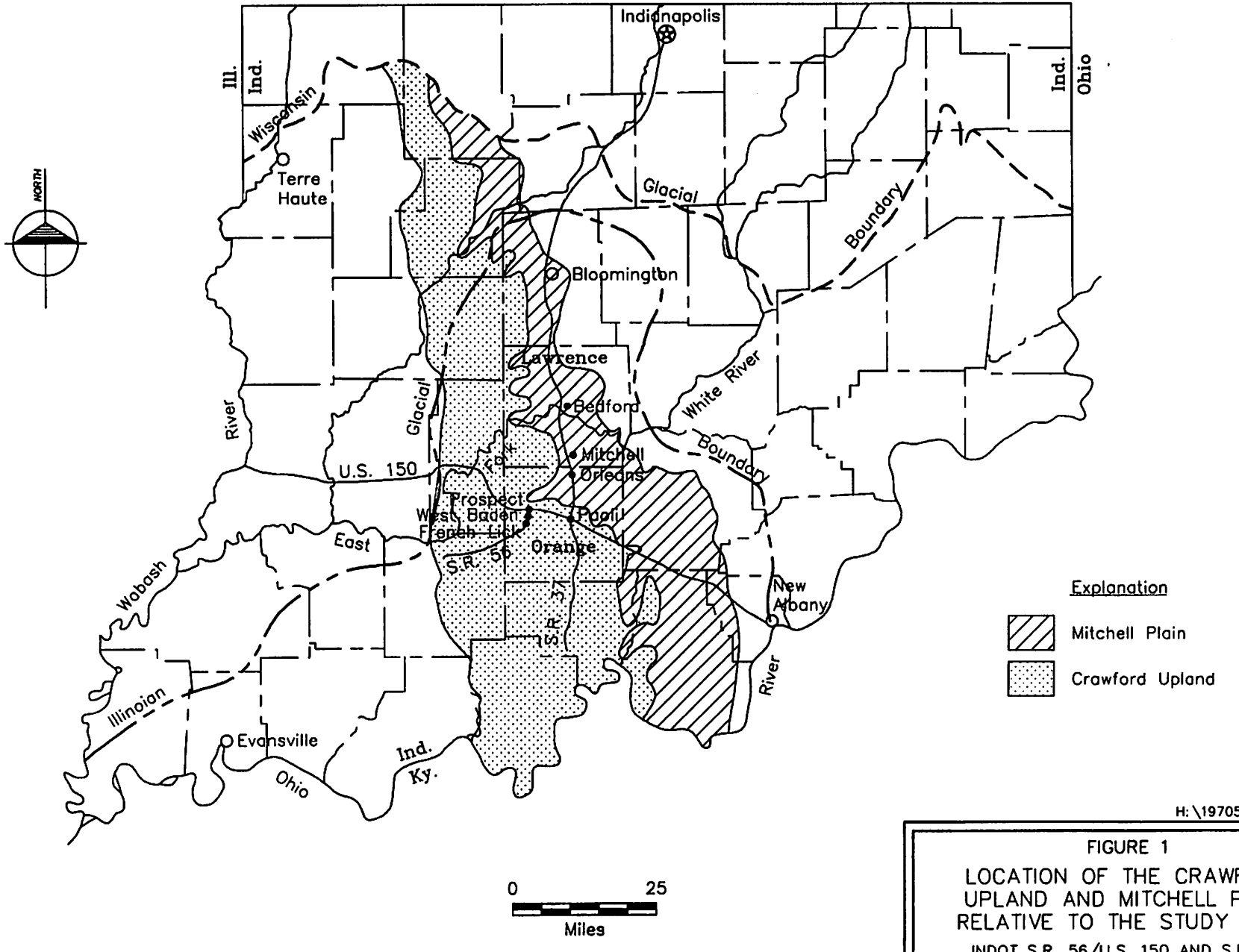

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FIGURE 1

LOCATION OF THE CRAWFORD UPLAND AND MITCHELL PLAIN RELATIVE TO THE STUDY AREA

INDOT S.R. 56/U.S. 150 AND S.R. 37
KARST INVESTIGATION
ORANGE AND LAWRENCE COUNTIES, INDIANA

EARTH TECH

E40

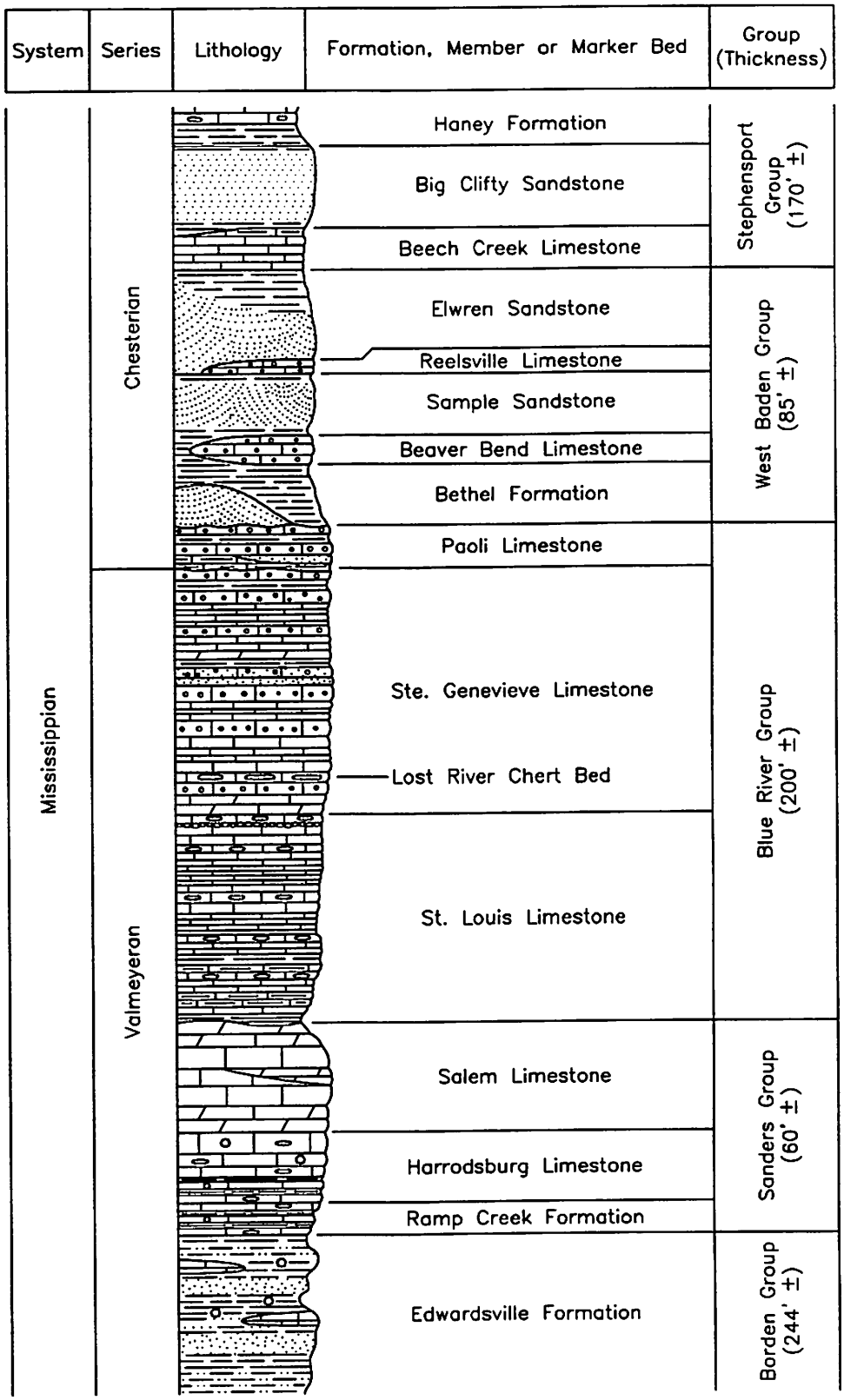
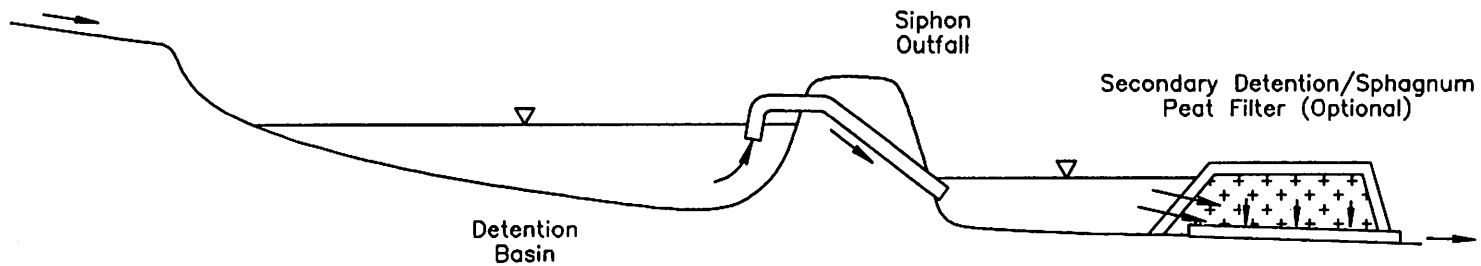


FIGURE 2

STRATIGRAPHIC SECTION IN THE VICINITY OF THE STUDY AREA

INDOT S.R. 56/U.S. 150 AND S.R. 37
KARST INVESTIGATION
ORANGE AND LAWRENCE COUNTIES, INDIANA



Drawing Not to Scale

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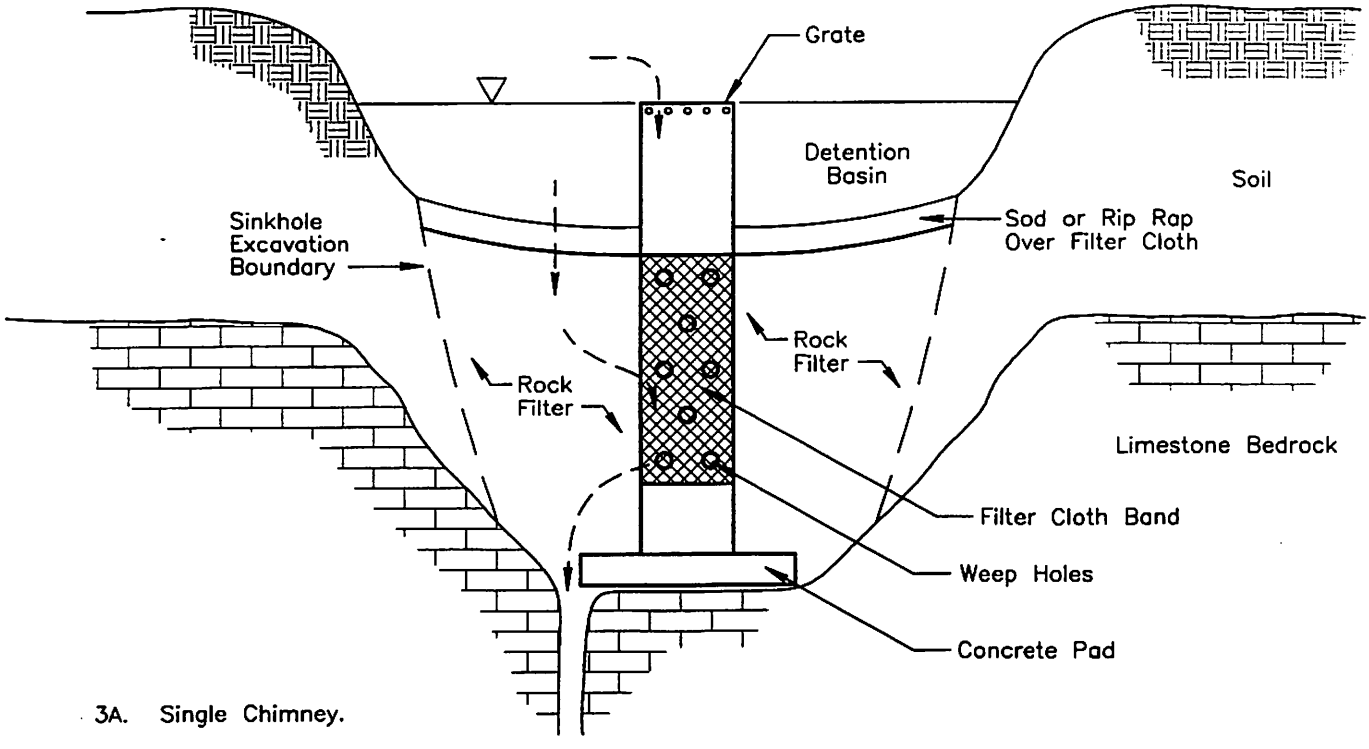
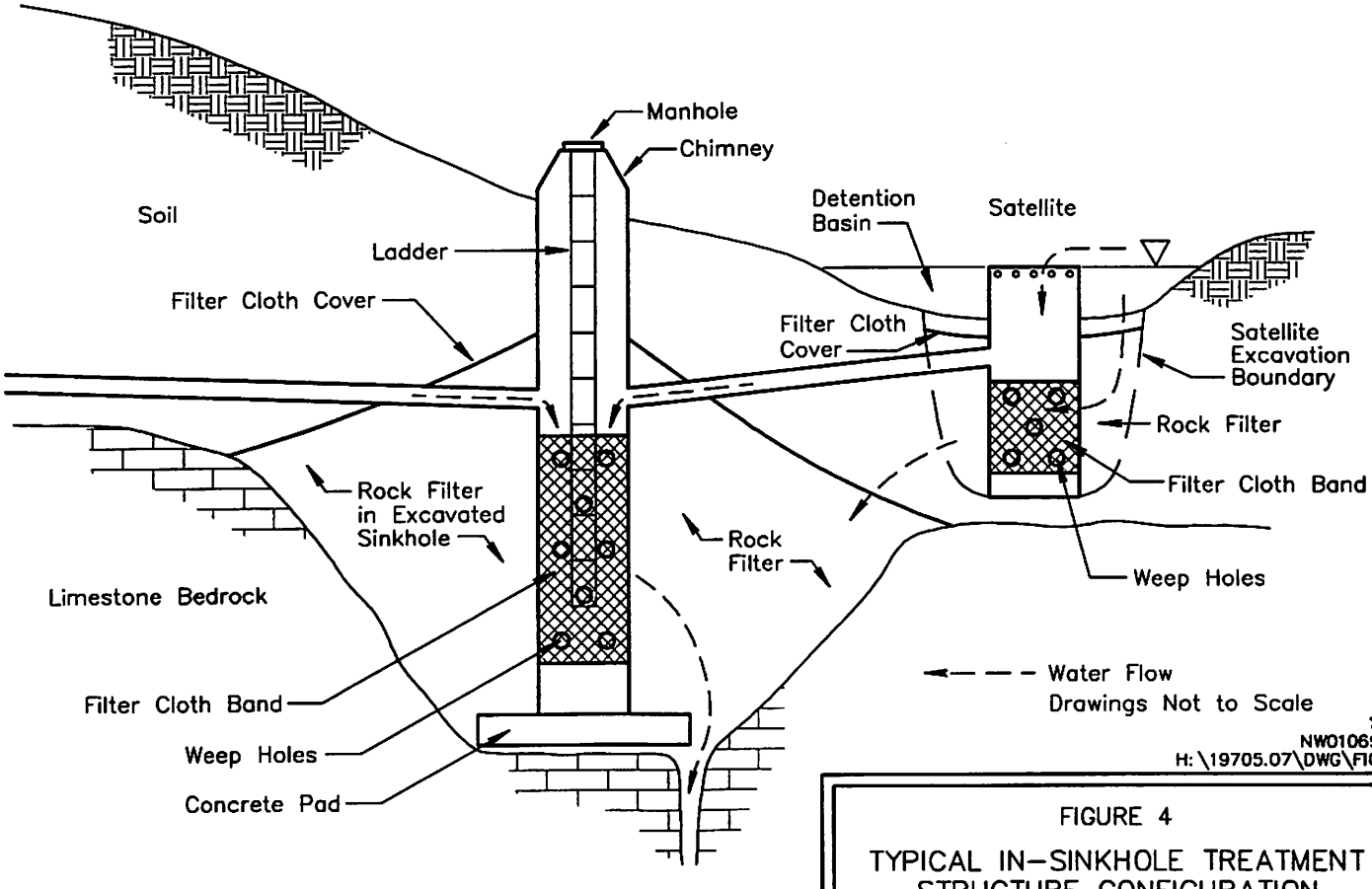
FIGURE 3

DIAGRAM OF A DETENTION BASIN/
HAZARDOUS MATERIALS TRAP

INDOT S.R. 56/U.S. 150 AND S.R. 37
KARST INVESTIGATION
ORANGE AND LAWRENCE COUNTIES, INDIANA



3A. Single Chimney.



3B. Chimney–Satellite Combination.

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FIGURE 4

TYPICAL IN–SINKHOLE TREATMENT STRUCTURE CONFIGURATION

INDOT S.R. 56/U.S. 150 AND S.R. 37
KARST INVESTIGATION
ORANGE AND LAWRENCE COUNTIES, INDIANA

EARTH TECH

TABLES

Table 1. Karst Features Along US 150/SR 56 Corridor - West Baden Springs to Paoli

Feature Designation	Station No.	R/L	Area	Depth	Land Use	Eye?	Hwy. runoff?	Left (Sta/Sta)	Right (Sta/Sta)	Comments
56O1	115+090	L	NA	NA	Lost River bridge abutment	NA	N	-	-	An old mineral well with a 3"steel casing drilled in the 1890s. Within ROW. An artesian flow of about 16 gpm. Water flows downslope about 10' to Lost River. There is red and white sulfur bacteria on the rocks and a strong hydrogen sulfide smell.
150O1	254+50	L	NA	NA	old quarry	NA	Y	252+010/ 255+040	-	Entrance to Just Off the Road Cave, located in the quarry face behind talus. Outside ROW. Water enters quarry and sinks in floor at east end. Cave reported to be 874 feet long with dry passage.
150O2	296+70	L	NA	NA	pasture/ wooded	NA	N	-	-	Clayton Conrad Cave, located 1000' southwest of ROW. Reported to be 4162' long. Trends southeasterly parallel with highway.
150O3	301+50	R	<0.01 ac.	1'	pasture	-	N	-	-	Sinkhole outside ROW. Filled with brush and rubble. Drains a west-flowing swale
150O4	3-2+00	R	0.01 ac.	2'	pasture	-	N	-	-	Sinkhole outside ROW. Filled with brush and rubble. Drains a west-flowing swale
150O5	317+80	L	NA	NA	highway culvert	N	Y	-	307+55/ 317+80	Possible seep or wet weather spring and downstream end of culvert within ROW.
150O6	324+00	R	NA	NA	old quarry	N	N	-	-	Buttermilk Spring/Cave discharges in the quarry and flows to nearby Lick Creek. Outside ROW.

Table 1. Karst Features Along US 150/SR 56 Corridor - West Baden Springs to Paoli

Feature Designation	Station No.	R/L	Area	Depth	Land Use	Eye?	Hwy. runoff?	Left (Sta/Sta)	Right (Sta/Sta)	Comments
150O7	335+50	R/L	0.60 ac.	NA	pasture/ under roadway	N	Y	327+20/ 344+55	327+20/ 344+55	Rise for a subterranean cutoff of Lick Creek. There is an associated rise and sink in the field about 200' to the southeast. The area defined also contains this second rise and sink, and some associated sinkholes. Within ROW.
150O8	423+90	L	<0.010 ac.	1'	lawn	-	Y	432+40/ 423+90	-	Three small but active slumps in a front yard. Adjacent to ROW.
150O9	424+75	R	<0.010 ac.	NA	ditch line	-	Y	-	431+60/ 424+75	Shows as a sinkhole on the 1927 highway plans. It is filled to grade with rubble and blacktop. Within ROW.
150O10	425+50	L	0.4 ac.	7'		N	N	-	-	A large blind sinkhole that drains the hill slope to the north. Outside ROW.
150O11	456+50	R	<0.010 ac.	4'	hay field	Y	Y	-	456+30/ 458+25	Small sinkhole mostly filled. Outside ROW.
150O12	458+60	R	0.02 ac.	3'	hay field	Y	Y	-	458+25/ 459+30	Some fill in eye of sinkhole. Outside ROW.
150O13	479+00	L	0.5 ac.	6'	hay field	Y	Y	477+45/ 482+50	-	Sinkhole at north edge of ROW.
150O14	480+40	L	0.1 ac.	3'	hay field	N	N	-	-	Sinkhole almost encroaches on 150O12. Outside ROW.
150O15	488+60	L	1.9 ac.	10'	hay field	N	Y	482+50/ 490+75	-	Sinkhole at north edge of ROW.
150O16	490+90	R	0.18 ac.	6'	pasture	Y	Y	-	490+75/ 491+70	Sinkhole on terrace above Lick Creek. Outside ROW.
150O17	491+60	L	<0.010 ac.	3'	hay field	N	N	-	-	Sinkhole outside ROW.
150O18	496+40	L	0.09 ac.	10'	hay field	N	N	-	-	Double sinkhole with steep sides. Outside ROW.
150O19	498+00	L	0.04 ac.	15'	hay field	Y	N	-	-	Deep steep-sided sinkhole. Eye partly filled with trash. Outside ROW.

