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Appendix

Thomas Marcuccilli Nature Park

FEBRUARY/2023

Content

THOMAS MARCUCCILLI NATURE PARK APPENDIX DOCUMENTS

Meeting Notes

Appendix 01: Frequently Asked Questions

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Thomas Marcuccilli Nature Park
Master Plan
Frequently Asked Questions

Q: How did Carmel Clay Parks and Recreation (CCPR) become owner of this property?
A: After it was determined that Carmel Utilities would build wellheads on the property, the City and the developer chose CCPR to manage/protect the wellhead area and as such receive the property via donation. CCPR stewards land where other Carmel wellheads are located, including at Founders Park. CCPR presented the potential donation to the Carmel/Clay Board of Parks and Recreation (the entity that governs CCPR), which adopted Resolution G-2021-004 accepting the donation.

Q: How was the property originally intended to be developed before it was donated to CCPR?
A: The property was originally planned to be a common area with trails and other community amenities maintained by the homeowner's association. The Legacy unit development plan approved by the City of Carmel Department of Community Services included trails on the current park site location. The amenities CCPR is discussing developing are substantially similar to what was already approved. Images of the approved plan are attached.

Q: Why is CCPR planning and developing another park in this area?
A: Adding this parkland to CCPR's portfolio fulfills several goals and recommendations outlined in the 2020-2024 Comprehensive Parks and Recreation Master Plan, which includes enhancing park and recreation opportunities within the community by expanding trails and environmental education near the White River. Since master plans created by CCPR are driven by community input, CCPR is working to fulfill a goal prioritized by Carmel and Clay Township residents.

Q: Why are the wellheads placed in the specific locations on the site that they are?
A: Carmel Utilities studied the site and chose the placement of the wellheads. CCPR was not involved in the placement of the wellheads. Questions regarding the wellhead project should be directed to Carmel Utilities Administration at 317-571-2443.

Q: Who is the park named after and why?
A: The park is named for Thomas Marcuccilli (pronounced Mark-ă-sell-ē), a native Hoosier and one of the original founders of STAR Financial Bank. The park name was chosen by the donor in honor of his late father-in-law. A biography with more information is attached.

Q: Was the site previously a nature preserve?
A: No, the site was not previously a nature preserve. Nature preserves have specific management and maintenance requirements and are subject to regulations. Nature preserves were established by the 1967 Nature Preserves Act found in Indiana Code 14-31-1. Natural areas can become dedicated nature preserves only with the agreement of the landowner, the Department of Natural Resources and the Natural Resources Commission. Once a preserve is dedicated, it is protected in perpetuity from development that would harm its natural character.

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Q: Why did CCPR call it a nature park?
A: CCPR chose to add "nature park" to the name to help indicate our intention to manage the site as a mostly natural area with minimum passive use development. Given the site limitations and unique soil conditions, the new park cannot support development of facilities like the program buildings in Founders or West Parks or amenities like a playground or splash pad.

Q: What is CCPR currently doing to maintain the land?
A: CCPR is mowing areas that were previously mowed by the HOA, inspecting existing trees for hazardous branches and dead wood, and emptying pre-existing dog pot stations. Ecologists have conducted a preliminary study of existing plant life and will continue to map target areas for restoration and invasive species management.

Q: Based on other passive use parks in the Carmel area, how many people are expected to visit the park on a daily basis?
A: It is not feasible to make visitation projections until a master plan is prepared. The largest drivers of park visitation are amenities like playgrounds, splash pads, and indoor buildings, which are not suitable for this park. As a nature-oriented park with only passive uses like trails, enhanced natural areas, and interpretive signage, attendance is likely to be significantly less than parks with more active amenities.

Q: Will park users be required to leash their dogs?
A: Carmel City Code §6-99(b)(10) requires dog owners to leash their animals when off their private property. Under this ordinance, off-leash use was already prohibited. Furthermore, §5-3(b)(5)(b) of the City Code requires any pet or domestic animal to be continuously restrained by a firmly held or attached non-retractable leash when visiting a park, except within a designated dog park. Since a dog park is not anticipated for this property based on site conditions, leashes will still be required. If you have concerns about unauthorized use of the park, please notify the Carmel Policy Department, who is responsible for enforcing City Code.

