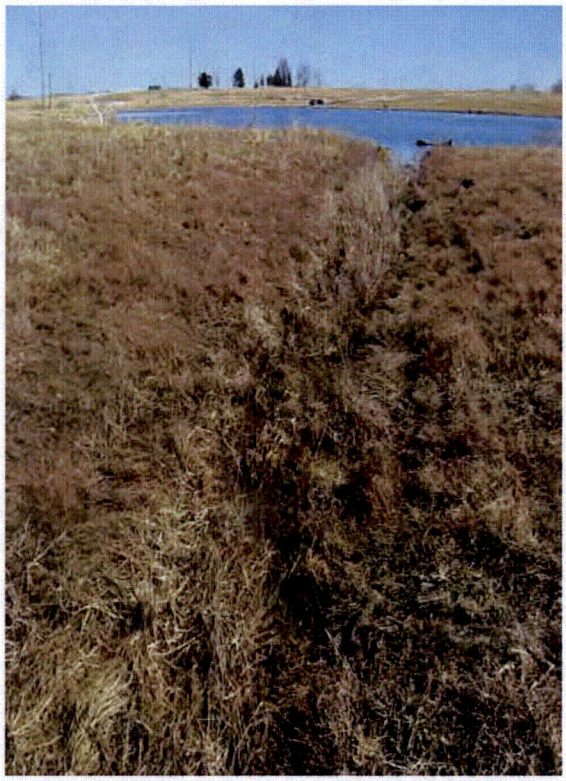
APPENDIX D
Ground Photographs

1. View of Wetland Area A, facing northeast.

2. View of Wetland Area A, facing southwest.



3. View of Wetland Area B, facing east.

4. View of Wetland Area B, facing west.

5. View of suspect drainageway, facing north.

6. View of suspect drainageway, facing south.

7. **View of suspect upland depression, facing west.**

8. **View of suspect upland depression, facing east.**

Federal Emergency Management Agency
Community Status Book Report
MISSOURI
Communities Participating in the National Flood Program

CID	Community Name	County	Init FHBM Identified	Init FIRM Identified	Curr Eff Map Date	Reg-Emer Date	Tribal
290180#	CARTERVILLE, CITY OF	JASPER COUNTY	12/28/73	07/16/84	05/02/07	07/16/84	No
290181#	CARTHAGE, CITY OF	JASPER COUNTY	03/15/74	06/15/83	05/02/07	06/15/83	No
290275#	CARUTHERSVILLE, CITY OF	PEMISCOT COUNTY	02/20/76	01/16/81	01/16/81	01/16/81	No
290783#	CASS COUNTY *	CASS COUNTY	03/14/78	04/15/82	03/16/06	04/15/82	No
290791#	CEDAR COUNTY *	CEDAR COUNTY		07/17/02	07/17/02	04/11/06	No
290311	CENTERVILLE, VILLAGE OF	REYNOLDS COUNTY	11/22/74	08/01/86	08/01/86(L)	08/01/86	No
290035	CENTRALIA, CITY OF	BOONE COUNTY	06/07/74	04/15/77	04/15/77(M)	04/15/77	No
290409	CHAFFEE, CITY OF	SCOTT COUNTY	03/15/74	09/27/85	09/27/85(M)	09/27/85	No
290270#	CHAMOIS, CITY OF	OSAGE COUNTY	03/29/74	11/15/84	09/02/05	11/15/84	No
290073#	CHARITON COUNTY*	CHARITON COUNTY	04/19/83	12/03/87	12/03/87	12/03/87	No
290743#	CHARLACK, CITY OF	ST. LOUIS COUNTY	02/14/75	11/23/84	08/23/00	11/23/84	No
290231#	CHARLESTON, CITY OF	MISSISSIPPI COUNTY	03/29/74	01/04/85	01/18/89	01/04/85	No
290896#	CHESTERFIELD, CITY OF	ST. LOUIS COUNTY		09/15/78	08/23/00	09/15/78	No
290216#	CHILLICOTHE, CITY OF	LIVINGSTON COUNTY	01/09/74	08/05/85	08/05/85	08/05/85	No
290847#	CHRISTIAN COUNTY *	CHRISTIAN COUNTY	04/19/83	04/01/04	04/01/04(L)	04/01/04	No
290792#	CLARK COUNTY *	CLARK COUNTY	09/15/81	02/01/97	01/19/00	02/01/97	No
290630#	CLARKSDALE, CITY OF	DEKALB COUNTY	02/21/75	11/19/03	11/19/03(M)	11/19/03	No
290340#	CLARKSON VALLEY, CITY OF	ST. LOUIS COUNTY	07/26/74	04/08/77	08/23/00	04/08/77	No
290289#	CLARKSVILLE, CITY OF	PIKE COUNTY	05/24/74	04/19/10	04/19/10(>)	04/01/77	No
290126#	CLARKTON, CITY OF	DUNKLIN COUNTY	12/21/73	01/29/80	04/17/95	01/29/80	No
290086#	CLAY COUNTY *	CLAY COUNTY	09/06/74	03/18/80	04/16/03	03/18/80	No
290089#	CLAYCOMO, VILLAGE OF	CLAY COUNTY	01/23/74	08/01/77	12/02/80	08/01/77	No
290341#	CLAYTON, CITY OF	ST. LOUIS COUNTY	04/05/74	02/14/76	08/23/00	02/14/76	No
290600	CLEVER, CITY OF	CHRISTIAN COUNTY	07/18/75		(NSFHA)	03/30/81	No
290793#	CLINTON COUNTY*	CLINTON COUNTY	07/05/84	06/18/87	06/18/87(M)	06/18/87	No
290155#	CLINTON, CITY OF	HENRY COUNTY	04/15/74	07/04/88	07/04/88	07/04/88	No
290601#	COBALT VILLAGE,VILLAGE OF	MADISON COUNTY	03/26/76	07/02/87	12/06/02(M)	07/02/87	No
290107#	COLE COUNTY*	COLE COUNTY	12/16/80	12/15/81	12/02/05	01/21/82	No
290036#	COLUMBIA, CITY OF	BOONE COUNTY	08/28/71	08/28/71	08/16/95	08/27/71	No
290410#	COMMERCE, CITY OF	SCOTT COUNTY	11/08/74	06/01/78	09/02/88	06/01/78	No
290745	CONCORDIA, CITY OF	LAFAYETTE COUNTY	02/07/75		(NSFHA)	02/09/79	No
290342#	COOL VALLEY, CITY OF	ST. LOUIS COUNTY	05/03/74	05/16/77	08/23/00	05/16/77	No
290794#	COOPER COUNTY *	COOPER COUNTY	11/16/83	09/01/89	09/01/89(L)	09/01/89	No
290603	COOTER, TOWN OF	PEMISCOT COUNTY			(NSFHA)	06/30/76	No
290159#	CORNING, TOWN OF	HOLT COUNTY	02/06/76	02/06/76	01/06/88	01/06/88	No
290898#	COTTLEVILLE, CITY OF	ST. CHARLES COUNTY		09/15/78	03/17/03	02/01/90	No
290746#	COUNTRY CLUB HILLS, CITY OF	ST. LOUIS COUNTY	05/07/76		(NSFHA)	05/25/78	No
290604	COUNTRY CLUB, VILLAGE OF	ANDREW COUNTY	08/22/75		(NSFHA)	08/24/84	No
290160#	CRAIG, CITY OF	HOLT COUNTY	12/06/74	12/06/74	01/06/88	01/06/88	No
290430#	CRANE, CITY OF	STONE COUNTY	06/07/74	07/16/80	07/16/80	07/16/80	No
290795#	CRAWFORD COUNTY*	CRAWFORD COUNTY	04/19/83	05/01/87	05/01/87(L)	05/01/87	No
290063#	CREIGHTON, CITY OF	CASS COUNTY	05/13/77	03/16/06	03/16/06	06/30/80	No
290343#	CRESTWOOD, CITY OF	ST. LOUIS COUNTY	05/03/74	05/02/77	08/23/00	05/02/77	No
290344#	CREVE COEUR, CITY OF	ST. LOUIS COUNTY	02/01/74	08/01/78	08/23/00	08/01/78	No
290189#	CRYSTAL CITY,CITY OF	JEFFERSON COUNTY	03/15/74	09/01/77	04/05/06	09/01/77	No
290345#	CRYSTAL LAKE PARK, CITY OF	ST. LOUIS COUNTY	05/13/77	08/02/95	(NSFHA)	08/01/86	No
290796#	DADE COUNTY *	DADE COUNTY		07/17/02	07/17/02	12/22/03	No
290464#	DALTON, VILLAGE OF	CHARITON COUNTY	12/13/74	03/17/03	03/17/03	10/10/03	No
290899#	DARDENNE PRAIRIE, CITY OF	ST. CHARLES COUNTY		12/15/92	03/17/03	03/13/95	No
295263#	DE SOTO, CITY OF	JEFFERSON COUNTY		05/26/72	04/05/06	05/26/72	No
290504#	DEARBORN, CITY OF	PLATTE COUNTY	09/19/75	06/15/79	06/15/79	06/15/79	No
290346#	DELLWOOD, CITY OF	ST. LOUIS COUNTY	08/13/76	06/27/78	(NSFHA)	06/27/78	No