Table 2. Karst Features Along SR 37 Corridor - Paoli to Orleans

Feature Designation	Station No.	R/L	Area	Depth	Land Use	Eye?	Hwy. runoff?	Left (Sta/Sta)	Right (Sta/Sta)	Comments
37O1	2+760	L	3' dia. each	1-2'	woods	Y	N	-	-	2 small slumps in drainageway, exposed ls. bedrock. Outside ROW.
37O2	2+870	L	each 8' across	4-5'	woods	Y	N	-	-	3 small sinkholes One has a vertical opening that leads into an enlarged joint. Outside ROW.
37O3	4+820	L	<0.01 ac.	3-4'	lawn	N	N	-	-	Shallow sinkhole about 150' west of road. Receives no water.
37O4	5+000	R	0.02 ac.	12'	woods/ trailer lots	Y	Y	3+835/ 4+920	3+600/ 4+920	Swallow hole 1100' east of highway draining 475 ac. in a karst valley formerly tributary to Lost River.
37O5	5+120	R	0.40 ac.	5'	lawn	N	Y	5+220/ 4+920	5+220/ 4+920	Sinkhole at east edge of ROW. Surrounded by highway/RR embankments and fill.
37O6	5+120	L	0.03 ac.	6'	row crop - soybeans	Y	N	-	-	Sinkhole west of ROW. May receive runoff if highway is widened.
37O7	5+220	R	1.02 ac.	10-12'	pasture	N	N	-	-	Sinkhole east of old SR 37. May receive water if highway is widened.
37O8	5+380	L	6.4 ac.	15-20'	row crop- soybeans	Y	Y	5+220/ 5+470	-	Sinkhole within and west of ROW. Two eyes 200' west of highway.
37O9	5+380	R	1.2 ac.	20'	woods	-	N	-	-	Sinkhole east of ROW. Bottom not examined. Does not receive highway runoff.
37O10	5+540	R	0.44 ac.	10'	walnut plantation	N	Y	-	5+220/ 5+590	Sinkhole with walnut plantation. No slumps or signs of soil disturbance. East edge of ROW.
37O11	5+660	R	0.18 ac.	3-4'	pasture	-	Y	5+470/ 5+870	5+590/ 5+860	Open joint enlarged by blasting 6' into bedrock, drains area of former pond. East edge of ROW.
37O12	5+660	R	1.6 ac.	pond	pond	NA	N	-	-	Sinkhole pond several feet above road level, in same valley as 37O4. East of ROW.
37O13	5+670	L	<0.01 ac.	2'	ditch line	N	Y	5+470/ 5+870	-	Sinkhole within ROW. Slump at culvert inlet. Intercepts some of flow to 37O11.

Table 2. Karst Features Along SR 37 Corridor - Paoli to Orleans

Feature Designation	Station No.	R/L	Area	Depth	Land Use	Eye?	Hwy. runoff?	Left (Sta/Sta)	Right (Sta/Sta)	Comments
37O14	5+710	L	9.2 ac.	4-5'	hay field	N	N	-	-	Sinkhole west of ROW. May receive water if highway is widened.
37O15	5+800	L	1.6 ac.	4-5'	hay field	N	N	-	-	Sinkhole west of ROW.
37O16	5+920	L	0.13 ac.	4-5'	hay field	N	Y	5+980/ 5+870	-	Sinkhole in ROW with small slump in embankment. Drains to 37O17.
37O17	5+930	R	0.71 ac.	15'	pasture	N	Y	-	5+970/ 5+860	Receives water from 37O16. Within and east of ROW.
37O18	6+060	R	0.70 ac	6'	lawn	N	Y	-	6+120/ 5+970	Very shallow sinkhole crossed by highway. Once part of 37O19.
37O19	6+090	L	2.1 ac.	5-6'	hay field	N	Y	6+120/ 5+980	-	Sinkhole within and west of ROW. Has a soil slump in the center that does not appear to be an eye.
37O20	6+150	L	0.03 ac.	3-4'	hay field	N	Y	6+230/ 6+120	6+220/ 6+120	Excavated basin below 6' CMP draining under highway from east. Water may sink here; otherwise drains northwest to Lost River dry bed. Within ROW.
37O21	6+400	R	0.70 ac.	6'	row crop-soybeans	N	N	-	-	Shallow sinkhole upslope and well east of right-of-way.
37O22	6+460	R	0.20 ac.	4'	row crop-soybeans	N	N	-	-	Shallow sinkhole upslope and well east of right-of-way.
37O23	6+630	L	<0.01 ac	2-3'	dry bed	swallet	Y	6+660/ 6+600	7+235/ 6+630	Small swallet on the east side of the Lost River dry bed at base of highway embankment West of ROW.
37O24	6+700	L	<0.01 ac.	4-5'	dry bed	possible swallet	Y	7+240/ 6+700	-	Small swallet on the east side of the Lost River dry bed at base of highway embankment. West of ROW.
37O25	6+910	R	2.6 ac.	10'	row crop-soybeans	N	N	-	-	Broad sinkhole well east of right-of-way.
37O26	7+000	R	0.20 ac.	6'	row crop-soybeans	N	N	-	-	Broad sinkhole well east of right-of-way.
37O27	7+190	R	0.75 ac.	15'	pasture	Y	N	-	-	Sinkhole well east of right-of-way.

Table 2. Karst Features Along SR 37 Corridor - Paoli to Orleans

Feature Designation	Station No.	R/L	Area	Depth	Land Use	Eye?	Hwy. runoff?	Left (Sta/Sta)	Right (Sta/Sta)	Comments
37O28	7+395	R	1.1 ac.	8'	brushy field	Y	Y	7+410/ 7+240	7+440/ 7+230	Sinkhole within and east of ROW. Rip rap at east culvert outfall may be filled eye.
37O29	7+450	L	0.18 ac.	6-8'	brushy field	N	Y	7+480/ 7+410	-	Sinkhole west of ROW. May pond at times.
37O30	7+580	L/R	NA	NA	Dry bed Lost River	N	Y	7+960/ 7+480	7+635/ 7+440	Dry bed of Lost River
37O31	7+690	R	0.05 ac.	5'	row crop-corn	N	Y	-	7+763/ 7+620	Sinkhole east of ROW. Bottom obscured by corn.
37O32	7+840	R	2.6 ac	15'	row crop-corn	N	Y	-	7+940/ 7+763	Very large sinkhole connected with 37O33; bottom obscured by corn. Within and east of ROW.
37O33	7+880	L	3.5 ac.	5-6'	pond/ pasture	N	N	-	-	Connected with 37O32. Within and west of ROW.
37O34	8+020	R	0.30 ac.	6'	row cop-corn	N	Y	-	8+080/ 7+940	Receives flow from 37O35. Mostly within ROW.
37O35	8+020	L	0.10 ac	4-6'	pasture	N	Y	8+480/ 7+960	-	Sinkhole mostly within ROW. Drains to 37O34.
37O36	8+140	L	0.5 ac.	6-8'	row crop-corn	N	N	-	-	Sinkhole west of right-of-way.
37O37	8+150	L	0.7 ac.	6-8'	row crop-corn	N	N	-	-	Sinkhole west of right-of-way.
37O38	8+180	R	1.6 ac.	8'	row crop-soybeans	N	Y	-	8+240/ 8+120	Broad, shallow sinkhole west of right-of-way.
37O39	8+285	L	0.45 ac.	6-8'	row crop-corn	N	N	-	-	Broad, shallow sinkhole west of right-of-way.
37O40	8+375	L	0.25 ac.	8-10'	row crop-corn	N	N	-	-	Broad, shallow sinkhole west of right-of-way.
37O41	8+405	R	0.20 ac.	4'	lawn	N	Y	-	8+432/ 8+380	Highway embankment abuts west slope of sinkhole.
37O42	8+480	R	0.02 ac.	6'	brushy spot in lawn	N	N	-	-	Small brush filled sinkhole. East of ROW.

Table 2. Karst Features Along SR 37 Corridor - Paoli to Orleans

Feature Designation	Station No.	R/L	Area	Depth	Land Use	Eye?	Hwy. runoff?	Left (Sta/Sta)	Right (Sta/Sta)	Comments
37O43	8+520	L	0.40 ac.	6-8'	row crop-corn	N	N	-	-	Broad, shallow sinkhole west of right-of-way.
37O44	8+530	R	0.06 ac.	10'	pasture	Y	N	-	-	Sinkhole east of ROW. Rubble filled eye 8' in dia.
37O45	8+585	R	0.13 ac.	10'	pasture	N	Y	-	8+630/ 8+500	Sinkhole mostly within ROW. May temporarily pond
37O46	8+600	R	0.06 ac.	8'	pasture	N	N	-	-	Sinkhole east of ROW.
37O47	8+620	L	1.4 ac.	10-12'	row crop-corn	Y	Y	8+780/ 8+480	8+760/ 8+630	Sinkhole within and west of ROW. Active slump at base of highway embankment is filled.
37O48	8+640	R	0.03 ac.	10'	pasture	N	N	-	-	Sinkhole east of ROW.
37O49	8+700	R	0.35 ac.	NA	shallow stock pond	N	N	-	-	Sinkhole east of right-of-way.
37O50	8+735	L	0.06 ac.	6-8'	woods	N	N	-	-	Sinkhole 45' west of right-of-way.
37O51	8+740	L	0.20 ac.	12-15'	woods	N	N	-	-	Sinkhole 200' west of right-of-way.
37O52	8+790	L	0.01 ac.	6-8'	woods	Y	N	-	-	Sinkhole 40' west of right-of-way.
37O53	8+790	L	0.20 ac.	10-12'	woods	N	N	-	-	Sinkhole 200' west of right-of-way.
37O54	8+800	L	0.06 ac.	6-8'	woods	N	N	-	-	Sinkhole 100' west of right-of-way.
37O55	8+840	L	0.12 ac.	8-10'	woods/hay field	N	N	-	-	Sinkhole 150' west of right-of-way.
37O56	8+860	L	0.23 ac.	5-7'	hay field	N	Y	8+960/ 8+780	8+960/ 8+780	Sinkhole probably continued to east. Fill for auto sales lot covers E. side of road. Culvert draining from east sinks at outfall. Mostly within ROW.
37O57	8+950	L	1.1 ac.	10-12'	brushy land	N	N	-	-	Sinkhole west of ROW. Wet spot near center indicates temporary ponding.
37O58	9+040	R	0.35 ac.	NA	Pond	N	Y	9+180/ 8+960	9+190/ 8+960	Sinkhole within and east of ROW. Has a small stock pond.
37O59	9+080	R	0.50 ac.	10-12'	brushy	?	N	-	-	Double sinkhole well east of right-of-way. Could not see eye for brush.

E50

Table 2. Karst Features Along SR 37 Corridor - Paoli to Orleans

Feature Designation	Station No.	R/L	Area	Depth	Land Use	Eye?	Hwy. runoff?	Left (Sta/Sta)	Right (Sta/Sta)	Comments
37O60	9+110	L	0.25 ac.	10-15'	brushy	N	N	-	-	Sinkhole west of right-of-way. Wet spot in center indicates temporary ponding.
37O61	9+140	R	0.04 ac.	8-10'	pasture	Y	N	-	-	Sinkhole east of ROW. Filled with rubble
37O62	9+240	R	0.25 ac.	8-10'	pasture	N	Y	-	9+320/ 9+190	Drains to 37O63 via culvert. Mostly within ROW.
37O63	9+240	L	4.1 ac.	15-20'	brushy	N	Y	9+320/ 9+190	-	Sinkhole within and west of ROW. Wet spot at west end indicates temporary ponding
37O64	9+300	R	0.18 ac.	15-20'	pasture	Y	N	-	-	Sinkhole east of ROW.
37O65	9+430	L	1.5 ac.	20-25'	brushy	Y	N	-	-	Sinkhole 60' west of right-of-way; hidden by rise of ground
37O66	9+460	R	1.8 ac.	12-15'	brushy	?	Y	-	9+685/ 9+320	Sinkhole within and east of ROW. Eye may be filled. Wet area in bottom indicates temporary ponding. Old quarry on east side.
37O67	9+480	L	0.33 ac.	10-12'	brushy	?	Y	9+500/ 9+320	-	Sinkhole with active slump in right-of-way. Eye may be filled.
37O68	9+550	L	1.2 ac.	10-12'	lawn	?	Y	9+720/ 9+500	-	Sinkhole within and west of ROW. Eye may be filled
37O69	9+560	R	0.15 ac.	4-5'	pasture	N	N	-	-	Sinkhole may be partly filled. Probably part of 37O68. Mostly within ROW.
37O70	9+800	L	2.9 ac.	6-8'	row crop-corn	N	Y	9+900/ 9+720	9+925/ 9+685	Sinkhole within and west of ROW.
37O71	9+930	R	0.13 ac.	6-7'	brushy	N	Y	-	9+980/ 9+925	Drains to 37O72 via culvert and sinks. Mostly within ROW.
37O72	9+930	L	0.08 ac.	6-7'	brushy	Y	Y	9+980/ 9+900	-	Sinkhole eye filled with rubble. Mostly within ROW.
37O73	10+020	L	0.70 ac.	15-20'	pasture	N	N	-	-	Sinkhole 150' west of ROW.
37O74	10+030	L	<0.010 ac.	10-12'	brushy	Y	Y	10+060/ 9+980	-	Sinkhole within ROW. Also receives runoff from 37O76 via culvert.

E51

Table 2. Karst Features Along SR 37 Corridor - Paoli to Orleans

Feature Designation	Station No.	R/L	Area	Depth	Land Use	Eye?	Hwy. runoff?	Left (Sta/Sta)	Right (Sta/Sta)	Comments
37O75	10+055	R	<0.010 ac.	6-8'	pasture/ lawn	N	Y	-	10+185/ 9+980	Sinkhole within ROW. Runoff runs by culvert to 37O76 and sinks.
37O76	19+055	L	<0.010 ac.	4-5'	pasture	Y	Y	10+185/ 10+060	-	Sinkhole within ROW. Eye filled with rubble.
37O77	10+290	R	1.7 ac.	8-10'	row crop/brush	N	Y	-	10+700/ 10+185	Sinkhole within and east of ROW. Sinkhole pond at southeast end. Water drains from 37O78via culvert.
37O78	10+290	L	0.23 ac.	6-8'	pasture	N	Y	10+700/ 10+185	-	Sinkhole within and west of ROW. Drains to 37O77via culvert.
37O79	10+410	R	0.18 ac.	4-5'	pasture	N	N	-	-	Sinkhole 125' east of ROW. Drains a small area of pasture. Slump in bottom does not appear to be an eye.
37O80	11+230	R	0.90 ac.	8-10'	pasture	N	Y	11+270/ 10+700	11+250/ 10+700	Sinkhole within and east of ROW. Drains east over a saddle to a wet area 400-500' from right-of-way.
37O81	11+350	R	<0.010 ac.	2'	ditch	N	Y	-	11+365/ 11+250	Sinkhole within ROW. Water sinks at low spot in ditch line.
37O82	11+380	L	0.70 ac.	6-8'	pasture	N	Y	11+395/ 11+270	-	Sinkhole just west of ROW.
37O83	11+500	R	0.60 ac.	5-6'	brushy/ poorly drained	N	Y	11+560/ 11+395	11+560/ 11+365	Sinkhole within and east of ROW. Possible wetland; very brushy.
37O84	11+530	L	2.25 ac.	10-15'	pasture	N	N	-	-	Sinkhole 150' west of ROW in field west of church camp.
37O85	11+585	L	0.01 ac	5-6'	lawn	N	N	-	-	Sinkhole 150' west of ROW at south end of church camp.
37O86	11+690	R	2.16 ac.	8-10'	hay field	N	Y	-	11+870/ 11+560	Sinkhole within and west of ROW. Probably part of 37O87. No connecting culvert found.
37O86-A	11+854	R	1.0 ac.	2'	hay field	N	Y	-	11+810/ 11+870	At southeast corner of intersection of Martin Road with SR 37
37O87	11+690	L	0.50 ac.	8-10'	lawn	N	Y	11+750/ 11+560	-	Sinkhole within and east of ROW.

E52

Table 2. Karst Features Along SR 37 Corridor - Paoli to Orleans

Feature Designation	Station No.	R/L	Area	Depth	Land Use	Eye?	Hwy. runoff?	Left (Sta/Sta)	Right (Sta/Sta)	Comments
37O88	11+790	L	0.85 ac.	8-10'	lawn	N	Y	11+870/ 11+750	-	Sinkhole west of ROW in church camp. Concrete cap at center was a stage. Manager says no eye present.
37O89	11+930	L	0.90 ac.	4'	lawn	N	Y	12+080/ 11+870	12+080/ 11+870	Sinkhole west of ROW between Wesleyan Church and Orleans Wesley Church Camp.
37O90	12+100	L	0.6 ac.	NA	pond	N	Y	12+130/ 12+080	-	Pond southwest of Farm Bureau with an extension toward the highway. West of ROW.
37O91	12+240	R	0.7 ac.	5'	grass	Y	N	-	-	Sinkhole east of ROW. Eye has a standpipe and gravel fill.
37O92	12+280	L	1.2 ac.	5-7'	commercial-partly filled	N	Y	12+345/ 12+130	12+345/ 12+080	Sinkhole west of ROW in front of Farm Bureau. Water sinks at a low spot
37O93	12+450	L	1.9 ac.	NA	commercial-mostly filled	N	N	-	-	Size taken from old highway plans. Most of original sinkhole has been filled.
37O94	12+500	R	0.20 ac.	NA	pond	N	Y	12+645/ 12+345	12+600/ 12+345	Sinkhole within and east of ROW. Pond surrounded by fill on all sides.

E53

Table 3. Karst Features Along SR 37 Corridor - Orleans to Mitchell

Feature Designation	Station No.	R/L	Area	Depth	Land Use	Eye?	Hwy. runoff?	Left (Sta/Sta)	Right (Sta/Sta)	Comments
37O95	12+800	R	0.80 ac.	6'	grass	N	Y	-	12+890/ 12+720	Sinkhole east of ROW. Filled on north end.
37O96	12+800	L	0.40 ac.	6'	lawn	N	N	-	-	Sinkhole west of ROW. Residential back and side yards bounded by Maple, Second, McKinley and Hanley Streets.
37O97	12+900	L	0.75 ac.	6'	lawn	N	N	-	-	Sinkhole west of ROW. Residential back and side yards bounded by Maple, Second, McKinley and Harrison Streets.
37O98	13+120	L	1.4 ac.	2-3'	lawn	N	N	-	-	Sinkhole west of ROW. Covers several back yards between Harding and Vincennes and Second and Maple. North end has been filled.
37O99	13+650	L	0.10 ac	8-10'	brushy	Y	Y	14+370/ 13+850	14+370/ 13+850	Swallowhole about 800 feet west of the highway. This is the sink point for Flood Creek, which crosses the highway from 14+035 to 14+390.
37O100	13+710	L	0.60 ac.	4'	lawn	N	N	-	-	Sinkhole about 100' west of highway between Monroe and Adams and Second and Maple. Partly filled.
37O101	14+500	R	<0.010 ac.	2'	ditch line	N	Y	14+710/ 14+370	14+700/ 14+370	Shows as a sinkhole on both tide of the road on old plans. West of the highway is filled. Water sinks at the east end of a culvert between the highway and railroad. Within ROW.
37O102	14+550	R	0.03 ac.	15'	row crop-soybeans	Y	N	-	-	A major sink point located 400' east of highway. Overflow from this feature is captured by twin 6' culverts upstream and directed to the Flood Creek channel.
37O103	14+915	L	<0.010 ac.	1'	ditch line	N	Y	15+180/ 14+710	-	A low spot in the ditch line where water stands, then drains slowly. Within ROW.