Q: Will having a park close by decrease my property values?
A: No, in fact studies show that living close to a park increases property values! Here's more information from the National Recreation and Park Association, the Trust for Public Land, and the American Planning Association.

Q: How can I give feedback on the Thomas Marcuccilli Nature Park Master Plan?
A: During the master planning process, CCPR will host focus groups and public open houses to identify community needs and discuss park concepts. There will also be a community input survey posted online. Stay tuned to our social media (@CarmelClayparks on Facebook and Instagram) and website (carmelclayparks.com) for announcements. You can also join our Thomas Marcuccilli Nature Park mailing list to receive email newsletters and park updates at https://www.carmelclayparks.com/parks/thomas-marcuccilli-nature-park/.

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Q and A of TMNP, 2022

Q: Who can I talk to if I have questions about Thomas Marcuccilli Nature Park?
A: Questions about Thomas Marcuccilli Nature Park should be directed to CCPR's Administration & Planning division, which can be reached by phone at 317-573-4022 or email at ncarson@carmelclaypark.com.

Thomas Marcuccilli Biographical Information

Thomas (Tom) Marcuccilli was born on June 9, 1918 to Luigi and Onoria (Bove) Marcuccilli in Marion, Indiana. Tom was the youngest of three sons in the Italian immigrant family, the oldest being Ralph, and Bernard being the middle child.

Tom's lists of achievements and responsibilities were endless, and his entrepreneurial and innovative spirit were woven throughout many milestones of his lifetime. In the '30s, he hauled catsup out of the Midwest Catsup Co. plant in Fowlerton. At the time, the only driving qualification for a truck was being big enough to see over the steering wheel. By 1935, brothers Ralph, Bernard and Tom had formed Marion Trucking Co. in partnership with Selah G. Wright. The trucking company hauled glass for Foster-Forbes Glass Co. in Marion for several years. After the outbreak of World War II in 1939, the Marcuccillis and Wrights operated Wright Canvas Co., manufacturing gas masks for the War. Tom Marcuccilli, who had taken up flying in 1938, also served as an Air Force flight instructor in both Indianapolis and Texas.

Tom married Mary Louise (Snyder) Marcuccilli on December 1, 1945. They had seven children – Thomas, Bernadine, Bernard, James, Jean Ann, Kathy and Ralph. Through their upbringing, the interests of the Marcuccilli-Bove-Wright partnership expanded into many other fields, including development of a shopping center, ready mix and stone quarries, an amusement park, a drive-in movie theater, mobile home parks and sales, real estate investments and transportation.

The Marcuccilli-Wright partnership moved into banking in 1943, when it purchased a failing bank branch in Upland, IN. The Marcuccillis and Wrights later acquired banks in Gaston, Elwood, Gas City, Columbia City, Anderson, Shirley and Van Buren. Today, STAR Financial Bank remains privately held, has grown to $2.7 billion in assets and is celebrating 78 years in business with second, third and fourth generation Marcuccilli and Wright family members still actively involved. The Wright and Marcuccilli families still try and emulate Tom Marcuccilli's approach to getting things done. "I've always treated my work as a vacation. If you like your work, you're on vacation."

Tom Marcuccilli passed away on October 21, 1981, at the age of 63. The plaque that for many years hung on the wall besides his office desk is etched in the memories of his family, friends, and colleagues as inspiration even today. It reads, "I Do Not Choose To Be A Common Man."

Thomas Marcuccilli was anything but common. His patience, generosity, and positive influence in Indiana's economy will forever be remembered.