Missouri Department of Conservation

Heritage Review Report

Policy Coordination Unit
P. O. Box 180
Jefferson City, MO 65102
heritage.review@mdc.mo.gov
573-522-4115 X 3367

Laura Murray
murraylau@umsystem.edu

Project type:	Site Assessment
Location/Scope:	Portions of Section 32 and 33 of T48N R12W northeast of Highway 63
County:	Boone
Query reference:	Discovery Ridge Property
Query received:	March 8, 2011

Prepared by: Shannon Cave

Authenticity may be confirmed by Policy Coordination Unit, Missouri Department of Conservation, 573-522-4115.

This NATURAL HERITAGE REVIEW is not a site clearance letter. Rather, it identifies public lands and sensitive resources known to have been located close to and/or potentially affected by the proposed project. *On-site verification is the responsibility of the project. Heritage records were identified at some date and location. This report considers records near but not necessarily at the project site. Animals move and, over time, so do plant communities. To say "there is a record" does not mean the species/habitat is still there. To say that "there is no record" does not mean a protected species will not be encountered. These records only provide one reference and other information (e.g. wetland or soils maps, on-site inspections or surveys) should be considered. Look for additional information about the biological and habitat needs of records listed in order to avoid or minimize impacts. More information is at http://mdc.mo.gov/discover-nature/places-go/natural-areas and mdc4.mdc.mo.gov/applications/mofwis/mofwis_search1.aspx. Contact information for the department's Natural History Biologist is online at http://mdc.mo.gov/contact-us.*

Level 3 (federal-listed) and Level 2 (state listed) issues:

Records of listed species or critical habitats:

Heritage records identify no wildlife preserves, no designated wilderness areas or critical habitats, no state or federal endangered-list species records within the public land survey sections listed above and northeast of highway 63

- The site does drain to Gans Creek, which downstream of Highway 63 is one of 138 state-designated spawning stream segments. Activities that alter, destabilize or destroy stream bottoms or banks should be avoided from March 15 to June 15 in order not to disrupt spawning (laying and fertilizing fish eggs). At all times, avoid habitat destruction or introducing heavy sediment loads, chemical or organic pollutants. Spawning stream segments were designated because they are important to maintaining, restoring, or avoiding future listing of species of conservation concern.
- Rock Bridge State Park could be affected by construction activities. Within its premises are records of species of conservation concern, including both gray (2002) and Indiana (2007) bat records.
- Gray bats (*Myotis grisescens*, federally and state listed "endangered") are likely to occur in the project area, as they forage over streams, rivers, and reservoirs in this part of Missouri. Avoid entry or disturbance of any cave inhabited by gray bats and when possible retain forest vegetation along the stream and from the gray bat cave opening to the stream. See http://mdc.mo.gov/104 for best management recommendations.
- Indiana bats (*Myotis sodalis,* federally and state listed "endangered") may occur in this area. These mammals hibernate during winter months in caves, in Missouri primarily in the southern half of the state. They are found in summer months, primarily north of the Missouri River, roosting and raising young under the bark of trees in riparian forests and upland forests near perennial streams. During project activities, avoid degrading stream quality and where possible leave snags standing and preserve mature forest canopy. If large trees with nesting cavities or loose bark need to be removed by your project, that should be done between November and March. Additional information to incorporate in planning documents is available at http://mdc.mo.gov/110.
- Topeka shiners (*Notropis Topeka*, federal- and state-listed "endangered") are recorded (1997) om Bonne Femme Creek to the south. Historically, they probably used Gans Creek as well. These fish typically occupy permanent pools of small, clear, high quality streams draining upland areas, usually on substrates of gravel, rubble, sand or bedrock. Best management practices for Topeka

shiners may be found at http://mdc.mo.gov/137.

FEDERAL LIST species/habitats are protected under the Federal Endangered Species Act. ***Consult with the U.S. Fish and Wildlife Service*** *(101 Park Deville Drive Suite A, Columbia, Missouri 65203-0007; 573-234-2132).*

General recommendations related to this project or site, or based on information about the historic range of species (unrelated to any specific heritage records):

- Streams in the area should be protected from soil erosion, water pollution and in-stream activities that modify or diminish aquatic habitats. Best management recommendations relating to streams and rivers may be found at http://mdc.mo.gov/79. Minimize erosion and sedimentation/runoff to nearby streams and lakes, including adherence to any "Clean Water Permit" conditions. Revegetate areas in which the natural cover is disturbed to minimize erosion using native plant species compatible with the local landscape and wildlife needs. Pollutants, including sediment, can have significant impacts far downstream. Use silt fences and/or vegetative filter strips to buffer streams and drainages, and monitor those after rain events and until a well-rooted ground cover is reestablished.
- This county has known karst geologic features (e.g. caves, springs, and sinkholes, all characterized by subterranean water movement). Few karst features are recorded in heritage records, and ones not noted here may be encountered at the project site or affected by the project. Cave fauna (many of which are species of conservation concern) are influenced by changes to water quality, so check your project site for any karst features and make every effort to protect groundwater in the project area. See http://mdc.mo.gov/nathis/caves/manag_construc.htm for best management information.
- The proposed project occurs in the historic range of greater prairie chickens (*tympanuchus cupido*), a bird on the state's list of endangered species. Populations have been in serious decline for decades, and have reached a point where greater prairie chickens could be gone from Missouri within a few years. The dominant factor in their decline is conversion of native prairie habitats to other uses. Other prairie dependent species are also in serious decline for the same reason. Prairie chickens range over a broad territory perhaps nesting, breeding and foraging in grasslands several miles apart. Even if prairie chickens are not present, it is important to conserve as much as possible any grasslands dominated by native plant cover in the project area. See http://mdc.mo.gov/130 for best management recommendations.
- Invasive exotic species are a significant issue for fish, wildlife and agriculture in Missouri. Seeds, eggs, and larvae may be moved to new sites on boats or construction equipment, so inspect and clean equipment thoroughly before moving between project sites.
  - Remove any mud, soil, trash, plants or animals from equipment before leaving any water body or work area.
  - Drain water from boats and machinery that have operated in water, checking motor cavities, live-well, bilge and transom wells, tracks, buckets, and any other water reservoirs.
  - When possible, wash and rinse equipment thoroughly with hard spray or HOT water (≧104° F, typically available at do-it-yourself carwash sites), and dry in the hot sun before using again.