Table 3. Karst Features Along SR 37 Corridor - Orleans to Mitchell

Feature Designation	Station No.	R/L	Area	Depth	Land Use	Eye?	Hwy. runoff?	Left (Sta/Sta)	Right (Sta/Sta)	Comments
37O104	14+980	R	0.05 ac.	3'	lawn	N	Y	-	15+180/ 14+710	Low spot in ROW at point of former water company land. Water stands and drains.
37O105	15+110	R	0.20 ac.	6-8'	lawn	N	N	-	-	Sinkhole east of ROW at former water company. There is a concrete pad, but no eye visible.
37O106	15+240	L	<0.010 ac.	3'	ditch line	N	Y	15+640/ 15+180	15+660/ 15+180	Water sinks in ditch at the west end of the culvert. Within ROW.
37O107	15+740	R	6.5 ac.	5-6'	row crop-soybeans	N	N	-	-	Sinkhole east of ROW. Shows on topographic maps, but not distinct in the field.
37O108	15+780	L	0.60 ac.	8-10'	pasture	N	Y	16+080/ 15+640	16+080/ 15+660	Sinkhole west of ROW. May once have been a pond.
37O109	15+880	L	2.2 ac.	4'	row crop-corn	N	N	-	-	Sinkhole west of ROW. Shows on topographic maps, but not distinct in the field.
37O110	16+100	L	1.1 ac.	6'	row crop-corn	N	Y	16+325/ 16+080	16+300/ 16+080	Sinkhole within and west of ROW.
37O111	16+280	R	0.04 ac.	3-4'	row crop-soybeans	N	Y	-	16+360/ 16+300	Sinkhole east of ROW.
37L112	16+370	L	0.25 ac.	3-4'	row crop-soybeans	N	Y	16+390/ 16+325	-	Sinkhole west of ROW.
37L113	16+380	R	11.0 ac.	8-10'	row crop-soybeans	Y	N	-	-	Sinkhole within and east of ROW. May once have been connected with 37O110. Eye in northwest corner.
37L114	16+415	L	0.20 ac.	8-10'	grass	N	Y	16+460/ 16+390	-	Sinkhole west of ROW.
37L115	16+420	R	0.60 ac.	6-8'	row crop-soybeans	Y	N	-	-	Sinkhole about 60' east of ROW.
37L116	16+460	R	0.80 ac.	8-10'	row crop-soybeans	N	N	-	-	Sinkhole about 200' east of ROW.
37L117	16+500	R	0.3 ac.	6-8'	row crop-soybeans	N	Y	-	16+750/ 16+360	Drains to 37L118via culvert. Mostly within ROW.

E55

Table 3. Karst Features Along SR 37 Corridor - Orleans to Mitchell

Feature Designation	Station No.	R/L	Area	Depth	Land Use	Eye?	Hwy. runoff?	Left (Sta/Sta)	Right (Sta/Sta)	Comments
37L118	16+500	L	4.8 ac.	10-12'	row crop-soybeans	Y	Y	16+740/ 16+460	-	Receives drainage from 37L117. Within and west of ROW.
37L119	16+640	L	2.9 ac.	10'	row crop-soybeans	Y	N	-	-	Sinkhole west of ROW. Eye filled with rubble.
37L120	16+700	R	0.06 ac.	1-3'	pasture	N	N	-	-	A cluster of slump features east of ROW. Some have been filled.
37L121	16+800	L	0.40 ac.	4'	row crop-soybeans	Y	Y	16+990/ 16+740	17+000/ 16+750	Sinkhole west of ROW.
37L122	17+100	L	3.4 ac.	10'	pasture	Y	Y	17+600/ 16+990	-	Sinkhole receives runoff from 37L123 via culvert. Within and west of ROW
37L123	17+100	R	2.1 ac.	10'	pasture	N	Y	-	17+600/ 17+000	Sinkhole drains to 37L122 via culvert. Within and east of ROW.
37L124	17+270	R	0.25 ac.	10'	pasture	?	N	-	-	Depression at the end of a south-flowing drainageway about 300' east of highway. Could not inspect bottom.
37L125	17+420	L	0.80 ac.	4'	row crop-soybeans	N	N	-	-	Broad, shallow sinkhole west of ROW.
37L126	17+430	R	1.6 ac.	15'	pasture	N	N	-	-	Sinkhole 100' east of highway. 1993 air photo shows a pond - now dry. in same drainageway as 37L124
37L127	17+440	R	<0.010 ac.	2'	pasture	N	N	-	-	Shallow sinkhole between 37L126 and highway. East of ROW.
37L128	17+480	R	0.20 ac.	8'	pasture	Y	N	-	-	Small sinkhole with an opening. East of ROW.
37L129	17+580	R	2.3 ac.	NA	stock pond	N	N	-	-	Sinkhole east of ROW.
37L130	17+790	R	0.01 ac.	4'	row crop-corn	N	N	-	-	Sinkhole partly within ROW. Above level of highway
37L131	17+940	R	0.70 ac.	8'	row crop-corn	N	Y	-	17+990/ 17+600	Sinkhole east of ROW connects with 37L132 via culvert. No flow direction noted between the two features.

Table 3. Karst Features Along SR 37 Corridor - Orleans to Mitchell

Feature Designation	Station No.	R/L	Area	Depth	Land Use	Eye?	Hwy. runoff?	Left (Sta/Sta)	Right (Sta/Sta)	Comments
37L132	17+980	L	0.45 ac.	4'	grass	N	Y	18+000/ 17+600	-	Sinkhole west of ROW connects with 37L131 via culvert. No flow direction noted between the two features.
37L133	18+120	R	3.2 ac.	8'	brushy	Y	Y	18+120/ 18+000	18+260/ 17+990	A trench has been excavated near the highway in sinkhole to intercept runoff. East of ROW.
37L134	18+140	L	<0.010 ac.	1'	ditch line	-	Yes	18+260/ 18+120	-	Slump in ditch line, some runoff may bypass and go to 37L132. Within ROW.
37L135	18+440	R	0.95 ac.	NA	pond	N	Y	-	-	Pond 200' east of right-of-way. Receives runoff from 37L135 via excavated ditch.
37L136	18+460	R	2.1 ac.	20'	lawn	N	Y	18+580/ 18+260	18+580/ 18+260	Sinkhole east of ROW. Conveys runoff to 37L134. North end partly filled.
37L137	18+620	R	1.6 ac.	15'	lawn	N	Y	18+780/ 18+580	18+700/ 18+580	Sinkhole east of ROW. Partly filled.
37L138	18+760	R	2..5 ac.	20'	lawn	N	Y	18+920/ 18+780	18+880/ 18+700	Large sinkhole that crosses several front yards. East of ROW.
37L139	18+880	L	0.10 ac.	4'	lawn	N	N	-	-	Shallow sinkhole in a front yard. West of ROW.
37L140	18+900	R	<0.010 ac.	2'	ditch line	-	Y	-	18+920/ 18+760	Slump in the ditch line filled with rubble. Within ROW.
37L141	18+980	R	>0.010 ac.	2'	ditch line	-	Y	-	19+000/ 18+920	Slump in the ditch line filled with rubble. Within ROW.
37L142	19+015	R	<0.010 ac.	1'	ditch line	-	Y	-	19+000/ 19+015	Filled slump in ditch line. Within ROW.
37L143	19+050	L	0.11 ac.	3'	pasture	N	N	-	-	Sinkhole in pasture west of ROW.
37L144	19+060	R	<0.010 ac.	2'	lawn	N	N	-	-	Sinkhole east of ROW.
37L145	19+080	R	0.03 ac.	6'	lawn	N	N	-	-	Sinkhole east of ROW.
37L146	19+050	L	0.06 ac.	3'	pasture	N	N	-	-	Sinkhole in pasture west of ROW.
37L147	19+115	R	0.06 ac.	5-6'	lawn	-	N	-	-	Sinkhole east of ROW. Partly filled slump may be an eye.

E57

Table 3. Karst Features Along SR 37 Corridor - Orleans to Mitchell

Feature Designation	Station No.	R/L	Area	Depth	Land Use	Eye?	Hwy. runoff?	Left (Sta/Sta)	Right (Sta/Sta)	Comments
37L148	19+180	L	<0.010 ac.	1'	ditch line	-	Y	19+180/ 19+150	-	Filled slump in ditch line. Within ROW.
37L149	19+190	R	<0.010 ac.	3'	ditch line	-	Y	-	19+210/ 19+040	Filled slump in ditch line. Within ROW.
37L150	19+195	L	<0.010 ac.	6'	ditch line	-	Y	19+220/ 19+180	-	Rock filled slump in ditch line. Within ROW.
37L151	19+223	R	<0.010 ac.	2'	ditch line	-	Y	-	19+210/ 19+220	Rubble filled slump in ditch line. Within ROW.
37L152	19+240	R	0.05 ac.	3'	lawn	-	N	-	-	Sinkhole east of ROW. Partly filled slump may be an eye.
37L153	19+270	L	0.02 ac.	6'	brushy	Y	Y	19+345/ 19+220	19+300/ 19+222	Steep sided sinkhole - mostly filled with trash and rock. West of ROW.
37L154	19+420	L	0.75 ac.	5'	hay field	N	N	-	-	Sinkhole adjacent to CR 50E. West of ROW.
37L155	19+620	R	0.10 ac.	4'	lawn	N	Y	-	19+755/ 19+300	Drains to 37L155 via culvert. Within and west of ROW.
37L156	19+620	L	0.85 ac.	10'	hay field, row crop-soybeans	N	Y	19+755/ 19+460	-	Sinkhole receives runoff from 37L154. Mostly within ROW.
37L157	19+770	L	0.15 ac.	4'	lawn, row crop-soybeans	N	N	-	-	Sinkhole west of ROW.
37L158	19+860	L	0.80 ac.	5'	pasture	N	Y	19+880/ 19+755	19+920/ 19+755	Sinkhole west of ROW.
37L159	19+950	R	<0.010 ac.	1'	ditch line	-	Y	-	20+050/ 19+920	Filled slump in ditch line. Within ROW.
37L160	19+975	L	<0.010 ac.	1'	ditch line	-	Y	-	-	Filled slump in ditch line. Runoff flows past to 37L161. Within ROW.
37L161	20+000	L	3.6 ac.	4'	row crop-soybeans	N	Y	20+050/ 19+880	-	Sinkhole west of ROW.

E58

Table 4. Drainage Areas and Runoff Estimates

Feature No.	Drainage Area (acres)	Highway Runoff?	Drainage Area Characteristics					Runoff (ac-ft.) From Design Storm		
			Soil Type	Hydrol. Group	Land Use	Curve No.	Acres	2 year	5 year	10 year
5601	NA	N	Flowing sulfur well adjacent to Lost River					-	-	-
15001	NA	N	Runoff does not appear to enter cave					-	-	-
15002	NA	N	Clayton Conrad Cave - drainage area southeast of highway					-	-	-
15003	3.4	N	-	-	-	-	-	-	-	-
15004	3.4	N	-	-	-	-	-			
15005	1.1	Y	CrC2	B	P&H	58	0.90			
				NA	pave	98	0.20	0.03	0.07	0.09
15006	NA	N	Buttermilk Spring/Cave -drainage area south of highway							
15007	NA	Y	Rise pit under highway - receives some runoff							
15008	1.5	Y	CrC2	B	res	70	1.30			
				NA	pave	98	0.20	0.12	0.20	0.24
15009	0.5	Y	CrB	B	P&H	58	0.30			
				NA	pave	98	0.20	0.04	0.06	0.08
150010	1.8	N	-	-	-	-	-	-	-	-
150011	0.4	Y	CrB	B	P&H	58	0.34			
				NA	pave	98	0.08	0.02	0.04	0.06
150012	<0.1	Y	Too small to calculate							
150013	2.2	Y	CrC2	B	P&H	58	2.10			
				NA	pave	98	0.10	0.07	0.13	0.18
150014	0.2	N	-	-	-	-	-	-	-	-
150015	23.0	Y	CrC2	B	P&H	58	21.70			
					res	70	1.10			
				NA	pave	98	0.20	0.70	1.30	1.70
150016	0.5	Y	CrC2	B	P&H	58	0.45			
				NA	pave	98	0.05	0.02	0.03	0.04
150017	<0.1	N	-	-	-	-	-	-	-	-
150018	0.2	N	-	-	-	-	-	-	-	-
150019	0.2	N	-	-	-	-	-	-	-	-
3701	1.1	N	-	-	-	-	-	-	-	-
3702	<0.1	N	-	-	-	-	-	-	-	-
3703	<0.1	N	-	-	-	-	-	-	-	-

Table 4. Drainage Areas and Runoff Estimates

Feature No.	Drainage Area (acres)	Highway Runoff?	Drainage Area Characteristics					Runoff (ac-ft.) From Design Storm		
			Soil Type	Hydrol. Group	Land Use	Curve No.	Acres	2 year	5 year	10 year
3704	475.0	Y	WgD2	B	wood	60	205.00			
					res	70	4.00			
			CrC2	B	wood	60	68.00			
					P&H	58	34.00			
					crop	74	12.00			
			CrB	B	P&H	58	4.00			
			WeC2	B	res	70	31.00			
					wood	60	33.00			
					P&H	58	8.00			
			WeC3	B	wood	60	4.00			
			ZaB	C	res	70	12.00			
					P&H	58	3.00			
			GoF	C	wood	60	15.00			
			Hd	B	P&H	58	11.00			
			CuD2	B	wood	60	6.00			
			CaD	C	P&H	58	4.00			
					wood	60	3.00			
			CxC2	B	P&H	58	12.00			
				NA	pave	98	6.00	17.40	32.10	42.70
3705	15.5	Y	WgD2	B	P&H	58	2.10			
					res	70	0.20			
			CrC2	B	crop	74	2.60			
					res	70	1.90			
					P&H	58	4.60			
			CxC2	B	crop	74	2.00			
					res	70	1.60			
				NA	pave	98	0.50	0.80	1.40	1.90
3706	6.5	N	-	-	-	-	-	-	-	-
3707	1.9	N	-	-	-	-	-	-	-	-

E60

Table 4. Drainage Areas and Runoff Estimates

Feature No.	Drainage Area (acres)	Highway Runoff?	Drainage Area Characteristics					Runoff (ac-ft.) From Design Storm		
			Soil Type	Hydrol. Group	Land Use	Curve No.	Acres	2 year	5 year	10 year
37O8	81.6	Y	WgD2	B	P&H	58	9.20			
					wood	60	24.60			
			CrC2	B	crop	74	20.30			
					wood	60	3.80			
			CxC2	B	crop	74	16.20			
			WeC2	B	wood	60	5.20			
					res	70	1.20			
				NA	pave	98	1.10	4.40	7.40	9.50
37O9	3.5	N	-	-	-	-	-	-	-	-
37O10	3.7	Y	CxC2	B	wood	60	3.00			
					res	70	0.35			
					P&H	58	0.20			
				NA	pave	98	0.15	0.12	0.25	0.33
37O11	13.8	Y	CxC2	B	crop	74	3.70			
					res	70	3.60			
					P&H	58	3.50			
			CrB	B	comm	92	1.90			
				NA	pave	98	1.10	1.10	1.70	2.10
37O12	8.5	N	-	-	-	-	-	-	-	-
37O13	NA	Y	Water flows past to 37O11					-	-	-
37O14	21.6	N	Located in the 37O11 watershed					-	-	-
37O15	1.6	N	-	-	-	-	-	-	-	-
37O16	NA	Y	Drains to 37O17					-	-	-
37O17	4.2	Y	CxC2	B	P&H	58	2.60			
					res	70	1.00			
					crop	74	0.40			
				NA	pave	98	0.20	0.18	0.32	0.42
37O18	2.1	Y	CxC2	B	P&H	58	1.40			
					res	70	0.50			
				NA	pave	98	0.20	0.13	0.22	0.28
37O19	2.3	Y	CxC2	B	crop	74	2.10			
				NA	pave	98	0.20	0.21	0.32	0.39

Table 4. Drainage Areas and Runoff Estimates

Feature No.	Drainage Area (acres)	Highway Runoff?	Drainage Area Characteristics					Runoff (ac-ft.) From Design Storm		
			Soil Type	Hydrol. Group	Land Use	Curve No.	Acres	2 year	5 year	10 year
37O20	8.6	Y	CxC2	B	P&H	58	8.40			
				NA	pave	98	0.20	0.24	0.48	0.65
37O21	1.4	N	-	-	-	-	-	-	-	-
37O22	0.5	N	-	-	-	-	-	-	-	-
37O23	95,950*		Swallet In Lost River Dry Bed					-	-	-
37O24	95,800*		Swallet In Lost River Dry Bed					-	-	-
37O25	5.2	N	-	-	-	-	-	-	-	-
37O26	1.9	N	-	-	-	-	-	-	-	-
37O27	1.5	N	-	-	-	-	-	-	-	-
37O28	2.3	Y	CxC2	B	P&H	58	2.00			
				NA	pave	98	0.30	0.09	0.16	0.22
37O29	0.8	Y	CxC2	B	P&H	58	0.70			
				NA	pave	98	0.05	0.02	0.05	0.06
37O30	95,600*		Dry Bed of Lost River					-	-	-
37O31	3.0	Y	CrB	B	res	70	0.60			
					crop	74	0.40			
			CxC2	B	crop	74	1.90			
				NA	pave	98	0.10	0.24	0.38	0.48
37O32	10.2	Y	CrB	B	res	70	1.40			
					crop	74	4.10			
			CxC2	B	crop	74	4.50			
				NA	pave	98	0.20	0.80	1.30	1.60
37O33	9.5	N	-	-	-	-	-	-	-	-
37O34	6.8	Y	CrB	B	P&H	58	3.30			
					res	70	1.80			
					crop	74	1.10			
				N	pave	98	0.60	0.36	0.62	0.79
37O35	NA	Y	Drains to 37O34					-	-	-
37O36	1.7	N	-	-	-	-	-	-	-	-
37O37	2.2	N	-	-	-	-	-	-	-	-
37O38	2.0	Y	CrB	B	P&H	58	0.90			
					crop	74	0.70			
				NA	pave	98	0.40	0.15	0.23	0.29

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Table 4. Drainage Areas and Runoff Estimates

Feature No.	Drainage Area (acres)	Highway Runoff?	Drainage Area Characteristics					Runoff (ac-ft.) From Design Storm		
			Soil Type	Hydrol. Group	Land Use	Curve No.	Acres	2 year	5 year	10 year
37O39	1.8	N	-	-	-	-	-	-	-	-
37O40	1.7	N	-	-	-	-	-	-	-	-
37O41	0.7	Y	CrB	B	res	70	0.60			
				NA	pave	98	0.06	0.05	0.08	0.10
37O42	0.1	N	-	-	-	-	-	-	-	-
37O43	1.3	N	-	-	-	-	-	-	-	-
37O44	0.3	N	-	-	-	-	-	-	-	-
37O45	0.7	Y	CxC2	B	P&H	58	0.60			
				NA	pave	98	0.10	0.02	0.04	0.06
37O46	0.2	N	-	-	-	-	-	-	-	-
37O47	4.9	Y	CxC2	B	crop	74	4.10			
				NA	pave	98	0.80	0.50	0.75	0.90
37O48	0.3	N	-	-	-	-	-	-	-	-
37O49	2.7	N	-	-	-	-	-	-	-	-
37O50	0.1	N	-	-	-	-	-	-	-	-
37O51	0.8	N	-	-	-	-	-	-	-	-
37O52	0.1	N	-	-	-	-	-	-	-	-
37O53	0.4	N	-	-	-	-	-	-	-	-
37O54	0.2	N	-	-	-	-	-	-	-	-
37O55	0.6	N	-	-	-	-	-	-	-	-
37O56	4.6		CxC2	B	comm	92	1.40			
					res	70	0.30			
					wood	60	0.30			
					P&H	58	0.80			
			CrB	B	comm	92	1.30			
					P&H	58	0.20			
				NA	pave	98	0.30	0.50	0.80	0.90
37O57	3.5	N	-	-	-	-	-	-	-	-
37O58	3.7	Y	CxC2	B	P&H	58	1.50			
					res	70	1.80			
				NA	pave	98	0.40	0.20	0.30	0.40
37O59	1.2	N	-	-	-	-	-	-	-	-
37O60	1.3	N	-	-	-	-	-	-	-	-