Appendix 02: Thomas Marcuccilli Biography

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Meeting Notes

Appendix 03: TMNP Master Plan Meeting (03/18/2022)

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TMNP MASTER PLAN MEETING 03/18

Hydrology/Ecology
Site well drained through tile system, very little horizontal flow through the site
Working to determine where everything flows and where the water outlets are
Any modifications made to the berms need to accommodate the existing drainage system
Historically the site was a wetland before the tiles were installed, restoring it to its historical hydrology would be important environmentally, would be of high value t the DNR program
To recreate what it was pre-settlement makes the site more interesting, can include the history of what the site was before
Sedge meadow, marsh, or fen (other in IN are 474, 134, 65 acres)
Very few nature preserves of those kinds in Indiana
What is a fen?
Richie woods has fens? This area historically had fens and sedge meadows prior to farming
Would need to determine exactly what would fit this specific environment
DNR program accepts any time of wetlands, their primary focus is forested, but they can accept any kind and this site is different because of the soil.
This site is more of headwaters to the White River
Let the site tell us what to do
Might have an overlap of multiple different kinds of wetland types
CBB needs to do a full investigation
Soils would have a hard time holding trees
Might have a hard time holding trees
Might have certain species that could work better
Those more native to northern or southern
Bald cyprus

Connections
Path from school to TMNP
All in the sun - any way to make that walk nicer?
About .5 mile walk
Overlook Park will be like our front door
Area around 146th street will be another frontage
Otherwise, the other road facing parts of the park will not be visible from main roads, seems more for locals/neighbors
Harvest Church discussions about having a trailhead on their property (along southern edge) with restroom, church is open to conversation, more people that come to park then more people see church, playground on church property is open to public use, need to find something that would benefit them as well

Historical info
Plaque on our side from Carmel/Clay Historical Society
Circular pit in west woods, could be a well need inspected and capped
Remnants of a foundation and chimney - previous structure

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Connection between TMNP and Overlook
Overlook will become more naturalized and become a viewshed and naturalized
Becomes connector to the school

Programming
Not looking for playground here, have 4 parks in close proximity that have strong playgrounds
No splashpad either
Want a true nature preserve feel
Education interpretive signage
Gathering like shelter or amphitheater or outdoor classroom
Will be expanding that piece of programming more and more
Nature program to introduce them to different ecological systems
On site for 1-2 hours
Restroom
Sustainable trail system
Shade
Parking and drop off turn around
Gathering spots, benches, along the trail to stop and give the educational talks, in the shade would be even better
Create a time capsule experience
use the landscape to create a time capsule
sequence oldest landscape and what did it turn into?

Lighting
Less lighting the better
Special lighting Kelvins that does not attract bugs
Goal for Joanna
Looking into light standards
Casey has some info to share
What is the most responsible way to provide that
Is there a shade that is more responsible?
What's the best way to do that?
Lit paths are questionable? Should they be lit or not?
Most of our paths are closed at night, so have lit paths seems like no because there is no need since the parks are closed at night
Neighbors would give kickback if we provided lit trails

Vegetation
River Heritage Tree Mitigation
Trees being planted at TMNP instead of Central Park
Land is incredibly free draining, very dry after rains, water just pours in and then ground immediately absorbs it
Will dictate which plant life can thrive there

Will need multiple strategies for parking and entrance,
Include Duffy's plans for well access, emergency vehicle access include input from emergency services

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IN DNR SWMP In Lieu Fee Program
Funds to mitigate or restore to wetlands, and then also funds to maintain the site, long term management, 50' compatible use buffer around the wetland area, can have passive use trail through the wetland area, cannot have bathroom or playground butt right up to wetland area, every easement will be written a little bit differently

Feasibility stage - March 2022 getting out to sites to look at for feasibility
Site is feasible pending drain issue
Mapping general
CBBE will be out onsite Tuesday finishing feasibility, there will be a feasibility document, that CBBE can share with everyone
By mid april will have sites we will move forward with
Will have idea of # of credits per site
Rest of april, may, june
Will do detailed assessments and analyses
Wetland delineation
Install monitoring wells to check the site
July-late fall
Will create a detailed plan for the regulators to review, make comments and changes
Work on getting approved
Will need to know what trails etc we are planning in TMNP MP
Once gets approved by regulators, they will work on design phase for DNR program
Construction in earliest 2023

Goals:
Measurable goals
Different experience than anything at our other parks
Needs to have a passive user experience
Strong educational component
Build strong partnerships and allow others to tell the site's story
Want this to stand out among our other parks
Celebrate water - history, water resource for the city, celebration of water, IDEM initiative protect headwater streams, important to have healthy headwater streams for health of the White River
Connectivity to the White River and neighborhoods
Sustainable maintenance solutions in how we design, collaborate, and create habitat enhancements, relationships, longterm monitoring