These recommendations are ones project managers might prudently consider based on a general understanding of species needs and landscape conditions. Heritage records largely reflect sites visited by specialists in the last 30 years. Many privately owned tracts have not been surveyed and could host remnants of species once but no longer common.

Pre-screen heritage data requests at http://tinyurl.com/heritagereview. A "Level 1 response" makes further submission to MDC or USFWS unnecessary.

CULTURAL RESOURCE ASSESSMENT
Section 106 Review

CONTACT PERSON/ADDRESS

Adam J. White
Terracon
3601 Mojave Court, Suite A
Columbia, Missouri 65203

C:

PROJECT:

Discovery Ridge Lots 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 & 18, Columbia

FEDERAL AGENCY

UNKNOWN

COUNTY:

BOONE

The State Historic Preservation Office has reviewed the information submitted on the above referenced project. Based on this review, we have made the following determination:

☐ After review of initial submission, the project area has a low potential for the occurrence of cultural resources. A cultural resource survey, therefore, is not warranted.

☐ Adequate documentation has been provided (36 CFR Section 800.11). There will be "no historic properties affected" by the current project.

☒ An adequate cultural resource survey of the project area has been previously conducted. It has been determined that for the proposed undertaking there will be "no historic properties affected".

For the above checked reason, the State Historic Preservation Office has no objection to the initiation of project activities. PLEASE BE ADVISED THAT, IF THE CURRENT PROJECT AREA OR SCOPE OF WORK ARE CHANGED, A BORROW AREA IS INCLUDED IN THE PROJECT, OR CULTURAL MATERIALS ARE ENCOUNTERED DURING CONSTRUCTION, APPROPRIATE INFORMATION MUST BE PROVIDED TO THIS OFFICE FOR FURTHER REVIEW AND COMMENT. Please retain this documentation as evidence of compliance with Section 106 of the National Historic Preservation Act, as amended.

By: Mark A. Miles — **March 7, 2011**

Mark A. Miles, Deputy State Historic Preservation Officer — **Date**

MISSOURI DEPARTMENT OF NATURAL RESOURCES
STATE HISTORIC PRESERVATION OFFICE
P.O. Box 176, Jefferson City, Missouri 65102
For additional information, please contact Judith Deel, (573) 751-7862. Please be sure to refer to the project number:
015-BO-11

February 21, 2011

MISSOURI DEPARTMENT OF NATURAL RESOURCES
STATE HISTORIC PRESERVATION OFFICE
Attn: Section 106 Review
P.O. Box 176
Jefferson City, Missouri 65102-0176

RE: Request for **Additional** Review
MDNR SHPO project number: 015-BO-11
Section 106 Review
Discovery Ridge
Lots 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, and 18
Discovery Drive and Discovery Ridge Parkway
Columbia, Boone County, Missouri
T 48N N, R 12W, Sec 33, N ½
Terracon Project No.: 09117701

Terracon Consultants, Inc. (Terracon), on behalf of the Trabue, Hansen & Hinshaw, Inc and the University of Missouri Research Parks – University of Missouri Systems, is assisting with a preconstruction Phase 1 Environmental Site Assessment for a proposed expansion of the current scientific research park, Discovery Ridge, located on a portion of a historic University of Missouri research farm at Discovery Drive and Discovery Ridge Parkway, east of U.S. Highway 63 in the vicinity of the southern limits of Columbia, Missouri.

We are enclosing a Section 106 Project Information Form, A section of the topographic map which includes the subject site, a developmental phasing plan, and photographs of the on-site metal machine shed type buildings located on Lot 17 and the quacent hut building located on Lot 5. Additionally, photos have been included of structures located on properties adjacent to the site. Please review your records and files to determine if historic features are located on the site.

The site has historically been agricultural land associated with a University of Missouri research farm. Portions of the site, which are located within Phase I of the project, have been graded to construct vacant lots suitable for development. We would appreciate a response within 30 days following receipt of this information. If you have any questions or wish to discuss this submittal, please contact me.

Sincerely,
Terracon
Adam White
Adam J. White
Staff Environmental Scientist

Enclosure

MISSOURI DEPARTMENT OF NATURAL RESOURCES
STATE HISTORIC PRESERVATION OFFICE

SECTION 106 PROJECT INFORMATION FORM

Submission of a completed Project Information Form with adequate information and attachments constitutes a request for a review pursuant to Section 106 of the National Historic Preservation Act of 1966 (as amended). We reserve the right to request more information. **Please refer to the CHECKLIST on Page 2 to ensure that all basic information relevant to the project has been included.** For further information, refer to our website at: http://dnr.mo.gov/shpo and follow the links to Section 106 Review.

NOTE: Section 106 regulations provide for a 30-day response time by the Missouri State Historic Preservation Office from the date of receipt.

PROJECT NAME

Discovery Ridge Lots 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, and 18

FEDERAL AGENCY PROVIDING FUNDS, LICENSE, OR PERMIT

APPLICANT	TELEPHONE
Trabue, Hasen & Hinshaw, Inc. and the University of Missouri, Research Parks - UM Systems	
CONTACT PERSON	**TELEPHONE**
Terracon - Adam J. White	(573) 214-2677

ADDRESS FOR RESPONSE

Terracon
3601 Mojave Court, Suite A
Columbia, MO 65203

LOCATION OF PROJECT

COUNTY

Boone

STREET ADDRESS	CITY
Discovery Drive and Discovery Ridge Parkway (land associated with UM research farm)	Columbia

LEGAL DESCRIPTION OF PROJECT AREA (TOWNSHIP, RANGE, SECTION, ¼ SECTION)

USGS TOPOGRAPHIC MAP QUADRANGLE NAME (SEE MAP REQUIREMENTS ON PAGE 2)

Columbia, Missouri

YEAR	TOWNSHIP	RANGE	SECTION
1981	48 North	12 West	33

PROJECT DESCRIPTION

DESCRIBE THE OVERALL PROJECT IN DETAIL. IF IT INVOLVES EXCAVATION, INDICATE HOW WIDE, HOW DEEP, ETC. IF THE PROJECT INVOLVES DEMOLITION OF EXISTING BUILDINGS, MAKE THAT CLEAR. IF THE PROJECT INVOLVES REHABILITATION, DESCRIBE THE PROPOSED WORK IN DETAIL. USE ADDITIONAL PAGES IF NECESSARY.