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Table 4. Drainage Areas and Runoff Estimates

Feature No.	Drainage Area (acres)	Highway Runoff?	Drainage Area Characteristics					Runoff (ac-ft.) From Design Storm		
			Soil Type	Hydrol. Group	Land Use	Curve No.	Acres	2 year	5 year	10 year
37O61	0.5	N	-	-	-	-	-	-	-	-
37O62	NA	Y	Drains to 37O63					-	-	-
37O63	13.2	Y	CxC2	B	P&H	58	13.00			
				NA	pave	98	0.20	0.40	0.70	1.00
37O64	1.2	N	-	-	-	-	-	-	-	-
37O65	3.7	N	-	-	-	-	-	-	-	-
37O66	11.6	Y	CxC2	B	P&H	58	6.50			
					res	70	2.80			
					comm	92	1.80			
				NA	pave	98	0.50	0.70	1.10	1.40
37O67	1.4	Y	CxC2	B	P&H	58	1.20			
				NA	pave	98	0.20	0.05	0.11	0.14
37O68	4.3	Y	CxC2	B	crop	74	2.20			
					res	70	1.90			
				NA	pave	98	0.20	0.30	0.50	0.70
37O69	0.9	N	-	-	-	-	-	-	-	-
37O70	8.2	Y	CxC2	B	crop	74	8.00			
				NA	pave	98	0.20	0.70	1.10	1.30
37O71	NA	Y	Drains to 37O72					-	-	-
37O72	2.8	Y	CrB	B	res	70	1.00			
					P&H	58	0.90			
			CxC2	B	P&H	58	0.40			
					crop	74	0.40			
				NA	pave	98	0.10	0.14	0.24	0.31
37O73	4.0	N	-	-	-	-	-	-	-	-
37O74	0.3	Y	CrB	B	P&H	58	0.25			
				NA	pave	98	0.05	0.01	0.02	0.03
37O75	2.1	Y	CrB	B	res	70	1.80			
					P&H	58	0.20			
				NA	pave	98	0.10	0.13	0.22	0.28
37O76	2.4		CrB	B	res	70	1.50			
			CxC2	B	P&H	58	0.80			
				NA	pave	98	0.10	0.13	0.22	0.28

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Table 4. Drainage Areas and Runoff Estimates

Feature No.	Drainage Area (acres)	Highway Runoff?	Drainage Area Characteristics					Runoff (ac-ft.) From Design Storm		
			Soil Type	Hydrol. Group	Land Use	Curve No.	Acres	2 year	5 year	10 year
37O77	23.5	Y	CxC2	B	P&H	58	11.70			
					crop	74	3.50			
					res	70	4.10			
			CrB	B	crop	74	1.70			
					res	70	1.60			
				NA	pave	98	0.90	1.20	2.00	2.60
37O78	NA	Y	Drains to 37O77					-	-	-
37O79	4.6	N	-	-	-	-	-	-	-	-
37O80	17.0	Y	CrC2	B	crop	74	6.40			
					P&H	58	0.50			
					res	70	0.20			
			CxC2	B	P&H	58	3.70			
					res	70	1.70			
					crop	74	0.50			
			CrB	B	crop	74	2.10			
					P&H	58	0.50			
					res	70	0.40			
				NA	pave	98	1.00	1.10	1.80	2.30
37O81	0.4	Y	CxC2	B	P&H	58	0.15			
				NA	pave	98	0.20	0.04	0.06	0.07
37O82	2.4	Y	CxC2	B	res	70	1.07			
					P&H	58	1.09			
				NA	pave	98	0.24	0.10	0.20	0.30
37O83	4.3	Y	CxC2	B	P&H	58	3.00			
					res	70	1.05			
				NA	pave	98	0.25	0.20	0.30	0.40
37O84	6.9	N	-	-	-	-	-	-	-	-
37O85	0.3	N	-	-	-	-	-	-	-	-
37O86	8.8	Y	CxC2	B	P&H	58	7.00			
			CrB	B	P&H	58	1.50			
				NA	pave	98	0.30	0.25	0.50	0.70
37O86-A	1.1	Y	CxC2	B	P&H	58	1.00			
					pave	98	0.10	0.03	0.06	0.08

Table 4. Drainage Areas and Runoff Estimates

Feature No.	Drainage Area (acres)	Highway Runoff?	Drainage Area Characteristics					Runoff (ac-ft.) From Design Storm		
			Soil Type	Hydrol. Group	Land Use	Curve No.	Acres	2 year	5 year	10 year
37O87	2.7	Y	CxC2	B	res	70	2.50			
				NA	pave	98	0.20	0.20	0.30	0.40
37O88	2.9	Y	CxC2	B	res	70	2.70			
				NA	pave	98	0.20	0.20	0.30	0.40
37O89	7.4	Y	CxC2	B	res	70	5.50			
					comm	92	0.80			
					crop	74	0.70			
				NA	pave	98	0.40	0.60	1.00	1.20
37O90	2.1	Y	CxC2	B	comm	92	1.10			
					P&H	58	0.95			
				NA	pave	98	0.05	0.20	0.30	0.40
37O91	3.2	N	-	-	-	-	-	-	-	-
37O92	6.1	Y	CxC2	B	comm	92	4.10			
					res	70	1.40			
					crop	74	0.30			
				NA	pave	98	0.30	0.90	1.25	1.50
37O93	1.9	Y	Drains to 37O94					-	-	-
37O94	7.4	Y	CrB	B	comm	92	5.80			
					P&H	58	0.50			
					res	70	0.70			
				NA	pave	98	0.40	1.20	1.60	1.90
37O95	8.0	Y	CrB	B	comm	92	4.00			
					P&H	58	3.30			
					res	70	0.50			
				NA	pave	98	0.20	0.70	1.10	1.40
37O96	1.6	N	-	-	-	-	-	-	-	-
37O97	3.2	N	-	-	-	-	-	-	-	-
37O98	1.5	N	-	-	-	-	-	-	-	-
37O99 Flood Cr.	1760.0	Y	-	B/C	res/comm/p ave	82	90.00			
					crop	74	1105.00			

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Table 4. Drainage Areas and Runoff Estimates

Feature No.	Drainage Area (acres)	Highway Runoff?	Drainage Area Characteristics					Runoff (ac-ft.) From Design Storm		
			Soil Type	Hydrol. Group	Land Use	Curve No.	Acres	2 year	5 year	10 year
					P&H	58	565.00	105.00	176.00	225.00
37O100	0.5	N	-	-	-	-	-	-	-	-
37O101	4.2	Y	CrB	B	P&H	58	1.80			
					res	70	1.10			
					comm	92	0.80			
				NA	pave	98	0.50	0.30	0.50	0.60
37O102	NA	N	See 37O99 - probably original Flood Creek sink point					-	-	-
37O103	9.8	Y	CrB	B	comm	92	5.00			
may over-					res	70	1.30			
flow to			CxC2	B	crop	74	3.10			
37O104				NA	pave	98	0.40	1.30	1.90	2.20
37O104	1.9	Y	CxC2	B	res	70	1.10			
			CrB	B	P&H	58	0.40			
				NA	pave	98	0.40	0.15	0.24	0.30
37O105	0.3	N	-	-	-	-	-	-	-	-
37O106	2.8	Y	CrB	B	P&H	58	1.40			
			CxC2	B	P&H	58	0.60			
				NA	pave	98	0.80	0.20	0.30	0.40
37O107	14.7	N	-	-	-	-	-	-	-	-
37O108	7.8	Y	CrB	B	P&H	58	3.00			
					res	70	2.60			
					crop	74	1.40			
				NA	pave	98	0.80	0.50	0.80	1.00
37O109	4.8	N	-	-	-	-	-	-	-	-
37O110	8.4	Y	CrB	B	crop	74	7.00			
					P&H	58	1.00			
				NA	pave	98	0.40	0.60	1.00	1.30
37L111	1.0	Y	FwC2	B	crop	74	0.95			
				NA	pave	98	0.05	0.08	0.13	0.16
37L112	1.0	Y	FwC2	B	crop	74	0.95			
				NA	pave	98	0.05	0.08	0.13	0.16
37L113	22.9	N	-	-	-	-	-	-	-	-
37L114	1.0	Y	FwC2	B	crop	74	0.95			

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Table 4. Drainage Areas and Runoff Estimates

Feature No.	Drainage Area (acres)	Highway Runoff?	Drainage Area Characteristics					Runoff (ac-ft.) From Design Storm		
			Soil Type	Hydrol. Group	Land Use	Curve No.	Acres	2 year	5 year	10 year
				NA	pave	98	0.05	0.08	0.13	0.16
37L115	1.3	N	-	-	-	-	-	-	-	-
37L116	1.2	N	-	-	-	-	-	-	-	-
37L117	NA	Y	Drains to 37L118							
37L118	12.3	Y	FwC2	B	crop	74	10.30			
					P&H	58	1.40			
				NA	pave	98	0.60	0.70	1.50	1.90
37L119	6.3	N	-	-	-	-	-	-	-	-
37L120	1.4	N	-	-	-	-	-	-	-	-
37L121	7.0	Y	CdC2	B	P&H	58	5.20			
			FwC2	B	crop	74	1.40			
				NA	pave	98	0.40	0.30	0.50	0.70
37L122	31.9	Y	CdC2	B	P&H	58	11.30			
					wood	60	7.70			
			FwC2	B	crop	74	1.20			
					P&H	58	10.70			
				NA	pave	98	1.00	1.00	1.90	2.60
37L123	NA	Y	Drains to 37L122		-	-	-	-	-	-
37L124	2.1	N	-	-	-	-	-	-	-	-
37L125	2.0	N	-	-	-	-	-	-	-	-
37L126	4.2	N	-	-	-	-	-	-	-	-
37L127	0.3	N	-	-	-	-	-	-	-	-
37L128	0.7	N	-	-	-	-	-	-	-	-
37L129	5.5	N	-	-	-	-	-	-	-	-
37L130	0.3	N	-	-	-	-	-	-	-	-
37L131	4.8	Y	CrB	B	crop	74	3.60			
					P&H	58	0.90			
				NA	pave	98	0.30	0.35	0.60	0.70
37L132	2.8	Y	CrB	B	P&H	58	1.50			

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Table 4. Drainage Areas and Runoff Estimates

Feature No.	Drainage Area (acres)	Highway Runoff?	Drainage Area Characteristics					Runoff (ac-ft.) From Design Storm		
			Soil Type	Hydrol. Group	Land Use	Curve No.	Acres	2 year	5 year	10 year
					crop	74	1.00			
				NA	pave	98	0.30	0.20	0.30	0.40
37L133	28.8	Y	FwC2	B	crop	74	8.60			
					P&H	58	8.40			
					res	70	1.20			
			CrB	B	P&H	58	4.50			
					crop	74	0.40			
					comm	92	0.35			
			CrC2	B	crop	74	4.40			
					comm	92	0.45			
				NA	pave	98	0.50	1.60	2.70	3.50
37L134	NA	Y	Water drains past to 37L133			-	-	-	-	-
37L135	3.1	N	Some overflow from 37L136 may enter after heavy rain							
37L136	11.5	Y	FwC2	B	res	70	8.40			
					crop	74	1.40			
					P&H	58	1.10			
				NA	pave	98	0.60	0.80	1.30	1.60
37L137	5.8	Y	FwC2	B	res	70	5.50			
				NA	pave	98	0.30	0.40	0.60	0.80
37L138	5.5	Y	FwC2	B	res	70	5.20			
				NA	pave	98	0.30	0.40	0.60	0.80
37L139	0.3	N	-	-	-	-	-	-	-	-
37L140	0.1	Y	FwC2	B	res	70	0.08			
				NA	pave	98	0.02	<0.01	0.01	0.02
37L141	0.4	Y	FwC2	B	res	70	0.33			
				NA	pave	98	0.07	0.03	0.05	0.07
37L142	<0.1	Y	Too small to calculate							
37L143	0.4	N	-	-	-	-	-	-	-	-
37L144	<0.1	N	-	-	-	-	-	-	-	-
37L145	<0.1	N	-	-	-	-	-	-	-	-
37L146	0.3	N	-	-	-	-	-	-	-	-
37L147	0.3	N	-	-	-	-	-	-	-	-
37L148	NA	Y	Water flows past to 37L153							

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Table 4. Drainage Areas and Runoff Estimates

Feature No.	Drainage Area (acres)	Highway Runoff?	Drainage Area Characteristics					Runoff (ac-ft.) From Design Storm		
			Soil Type	Hydrol. Group	Land Use	Curve No.	Acres	2 year	5 year	10 year
37L149	0.7	Y	FwC2	B	res	70	0.50			
				NA	pave	98	0.20	<0.1	0.11	0.13
37L150	NA	Y	Water flows past to 37L153							
37L151	NA	Y	Water flows past to 37L153							
37L152	0.2	N	-	-	-	-	-	-	-	-
37L153	2.7	Y	FwC2	B	P&H	58	2.40			
				NA	pave	98	0.30	0.10	0.20	0.24
37L154	3.4	N	-	-	-	-	-	-	-	-
37L155	NA	Y	Drains to 37L156		-	-	-	-	-	-
37L156	7.3	Y	FwC2	B	res	70	3.40			
					crop	74	1.50			
					P&H	58	0.90			
				NA	pave	98	1.50	0.60	1.00	1.20
37L157	0.7	N	-	-	-	-	-	-	-	-
37L158	4.7	Y	FwC2	B	res	70	2.00			
					P&H	58	1.70			
				NA	pave	98	1.00	0.30	0.50	0.70
37L159	0.6	Y	FwC2	B	P&H	58	0.50			
				NA	pave	98	0.10	<0.1	<0.1	<0.1
37L160	NA	Y	Water flows past to 37L161							
37L161	6.1	Y	FwC2	B	crop	74	4.60			
					P&H	58	1.40			
				NA	pave	98	0.10	0.40	0.70	0.90

* - Drainage area estimates for Lost River are based on Hoggatt (1975)

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Table 5. Estimated Concentrations of Metals, Chloride and TSS in Highway Runoff

PARAMETER	During Construction		Post Construction
	Summer	Winter	
Chloride (mg/L)			
Average	14	80	no change
UCL	25	105	no change
TSS (mg/L)			
Average	113	190	60
UCL	245	285	105
Total Cr (ug/L)			
Average	70	20	15
UCL	135	30	23
Total Cu (ug/L)			
Average	50	30	25
UCL	80	40	45
Total Pb (ug/L)			
Average	20	10	20
UCL	40	20	30
Total Ni (ug/L)			
Average	55	10	10
UCL	100	20	20
Total Zn (ug/L)			
Average	225	130	70
UCL	390	205	100
Diss. Cu (ug/L)			
Average	5	5	5
UCL	5	5	5
Diss. Pb (ug/L)			
Average	<5	<5	<5
UCL	<5	<5	<5
Diss. Zn (ug/L)			
Average	20	20	20
UCL	20	20	20

UCL - 90 percent upper confidence limit (one-tailed t-test)

Table 6. Potential Impacts to US 150/SR 56 Features and Recommendations

Feature No.	Construction-Related Impacts	Recommended Protection/Mitigation/Runoff Management
56O1	Soil stability problems from flowing water.	Remove casing and cap, or grout well in accordance with 310 IAC 16-10.
150O1	Destruction of cave entrance if alignment shifted to north into ridge.	Avoid shifting alignment north.
150O2	Passage damage resulting from blasting.	Avoid blasting in this area.
	Highway runoff into system if highway alignment shifted south.	Avoid shifting alignment south, or prevent runoff from entering swale.
150O3	Highway runoff into feature if highway alignment shifted south.	Avoid shifting alignment south, or prevent runoff from entering swale.
150O4	See 150O3	See 150O3
150O5	Soil stability problems from water.	Ensure area properly backfilled.
150O6	Damage to passage/drainage from blasting	Avoid blasting in this area.
150O7	Collapse/plugging of rise.	Minimize earthmoving adjacent to rise
		Avoid blasting
		Use gabions on slopes
150O8	Siltation from runoff	Erosion controls (see end of section); ditch line mini-basins
150O9	Sink point in ditch can short circuit karst protection measures	Excavate; backfill with rip rap; concrete cap; fill to grade
150O10	None	None
150O11	Siltation from runoff	Erosion controls (see end of section); ditch line mini-basins
150O12	Siltation from runoff	Erosion controls (see end of section); ditch line mini-basins
150O13	Siltation from runoff	Erosion controls (see end of section); ditch line mini-basins
150O14	None	None
150O15	Siltation from runoff	Erosion controls (see end of section); ditch line mini-basins
150O16	Siltation from runoff	Erosion controls (see end of section); ditch line mini-basins
150O17	None	None
150O18	None	None
150O19	none	None

Table 7. Potential Impacts to SR 37 Features Between Paoli and Orleans and Recommendations

Feature No.	Construction/Post Construction Impacts	Recommended Protection/Mitigation/Runoff Management
37O1	None	None
37O2	None	None
37O3	None	None
37O4	Runoff into major swallowhole	Erosion controls; ditch line mini-basins
37O5	Runoff into closed basin	Erosion controls; ditch line mini-basins
37O6	May receive runoff if highway widened	Erosion controls; ditch line mini-basins
37O7	May receive runoff if highway widened	Erosion controls; ditch line mini-basins
37O8	Runoff into closed basin	Erosion controls; ditch line mini-basins
37O9	None	None
37O10	Runoff into closed basin	Erosion controls; ditch line mini-basins
37O11	Runoff into open basin	Erosion controls; detention basin/hazardous materials trap
37O12	None	None
37O13	Slump in ditch can short circuit karst protection measures	Excavate; backfill with rip rap; concrete cap; fill to grade
37O14	May receive water if highway widened	Erosion controls; ditch line mini-basins
37O15	None	None
37O16	Drains to 37O17 via culvert; runoff into open basin	Consider removing culvert; erosion controls; in-sinkhole structure
37O17	Runoff into closed basin	Consider removing culvert; erosion controls; ditch line mini-basins
37O18	Runoff into closed basin	Erosion controls; ditch line mini-basins
37O19	Runoff into open basin	Erosion controls; detention basin/hazardous materials trap
37O20	Possible runoff into open basin	Erosion controls; backfill with rip rap, cap; fill to grade
37O21	None	None
37O22	None	None

Table 7. Potential Impacts to SR 37 Features Between Paoli and Orleans and Recommendations

Feature No.	Construction/Post Construction Impacts	Recommended Protection/Mitigation/Runoff Management
37O23	Runoff to swallet in Dry Bed of Lost River	Erosion controls; detention basin/hazardous materials trap
37O24	Runoff to swallet in Dry Bed of Lost River	Erosion controls; detention basin/hazardous materials trap
37O25	None	None
37O26	None	None
37O27	None	None
37O28	Runoff into open basin	Erosion controls; in-sinkhole structure
37O29	Runoff into closed basin	Erosion controls; ditch line mini-basins
37O30	Runoff to Dry Bed of Lost River	Erosion controls; ditch line mini-basins
37O31	Runoff into closed basin	Erosion controls; ditch line mini-basins
37O32	Runoff into closed basin	Erosion controls; ditch line mini-basins
37O33	Runoff to sinkhole pond	Erosion controls; ditch line mini-basins
37O34	Runoff into closed basin	Erosion controls; ditch line mini-basins
37O35	Runoff into closed basin	Erosion controls; ditch line mini-basins
37O36	None	None
37O37	None	None
37O38	Runoff into closed basin	Erosion controls; ditch line mini-basins
37O39	None	None
37O40	None	None
37O41	Runoff into closed basin	Erosion controls; ditch line mini-basins; or divert to 37O38
37O42	None	None
37O43	None	None
37O44	None	None
37O45	Runoff into closed basin	Erosion controls; ditch line mini-basins; or divert to 37O47
37O46	None	None
37O47	Runoff into open basin	Erosion controls; in-sinkhole structure

Table 7. Potential Impacts to SR 37 Features Between Paoli and Orleans and Recommendations