Would like to replace the culverts with ones that include wildlife passage, and replace the culverts to include space for wildlife passage, would be worth considering whether or not we could include that in the project

Public messaging
First park system certified as wildlife friendly by IWF
Making more friendly for different species
80% of our parks are maintained in a natural state

Appendix 04: TMNP Steering Committee Meeting (03/22/2022)

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TMNP Steering Commitee Meeting 03/22, WIth Mark and Paul

Mark asked how deep the bedrock is
MK - we don't know
Rioux - soil is marrow soil
Combo of organic and sand, more like peat, like clay and organic
Can squeeze through hands like pudding
Conventional wells that are 80 feet deep

Mark asked what is out there now plant-wise?
Mark recalled planting prairie and that breaking up the drainage tiles and it becoming a sedge meadows
Mark said that prairie plants would destroy the drainage tiles and allow the water to stay on the site

Mark wanted to know if this property has been delineated as a wetland,
MK stated that most of this property has been delineated as a wetland

Goal #3
Jessica Beer said: Sounds like an amazing project based learning opportunity for students - history, ecology

One of the accreditation standards related to cultural and historical plans
We are strong on the ecological side, but lacking in the cultural/historical plans
This site has the ability to fulfill that initiative

Mark wants to know what date the artifacts are from
Casey - the literature that we have does not specify when the artifacts are from
Mark wants to know if we are conducting an archaeological survey - MK/NC confirming that yes we are

MK likes the idea of working with Ball State and the students on the anthropological work, already have strong relationships with the tribes, interpretation and education is coming from the tribes instead of from us

Mark reminded about Karen LaMere and former Park Board member that represented tribe [who is that?] Nick Plopper

Mark - no ampitheater, programs overload the neighborhoods, creates a noise problem, neighbors are always upset, lean more towards outdoor classroom

Mark - what is load limitation on boardwalks? Will soils be able to support boardwalks and UTVs?

Paul - John Duffy did a lot of soil studies to find a path for trucks to make it between wellheads
Stories about cows disappearing in the field and tractors not being there, lots of those stories when bought it in 2002
Paul says bedrock level is way down
Peninsula of townhomes at the north was all good soil, randomly
Southern 14 acres is sand 40ft deep

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Harvest site is about 12ft above level of ours
MK talked to Harvest church about sharing parking with TMNP
Could potentially do a trailhead at the southern part of the harvest church property
Parking off the north frontage road, could have good enough soils right there to put in 15-20 parking spaces depending

Structure with foundation in west woods
Can connect to other sides of the woods that is still owned by the HOAs

Jessica
Very excited about educational opp and working w ball state
Getting students to the park, mixing play and educational at the park
Give adults opp to learn about history and ecology too
Presentation is on the right track

Meeting Notes

Appendix 05: Harvest Church Meeting Notes 03/29

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Harvest Church Meeting 03/29, with
Brian White - Pastor
Grace Fugate - Admin Asst to Brian
MK/KB/JB/NC
Casey May

HC been on property about 6 years
Always wondered what would be on adjoining property

Casey ran though SC presentation

HC - lots pf peat and porous soil - never tried to walk across it, not sure would make it.
Had to use porous pavement, lots of soil testing to see where edge of buildable land was for HC parking lot

Well inspo pics pull from agro and tribal history

HC
Chose to keep old pre-existing silo; wanted to add lights inside initially, currently has lights on the outside, would like to add those kinds of lights, like the ones inside the wellhouses to compliment ours
Were going to reuse the barn wood, but instead just fab'ed something like it to work of barn wood look
Want to see what can be done on south end of their prop

Discussion of goals

#1
HC - People who have been in Carmel for a long time talk about what it used to be, then you built a church on it

MK - the little building on the church property used to be Eli Lilly's field office, used to sit on HC property where buildings are, then was move to be preserved

#2
HC asked if soils will even support boardwalks
Response: will bring in soil engineers t show what areas are buildable for boardwalks etc.