The site consist of 15 lots. Eight of the lots (Lots 2, 5, 6, 7, 8, 9, 10, and 11) are located within Phase I of the research park development plan. Of the lots located within Phase I of the developmental plan, Lots 2, 6, 7, and 8 have been graded to construct vacant lots suitable for development, additional, Lot 9 is currently in the process of being graded to facility a lot suitable for development. Currently lot 5 is the location of a quacent hut type building. Seven of the lots that comprise the site (Lots 12, 13, 14, 15, 16, 17, and 18) are located within Phase II of the developmental plan and consist of vacant grass covered farm land utilized as grazing pasture for livestock and row crop research. Currently Lot 17 is the location of two small metal machine sheds and one large machine shed type buildings. Historically a residential structure, and four small metal machine sheds were located at the site starting between 1939-1968 with the residence being removed in 2001 and two of the machine sheds being removed in 2007. Historically the site has been utilized as farm land associated with a University of Missouri research farm (South Farms). Beginning in the early 2000s the area surrounding the site has been utilized as Discovery Ridge, a scientific research park . The applicant is investigating the site for expanded use as a scientific research park.

ARCHAEOLOGY (EARTHMOVING ACTIVITIES)

HAS THE GROUND INVOLVED BEEN GRADED, BUILT ON, BORROWED, OR OTHERWISE DISTURBED? PLEASE DESCRIBE IN DETAIL (USE ADDITIONAL PAGES, IF NECESSARY) PHOTOGRAPHS ARE HELPFUL:

The site has historically been farmed associated with a University of Missouri research farm. During the early 2000s portions of the lots that comprise Phase I of the site were graded to construct multiple vacant building lots suitable for development. Currently lots located within Phase II of the developmental plan are vacant grass covered land with portion utilized for row crop research.

WILL THE PROJECT REQUIRE FILL MATERIAL? ☐ YES ☐ NO

IF **YES**, INDICATE PROPOSED BORROW AREAS (SOURCE OF FILL MATERIAL) ON TOPOGRAPHIC MAP

ARE YOU AWARE OF ARCHAEOLOGICAL SITES ON OR ADJACENT TO PROJECT AREA? ☐ YES ☑ NO

IF **YES**, IDENTIFY THEM ON THE TOPOGRAPHIC MAP

STRUCTURES (REHABILITATION, DEMOLOTION, ADDITIONS TO, OR CONTRUCTION NEAR EXISTING STRUCTURES)

TO THE BEST OF YOUR KNOWLEDGE, IS THE STRUCTURE LOCATED IN ANY OF THE FOLLOWING?

☐ AN AREA PREVIOUSLY SURVEYED FOR HISTORIC PROPERTIES.	☐ A NATIONAL REGISTER DISTRICT	☐ A LOCAL HISTORIC DISTRICT
IF YES, PLEASE PROVIDE THE NAME OF THE SURVEY OR DISTRICT:	IF YES, PLEASE PROVIDE THE NAME OF THE SURVEY OR DISTRICT:	IF YES, PLEASE PROVIDE THE NAME OF THE SURVEY OR DISTRICT:

- PLEASE PROVIDE PHOTOGRAPHS OF ALL STRUCTURES, SEE PHOTOGRAPHY REQUIREMENTS
- **NOTE:** ALL PHOTOGRAPHS SHOULD BE LABELED AND KEYED TO ONE MAP OF THE PROJECT AREA
- PLEASE PROVIDE A BRIEF HISTORY OF THE BUILDING(S), INCLUDING CONSTRUCTION DATES AND BUILDING USES. (USE ADDITONAL PAGES, IF NECESSARY.)

ADDITIONAL REQUIREMENTS

Map Requirements: Attach a copy of the relevant portion (8 ½ x 11) of the current USGS 7.5 min. topographic map **and**, if necessary, a large scale project map. Please do not send an individual map with each structure or site. While an original map is preferable, a good copy is acceptable. For a list of sites from which to order, download or print the required USGS 7.5 min. topographic maps at little or no cost, consult http://dnr.mo.gov/shpo/sectionrev.htm .

Photography Requirements: Clear black and white or color photographs (minimum 3" x 5") are acceptable. Polariods, photocopies, emailed or faxed photographs are not acceptable. **Good quality photographs are important for expeditious project review.** Photographs of neighboring or nearby buildings are also helpful. All photographs should be labeled and keyed to one map of the project area.

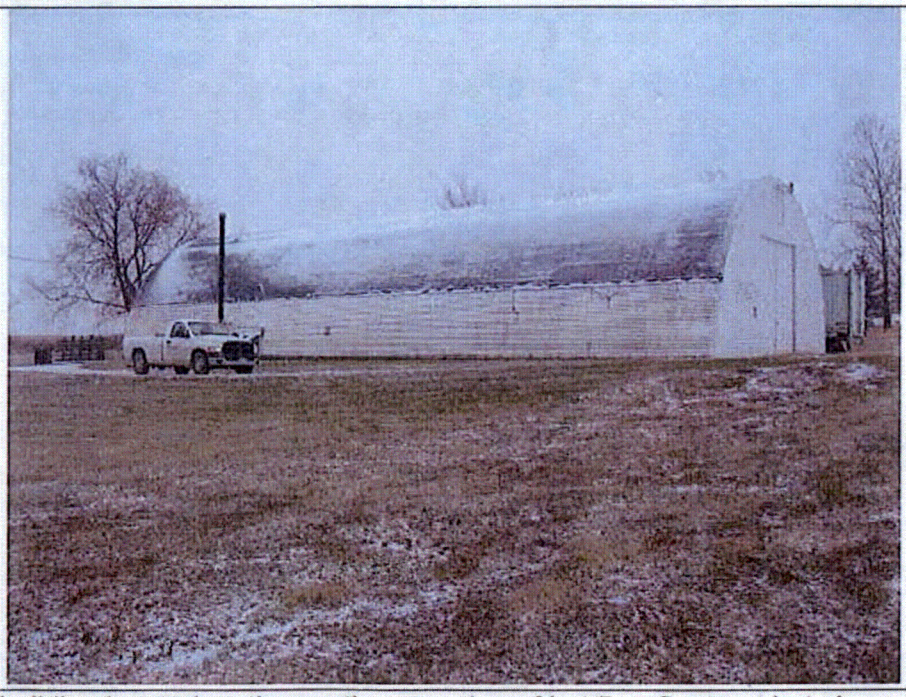
CHECKLIST-DID YOU PROVIDE THE FOLLOWING INFORMATION?

☑ Topographic map 7.5 min. (per project, not structure)	☑ Other supporting documents (If necessary to explain the project)
☐ Thorough description (all projects)	☐ For new construction, rehabilitations, etc., attach work write-ups, plans, drawings, etc.
☑ Photographs (all structures)	☑ Is topographic map identified by quadrangle and year?

Return this Form and Attachments to:

MISSOUR DEPARTMENT OF NATURAL RESOURCES
STATE HISTORIC PRESERVATION OFFICE
Attn: Section 106 Review
P.O. BOX 176
JEFFERSON CITY, MISSOURI 65102-0176

Quacent hut building located on the southern portion of Lot 5. Quacent hut viewed from the south adjoining property. Quacent hut constructed between 1980 and 1992.