Feature No.	Construction/Post Construction Impacts	Recommended Protection/Mitigation/Runoff Management
37O48	None	None
37O49	None	None
37O50	None	None
37O51	None	None
37O52	None	None
37O53	None	None
37O54	None	None
37O55	None	None
37O56	Runoff to closed basin	Erosion controls; in-sinkhole structure
37O57	None	None
37O58	Runoff to sinkhole pond	Erosion controls; ditch line mini-basins
37O59	None	None
37O60	None	None
37O61	None	None
37O62	Runoff into closed basin	Erosion controls; ditch line mini-basins
37O63	Runoff into closed basin	Erosion controls; ditch line mini-basins
37O64	None	None
37O65	None	None
37O66	Runoff into closed basin	Erosion controls; ditch line mini-basins
37O67	Runoff into open basin	Erosion controls; in-sinkhole structure
37O68	Runoff into open basin	Erosion controls; detention basin/hazardous materials trap
37O69	None	None
37O70	Runoff into closed basin	Erosion controls; ditch line mini-basins
37O71	Runoff into closed basin	Erosion controls, ditch line mini-basins

Table 7. Potential Impacts to SR 37 Features Between Paoli and Orleans and Recommendations

Feature No.	Construction/Post Construction Impacts	Recommended Protection/Mitigation/Runoff Management
37O72	Runoff into open basin	Erosion controls; in-sinkhole structure
37O73	None	None
37O74	Runoff into open basin	Erosion controls, ditch line mini-basins; divert to 37O76
37O75	Runoff into open basin	Erosion controls, detention basin/hazardous materials trap; remove culvert to 37O76
37O76	Runoff into open basin	Erosion controls; in-sinkhole structure
37O77	Runoff to sinkhole pond	Erosion controls; ditch line mini-basins
37O78	Runoff to closed basin	Erosion controls; ditch line mini-basins
37O79	None	None
37O80	Runoff to closed basin	Erosion controls; ditch line mini-basins
37O81	Slump in ditch can short circuit karst protection measures	Excavate; backfill with rip rap; concrete cap; fill to grade
37O82	Runoff to closed basin	Erosion controls; ditch line mini-basins
37O83	Runoff to sinkhole pond	Erosion controls; ditch line mini-basins
37O84	None	None
37O85	None	None
37O86	Runoff to closed basin	Erosion controls; ditch line mini-basins
37O87	Runoff to open basin	Erosion controls; in-sinkhole structure
37O88	Runoff to possible open basin	Erosion controls; detention basin/hazardous materials trap
37O88A	Runoff to closed basin	Erosion controls; ditch line mini-basins
37O89	Runoff to closed basin	Erosion controls; ditch line mini-basins
37O90	Runoff to sinkhole pond	Erosion controls; ditch line mini-basins
37O91	none	None
37O92	Runoff to possible open basin	Erosion controls; detention basin/hazardous materials trap
37O93	None	None
37O94	Runoff to sinkhole pond	Erosion controls; ditch line mini-basins

Table 8. Potential Impacts to SR 37 Features Between Orleans and Mitchell and Recommendations

Feature No.	Construction/Post Construction Impacts	Recommended Protection/Mitigation/Runoff Management
37O95	None	None
37O96	None	None
37O97	None	None
37O98	None	None
37O99	Runoff into a major swallowhole	Erosion controls; detention basin/hazardous materials trap
37O100	None	None
37O101	Sink point in ditch can short circuit karst protection measures	Excavate; backfill with rip rap; concrete cap; fill to grade
37O102	None	None
37O103	Sink point in ditch can short circuit karst protection measures	Excavate; backfill with rip rap; concrete cap; fill to grade
37O104	Runoff into closed basin	Erosion controls; ditch line mini-basins
37O105	None	None
37O106	Sink point in ditch can short circuit karst protection measures	Excavate; backfill with rip rap; concrete cap; fill to grade
37O107	None	None
37O108	Runoff into closed basin	Erosion controls; ditch line mini-basins
37O109	None	None
37O110	Runoff into closed basin	Erosion controls; ditch line mini-basins
37L111	None	none
37L112	Runoff into closed basin	Erosion controls; ditch line mini-basins
37L113	None	None
37L114	Runoff into closed basin	Erosion controls; ditch line mini-basins
37L115	Runoff into open basin	Erosion controls; detention basin/hazardous materials trap
37L116	None	None

Table 8. Potential Impacts to SR 37 Features Between Orleans and Mitchell and Recommendations

Feature No.	Construction/Post Construction Impacts	Recommended Protection/Mitigation/Runoff Management
37L117	Runoff into closed basin	Erosion controls; ditch line mini-basins
37L118	Runoff into open basin	Erosion controls; detention basin/hazardous materials trap
37L119	None	None
37L120	None	None
37L121	Runoff into open basin	Erosion controls; detention basin/hazardous materials trap
37L122	Runoff into open basin	Erosion controls; detention basin/hazardous materials trap
37L123	Runoff into closed basin	Erosion controls; ditch line mini-basins
37L124	None	None
37L125	None	None
37L126	None	None
37L127	None	None
37L128	None	None
37L129	None	None
37L130	None	None
37L131	Runoff into closed basin	Erosion controls; ditch line mini-basins
37L132	Runoff into closed basin	Erosion controls; ditch line mini-basins
37L133	Runoff into open basin	Erosion controls; detention basin/hazardous materials trap
37L134	Sink point in ditch can short circuit karst protection measures	Excavate; backfill with rip rap; concrete cap; fill to grade
37L135	Discharge into sinkhole pond	Erosion controls; ditch line mini-basins
37L136	Discharge into closed basin	Erosion controls; ditch line mini-basins
37L137	Discharge into closed basin	Erosion controls; ditch line mini-basins
37L138	Discharge into closed basin	Erosion controls; ditch line mini-basins
37L139	None	None
37L140	Sink point in ditch can short circuit karst protection measures	Excavate; backfill with rip rap; concrete cap; fill to grade

Table 8. Potential Impacts to SR 37 Features Between Orleans and Mitchell and Recommendations

Feature No.	Construction/Post Construction Impacts	Recommended Protection/Mitigation/Runoff Management
37L141	Sink point in ditch can short circuit karst protection measures	Excavate; backfill with rip rap; concrete cap; fill to grade
37L142	Sink point in ditch can short circuit karst protection measures	Excavate; backfill with rip rap; concrete cap; fill to grade
37L143	None	None
37L144	None	None
37L145	None	None
37L146	None	None
37L147	None	None
37L148	Sink point in ditch can short circuit karst protection measures	Excavate; backfill with rip rap; concrete cap; fill to grade
37L149	Sink point in ditch can short circuit karst protection measures	Excavate; backfill with rip rap; concrete cap; fill to grade
37L150	Sink point in ditch can short circuit karst protection measures	Excavate; backfill with rip rap; concrete cap; fill to grade
37L151	Sink point in ditch can short circuit karst protection measures	Excavate; backfill with rip rap; concrete cap; fill to grade
37L152	None	None
37L153	Runoff into open basin	Erosion controls; detention basin/hazardous materials trap
37L154	None	None
37L155	Runoff into closed basin	Erosion controls; ditch line mini-basins
37L156	Runoff into closed basin	Erosion controls; ditch line mini-basins
37L157	None	None
37L158	Runoff into closed basin	Erosion controls; ditch line mini-basins

Table 8. Potential Impacts to SR 37 Features Between Orleans and Mitchell and Recommendations

Feature No.	Construction/Post Construction Impacts	Recommended Protection/Mitigation/Runoff Management
37L159	Sink point in ditch can short circuit karst protection measures	Excavate; backfill with rip rap; concrete cap; fill to grade
37L160	Sink point in ditch can short circuit karst protection measures	Excavate; backfill with rip rap; concrete cap; fill to grade
37L161	Runoff into closed basin	Erosion controls; ditch line mini-basins

Table 9. Potential Impacts to Significant Area Caves and Karst Features and Recommendations

Feature	Construction/Post Construction Impacts	Recommended Protection/Mitigation/Runoff Management
Barnett Cave	None	None
Buttermilk Spring Cave	See Table 6	See Table 6
Cave Street Cave	None	None
Clayton Conrad Cave	See Table 6	See Table 6
Hamer Cave in Spring Mill State Park	Runoff into sinkholes along SR 37	Erosion controls; detention basin/hazardous materials trap
Hobo Cave	None	None
Just Off the Road Cave	See Table 6	See Table 6
Kids Cave	None	None
Kool Spring Cave	None	None
Lost River System		
Boiling Spring	None	None
Cul de Sac	None	None
Dry Bed	Runoff discharge into swallowholes near SR 37	Erosion controls; ditch line mini-basins; detention basins/hazardous materials traps
Elrod Cave	None	None
Hudelson Cavern	Inflow of waters from swallowholes near SR 37	Erosion controls; ditch line mini-basins; detention basins/hazardous materials traps
Mathers Stormwater Rises	None	None
Nichols Cave	None	None
Peachers Caves	None	None
Orangeville Rise	None	None
Rise of Lost River	None	None
Stein Swallowholes	None	None

Table 9. Potential Impacts to Significant Area Caves and Karst Features and Recommendations

Feature	Construction/Post Construction Impacts	Recommended Protection/Mitigation/Runoff Management
Lost River System (cont.)		
Tolliver Swallowhole	Inflow of waters from swallowholes near SR 37	Erosion controls; ditch line mini-basins; detention basins/hazardous materials traps
Turner Swallowholes	Runoff discharge into swallowholes from SR 37	Erosion controls; ditch line mini-basins; detention basins/hazardous materials traps
Wesley Chapel Gulf	None	None
Murray Spring Cave	None	None
Robbin's Roaring Resurgence Cave	None	None
Tomato Cave	None	None

Appendix A, B and C have been removed from this report and are available in the INDOT project file.

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REVIEW AND COMMENT ON KARST PROTECTION DLZ PRELIMINARY FIELD CHECK PLANS INDOT SR 56 RECONSTRUCTION PROJECT PROSPECT TO PAOLI SECTION ORANGE COUNTY, INDIANA

PROJECT NO. STP-024-4( )
DES. NOS. 9804660, 9804680, 9804690, 0012540, 0012290, 012530, 0012280, 0012550

Prepared for:

Indiana Department of Transportation
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Prepared by:

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May 2004

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APPENDIX

I EXECUTIVE SUMMARY

Earth Tech has reviewed and field checked the Preliminary Field Check plans and cross sections provided by DLZ Indiana, LLC for the Prospect to Paoli Section of the SR 56/US 150 Rehabilitation Project in Orange County, Indiana [Project No. STP-024-4( ); Des. Nos. 9804660, 9804680, 9804690, 0012540, 0012290, 012530, 0012280, 0012550]. Earth Tech was provided with full sized plans for review.

DLZ personnel identified twenty-seven karst features in the field that had not been identified by Earth Tech during its 1997-98 field investigations along SR 56. Earth Tech personnel checked all of these locations in the field. Fourteen of the features were determined not to be karst features. Eight were found to be karst features located along new alignments or traffic runarounds, or in brushy areas that could not be properly examined during the growing season. Five were possible karst features, for which Earth Tech recommends test borings or excavations to determine if they are in fact karst features. Treatment recommendations are tabulated for karst features and possible karst features.

Unlike the Mitchell Plain and other areas of intense sinkhole development, swallowholes and sinking streams are not common in the Prospect to Paoli Section. Many surface drainage routes appear to flow uninterrupted to Lick Creek or the nearest receiving stream. No base level spring outlets were identified along Lick Creek that might be habitat for endangered species, or affected by highway construction or runoff. Earth Tech recommends that whenever possible, such flow routes be utilized, and modified to direct runoff away from karst features, rather than to construct runoff treatment measures at individual features.

No dye tracing is recommended for any karst feature in the Prospect to Paoli Section.

II. INTRODUCTION

Earth Tech has reviewed and field checked the Preliminary Field Check plans and cross sections provided by DLZ Indiana, LLC for the Prospect to Paoli Section of the SR 56/US 150 Rehabilitation Project in Orange County, Indiana [Project No. STP-024-4( ); Des. Nos. 9804660, 9804680, 9804690, 0012540, 0012290, 012530, 0012280, 0012550]. Earth Tech was provided with full sized plans for review, and compared these with the Earth Tech 1998 draft report on karst for this highway segment (Earth Tech, 1998).

After a review of the above documents each feature discussed was checked in the field. This report provides an update to the 1998 draft report on karst for this highway segment. All karst features discussed in the Earth Tech report and the shown on the DLZ plans are located with respect to the new stationing, described, and recommendations for long-term runoff management are discussed.

III. PROJECT LOCATION AND DESCRIPTION

See Figure 1. The Prospect to Paoli Section of this highway rehabilitation project begins at Station 4+397.986 on SR 56 just east of Prospect, Orange County, Indiana. The project ends at Station 15+633.067 just east of Indian Boundary Road (CR 225W), and just west of Paoli, Orange County, Indiana. The plans show project exceptions just west of the Lost River Bridge (Station 5+086.000 to 5+715.076), and two Lick Creek bridge crossings (Station 12+460.000 to 12+850.000 and Station 13+290.000 to 13+560.000). The total project length (including exceptions) is 10.975 km (6.82 miles).

IV. HYDROGEOLOGY OF THE STUDY AREA

The portion of the project discussed in this report is located within the Crawford Upland physiographic unit, a rugged, hilly upland that is deeply dissected by surface streams. The Prospect to Paoli Section runs roughly parallel with Lick Creek, a major southern tributary of Lost River. Hilltops and ridges in the Crawford Upland are underlain by mixed sandstone, shale and thin limestone strata assigned to the West Baden and Stephensport Groups (Mississippian, Chesterian). These are underlain by a thick sequence of limestones assigned to the .Blue River and Sanders Groups (Mississippian, Valmeyeran and Chesterian) (Figure 2).

The Chester shales and sandstones are more resistant to solutional weathering processes than the limestones of the Blue River Group. Therefore, the topography of the Crawford Upland is composed of a series of high upland ridges capped by clastic rocks. Karst features in the Crawford Upland generally occur on the lower slopes of ridges and valley areas where the Blue River Group limestones are exposed beneath the overlying clastics. In the Prospect to Paoli Section, Blue River Group limestones are exposed along the valley walls of Lost River, and Lick Creek. As the grade of Lick Creek is slightly less than the dip of the limestone strata, the limestones eventually dip beneath the valley floor, and karst features along the highway are uncommon at the west end of the segment.

Unlike the Mitchell Plain and other areas of intense sinkhole development, swallowholes and sinking streams are not common in the Prospect to Paoli Section. Many surface drainage routes appear to flow uninterrupted to Lick Creek or the nearest receiving stream. No base level spring outlets were identified along Lick Creek that might be habitat for endangered species, or affected by highway construction or runoff. Earth Tech recommends that whenever possible, such flow routes be utilized, and modified to direct runoff away from karst features, rather than to construct runoff treatment measures at individual features.

V. DISCUSSION OF INDIVIDUAL FEATURES

Table 1 provides a summary of features identified by Earth Tech and DLZ in the SR as karst features in the SR 56 corridor. Each feature is identified and discussed, and runoff management treatments are recommended.

VI.1. FEATURE A

Feature A is located at Station 5+223 right, about 18 m (60 feet) south of line 'H-1', at the edge of the existing right-of-way. It is identified as a sinkhole by DLZ on Plan and Profile sheet 78. Feature A appears to be an erosion feature near the top of the north bank of Lick Creek about 3 m (10 feet) long and 1 m (3 feet) deep. It does not appear to be a karst feature. The1927 highway plans utilized by Earth Tech show a drainage ditch outfall at this location.

VI.2. FEATURE B

Feature B is located at Station 5+775 left, about 15m (50 feet) north of line 'H-1', within the proposed right-of-way. It is identified as a sinkhole by DLZ. Feature B does not appear to be a karst feature. It is a shallow depression approximately 1.8 m (6 feet) wide x 3.6 m (12 feet) long x 30 cm (1 foot) deep. There is no opening. Feature B was previously evaluated by Earth Tech for INDOT in 1997 during planning for the replacement of the bridge over Lost River. The feature may be an artifact resulting from grading, plowing or an old fence row.

VI.3. FEATURE C

Feature C is located at Station 5+845 right, about 12 m (40 feet) south of line 'PRH-1-D', at the edge of the existing right-of-way. Feature C is a circular depression about 2 m (6 feet) in diameter and about 0.5 m (18 inches) deep at the top of the north bank of Lick Creek. There is no opening. It is identified as a sinkhole by DLZ. It does not appear to be a karst feature. It may be a subsidence feature related to Feature D.

VI.4. FEATURE D

Feature D is located at Station 5+845 right, about 20 m (65 feet) south of line 'PRH-1-D', just outside the existing right-of-way. Feature D is an opening about halfway up the steep north bank of Lick Creek. It is identified as an underground stream outflow by DLZ. It does not appear to be a karst feature. The opening appears to be an 8-inch VCP field drain outfall hidden by tree roots. A drainage tile is shown in 1927 plans. There was no discharge when Earth Tech checked the feature. A nearby 12-inch culvert along Lick Creek receives drainage from the north, but does not appear to discharge to Lick Creek. The culvert flow may have "short circuited", and water may be draining laterally to the smaller 8-inch VCP field drain.

VI.5. FEATURE E

Feature E is located at Station 6+200 left, about 5 m (16 feet) north of line 'PRH-1-D', within the right-of-way. Feature E is a shallow soil slump 0.6 m (2 feet) in diameter at the base of the highway embankment. There is no opening. It is identified as a sinkhole by DLZ. Feature E does not appear to be a karst feature. There are exposed rip rap-sized pieces of stone in the depression. On the edge of the south side of the road embankment, the ground drops almost vertically to Lick Creek. There are exposed limestone blocks (not bedrock) nearly all the way to the water. The road embankment appears to be built up with limestone rubble, and Feature E may be a result of soil piping between the rock interstices.

VI.6. FEATURE F

Feature F is located at Station 6+350 right, about 12 m (40 feet) south of line'PRH-1-D', and within the proposed right-of-way. It is a depression located on a wooded, alluviated terrace about 100 feet north of Lick Creek. Feature F is about 9 m (30 feet) in diameter and about 1.2 m (4 feet) deep. It is partly filled with trash, including lumber, metal, concrete, lawn furniture and appliances. It is identified as a sinkhole by DLZ. This is an unusual location for a sinkhole. There are no springs or exposed bedrock along Lick Creek. The feature should be investigated by test borings or excavations. If it is a karst feature, it should be excavated to bedrock, filled, capped and brought up to grade.

VI.7. FEATURE G

Feature G is located at Station 6+355 right, about 12 m (40 feet) south of line 'PRH-1-D', within the proposed right-of-way. It is a small depression about 1.2 m (4 feet) in diameter and about 0.3 m (one foot) deep. It is identified as a sinkhole by DLZ. Feature G does not appear to be a karst feature. It appears to be a shallow pit, perhaps excavated by hand. It may or may not be associated with nearby Feature F, but should be investigated along with that feature.

VI.8. FEATURE H

Feature H is located at Station 7+500 on both sides of the existing road. Feature H is a depression covered by rip rap at the location of a culvert in 1927 highway plans. It is identified as a sinkhole by DLZ. Feature H appears as a broad depression at the base of the rip rap slope about 16 m (55 feet) in an east-west direction, 10 m (30 feet) in a north-south direction and about 1.5 m (5 feet) deep. It does not appear to be a sinkhole. The original culvert infall appears to have been covered by rip rap. The outfall is located at the edge of Lick Creek, and is obscured by mud and tree roots. There is a slight discharge of water. The drainageway formerly served by the culvert is cut off by fill, possibly as the result of land development activities north of the highway. The 1927 plans indicate a possible spring north of Feature H, but if present,

it has been covered by rip rap or fill and would not be affected by highway construction. A new culvert is proposed for that location.

VI.9. FEATURE 150O1

This is the entrance to Just Off the Road Cave. It is located at station 7+800 left, about 40 m (130 feet) north of line 'H-1'. The cave entrance is located outside of the proposed right-of-way, halfway up the highwall of an old quarry. It is obscured by fallen rock. A depression in the limestone rubble at the base of the highwall is located within the proposed right-of-way, and probably carries runoff from the quarry area to Lick Creek, located immediately to the south across the road. There do not appear to be any spring outlets along Lick Creek in this area. No impacts to the cave are expected as the result of highway construction. Highway runoff can be routed to bypass this sinkhole.

VI.10. FEATURE I

Feature I is located at Station 8+140 right, about 20 m (65 feet) south of line 'H-1'. The feature described consists of several closed, linear soil depressions along Lick Creek. The depressions comprising the feature are located along the edge of the proposed right-of-way. They are identified as sinkholes by DLZ. The depressions comprising Feature I do not appear to be karst features. They appear to be soil erosion/soil piping features along the upper part of the stream bank that is located in a zone of concentrated surface runoff from a farm field to the southeast.