#3
MK discuss BSU AAL and White River Greenway
HC - what's the timeline on WRG?
MK - hoping to start construction in Fall, depends on funding, will be funded through READI or Next Level Trails

#5
HC - on HC's hearts that people would be on their property as much as possible, thought about an ampitheatre in original site plan, need help figuring out what that looks like

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Rest of HC site plan
Plan for TMNP can coincide with plan for south part of HC property
Any future building expansion needs to be to south,
Going to double the buildings with parking to the south
Need some kind of green buffer between parking and the apartments
HC doesn't want to lose frontage view into the park
Don't want to duplicate efforts and programming

How does HC property fit into our plan?
MK - could we put a trailhead on the southern end of HC property?
HC - asked Grace to get a copy of the orig master plan for CCPR - to get from Steve Horn
Elders would likely not be opposed to trailhead on south end of property
Would want to discuss: ownership, liability, insurance, indemnity, agreement, lease, management
Utilities run on west side of property
Road runs along to give fire access
See triangle piece of land, what would HC do with that? Possible area for trailhead?

Host July mtg at HC?
Happy to do that, send dates to Grace
Focus group?
Sure, send dates to Grace

HC members don't currently engage with interior of park, would be used for picnicking, youth group, families, , more they see the complimentary aspects, the more they will use, connect into park, connect to sidewalk off north, more connections = more church users

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Meeting Notes

Appendix 06: BSU Applied Anthropology Meeting Notes 04/14

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Introductions
MK, JB, NC
Casey May
Kevin Nolan
Chris Thompson - 2d career, has MBA and background in project mgmt

MK introducing the project
Conner Prairie's focus is the European settlement and the future
Looking at partnership w/ CP to create river ecology center to celebrate the river and natural resources
Want to create innovation center with offices, or education center of some kind
Want to be respectful, how do we reach out, we want them to be proud of the history that is being told, feel like it is being their history being told
Feel like as an accredited and two time gold medalist, we are required to push the bar and set this as the new level for others to attain

CM - ILF program is an opportunity, will play into what the scope ends up being

MK - need to have convo w/ CBB, but no matter what we want to bring BSU into the fold whatever way we need to bring them in, whether that is a contract through CBB or CCPR

If going through ILF it might trigger certain regulations, but that wouldn't determine who we try to talk to, but if we have a federal regulatory undertaking to be aware of, whatever sections are touched by IDNR would be subjected to the standards applicable to an IDNR project, areas that are not an IDNR project site can be done to the standards that CCPR is comfortable to

MK - message of this park needs to be talking about people who stewarded the land before us

Acknowledge that there are other ways to engage with nature, diff approaches to understanding these natural resources

MK - sees this as the beginning as a longer term approach to education in our park system

KN - only thing that is fixed is our approach to working with the tribes, the way they listen to, work with, and respond to the tribes is the only thing that is fixed
Likely won't have much in the low part of the wetlands because difficult to sleep in water, would likely be reserved deposits in the high spots unless those were agricultural spots, might have well preserved information about other activities that were taking place there
A few years ago they did a survey in Hamilton, were trying to identify indigenous agricultural fields through chemical analysis of the soil (did in horseshoe prairie at CP), history beyond just artifacts

MK - like that connection to the land and how that connects to what we are as an organization

CM - some common ground, not too many years ago it was hard to plant a prairie without people complaining

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CT - what do you want people to feel when they come to this traveling exhibit? Sad, I want people to feel sad about what happened

KN - Master plan would be reaching out to the leadership, making contact with core partners and get regular meetings set up, want them to hear the broader mission and goal, talk about changing the way we educate the way the public about nature, show them that this will be more impactful, start having meetings and collecting input
Then allow the conversations to drive the research, would work on the cultural resource and interpretation tasks portion after the tribal consultation tasks

MKSK/CCPR Have a 1-2 page summary of the project, where it's located, with a little bit of information
When building summary, KN says just be clear that there's another project driven by its own demands driven by its own timeline
What kind of feedback could be give now on the wellhouse? Maybe with the skewed poles - we will get KN/CT feedback, MK share with John Duffy as well that we are going to be working with the tribes, be honest and open about what

Advice for those in the community that are not happy with it?
Educate, make materials available, be transparent, it's a best practice, it's the right thing to do
Working with federally recognized tribes, chiefs, second chiefs

MK - we should have more latitude about how we can interpret the site

CT - show up at their speaking engagements and meetings, educate ourselves, shows our commitment, for the different tribes

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Ball State Applied Anth. Lab Meeting, 04/14
MK, KN, CT, MKSK/CCPR

MK - dispels the myth of the national parks service that these lands were untouched by man, they were touched and managed
Can you share a bit about the communication and relationship development?