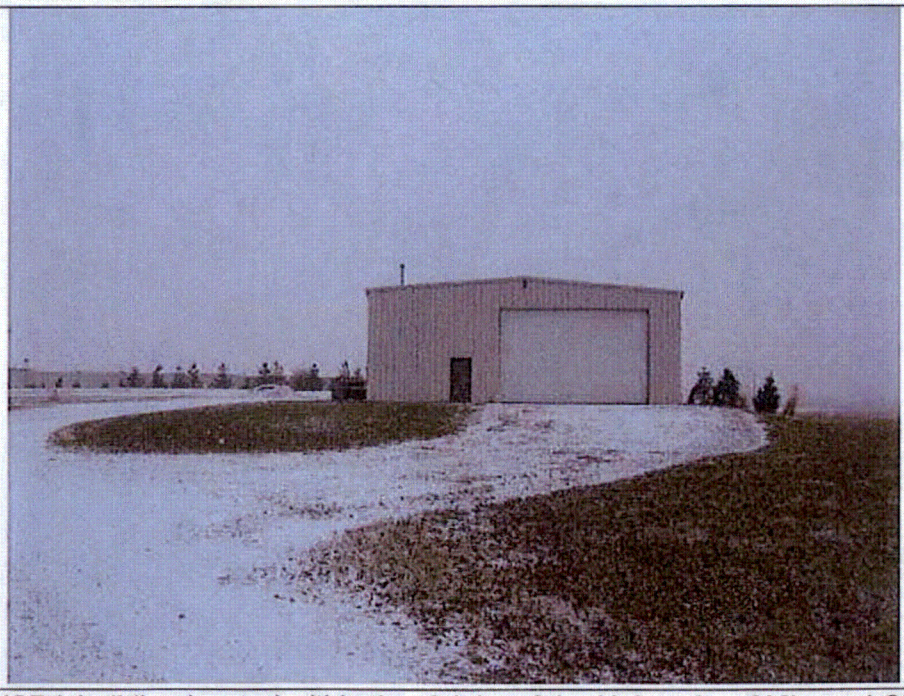


Quacent hut building located on the southern portion of Lot 5. Quacent hut viewed from the west portion of Lot 5. Quacent hut constructed between 1980 and 1992.

Trailer park located west of Lots 5, and 16. Trailer park established between 1956 and 1968. Trailer park viewed from the western portion of Lot 5.

Trailer park located west of Lots 5, and 16. Trailer park established between 1956 and 1968. Trailer park viewed from the western portion of Lot 5.

University of Missouri Civil Engineering research building located east of Lot 5. Building constructed between 1956 and 1968.



Metal sided USDA building located within the vicinity of the University of Missouri Civil Engineering research building and east of Lot 5. Building constructed between 1995 and 2002.

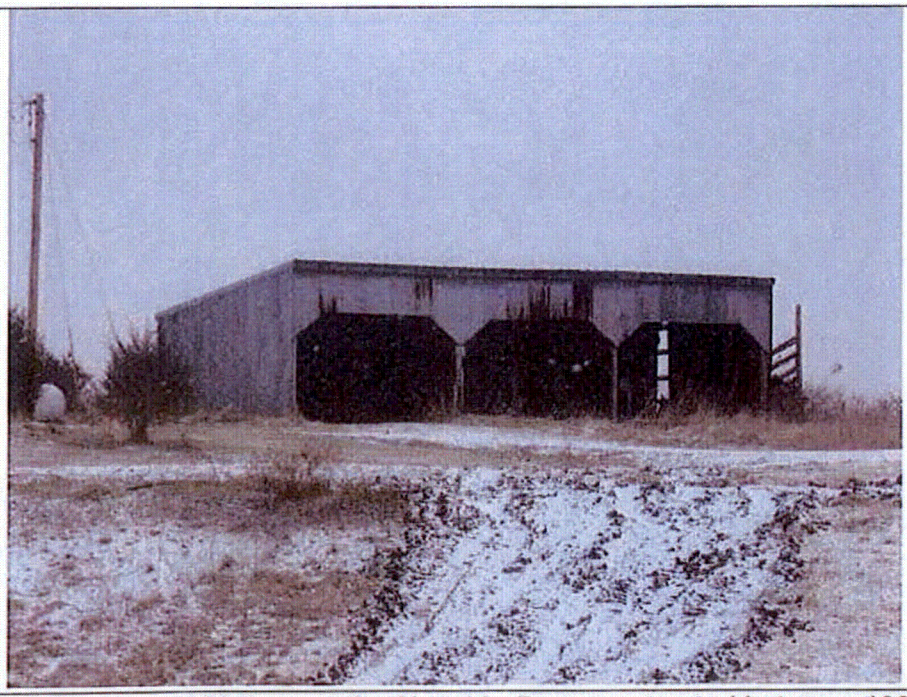
ABC Lab building located west of Lot 2. Building constructed between 2002 and 2007. Building viewed from Discovery Drive.

Radil building located east of Lot 2. Building constructed between 2002 and 2007. Building viewed from the intersection of Discovery Drive and Discovery Parkway.

Residence located south of Lot 11. Residence constructed between 1939 and 1956.
Residence viewed from US Highway 63, southwest of the structure.

Residence located south of Lot 11. Residence constructed between 1939 and 1956.
Residence viewed from US Highway 63, southwest of the structure.

Residence located south of Lot 11. Residence constructed between 1939 and 1956.
Residence viewed from Lot 11, north of the structure.



Barn located south of the residence south of Lot 11. Barn constructed between 1939 and 1956.
Barn viewed from US Highway 63, southwest of the structure.

Residence located south of Lot 11. Residence constructed between 1939 and 1956. Residence viewed from Lot 11 looking southwest.

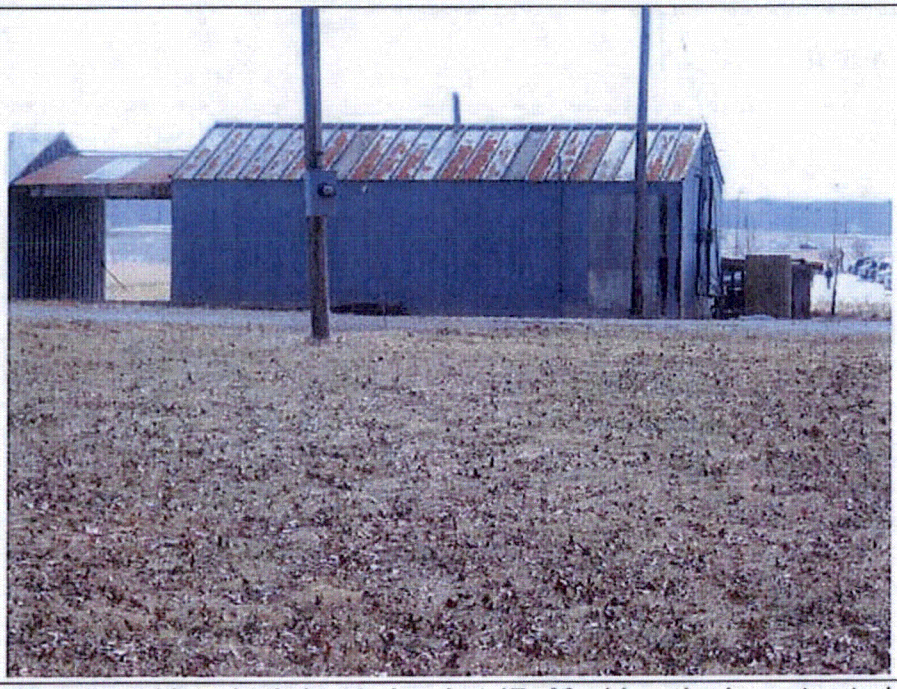
Barn located south of Lot 11. Barn constructed between 1939 and 1956. Barn viewed from Lot 11 looking southwest.