VI.11. FEATURE J

Feature J is located at Station 8+620 left, about 40 m (130 feet) north of line 'H-1', where a traffic runaround is to be located. The feature described is a cluster of soil depressions along Lick Creek. They are described as sinkholes by DLZ. The depressions comprising Feature I do not appear to be karst features. They appear to be soil erosion/soil piping features along a zone of concentrated surface runoff from a farm field to the west.

VI.12. FEATURE 150O2

Feature 150O2 is Clayton Conrad Cave. Owing to the distance from the highway, it should not be affected by this project.

VI.13. FEATURE K

Feature K is located at Station 9+220 right, about 35 m (115 feet) south of line 'PRH-1-D', and within the proposed right-of-way. The feature is described as a sinkhole by DLZ. Inspection in the field indicates that Feature K is a sinkhole located in a brushy fence line. The feature is about 1.8 m (6 feet) in diameter, and about 30 cm (one foot) deep. It appears to receive sheet wash from the highway at present.

The feature is located within the boundaries of a proposed runoff treatment area for runoff entering any karst features, and in in-sinkhole treatment structure is recommended. Overland flow routes to Lick Creek already exist in this area. Earth Tech recommends that this feature be protected from construction runoff by employing BMPs. Long-term runoff management can best be accomplished by diverting runoff from the highway past this feature.

VI.14. FEATURES 150O3 AND 150O4

These features are located at Stations 9+220 and 9+223 right, respectively, about 82 m (270 feet) south of line 'PRH-1-D'. They are two small sinkholes located along the bottom of a very shallow drainage swale. Each feature is about 2.5 m (8 feet) in diameter. 150O3 is about 30 cm (12 inches) deep and 150O4 is about 50 cm (18 inches) deep. They currently receive no highway runoff, but runoff from a new highway alignment will be directed toward these features.

The features are located within the boundaries of a proposed runoff treatment area for runoff entering any karst features, and an in-sinkhole treatment structure is recommended. Overland flow routes to Lick Creek already exist in this area. It is recommended that these features be protected from construction runoff by employing BMPs. Long-term runoff management may best be accomplished by diverting runoff from the highway past these features.

VI.15. FEATURE L

Feature L is a small depression on a grassy slope located at Station 9+225 right, about 25 m (83 feet) south of line 'PRH-1-D', and within the proposed right-of-way. The feature is described as a sinkhole by DLZ. The feature is a shallow depression about 1.5 m (5 feet) in diameter and about 15 cm (6 inches) deep. There is a small opening. The feature appears to be a soil piping feature, and may be a karst feature. The feature may receive some sheet runoff from the present highway, but should not receive runoff from the new alignment. DLZ recommends excavating, filling and capping this feature. Earth Tech concurs.

VI.16. FEATURE M

Feature M is a broad, shallow closed depression in a farm field at station 9+550. The feature is located within the proposed right-of-way along Line 'PRH-1-D'. The feature is approximately 30 m (100 feet) in diameter. The floor of the depression dips in a northeasterly direction, and there is a low lip on the north side that closes the depression. The lip may be an artifact of grading or plowing. Earth Tech recommends that this feature be investigated by means of a series of geotechnical borings. If Feature M is a karst feature, filling and capping in the vicinity of the roadway may be necessary. It may be possible to direct runoff past this feature.

VI.17. FEATURE N

Feature N is a large sinkhole in the same farm field as Feature M, at Station 9+620. The feature is located within the proposed right-of-way long Line 'PRH-1-D'. Feature N is approximately 30 m (100 feet) in diameter, and approximately 2.1 m (7 feet) deep. There are several small soil piping features in the center. DLZ makes no recommendations regarding this feature. Earth Tech recommends Feature N be investigated by means of excavation or a series of geotechnical borings. Filling and capping in the vicinity of the roadway may be necessary. It may be possible to direct runoff past this feature.

VI.18. FEATURE 150O5

Feature 150O5 is a small seep that was discovered at the base of the old highway embankment. This feature should not be affected by the proposed project.

VI.19. FEATURE 150O6

Feature 150O6 is the entrance of Buttermilk Spring Cave. It is located At Station 9+860, about 50 m (165 feet) south of Line 'PRH-1-D', and outside of the proposed right-of-way. The cave entrance is located in the wall of a limestone outcrop. The passage immediately constricts just inside the entrance, making exploration impossible. The stream appears to be flowing from the south, away from the highway. The new highway alignment will require cutting through about 6 m (20 feet) through the highwall of an old limestone quarry located just north of the cave entrance. Blasting should be avoided if possible.

VI.20. FEATURE O

Feature O is a small sinkhole located at Station 10+215 right, about 20 m (65 feet) south of Line 'H-1'. The feature is within the proposed right-of-way, but outside the proposed construction limits. Feature O is a linear depression about 3 m (10 feet) long x 1 m (3 feet) wide and about 50 cm (18 inches) deep. DLZ recommends excavating, filling and capping. Earth Tech concurs. Long-term runoff management can best be accomplished by ensuring that highway runoff is diverted past this feature. Whenever possible, earthmoving machinery should operate from pads or mats to distribute the weight and prevent potential collapse into underlying voids.

VI.21. FEATURE 150O7

This karst feature is a rise pit of the underground cutoff of Lick Creek. It is located at Station 10+240 directly beneath the roadway. The discharge from this pit flows northwesterly and into Lick Creek. Geophysical testing should be undertaken at this location to ensure that the new highway and bridge are set on competent bedrock. Whenever possible, earthmoving machinery should operate from pads or mats to distribute the weight and prevent potential collapse into underlying voids.

VI.22. FEATURE P

Feature P consists of two small openings in the present south ditch line of SR 56 at station 10+270 right, about 15 m (50 feet) south of Line'PRH-1-D'. The openings are about 15 cm (6 inches) in diameter, and are located in the ditch floor, about 21 m (70 feet) east of the east abutment of the present bridge over Feature 150O7. The openings did not appear to have received water recently, as no debris was observed. Ditch runoff is probably intercepted first by Feature Q (see below). DLZ recommends excavating, filling and capping. Earth Tech concurs.

VI.23. FEATURE Q

Feature Q is a small opening in the present south ditch line of SR 56 at Station 10+300 right, about 15 m (50 feet) south of Line 'PRH-1-D'. The feature is about 30 m (100 feet) east, and upgradient from, Feature P. Feature Q is about 15 cm (6 inches) in diameter and was observed receiving ditch runoff from upgradient. In the event that ditch flow exceeded the intake capacity of this feature, the water would continue to Feature P. DLZ recommends excavating, filling and capping. Earth Tech concurs.

VI.24. FEATURE R

Feature R is a closed depression located at Station 10+450 right, about 30 m (100 feet) south of Line 'PRH-1-D'. It is located outside the proposed right-of-way. DLZ identified the feature as a sinkhole. It is surrounded on two sides by private driveways, on the north by SR 56, and on the south by a hill slope. It does not appear to be a karst feature. It is more likely that the depression is an artifact caused by grading and filling for the roads.

VI.25. FEATURE S

Feature S is an opening in the ground at Station 10+420 right, about 15 m (50 feet) south of Line 'PRH-1-D'. It is located inside the proposed right-of-way. DLZ identified the feature as a sinkhole. Feature S is a soil piping feature associated with a concrete box that receives runoff from the property to the south, and a buried drainage tile from the east that runs parallel with SR 56. The box discharges onto the ditch line on the south side of the highway. It is likely that the soil is piping into openings in the drain tiles and concrete box, rather than into subsurface voids. DLZ recommends excavating, filling and capping. Earth Tech concurs.

VI.26. FEATURE T

Feature T is a large depression at Station 10+440 right, about 30 m (100 feet) south of Line 'PRH-1-D'. The depression is approximately 30 m (100 feet) in length, approximately 12 m (40 feet) in width and 4.5 m (15 feet) high at the south end. DLZ identified the feature as a sinkhole. The sides and floor of the depression are grassed,

and no eyes or rock outcrops were apparent. There is a concrete headwall with a wooden doorframe and door set into the southeast corner of the depression. The door opens into a cellar with a concrete floor. The depression does not appear to be a sinkhole.

VI.27. FEATURE U

Feature U is a small depression at Station 11+110 right, about 11m (36 feet) west of Line 'H-1'. The depression is about 60 cm (2 feet) in diameter and about 15 cm (6 inches) deep. It is located within the proposed right-of-way between the existing roadside ditch and a fence line. DLZ identified the feature as a sinkhole. The depression may have been dug. DLZ recommends excavating, filling and capping. Earth Tech concurs.

VI.28. FEATURE V

Feature V is a sinkhole located at Station 11+320 right, about 30 m (100 feet) west of Line "H-2'. It is located on a proposed traffic runaround, and is within the proposed right-of-way. The sinkhole is approximately 3 m (10 feet) in diameter, and approximately 1.2 m (4 feet) deep. The sinkhole is in a farm field, and is obscured by roadside vegetation and crops during the growing season. DLZ recommends excavating, filling and capping. Earth Tech concurs.

VI.29. FEATURE 150O8

Feature 150O8 is located at Station 12+900 left, about 10 m (32 feet) north of Line "H-2", just within the proposed right-of-way. The feature comprises a cluster of soil slumps in a yard, the largest of which is about 2.7 m (9 feet) in diameter, about 0.6 m (2 feet) deep, and filled with brush. The slumps were backfilled after the original Earth Tech report, but are beginning to open up again. DLZ recommends excavating, filling and capping. Earth Tech concurs.

VI.30. FEATURE 150O9

Feature 150O9 is located at Station 12+955 right, about 9 m (30 feet) south of Line "H-2", on the existing right-of-way line. The feature is a filled sinkhole or soil slump along an existing fence line and right-of-way line. The feature was noted on 1927 highway plans as a 15-foot wide sinkhole. The feature has been filled to grade, and there is at present no evidence of further slumping. DLZ makes no recommendation for this feature. Earth Tech recommends that Feature 150O9 be excavated, filled and capped.

VI.31. FEATURE 150O10

Feature 150O10 is located at Station 13+00 right, about 75 m (250 feet) north of line 'H-2", and outside the proposed right-of-way. Feature 150O10 appears to be a

sinkhole located upgradient from the highway. It will not be affected by construction or highway runoff.

VI.32. FEATURE W

Feature W is located at Station 13+065 right, about 16 m (52 feet) south of Line 'H-2', at the edge of the proposed construction boundary. Feature W is a shallow soil slump about 1 m (3 feet) in diameter and about 15 cm (6 inches) deep at the base of an abandoned railroad grade. It may be a small karst feature. The feature is upgradient from the roadway. It should be protected from runoff inflow during construction, and the feature should be bypassed by highway runoff.

VI.33. FEATURE X

Feature X is located Station 13+738 left, about 14 m (45 feet) north of Line 'H-2', and within the proposed right-of-way. DLZ identified the feature as a sinkhole. The feature appears to be a large brushy soil slump or swallowhole that terminates at the point where a surface drainageway meets the base of the north highway embankment. The drainage area is estimated to be less than an acre. The slump is about 6 m (20 feet) northwest of the existing inlet of a culvert that drains southerly beneath the highway. The culvert does not appear to carry runoff, as runoff does not appear to enter the infall and the outfall is mostly blocked by soil and vegetation. No discharge for the feature could be identified south of the highway. Feature X may be a karst feature, and should be investigated by excavation, and filled and capped if necessary. It may be necessary to move the culvert so that the infall can directly capture runoff being carried by the drainageway.

VI.34. FEATURE Y

Feature Y is located at Station 13+740 right, about 18 m (60 feet) south of Line 'H-2', and within the proposed right-of-way. DLZ identified the feature as a sinkhole. Feature Y is located on the opposite side of the highway from Feature X. It is just east of the swale draining the culvert outfall, and falls within the proposed right-of-way. Feature Y is a collapse feature. It receives runoff from the residence and yard to the east, but presently receives no highway runoff. In 1998, the edge of a concrete slab was visible at the top edge of the depression, suggesting a possible building or other structure at that location, with collapse into an old basement, cistern or bedrock void. More recently the collapse has been backfilled to the surface by concrete. DLZ recommends an in-sinkhole treatment structure. Earth Tech recommends that the feature be excavated, filled and capped, and that runoff be routed past the feature.

VI.35. FEATURE 150O11

Feature 150O11 is located at Station 13+905 right, about 23m (75 feet) south of Line 'H-2'. Feature 150O11 is a sinkhole about 4.5 m (15 feet) wide and 1.4 m (4.5 feet) deep. There is an opening in the bottom, and the feature presently receives highway

runoff. DLZ recommends an in-sinkhole treatment structure. Earth Tech recommends protecting the feature from runoff during construction, and directing highway runoff past the feature.

VI.36. FEATURE 150O12

Feature 150O12 is located at Station 13+960 right, about 42 m (140 feet) south of Line 'H-2'. Feature 150O12 is a sinkhole about 2 m (7 feet) in diameter and about 50 cm (18 inches) deep. There is no apparent opening, but the feature presently receives some highway runoff. DLZ proposes an in-sinkhole treatment structure. Earth Tech recommends protecting the feature from runoff during construction, and directing highway runoff past the feature.

VI.37. FEATURE Z

Feature Z is located at Station 14+024 right, about 10 m (30 feet) south of Line 'H-2', and within the proposed right-of-way. Feature Z is a soil slump near the base of a power pole, and appears to be recent (i.e., there was fresh soil in the sides of the slump). Feature Z is about 1.5 m (5 feet) long x 1 m (3 feet) wide X 1 m (3 feet) deep. It presently receives highway runoff. DLZ recommends filling and capping. Earth Tech concurs.

VI.38. FEATURE AA

Feature AA is located at Station 14+160 left, about 20 m (65 feet) north of Line 'H-2', and within the proposed right-of-way. DLZ described the feature as a sinkhole. Feature AA is a small depression at the base of an elm tree about 1 m (3 feet) in diameter and about 15 cm (6 inches) deep. It is located at the edge of a drainageway that is covered with fill, including soil, and pieces of rock and masonry. Feature appears to be the results of soil piping through the fill rather that a karst feature. Earth Tech recommends that the feature be investigated by excavation. If the feature proves to be a karst feature, it should be filled and capped.

VI.39. OTHER FEATURES

Features 150O13, 14, 15, and 16 should be protected from construction runoff and should be bypassed by highway runoff. Features 150O17, 18 and 19 are located east of the project terminus and are not considered in this report

VII. CONCLUSIONS AND RECOMMENDATIONS

Earth Tech has reviewed and field checked the Preliminary Field Check plans and cross sections provided by DLZ Indiana, LLC for the Prospect to Paoli Section of the SR 56/US 150 Rehabilitation Project in Orange County, Indiana [Project No. STP-024-4( ); Des. Nos. 9804660, 9804680, 9804690, 0012540, 0012290, 012530, 0012280, 0012550]. Earth Tech was provided with full sized plans for review.

DLZ personnel identified twenty-seven karst features in the field that had not been identified by Earth Tech during its 1997-98 field investigations along SR 56. Earth Tech personnel checked all of these locations in the field. Fourteen of the features were determined not to be karst features after examining them in the field. Eight were found to be karst features located along new alignments or traffic runarounds, or in brushy areas that could not be properly examined during the growing season. Five were possible karst features, for which Earth Tech recommends test excavations to determine if they are in fact karst features. Treatment recommendations are tabulated for karst features and possible karst features.

Unlike the Mitchell Plain and other areas of intense sinkhole development, swallowholes and sinking streams are not common in the Prospect to Paoli Section. Many surface drainage routes appear to flow uninterrupted to Lick Creek or the nearest receiving stream. No base level spring outlets were identified along Lick Creek that might be habitat for endangered species, or affected by highway construction or runoff. Earth Tech recommends that whenever possible, such flow routes be utilized, and modified to direct runoff away from karst features, rather than to construct runoff treatment measures at individual features.

No dye tracing is recommended for any karst feature in the Prospect to Paoli Section.

VIII. BIBLIOGRAPHY

Earth Tech, 1998, Description/Delineation of Karst Features in the Vicinity of U.S. Highway 150/State Road 56 Between West Baden Springs and Paoli, and State Road 37 Between Paoli and Mitchell (Orange and Lawrence County), Indiana, and Recommendations for Their Protection (Draft, revised 2001), 26 pp.

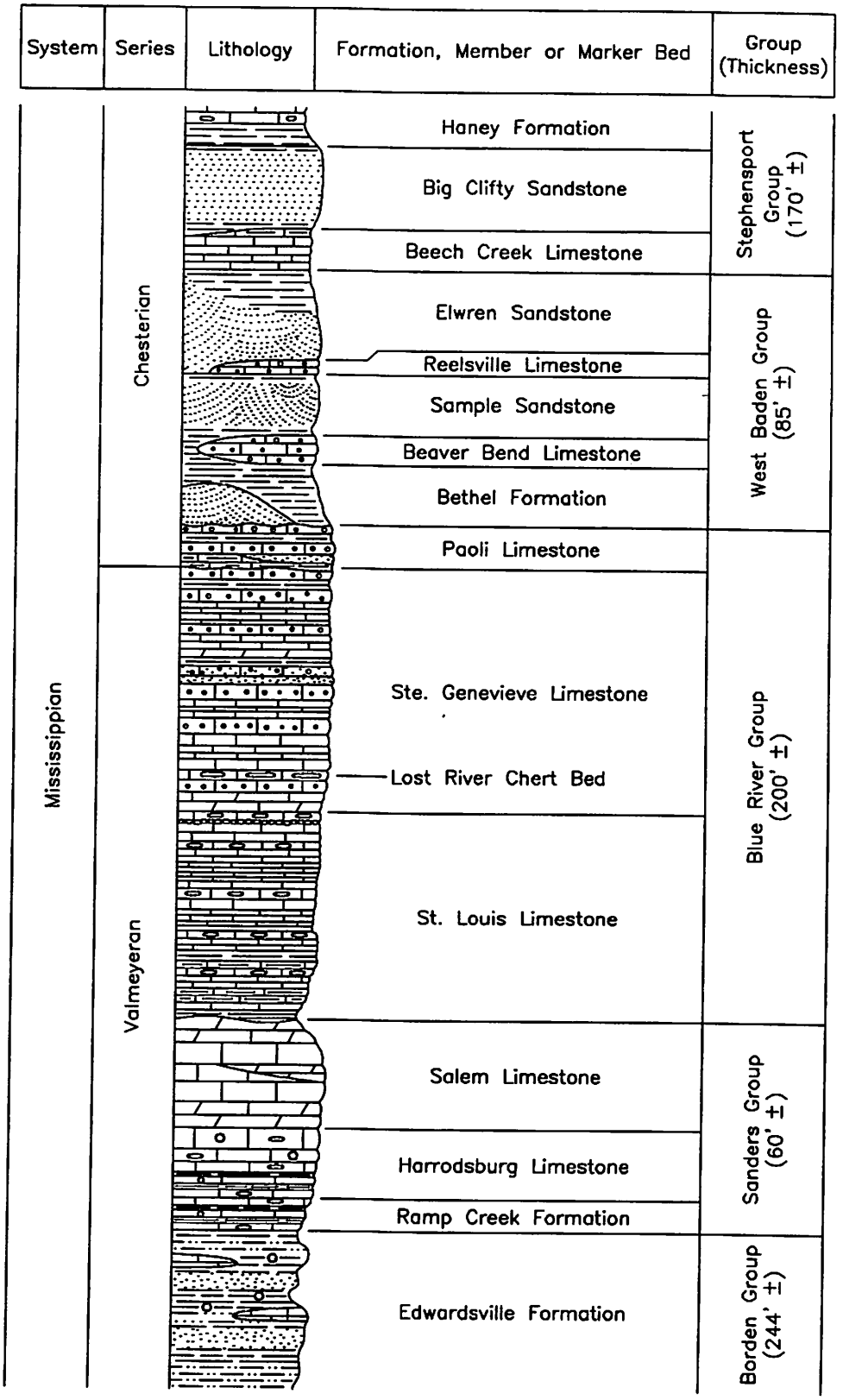

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FIGURE 2

STRATIGRAPHIC SECTION IN THE VICINITY OF THE STUDY AREA

INDOT S.R. 56 PROSPECT TO PAOLI SECTION
KARST INVESTIGATION
ORANGE COUNTY, INDIANA

Table 1. Review of Potential Karst Features Identified in DLZ Plans Along SR 56 - French Lick to Paoli (November 2002)