KN - didn't go as planned, developing an exhibits around a NW indian war battlefield, entirety of us army wiped out in 3 hours, 4 diff powerpoints, used none of them, this was a t a tribal meeting, started asking questions, about what they knew about battle, why they didn't have info about that specific event, and then there was lots of information about what happened after that, to make sure that they couldn't keep these records, the erasure processes, the near extinction that was the intention of the government, might get some information that was very unexpected
When working with ODNR, you have to take this seriously, architects got beat up in first presentation because they didn't think the designs represented the shawnee people, then the second round the design had
Have to show that you are responsive to their feedback

CT - will involve tribes very early on, would be the tribes with their homeland in this area and that are very active, would explain project, explain everyone's roles, then ask how involved they want to be, depending on whether or not they want to be involved we would have a series of meetings to ask questions like who do you want to write interpretive information, the chief of tribes would be included in writing the interpretive; they want to be very involved in writing information on treaties etc.; we move along how the tribes direct us to
The chiefs make time for the stories that they think are important to tell

MK - one of the wellheads will be developed next year due to water supply in 2023; start with park master plan that is very conceptual by October 2022, have wiggle room if we need to extend for any reason; identify funding sources; working on construction documents, words and locations of interpretive signage - would have continued involvement

MK - can identify grant and funding opportunities?

KN/CT - totally grant funded, that's how we still have jobs, sometimes partner with historical societies on grants that they can't qualify for
Use QR codes on the signs and they can pull up the full interview, pull up videos using QR codes
People only seemed to care about tribes where they interacted with white people, what is happening the rest of the time?
We think of them as bewildered and wild, but they weren't, they were developed nations with complex relationships

Traveling exhibit contents
25% on battle
25% on day to day life
25% on removal and boarding schools
25% on tribes today

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Hamilton County Ledger. 23 Jun 1905, p. 8.

Thomas Marcuccilli Nature Park – Historical Site Report

Prehistoric Findings

Ice Age fossils are rare in Carmel, but there was a significant find on the Lacy farm, part of which constitutes the northeast corner of the Thomas Marcuccilli Nature Park. In 1893, four mastodon teeth were discovered when a ditch was dug on the farm. The teeth from the upper jaw measured about eight inches across, and those from the lower jaw were about six inches. Two of the teeth weighed thirteen pounds. In 1905, Joseph McDonald found part of a tooth from a mammoth in Vestal Ditch a mile west of the park site in what is now the Cherry Creek Estates subdivision.

Residents have also collected artifacts from early Native Americans. Some date as far back as the Early Archaic period. Stone tools, such as arrowheads, hammers, tomahawks, whetstones and mortars and pestles, were once prevalent; hundreds, if not thousands, were found on Carmel's east side. Finds of this nature are rarer today, but they are still occasionally discovered. In 2017, a city engineer found a banner stone during the construction of a roundabout at Smoky Row Road and Gray Road. The artifact was thought to be as much as four thousand years old. Archaeological finds suggest there was activity as far back as the Late Archaic period near the site of the nature park.

Lenape Site

The first people of record in what is now Carmel were the Lenape, also known as the Delaware Indians.
At the time of first contact with Europeans in the early 1600s, the Lenape lived in the Delaware Valley near Philadelphia. Two centuries of European colonialism and American expansionism splintered the tribe, greatly diminished their population, and pushed them west into the Ohio River Valley. After an alliance of tribes was defeated in the Battle of Fallen Timbers in 1794, the Lenape ceded much of their land in Ohio and Pennsylvania to the United States. The Miami invited the displaced tribes to settle in their territory, allocating the area around White River to the Lenape.