Large metal machine shed structure located on Lot 17. Machine shed placed on-site in approximately 2007. Machine shed viewed from the north adjoining property.

Large metal machine shed structure located on Lot 17. Machine shed placed on-site in approximately 2007. Machine shed viewed from the north adjoining property.

Two small metal machine sheds located on Lot 17. Small metal machine sheds constructed between 1939 and 1968.

Eastern small metal machine sheds located on Lot 17. Machine shed constructed between 1939 and 1968.



Western small metal machine sheds located on Lot 17. Machine shed constructed between 1939 and 1968.

CULTURAL RESOURCE ASSESSMENT
Section 106 Review

CONTACT PERSON/ADDRESS

Adam J. White
Terracon
3601 Mojave Court, Suite A
Columbia, Missouri 65203

C:

PROJECT:

Discovery Ridge Lots 2, 5, 8, 9, 10, 11, 12, 13, 14, 15 & 16, Columbia

FEDERAL AGENCY

UNKNOWN

COUNTY:

BOONE

The State Historic Preservation Office has reviewed the information submitted on the above referenced project. Based on this review, we have made the following determination:

☐ After review of initial submission, the project area has a low potential for the occurrence of cultural resources. A cultural resource survey, therefore, is not warranted.

☐ Adequate documentation has been provided (36 CFR Section 800.11). There will be "no historic properties affected" by the current project.

☒ An adequate cultural resource survey of the project area has been previously conducted. It has been determined that for the proposed undertaking there will be "no historic properties affected".

For the above checked reason, the State Historic Preservation Office has no objection to the initiation of project activities. PLEASE BE ADVISED THAT, IF THE CURRENT PROJECT AREA OR SCOPE OF WORK ARE CHANGED, A BORROW AREA IS INCLUDED IN THE PROJECT, OR CULTURAL MATERIALS ARE ENCOUNTERED DURING CONSTRUCTION, APPROPRIATE INFORMATION MUST BE PROVIDED TO THIS OFFICE FOR FURTHER REVIEW AND COMMENT. Please retain this documentation as evidence of compliance with Section 106 of the National Historic Preservation Act, as amended.

By: Mark A. Miles — **February 9, 2011**

Mark A. Miles, Deputy State Historic Preservation Officer — **Date**

MISSOURI DEPARTMENT OF NATURAL RESOURCES
STATE HISTORIC PRESERVATION OFFICE
P.O. Box 176, Jefferson City, Missouri 65102
For additional information, please contact Judith Deel, (573) 751-7862. Please be sure to refer to the project number: 015-BO-11

Preliminary Geotechnical Engineering Report

Discovery Ridge – Certified Site Program
Lots 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18
Columbia, Missouri

February 17, 2011
Terracon Project No. 09105094.1

Prepared for:
Trabue, Hansen & Hinshaw, Inc.
Columbia, Missouri

Prepared by:
Terracon Consultants, Inc.
Columbia, Missouri

February 17, 2011

Terracon

Trabue, Hansen & Hinshaw, Inc.
1901 Pennsylvania
Columbia, Missouri 65202

Attn: Mr. John Huss, P.E.
P: [573] 814-1568
F: [573] 814-1128

Re: Preliminary Geotechnical Engineering Report
Discovery Ridge – Certified Site Program
Lots 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18
Columbia, Missouri
Terracon Project Number: 09105094.1

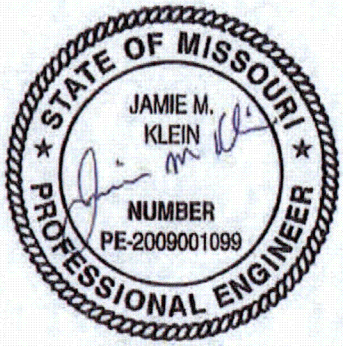
Dear Mr. Huss

Terracon Consultants, Inc. (Terracon) has completed the preliminary geotechnical engineering services for the above referenced project. This study was performed in general accordance with our proposal number D0910226 dated December 15, 2010 and our Supplemental Change Order dated February 2, 2011. This report presents the findings of the subsurface exploration and provides preliminary geotechnical recommendations concerning earthwork and the design and construction of foundations, floor slabs and pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Jamie M. Klein, P.E.
Staff Geotechnical Engineer
Missouri: PE 2009001099



2-17-11

Eric H. Lidholm, P.E.
Senior Principal
Office Manager

Enclosures
cc: 3 – Client
1 – File

TABLE OF CONTENTS

EXECUTIVE SUMMARY

A preliminary geotechnical investigation has been performed for the proposed certified site which consists of Lots 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18 of the Discovery Ridge Research Park in southeastern Columbia, Missouri. Nine (9) borings, designated B-1 through B-9, were performed to depths of approximately 13 to 20 feet below the existing ground surface at the subject site.

Based on the information obtained from our subsurface exploration, the site can be developed for future construction. The following geotechnical considerations were identified:

- Typical lightly loaded commercial buildings may be supported on shallow footings bearing on stiff to very stiff native clay or on compacted structural fill.
- Assuming proper site preparation and any necessary subgrade repair, total and differential settlement should be within anticipated client/owner specifications.
- Existing fill was encountered in Borings B-3 and B-4, however we understand that this material was placed as part of mass grading during mid to late 2008. At that time, Terracon was onsite to observe and test the density and moisture during placement of engineered fill material.
- Based on the USGS map, it appears that a pond may have been located in the vicinity of lot 16 and that the existing pond located north of the Radil Facility previously extended west onto a portion of Lot 2. We recommend these areas be thoroughly investigated during the final geotechnical investigation for each respective lot.
- The near-surface soils are active and prone to volume change with variations in moisture content. For this reason, a low volume change zone (LVC) is typically constructed beneath at-grade, grade-supported floor slabs. Depending on final grading plans, construction of the LVC may require overexcavation within future building pads.
- On-site soils appear suitable for use as compacted structural fill; however, if they do not meet the low plasticity fill criteria, they should not be utilized for LVC material.
- The 2006/2009 International Building Code (IBC), Table 1613.5.2 seismic site classification for this site is C
- The Modified Mercalli Intensity Scale for seismic events for Boone County is VII.

EXECUTIVE SUMMARY (continued)

- Close monitoring of the construction operations discussed herein will be critical in achieving the design subgrade support. We recommend that Terracon be retained to monitor this portion of the work.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations. Although this report discusses design parameters, these parameters are preliminary. This preliminary report is not intended to be relied upon for final design.

PRELIMINARY GEOTECHNICAL ENGINEERING REPORT
DISCOVERY RIDGE – CERTIFIED SITE PROGRAM
LOTS 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18
COLUMBIA, MISSOURI

Terracon Project No. 09105094.1
February 17, 2011

1.0 INTRODUCTION

A preliminary geotechnical engineering report has been completed for the proposed certified which consists of Lots 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18 of Discovery Ridge Research Park in Columbia, Missouri. Nine (9) borings, designated B-1 through B-9, were performed to depths of approximately 13 to 20 feet below the existing ground surface at the subject site. Logs of the borings along with a site location map, USGS map, geologic map and boring location diagram are included in Appendix A of this report.