Feature	Station Old Plan	DLZ Station (Line)	Type	Suggested Treatment	Comments
A	171+50 Rt	5+223 18 m Rt (H-1)	Soil slump	None	**Not a karst feature.**
B	189+25 Lt	5+775 15 m Lt (H-1)	Shallow depression	None	**Not a karst feature.**
C	192+45 Rt.	5+845 12 m Rt. (PRH-1-D)	Small circular depression	None	**Not a karst feature.**
D	192+45 Rt.	5+845 20 m Rt. (PRH-1-D)	Discharge to Lick Creek	None	**Not a karst feature.**
E	204+00 Lt.	6+200 5 m Lt. (PRH-1-D)	Shallow depression	None	**Not a karst feature.**
F	208+50 Rt.	6+350 12 m Rt. (PRH-1-D)	Depression in alluvium	Investigate. Fill and cap if necessary. Avoid diverting runoff to feature.	**Possible karst feature.** Broad, shallow closed depression on new alignment. Possible opening under trash fill. Presently receives highway runoff.
G	208+70 Rt.	6+355 12 m Rt. (PRH-1-D)	Depression in alluvium	Investigate. Fill and cap if necessary. Avoid diverting runoff to feature.	**Unlikely to be a karst feature.**
H	245+00 CL	7+500 CL	Large depression in rip rap	Extend culvert at 7+450 as planned and install drainageway to proper grade	**Not a karst feature.**
150O1	254+00 Lt.	7+800 40 m Lt. (H-1)	Cave entrance	Avoid diverting runoff into the sinkhole.	**Just Off the Road Cave** in the highwall of an old quarry, and a sinkhole in the quarry floor.
I	264+00 Rt.	8+140 20 m Rt. (H-1)	Depressions	None	**Not a karst feature.**
J	283+00 Lt.	8+620 40 m Lt. (H-1)	Depressions	None	**Not a karst feature.**

E100

Table 1. Review of Potential Karst Features Identified in DLZ Plans Along SR 56 - French Lick to Paoli (November 2002)

Feature	Station Old Plan	DLZ Station (Line)	Type	Suggested Treatment	Comments
K	301+75 Rt.	9+220 35 m Rt. (PRH-1-D)	Depression in fence line	Protect from inflow during construction by using BMPs. Bypass or fill and cap.	**Karst feature**. Small sinkhole in fence line. Obscured by brambles on original survey. New alignment will direct runoff toward feature.
150O2	-	-	-	Not expected to be affected by project.	**Clayton Conrad Cave** entrance. Cave passages are mainly south of the cave entrance and should not be affected by this project.
150O3 150O4	301+50 Rt. 302+50 Rt.	9+220 9+223 82 m Rt. (PRH-1-D)	Two small sinkholes	Protect from inflow during construction by using BMPs. Bypass with ditches or fill and cap.	**Karst features**. Two small sinkhole in a shallow drainage swale. A new alignment will direct runoff toward features.
L	312+00 Rt.	9+225 25 m Rt. (PRH-1-D)	Soil piping feature	Protect from inflow during construction by using BMPs. Fill and cap.	**Karst feature.** Shallow depression with evidence of soil piping in center.
M	312+00 Rt.	9+550 C.L. (PRH-1-D)	Closed depression	Investigate. Fill and cap if necessary. Bypass runoff if possible.	**Possible karst feature.** Broad, shallow closed depression on new alignment. No openings.
N	313+00 Rt.	9+620 C.L. (PRH-1-D)	Sinkhole	Excavate. Fill and cap. Bypass runoff if possible.	**Karst feature** 100' dia x 7' deep on new alignment. Small piping features in center. May provide recharge to Buttermilk Spring Cave, but more likely to Feature 150O5
150O5	317+80 Lt.	NA	Seep	None	Will not be affected by this project.
150O6	324+00 Rt.	9+860 50 m Rt. (PRH-1-D)	Spring cave entrance	Avoid blasting along road cut.	**Buttermilk Spring Cave.** New alignment cuts through quarry north of cave entrance.
O	335+25 Rt.	10+215 20 m Rt. (H-1)	Sinkhole	Excavate. Fill and cap. Bypass runoff if possible.	**Karst feature**. Within the proposed right-of-way, but outside construction limits
150O7	335+50 C.L.	10+240 C.L. (PRH-1-D)	Spring rise pit	Ensure abutments are set on competent bedrock. There are numerous small sinkholes in this area. Earthmoving machinery should operate from pads or mats to distribute the weight and prevent potential collapse into underlying voids.	**Karst feature**. Rise of the underground cutoff of Lick Creek. Labeled "Mysterious Springs" on plan.

E101

Table 1. Review of Potential Karst Features Identified in DLZ Plans Along SR 56 - French Lick to Paoli (November 2002)

Feature	Station Old Plan	DLZ Station (Line)	Type	Suggested Treatment	Comments
P	336+00 Rt.	10+270 15 m Rt. (PRH-1-D)	Small openings in ditch line	Excavate. Fill and cap	**Karst feature**. There is no evidence the openings have taken water recently. Not observed during original survey.
Q	337+50 Rt.	10+300 15 m Rt. (PRH-1-D)	Swallet in ditch line	Excavate. Fill and cap	**Karst feature**. Small (6") opening in ditch floor taking flow from upgradient. Not observed during original survey. Located 80' west of barn.
R	340+00 Rt.	10+450 30 m Rt. (PRH-1-D)	Depression	None	**Not a karst feature**. It is a closed depression surrounded by roads on three sides, but is probably the result of filling and grading.
S	341+20 Rt.	10+420 15 m Rt. (PRH-1-D)	Soil piping	Investigate. Fill and cap if necessary	**Not a karst feature. It** is related to a concrete culvert box with incoming pipes from feature T and the ditch line to the east.
T	342+50 Rt.	10+440 30 m Rt. (PRH-1-D)	Depression	None	**Not a karst feature.** Appears man made. There is a concrete wall in the southeast corner holding a wood door frame that opens into a cellar with a concrete floor.
U	not shown	11+110 10 m Rt. (H-1)	Depression	Investigate. Fill and cap if necessary	**Unlikely to be a karst feature**. Small depression near the ditch by a farm gate. May have been dug.
V	370+60 Rt.	11+320 30 m Rt. (H-1)	Sinkhole	Excavate and cap. Bypass runoff.	**Karst feature**. Within new ROW at edge of runaround. Probably under edge of runaround pavement.
150O8	423+90 Lt.	12+900 10 m Lt. (H-2)	Sinkhole cluster	Excavate and cap	**Karst feature** has been partly backfilled but is still actively slumping.
150O9	424+75 Rt.	12+955 9 m Rt. (H-2)	Sinkhole	Excavate and cap	**Karst feature**. No significant change since 1997.
150O10	-	13+000 75 m Lt. (H-2)	Sinkhole	None	**Karst feature**. Will not be affected by highway construction or runoff.
W	429+00 Rt.	13+065 16 m Rt. (H-2)	Small depression in old RR embankment	Protect from runoff inflow during construction. Bypass	**Possible karst feature** noticeable because gravel is exposed there.

E102

Table 1. Review of Potential Karst Features Identified in DLZ Plans Along SR 56 - French Lick to Paoli (November 2002)

Feature	Station Old Plan	DLZ Station (Line)	Type	Suggested Treatment	Comments
X	450+70 Lt.	13+738 14 m Lt. (H-2)	Collapse/ piping near head of culvert	Investigate. Fill and cap if necessary. Consider moving culvert alignment.	**Possible karst feature.**
Y	450+75 Rt.	13+740 18 m Rt. (H-2)	Opening along drainageway	Investigate and cap if necessary	**Possible karst feature.**
150O11	456+50 Rt.	13+905 23 m Rt. (H-2)	Sinkhole	Protect from inflow during construction. Consider runoff bypass	**Karst feature**. Plans call for in-sinkhole drainage treatment, but looks as if it could be bypassed.
150O12	458+60 Rt.	13+960 42 m Rt. (H-2)	Sinkhole	Protect from inflow during construction. Bypass	**Karst feature**. Plans call for in-sinkhole drainage treatment, but looks as if it could be bypassed.
Z	?	14+024 10 m Rt. (H-2)	Soil piping feature	Excavate and cap	**Karst Feature**. A new-looking soil slump 5' longx3' widex 3' deep at the base of the highway embankment. Takes water from the right ditch line.
AA	473+60 Lt.	14+160 20 m Lt. (H-2)	Depression	Investigate and cap if necessary	**Unlikely to be a karst feature.**
150O13	429+00 Lt.	14+600 38 m Lt. (H-2)	Sinkhole	Protect from inflow during construction. Bypass	**Karst feature**. Plans show north ditch will bypass sinkhole.
150O14	480+90 Lt.	14+640 44 m Lt. (H-2)	Sinkhole	Protect from inflow during construction. Bypass	**Karst feature**. Plans show north ditch will bypass sinkhole.
150O15	488+60 Lt.	14+780 46 m Lt. (H-2)	Sinkhole	Protect from inflow during construction. Bypass	**Karst feature**. Plans show north ditch will bypass sinkhole.
150O16	490+90 Rt.	15+000 36 m Rt. (H-2)	Sinkhole	Protect from inflow during construction. Bypass	**Karst feature**. Plans show north ditch will bypass sinkhole.

Note: Features 150O17, 150O18 and 150O19 are located east of the project terminus

E103

PRELIMINARY SITE INVESTIGATION
INDOT PROJECTS STP-024-4( ) AND STP-095-3; DES. NO. 9804660, 9804680, 9804690, 9804790, and 9804650
ROAD REHABILITATION ON SR 56, US 150, AND ST 37 FROM FRENCH LICK TO MITCHELL IN ORANGE AND LAWRENCE COUNTIES

EXECUTIVE SUMMARY

As requested by INDOT, SIECO Division of Strand Associates, Inc. completed the Preliminary Site Investigation for the above referenced project. Initially, this project was assigned to Patriot Engineering and Environmental Co., LLC (Patriot). Patriot performed soil and groundwater sampling for this project in August 2001, according to recommendations presented in the Initial Site Assessment. The project was then re-assigned to SIECO for the conclusion of the report.

The investigation included forty-seven (47) parcels. According to the analytical results reported from the field investigation, environmental concerns were found in the soil and/or groundwater on twelve (12) parcels. A summary of sampling information, including analyzed parameters, is listed in the following table.

Parcel No. and Description	Environmental Concerns
1. Marathon/Tobacco Road; SE, SR 56 and SR 145	SB-1=2.9 gasoline 19.0 diesel
2. Huck Food and Fuel Store;208 SR 145, French Lick	ND-Petroleum odor @ 8 feet
3. Ron's Auto Sales; 8597W SR 56, French Lick	ND-Petroleum odor @ 6-8 feet
8. Vacant Building; NW, SR 56 and Sinclair St.	SB-14=5.9 gasoline
10. Games and More; 8205 W. SR 56, West Baden	VOC=Acetone 23.0 ppb
11. Former Mark's Garage; 8208 W. SR 56	SB-20=11.0 diesel
14. Vacant Lot; SR 56, West Baden Springs	SB-27=6.3 gasoline
16. Vacant Service Station; SR 56 & US 150, Prospect	SB-33=2.7 gasoline 11.0 diesel
21. White Building, East of CR 725 W, US 150	Soil – 1.1 gasoline
22. Somebody's Place; 3882 W. US 150, Paoli	SB-40=36.0 diesel 7.2 gasoline SB-42=7.6 gasoline

Parcel No. and Description	Environmental Concerns
26. Tobacco Road Service Station; 812 W. Main St, Paoli	SB-49=3,200 gasoline 330 diesel
27. Sunoco Service Station; 701 W. Main St, Paoli	SB-55=1.2 gasoline
39. Vacant Building; North of Lost River, Paoli	ND-Petroleum odor @ 2-4 feet
49. Vacant Building; SW, Maple St. & Washington	SB-95=16.0 gasoline 210 diesel
54. The Flower Cottage; 437 N. Maple St., Orleans	SB-107=48.0 diesel

CONTRACTORS SUMMARY

Petroleum impact was observed or detected in the soil and/or groundwater of thirteen (13) investigated sites. This includes two (2) parcels requiring R/W acquisition, and eleven parcels that will not require additional R/W. One additional parcel not requiring additional R/W was found to have low level solvent impact in soil. Please refer to each parcel discussion regarding the significance of identified environmental impact. The estimated lateral extent of contamination within current and proposed R/W of these sites is provided on the respective site diagrams in Appendix A. The following summary tables are provided for your use.

The following results are from parcels that require R/W acquisition.

Parcel/Description	R/W Required	Highest TPH in Soil (ppm)	MBTEX in Groundwater (ppb)
21 - White Building, East of CR 725 W, US 150	South	**1.1**	NA
22 - Somebody's Place; 3882 W. US 150, Paoli	North	**36.0**	NA
37 - Mick's Yard; 1600 N. SR 37, Paoli	West	NA	NA
38 - Morgan's Auto, Inc.; 1875 N. SR 37, Paoli	East	NA	NA
39 - Vacant Building; North of Lost River, Paoli	West	NA	NA
40 - Red Barn; 5028 N. SR 37, Orleans	West	NA	NA
41 - CO-OP; 1281 S. Maple St., Orleans	East	NA	NA
44 - Orleans Oil Company, Inc.; SR 37, Orleans	West	NA	NA

The following results are provided for parcels not indicated for R/W acquisition.

Parcel/Description	Highest TPH in Soil (ppm)	MBTEX in Groundwater (ppb)
1 - Marathon/Tobacco Road; SE, SR 56 and SR 145	**19.0**	ND
2 - Hucks Food & Fuel Store; 208 S. SR 145, French Lick	ND	NA
3 - Ron's Auto Sales; 8597 W. SR 56, French Lick	ND	NA
4 - French Lick Auto Sales; SR 56, French Lick	NA	NA
5 - CarQuest; SR 56, West Baden Springs	NA	NA
6 - Fast Eddie's Service Station; SR 56, W. Baden Springs	ND	NA
7 - Springs Valley Manufacturing; 8331 W. SR 56	NA	NA
8 - Vacant Building; NW, SR 56 and Sinclair St.	**5.9**	NA
9 - Carnes Auto Sales; SW, SR 56 and Maple St.	NA	NA
10 - Games And More; 8205 W. SR 56, W. Baden Springs	ND	NA
11 - Former Mark's Garage; 8208 W. SR 56	**11.0**	NA
12 - Motor Valet Car Wash; SR 56, West Baden Springs	ND	NA
13 - Honey-Do-Stop; SE Corner, SR 56 and Ballard St.	ND	NA
14 - Vacant Lot; SR 56, West Baden Springs	**6.3**	NA
15 - White Building; SR 56, West Baden Springs	ND	NA
16 - Vacant Service Station; SR 56 & US 150, Prospect	**11.0**	NA
17 - Vacant Building; SR 56 & US 150, Prospect	ND	NA
19 - Residence; SR 56 and US 150, Prospect	ND	NA
20 - Former Service Station, SR 56 & US 150, Prospect	ND	NA
23 - Rael Oil; 1500 Willow Creek Road, Paoli	ND	NA
24 - Indiana Handle Company; 1514 Main St., Paoli	NA	NA
25 - Citgo Service Station; 1608 W. Main St., Paoli	ND	NA
26 - Tobacco Road Service Station; 812 W. Main St, Paoli	**3,200**	NA
27 - Sunoco Service Station; 701 W. Main St, Paoli	**1.2**	NA
28 - Antiques/Used Furniture Store; 416 W. Main St.	ND	NA
29 - State Farm Insurance; 402 W. Main St., Paoli	ND	NA
30 - Shell/Dairy Land; 201 W. Main St., Paoli	ND	NA
31 - Vacant Lot; SW, E. Main St & 2nd St., Paoli	ND	NA
32 - Former Northside Marathon; 111 N. Gospel St.	ND	NA
33 - Paoli Tobacco Road; 221 N. Gospel St, Paoli	ND	NA
34 - Winiger Motors; SE, Gospel St. & Thornton St.	NA	NA
35 - Kemple's Quick Lube; 329 N. Gospel St., Paoli	NA	NA
36 - Former Foamcraft Inc.; 324 Hospital Road, Paoli	NA	NA

TABLE 1
SUMMARY OF ANALYTICAL RESULTS
INDOT PROJECTS STP-024-40, STP-095-30
DES NOS. 9804660, 9804680, 9804690, 9804790, & 9804650
ROAD REHABILITION ON SR 56, US 150, & SR 37,
FROM FRENCH LICK TO MITCHELL IN ORANGE & LAWRENCE COUNTIES
(All Results in ppm)

			Soil		
PARCEL	**SOIL BORING**	**SAMPLE DEPTH (ft)**	**Diesel TPH**	**Gasoline TPH**	**VOC**
Parcel 1	SB-1	3-4	ND	ND	NA
Marathon/Tobacco Road	SB-1	7-8	**19.0**	**2.9**	NA
SE Corner SR 56 and SR 145	SB-2	3-4	NA	ND	NA
French Lick	SB-3	3-4	NA	ND	NA
	WS-1		NA	NA	NA
Parcel 2					
Huck's Food & Fuel	SB-4	3-4	NA	ND	NA
208 S. SR 145	SB-5	7-8	NA	ND	NA
French Lick	SB-6	3-4	NA	ND	NA
Parcel 3					
Ron's Auto Sales	SB-7	2-3	NA	ND	NA
8597 W SR 56	SB-8	7	NA	ND	NA
French Lick	SB-9	6	NA	ND	NA
Parcel 6					
Fast Eddie's Service Station	SB-10	3-4	NA	ND	NA
SR 56	SB-11	7-8	NA	ND	NA
West Baden	SB-12	3-4	NA	ND	NA
Parcel 8					
Vacant Building	SB-13	3-4	NA	ND	NA
NW corner SR 56 & Sinclair	SB-14	7-8	NA	**5.9**	NA
West Baden	SB-15	3-4	NA	ND	NA
Parcel 10					
Games and More	SB-16	3-4	NA	ND	VOC = ND
8205 W SR 56	SB-17	7-8	NA	ND	**Acetone = 23.0**
West Baden	SB-18	3-4	NA	ND	VOC = ND
Parcel 11	SB-19	3-4	NA	ND	NA
Former Mark's Garage	SB-20	3-4	11.0	ND	NA
8208 West SR 56	SB-20	7-8	ND	ND	NA
West Baden	SB-21	3-4	NA	ND	NA
Parcel 12					
Motor Valet Car Wash	SB-22	3-4	NA	ND	NA
SR 56					
West Baden					
Parcel 13					
Honey-Do-Stop	SB-23	7-8	NA	ND	NA
SE SR 56 & Ballard Street	SB-24	3-4	NA	ND	NA
West Baden	SB-25	7-8	NA	ND	NA
Parcel 14	SB-26	3-4	NA	ND	NA
Vacant Lot	SB-27	3-4	ND	NA	NA
SR 56	SB-27	7-8	ND	**6.3**	NA
West Baden	SB-28	3-4	NA	ND	NA

TABLE 1 (Continued)
SUMMARY OF ANALYTICAL RESULTS
INDOT PROJECTS STP-024-40, STP-095-30
DES NOS. 9804660, 9804680, 9804690, 9804790, & 9804650
ROAD REHABILITION ON SR 56, US 150, & SR 37,
FROM FRENCH LICK TO MITCHELL IN ORANGE & LAWRENCE COUNTIES
(All Results in ppm)

			Soil		
PARCEL	**SOIL BORING**	**SAMPLE DEPTH (ft)**	**Diesel TPH**	**Gasoline TPH**	**VOC**
White Building SR 56 West Baden	SB-29 SB-30 SB-31	3-4 5 3-4	NA NA NA	ND ND ND	NA NA NA
Parcel 16 Vacant Service Station SR 56 & US 150 Prospect	SB-32 SB-33 SB-33 SB-34	3-4 3-4 7-8 3-4	NA ND **11.0** NA	ND ND **2.7** ND	NA NA NA NA
Parcel 17 Vacant White Building SR 56 & US 150 Prospect	SB-39	3-4	NA	ND	NA
Parcel 19 Residence SR 56 & US 150 Prospect	SB-35 SB-36	3-4 7-8	NA NA	ND ND	NA NA
Parcel 20 Former Service Station SR 56 & US 150 Prospect	SB-37 SB-38	3-4 7-8	NA NA	ND ND	NA NA
Parcel 21 White Building East of CR725 W on US 150 Paoli	SB-43 SB-44 SB-45	3-4 3-4 7-8	NA NA NA	**1.1** ND ND	NA NA NA
Parcel 22 Somebody's Place 3882 W US 150 Paoli	SB-40 SB-40 SB-41 SB-41 SB-42	4 9-10 3-4 10.5 8-9	ND **36.0** ND ND NA	ND **7.2** ND **7.6** ND	NA NA NA NA NA
Parcel 23 Rael Oil 1500 Willow Creek Road Paoli	SB-51 SB-52 SB-53	7-8 3-4 3-4	NA NA NA	ND ND ND	NA NA NA
Parcel 25 Citgo Service Station 1608 West Main Street Paoli	SB-46 SB-47	3-4 7-8	NA NA	ND ND	NA NA
Parcel 26 Tobacco Road 812 West Main Street Paoli	SB-48 SB-49 SB-49 SB-50	6 3-4 6-7 6	NA **330** **320** NA	ND **3,200** **3,100** ND	NA NA NA NA