The purpose of these services is to provide information and preliminary geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- earthwork
- pavements
- foundation design and construction
- floor slab design and construction
- seismic considerations

It is important to note that this preliminary geotechnical engineering report is not meant to provide final design recommendations. Once final development plans are available, a final geotechnical investigation should be performed for site and structure-specific geotechnical recommendations.

2.0 PROJECT INFORMATION

2.1 Project Description

ITEM	DESCRIPTION
Site layout	See Appendix A, Exhibit A-4: Boring Location Diagram
Structures	The project will include future development of approximately 90 acres of vacant land. Finalized specific building or site layout details were unknown at the time this report was prepared.

ITEM	DESCRIPTION
Grading	Site grading information was not available at the time that this report was prepared. However for the purpose and scope of this report, we have assumed that local cuts and/or fills required for development will be limited to approximately 10 feet. Additionally, we understand that mass grading was performed in mid to late 2008 in the vicinity of the existing Radil Facility and ABC Laboratories building. At that time, Terracon was onsite to observe and test the placement of engineered fill material.
Cut and fill slopes	No steeper than 3H:1V (Horizontal to Vertical) (assumed)

2.2 Site Location and Description

ITEM	DESCRIPTION
Location	The proposed project site consists of Lots 2, 5, 6, 7 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18 of Discovery Ridge Research Park in Columbia, Missouri.
Existing improvements	The lots are vacant with the exception of Lot 5 which is developed with a storage building.
Current ground cover	Generally grass covered, however portions of the site in the vicinity of Lot 16 were cultivated fields.
Existing topography	In general, slightly to moderately sloped downward towards the south and west.

3.0 SUBSURFACE CONDITIONS

3.1 Geology

Most of the upland area is covered by a thin loess blanket and glacial drift. Highly plastic clays that exhibit volume change with variations in moisture are commonly encountered near the ground surface.

Based on the 2003 Geologic Map of Missouri, Missouri Department of Natural Resources, bedrock at this site consists primarily of the Pennsylvanian aged Cherokee Group (Pc), the Pennsylvanian aged Marmaton Group (Pm), and the Mississippian aged Burlington formation (Mo). The Cherokee Group is predominantly shale with minor amounts of carbonates and sandstone. This group contains most of the mineable coal beds in Missouri. The Marmaton Group consists of a succession of shale, limestone, clay, and coal beds.

The Burlington formation is characteristically a white to gray, medium to coarsely crystalline, medium to coarsely crinoidal, chert free to sparsely cherty limestone. Solution features, including caves and sinkholes, are commonly present in this formation. No caves or sinkholes are known to exist, or are published to exist, within approximately 1 mile of this project site. However several areas of known karst activity are present west and southwest of the project site.

It is difficult to predict future sinkhole activity. Sinkholes and caves in this area are in various stages of development and can appear at any time. Site grading and drainage may alter site conditions and could possibly cause sinkholes in areas that have no history of this activity.

3.2 Typical Profile

Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/Density
Surface	0.2 to 0.5	Topsoil: brown, friable and contained significant organic matter	N/A
1	3 to 12 (Borings B-3 & B-4 only)	Existing Fill [1] consisting of lean clay and lean to fat clay with varying amounts of sand and gravel	Very stiff to hard
2	3 to 12	Lean clay, lean to fat clay and fat clay	Stiff to very stiff
3	Undetermined: Borings B-1 through B-5, B-8 and B-9 terminated within this stratum at the planned depth of approximately 20 feet	Lean to fat clay and fat clay with varying amounts of sand, gravel and possible cobbles (visually classified as glacial drift)	Stiff to hard
4	Undetermined: Borings B-6 and B-7 terminated within this stratum.	Limestone	Caused split spoon sampler refusal and auger refusal

Note 1: The existing fill material was placed in mid to late 2008. Terracon provided onsite observation and moisture/density testing during the placement of fill material.

The upper soil encountered in the borings generally consisted of lean to fat clay and fat clay which was of moderate to high plasticity, and had the following measured liquid limits, plastic limits, and plasticity indices:

Sample Location	Depth (feet)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
Boring B-1	3 – 5	43	15	28
Boring B-3	1 – 3	41	16	25
Boring B-5	1 – 3	31	21	10
Boring B-9	1 – 3	44	21	23

Conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in situ, the transition between materials may be gradual. Details for each of the borings can be found on the boring logs in Appendix A of this report.

3.3 Groundwater

The boreholes were observed while drilling and after completion for the presence and level of groundwater. Groundwater was observed at in Borings B-5 and B-6 at depths of approximately 12 to 18.5 feet. Groundwater was not observed in the remaining borings during drilling or for the short amount of time the borings were allowed to remain open following drilling completion. However, this does not necessarily mean that stable groundwater levels were observed in Borings B-5 and B-6, or that the remaining borings were terminated above groundwater.

Due to the low permeability of the soils encountered in the borings, a relatively long period of time may be necessary for a groundwater level to develop and stabilize in a borehole in these materials. Long term observations in piezometers or observation wells sealed from the influence of surface water are often required to define groundwater levels in materials of this type.

Pockets, lenses, and stringers of sand are sometimes encountered in the glacial soils found in the vicinity of the referenced project. These sand pockets are normally discontinuous and often contain water of variable quality and quantity. These sand pockets may be encountered during foundation excavation. This possibility should be considered when developing design and construction plans and specifications for the project.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff, proximity to existing ponds, and other factors not evident at the time the borings were performed. In addition, perched water can develop over low permeability soil strata. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

4.0 SITE SUITABILITY AND PRELIMINARY FINDINGS AND RECOMMENDATIONS

4.1 Geotechnical Considerations

The borings performed for this project generally encountered native lean to fat clay and fat clay underlain by glacial drift. Existing fill was encountered in Borings B-3 and B-4 to depths of 3 to 12 feet, and limestone bedrock was encountered in Borings B-6 and B-7 at depths of approximately 17 and 12.5 feet, respectively. Depending on final site grading plans, we anticipate that either the native clay or compacted structural fill will form the subgrade for future building foundations and floor slabs.

Based on the USGS map, it appears that a pond may have been located in the vicinity of lot 16. Further, based on aerial photography the existing pond located north of the Radil Facility previously extended southwest onto a portion of Lot 2. We recommend these areas be thoroughly investigated during the final geotechnical investigation for each respective lot.

Performance of foundations depends on many factors including, but not limited to, the depth of footings, amounts of cuts or fill, bearing material, and foundation loads. Structural loads, final grades, and other design details should be provided when available. Although this report discusses design parameters, these parameters are preliminary. This preliminary report is not intended to be relied upon for final design. We recommend a more detailed study be performed when specific project details are known, and/or possibly following completion of general site grading.

Examination of the boring logs indicates a range of soil-moisture conditions are present at this site. At the time of drilling, some of the soils at various depths are at moisture levels above their measured plastic limit. Typically, soil with moisture levels above their measured plastic limit may be prone to rutting, pumping, and can develop into unstable subgrade conditions during general construction operations.