TABLE 1 (Continued)
SUMMARY OF ANALYTICAL RESULTS
INDOT PROJECTS STP-024-4(), STP-095-3()
DES NOS. 9804660, 9804680, 9804690, 9804790, & 9804650
ROAD REHABILITION ON SR 56, US 150, & SR 37,
FROM FRENCH LICK TO MITCHELL IN ORANGE & LAWRENCE COUNTIES
(All Results in ppm)

			Soil		
PARCEL	SOIL BORING	SAMPLE DEPTH (ft)	Diesel TPH	Gasoline TPH	VOC
Parcel 27 Sunoco Service Station 701 W Main Street Paoli	SB-54 SB-54 SB-55 SB-56	2 5-6 7-8 3-4	ND ND NA NA	ND ND 1.2 ND	NA NA NA NA
Parcel 28 Antiques/Used Furniture 416 West Main Street Paoli	SB-57 SB-58	3-4 3-4	NA NA	ND ND	NA NA
Parcel 29 State Farm Insurance 402 W Main Street Paoli	SB-59 SB-60	3-4 4-5	NA NA	ND ND	NA NA
Parcel 30 Shell/Dairyland 201 W Main Street Paoli	SB-63	6	NA	ND	NA
Parcel 31 Vacant Lot Main Street & 2nd Street Paoli	SB-61 SB-62	3-4 7-8	NA NA	ND ND	NA NA
Parcel 32 Former Northside Marathon 111 N Gospel Street Paoli	SB-64 SB-65	3-4 3-4	NA NA	ND ND	NA NA
Parcel 33 Paoli Tobocco Road 221 North Gospel Street Paoli	SB-66 SB-67	3-4 3-4	NA NA	ND ND	NA NA
Parcel 37 Mick's Yard 1600 N SR 37 Paoli	SB-68 SB-69 SB-70	3-4 7-8 10.5	NA NA NA	ND ND ND	NA NA NA
Parcel 38 Morgan's Auto, Inc. 1875 N SR 37 Paoli	SB-71 SB-72 SB-73	7-8 3-4 3.5	NA NA NA	ND ND ND	NA NA NA
Parcel 39 Vacant Building North of Lost River Paoli	SB-74 SB-75	3-4 7-8	NA NA	ND ND	NA NA

TABLE 1 (Continued)
SUMMARY OF ANALYTICAL RESULTS
INDOT PROJECTS STP-024-40, STP-095-30
DES NOS. 9804660, 9804680, 9804690, 9804790, & 9804650
ROAD REHABILITION ON SR 56, US 150, & SR 37,
FROM FRENCH LICK TO MITCHELL IN ORANGE & LAWRENCE COUNTIES
(All Results in ppm)

			Soil		
PARCEL	SOIL BORING	SAMPLE DEPTH (ft)	Diesel TPH	Gasoline TPH	VOC
Parcel 40 Red Barn 5028 North SR 37 Orleans	SB-76 SB-77 SB-78	3-4 7-8 3-4	NA NA NA	ND ND ND	NA NA NA
Parcel 41 Orange County CO-OP SR 37 Orleans	SB-79 SB-80 SB-81	2-3 3-4 7-8	NA NA NA	ND ND ND	NA NA NA
Parcel 44 Orleans Oil Co., Inc. SR 37 Orleans	SB-82 SB-83 SB-84	3-4 7-8 3-4	NA NA NA	ND ND ND	NA NA NA
Parcel 45 Bell's Exhaust 411 South Maple Street Orleans	SB-85 SB-86	7-8 3-4	NA NA	ND ND	NA NA
Parcel 46 Tobacco Road 363 South Maple Street Orleans	SB-87 SB-88 SB-89	3-4 7-8 3-4	NA NA NA	ND ND ND	NA NA NA
Parcel 47 Fifth-Third Bank 200 S Maple Street Orleans	SB-90 SB-91 SB-92	3-4 3-4 7-8	NA NA NA	ND ND ND	NA NA NA
Parcel 48 Dairyland/Shell Station 281 South Maple Street Orleans	SB-93 SB-94	3-4 7-8	NA NA	ND ND	NA NA
Parcel 49 Vacant Building SW Maple & Washington Stree Orleans	SB-95 SB-95 SB-96	2 7-8 3-4	**210** **17.0** NA	**16.0** ND ND	NA NA NA
Parcel 50 Boyer Real Estate/Travel 143 N Maple Street Orleans	SB-97 SB-98	7-8 3-4	NA NA	ND ND	NA NA
Parcel 51 Orleans Police Department 148 North maple Street Orleans	SB-99 SB-100	3-4 7-8	NA NA	ND ND	NA NA

TABLE 1 (Continued)
SUMMARY OF ANALYTICAL RESULTS
INDOT PROJECTS STP-024-40, STP-095-30
DES NOS. 9804660, 9804680, 9804690, 9804790, & 9804650
ROAD REHABILITION ON SR 56, US 150, & SR 37,
FROM FRENCH LICK TO MITCHELL IN ORANGE & LAWRENCE COUNTIES
(All Results in ppm)

			Soil		
PARCEL	**SOIL BORING**	**SAMPLE DEPTH (ft)**	**Diesel TPH**	**Gasoline TPH**	**VOC**
Parcel 52 Rosezadas Restaurant SW Maple & Monroe St. Orleans	SB-101 SB-102 SB-103	3-4 7-8 3-4	NA NA NA	ND ND ND	NA NA NA
Parcel 53 Video Superstore 215 North Maple Street Orleans	SB-104 SB-105 SB-106	3-4 7-8 3-4	NA NA NA	ND ND ND	NA NA NA
Parcel 54 The Flower Cottage 437 N Maple Street Orleans	SB-107 SB-108 SB-108	3-4 3-4 7-8	NA **48.0** ND	ND ND ND	NA NA NA
Parcel 55 Sprint Oil Company 465 N Maple Street Orleans	SB-109 SB-110	7-8 3-4	NA NA	ND ND	NA NA
Parcel 56 Vacant Building SW Maple ST. & Marley St. Orleans	SB-111	3-4	NA	ND	NA
Parcel 57 Baker Oil Company NE Maple St. & Polk St. Orleans	SB-114 SB-115 SB-116 SB-117 SB-118	7-8 3-4 3-4 3-4 7-8	NA NA NA NA NA	ND ND ND ND ND	NA NA NA NA NA
Parcel 58 Orleans Cleaners SR 37, North of CR 800N Orleans	SB-112 SB-113	3-4 7-8	NA NA	ND ND	NA NA

BOLD= Environmental Concern
NA = Not Analyzed
ND = Non-Detect

Date: 7/23 – 7/24/2002

POTENTIAL HAZARDOUS WASTE SITE ASSESSMENT FORM

Project Information:

Road: US 150/SR 56/SR 37 Project:# STP-024-4( ) Des.# 9804680, 9844690, 9804790 and 984650

Description: Proposed Road Rehabilitation US 150/State Road 56 and State Road 37 from Prospect to Mitchell in Orange and Lawrence Counties, Indiana

Screening Criteria:

1. Description of right-of-way requirements (existing and proposed):

   Existing right-of-way widths vary throughout the project.
   Approximately 36.57 ha (90.4 acres) will be required for the completion of this project.

2. Land Use History and Development:

   Setting (rural/urban): rural/urban

   Current Land Uses: Agricultural, residential, commercial

   Previous Land Uses: more rural

   Adjacent Land Uses: The project follows US 150/SR 56/SR 37 from Prospect, through Paoli and Orleans to the south side of Mitchell.

   (Industrial, Light Industry, Commercial, Agricultural, Housing, Other - Indicate source of data, i.e. visual inspection, aerial photos, U.S.G.S. quad. maps, etc.)

3. Visual Inspection:

Storage Structures:		Contamination:	
Underground Tanks	x	Junkyard	
Surface Tanks	x	Auto Graveyard	
Transformers		Surface Staining	
Sumps		Oil Sheen	
Ponds		Odors	
Drums		Vegetation Damage	
Basins		Dumps	
Landfills		Other	
Other		Site(s)	
Site(s)			

Potential Asbestos-Containing Materials:

Buildings	x
Sprayed-on Fireproofing	x
Acoustical Plaster	x
Serpentine	x
Pipe Wrap	x
Friable Tape	x
Site(s)	

4. In-House Records Review:

(Indiana Department of Environmental Management, Local (City/County, i.e. City/County Health Departments, City/County Civil Defense, County Assessor, Local Fire Marshals and Fire Departments, City/County Environmental Departments, Department of Public Works), U.S. Environmental Protection Agency.)

5. Any known hazardous waste sites in vicinity? Yes

Butler, Fairman and Seufert, Inc. has completed a Preliminary Site Investigation (PSI) at the former Indiana Oil Company located on the north side of US 150/SR 56 approximately 1 mile west of the downtown square in the Town of Paoli, Orange County, Indiana. The site is located at the west end of the existing Indiana Handle Company and approximately 330 ft east of the US 150/SR 56 intersection with Willow Creek Road. This investigation was performed as part of environmental services for the reconstruction of US 150/SR 56/SR 37 from Prospect to Mitchell in Orange and Lawrence Counties. David Bourff, Environmental Specialist with Butler, Fairman and Seufert, Inc., conducted the investigation on July 24, 2003. This investigation was initiated based on Underground Storage Tank operations at this facility.

Three borings were placed at the site of the former Indiana Oil Company and advanced to depths of 7, 4.5, and 8 feet below ground surface (bgs) where probe refusal was encountered. Soil borings were placed in this investigation to determine if this property has been impacted by past operations. Each boring was refused at depths indicating a shallow bed of limestone under this property. The soil sample from each boring exhibiting the greatest potential for impact was collected for laboratory analysis. A soil sample was collected from each of the three borings placed at the former Indiana Oil Company property. Groundwater was not encountered in any of the borings placed as part of this investigation; therefore, groundwater could not be collected for laboratory analysis.

Analytical results of the soil samples collected from two of the three borings placed at the former Indiana Oil Company (SB-1 and SB-3) contained peaks in both the gasoline and diesel ranges but the patterns did not match that of gasoline or diesel standards. Therefore, they were reported as GRO/DRO only. Concentrations within SB-1 are above the Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) Industrial Default Closure guidelines. No Total Petroleum Hydrocarbons (TPH) were detected. No Total Petroleum Hydrocarbons (TPH), neither diesel range (dro) nor gasoline range (gro), were detected in the sample collected from the second boring at this property (SB-2). Results indicate that the subsurface soils in this area have been adversely impacted by past operations. This is an assessment of the current conditions of the property, as these conditions can change over time. At this time, no additional investigations are recommended for the former Indiana Oil Company Paoli property located approximately 1 mile west of the downtown square in the Town of Paoli, Orange County, Indiana at the west end of the existing Indiana Handle Company and approximately 330 ft east of the US 150/SR 56 intersection with Willow Creek Road.

Concentrations of lead were detected in the soil samples (SS-1, SS-2 and SS-3) collected from this property, however the concentrations detected in the samples collected were below the Indiana

Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) Industrial Default Closure guidelines.

Based on the analytical results of the soils collected from this property, it is suspected that the subsurface of the former Indiana Oil Company has been adversely impacted by past operations, and the following is recommended for this property:

1) Prior to construction activities, a proper health and safety plan (HASP) should be designed, implemented, and provided for all contractors and subcontractors. All workers involved in site activities should be equipped with appropriate personal protective equipment.

2) During construction, any subsurface soils generated from excavation activities at the former Indiana Oil Company property should be properly characterized and disposed of in accordance with all local, state, and federal regulations at a proper facility.

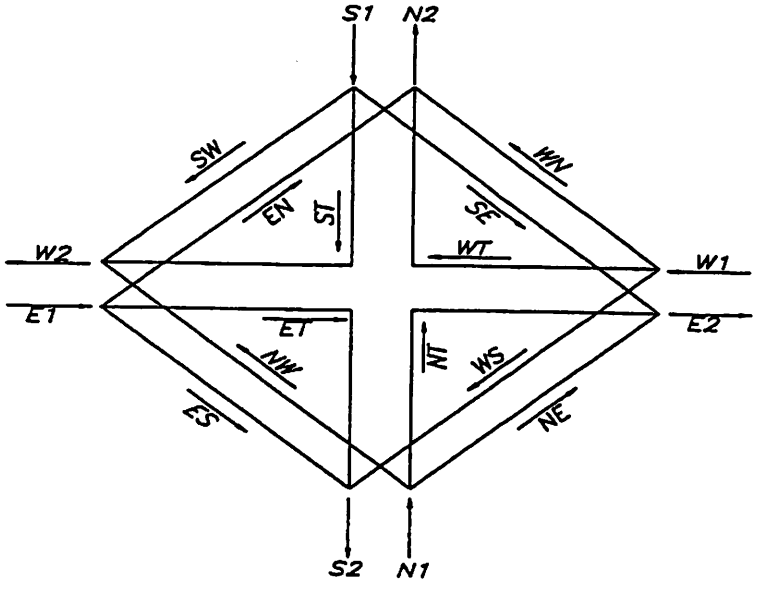
3) The subsurface impacts at this site should be reported to the Indiana Department of Environmental Management Leaking Underground Storage Tank Section to initiate appropriate action

Comments: This investigation supplements the Preliminary Site Investigation completed by Sieco, Inc. on July 19, 2002 and revised on August 13, 2002.

Conducted by David M. Bourff

TRAFFIC VOLUME FORECAST FOR INTERSECTIONS

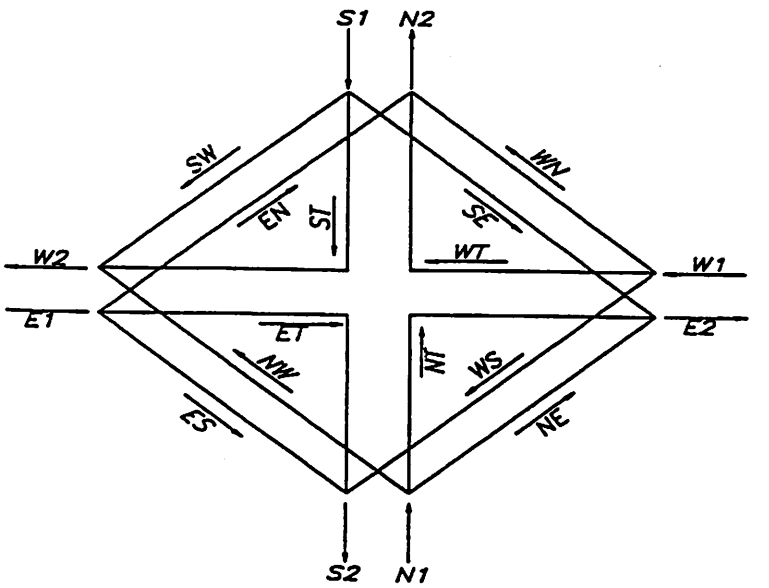
Date: July 1999
Project: Des. No. 9804660
Route: State Road 56 at State Road 145
County: Orange & Lawrence Counties
Other Info: PM-DHV



Turning Movements	AADT					DHV %	COMMERCIAL VEHICLES	
	1999	2001	2006	2011	2021		% AADT	% DHV
NE	710	750	850	960	1160	3	5	5
NW	100	110	120	130	160	10	4	4
NT	4680	4950	5630	6310	7670	7	10	8
SE	4240	4490	5100	5720	6950	6	10	9
SW	100	110	120	130	160	10	4	4
ST	4370	4620	5260	5890	7160	7	11	7
ES	100	110	120	130	160	10	4	4
EN	100	110	120	130	160	10	4	4
ET	100	110	120	130	160	10	3	3
WN	3730	3950	4490	5030	6110	7	10	7
WS	580	610	700	780	950	4	9	9
WT	100	110	120	130	160	10	3	3
N1	5490	5810	6600	7400	8990	6	9	8
S2	5050	5340	6080	6800	8270	7	11	7
S1	8710	9220	10480	11740	14270	7	10	8
N2	8510	9010	10240	11470	13940	7	10	8
E1	300	330	360	390	480	10	4	4
W2	300	330	360	390	480	10	4	4
W1	4410	4670	5310	5940	7220	6	10	7
E2	5050	5350	6070	6810	8270	6	9	8

TRAFFIC VOLUME FORECAST FOR INTERSECTIONS

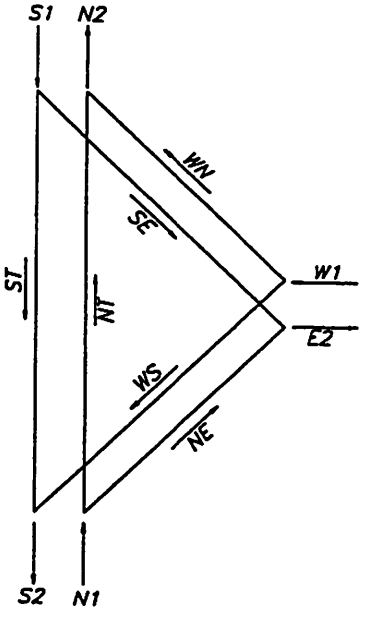
Date: July 1999
Project: Des. No. 9804660
Route: State Road 56 at State Road 145
County: Orange & Lawrence Counties
Other Info: AM-DHV



Turning Movements	AADT					DHV %	COMMERCIAL VEHICLES	
	1999	2001	2006	2011	2021		% AADT	% DHV
NE	710	750	850	960	1160	6	5	6
NW	100	110	120	130	160	10	4	5
NT	4680	4950	5630	6310	7670	3	10	15
SE	4240	4490	5100	5720	6950	7	10	11
SW	100	110	120	130	160	10	4	5
ST	4370	4620	5260	5890	7160	6	11	14
ES	100	110	120	130	160	10	4	5
EN	100	110	120	130	160	10	4	5
ET	100	110	120	130	160	10	3	4
WN	3730	3950	4490	5030	6110	4	10	18
WS	580	610	700	780	950	7	9	10
WT	100	110	120	130	160	10	3	4
N1	5490	5810	6600	7400	8990	4	9	14
S2	5050	5340	6080	6800	8270	6	11	13
S1	8710	9220	10480	11740	14270	7	10	12
N2	8510	9010	10240	11470	13940	4	10	16
E1	300	330	360	390	480	10	4	5
W2	300	330	360	390	480	10	4	5
W1	4410	4670	5310	5940	7220	5	10	17
E2	5050	5350	6070	6810	8270	7	9	10

TRAFFIC VOLUME FORECAST FOR INTERSECTIONS

Date: July 1999
Project: Des. No. 9804660
Route: State Road 56 at Beachwood Road
County: Orange & Lawrence Counties
Other Info: PM-DHV



Turning Movements	AADT 1999	2001	2006	2011	2021	DHV %	COMMERCIAL VEHICLES % AADT	% DHV
NE	250	260	300	340	410	10	5	5
NW								
NT	7220	7640	8690	9730	11830	8	10	8
SE	630	670	760	850	1030	9	5	5
SW								
ST	8430	8920	10140	11360	13810	6	11	7
ES								
EN								
ET								
WN	690	730	830	930	1130	8	5	5
WS	330	350	400	440	540	7	5	5
WT								
N1	7470	7900	8990	10070	12240	8	10	8
S2	8760	9270	10540	11800	14350	6	11	7
S1	9060	9590	10900	12210	14840	6	11	7
N2	7910	8370	9520	10660	12960	8	10	8
E1								
W2								
W1	1020	1080	1230	1370	1670	7	5	5
E2	880	930	1060	1190	1440	9	5	5