Moderately to highly plastic, lean to fat clay and fat clay soils were present on site. Such soils are commonly referred to as "expansive" or "swelling" soils because they expand or swell as their moisture contents increase. However, these soils also "contract" or "shrink" as their moisture levels decrease. Footings, floor slabs, and pavements supported on expansive soils will move upward and downward and such movements will result in distortion, possibly causing cracking or structural damage to structures. For this reason, a low volume change zone will likely be required beneath at-grade floor slabs. We recommend that additional laboratory testing be performed during the final geotechnical exploration to better evaluate the expansive nature of these soils.

We recommend that the exposed subgrade be thoroughly evaluated after stripping of any topsoil and creation of all cut areas, but prior to the start of any fill operations. We recommend that the geotechnical engineer be retained to evaluate the bearing material for the foundations and floor slab subgrade soils. Subsurface conditions, as identified by the field and laboratory testing programs, have been reviewed and evaluated with respect to the proposed development plans known to us at this time.

4.2 Earthwork

The widely spaced preliminary borings typically encountered stiff to hard lean to fat clay and fat clay. Shallow bedrock, karst features, or extensive pervious deposits of water-bearing sand that could impact site development did not appear to be present based on the preliminary site and subsurface information gathered at this time.

Based on the subsurface conditions encountered in the widely spaced borings, the site soils are suitable for future development. Additional borings should be completed so that each site can be adequately characterized and recommendations can be more fully developed to assist and guide future mass grading.

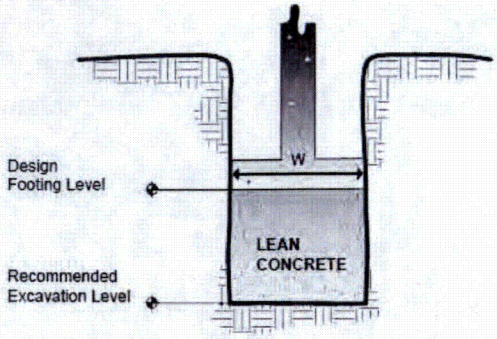
Recommendations will need to be developed for site preparation and proof-rolling operations as well as construction of cut and structural fill operations. In our opinion, full-time testing and observation should be employed during mass grading to evaluate compliance with project earthwork recommendations and requirements. If site grading results in relatively thick structural fills, settlement and cut/fill slope stability may need to be evaluated.

4.3 Foundations

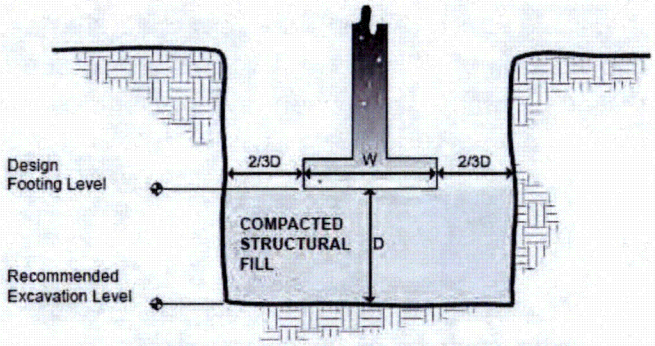
Shallow foundations could be used to support lightly loaded commercial structures provided the footings are supported by suitable material (stiff to hard native clay or compacted structural fill). Depending on the design footing elevation and bearing material (native clay or newly placed compacted structural fill), allowable bearing pressures would likely be in the range of 1,000 psf to 3,000 psf. Due to the presence of clay soils, shallow foundations are typically soil-formed in the general vicinity of this site. Further testing at the individual structure locations should be performed to determine the appropriate bearing capacity for structural support.

Heavier loads, which could cause excessive settlement, are normally supported by shallow foundations which are supported, in turn, by aggregate-pier intermediate foundations or by drilled piers. Pier drilling through the native soils is not expected to become difficult based upon the material encountered within the borings; however, the drilled pier contractor should be prepared should sandy zones or large boulders be encountered. These materials, although not

encountered in our borings, can sometimes be encountered in the glacial soils that are present in the vicinity of this site when drilling pier holes which are much larger in diameter than the bore holes.



Lean Concrete Backfill



Overexcavation / Backfill

NOTE: Excavations in sketches shown vertical for convenience. Excavations should be sloped as necessary for safety.

4.4 Seismic Considerations

Method Used	Site Classification
Modified Mercalli Intensity Scale [1]	VII [2]

1. Missouri State Emergency Management Agency; P.O. Box 116; Jefferson City, MO 65102
2. See Appendix C, Exhibit C-4 for Projected Earthquake Intensities (Modified Mercalli Scale)

Code Used	Site Classification
2006/2009 International Building Code (IBC) [1]	C [2]

1. In general accordance with the *2006/2009 International Building Code,* Table 1613.5.2.
2. The 2006/2009 International Building Code requires a site soil profile determination extending a depth of 100 feet for seismic site classification. The current scope requested does not include the required 100 foot soil profile determination. Borings for this report extended to a maximum depth of approximately 20 feet and this seismic site class assignment considers that shale or limestone bedrock is present within approximately 30 feet of the ground surface and continues below the maximum depth of the subsurface exploration. Additional exploration to greater depths could be considered to confirm the conditions below the current depth of exploration. Alternatively, a geophysical exploration could be utilized in order to attempt to justify a more favorable seismic site class.

4.5 Floor Slabs

Many of the clay soils in this locale have the potential to increase or decrease in volume with variations in moisture content. Soil having high plasticity characteristics (i.e., fat clay) generally has a greater potential for moisture related volume change than less plastic materials such as lean clay. In addition, swell potential is generally greater in material with a high dry unit weight and low initial moisture content. However, even low plasticity soils can swell significantly if their moisture levels are initially low.

Because of the moderate to high shrink-swell potential of the lean to fat clay and fat clay soil encountered in the borings, a low volume change layer will likely be required below at-grade floor slabs. This layer typically varies from 12 to 36 inches in thickness. The on-site lean to fat clay and fat clay soils encountered in the borings performed for this report are typically not suitable for use as low volume change material; however, on-site materials may exist which would meet the low volume change material criteria. Further testing at the individual structure locations should be performed to determine the required low volume change layer thickness.

4.6 Pavements

On most project sites, the site grading is accomplished relatively early in the construction phase. Fills are placed and compacted in a uniform manner. However, as construction proceeds, excavations are made into these areas, rainfall and surface water saturates some areas, heavy traffic from concrete trucks and other delivery vehicles disturbs the subgrade and many surface irregularities are filled in with loose soils to improve trafficability temporarily. As a result, the pavement subgrades, initially prepared early in the project, should be carefully evaluated as the time for pavement construction approaches.

Pavement thickness can be determined using AASHTO, Asphalt Institute and/or other methods if specific wheel loads, axle configurations, frequencies, and desired pavement life are provided. Pavement design methods are intended to provide structural sections with adequate thickness over a particular subgrade such that wheel loads are reduced to a level the subgrade can support. The support characteristics of the subgrade for pavement design do not account for shrink/swell movements of an expansive clay subgrade such as the soils encountered on this project. Thus, the pavement may be adequate from a structural standpoint, yet still experience cracking and deformation due to shrink/swell related movement of the subgrade.

Expansive soils are present at this site. It is important to minimize moisture changes in the subgrade both during construction and during the life of the pavement to reduce shrink/swell movements.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The preliminary analysis and preliminary recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this preliminary report. This preliminary report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this preliminary report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.