In August 1802, William Conner built a log trading post in a prairie on the east side of White River, where Conner Prairie is today. A Lenape village developed around the trading post and came to be called Conner's Town. It extended across the river just east of the park site. Other Lenape villages in the area included Upper Delaware Town about two miles north of Conner's Town in what was known as the Horseshoe Prairie, Ketchum's Town along Cool Creek in present-day Carmel, and Lower Delaware Town, which was a half mile south of the Marion County line.

During the War of 1812, Indiana Territorial Governor William Henry Harrison was concerned that the Lenape would be pulled into the conflict and give up their neutrality, so he moved the tribe from their villages along White River to an abandoned Shawnee village in Piqua, Ohio. Many of the abandoned village sites along White River were burned to the ground during the war. This was the fate of the village site that was located near the nature park. It was not resettled when the Lenape returned to Indiana.

The First Settler in Carmel

In 1818, John and William Conner influenced the Lenape into signing the treaty of St. Mary's in which the tribe relinquished its claim to the land along White River in exchange for a reservation west of the Mississippi River. The tribe was given three years to vacate the land, after which it was opened for settlement. However, pioneers began to establish squatter settlements soon after the treaty was signed. Some settled in the prairies around William Conner's trading post.

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George Shirts and his family were the first to arrive in what is now Hamilton County. They settled in Conner's Town in March 1819. Later that month, Charles Lacy became the first to settle in what is now Carmel when he set up camp on the remnants of the Lenape village site on the west bank of White River opposite Conner's Town. That spring, he planted a crop of corn in a field the Lenape had cultivated for the same purpose. He built a cabin and brought his wife Mary and their eight children to the site in September. The northeast corner of the park site was entered by Charles Lacy in September 1822. The remainder of the park site was entered by Bethel Dunning and Benjamin Blythe in 1834 and 1835.

River Road

River Road was originally a Lenape trail that connected Barbara Burget's trading post on the Marion County line to the Upper Delaware Town in what came to be called the Horseshoe Prairie. This trail was also part of the first county road petitioned in August 1823. The road commenced at the Madison County border just north of White River, crossed the river at Strawtown, and followed the path of the Lenape trail past Lacy's farm to Burget's trading post. Parts of Hazel Dell Parkway, 116th Street and River Road follow the path of this two hundred year old road.

Later use of the Site

The Lacy farm remained in the Lacy family until Tunis Gerard purchased it in 1881. Gerard sold the farm around the turn of the century. Around 1920, John Owen purchased about four hundred acres that included the old Lacy farm and the park site and operated Owen Dairies, Inc. Before the company dissolved in 1935, it had the largest herd of dairy cows in the county.

In 1934 Eli Lilly purchased farms on the east and west side of White River, including the original Conner homestead and Owen's dairy, which he transformed into a horse, grain and hog farm. Lilly's massive farm covered about fifteen hundred acres and employed twenty-two full-time farmhands, many of whom lived in residences on the property. Lilly kept carpenters on staff year-round to keep the buildings and fences in good repair. The farm continued in operation on the west side of the river until the 1990s.

Plat maps dating back as far as 1866 and aerials from 1936 to the present indicate that there were no buildings on the park site. There were dwellings east of the site along River Road in the nineteenth century, and farm buildings during the Owen Dairy and Conner Prairie Farm years, but these were outside the boundaries of the park. It would be a significant discovery worthy of further investigation if a foundation is uncovered during site work for the park.

Meeting Notes

Appendix 07: CHHS Meeting (04/14/2022)

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CHS Meeting, 04/14
Began ~ 10:05 am
With Andy Wright, MA, Casey,

Casey started with running through of slide show
Discussing wellheads

MA - create interp signage on native history of land use and management using certain plants, recreating what might have been there historically, discuss how previous occupants managed the land and tell that story, maybe compare and contrast how it was managed before and how it is managed now

Andy Wright began at about 10:35
Looked at old plat maps dating back to 1866, aerials back to 1936 or later
No indication that anything was built there
Were some building along River Road

There are 3 cases where ice age mammals were found in Carmel
2 are pretty much where we are talking
One was on the Lacey farm - NE part of park was part of the original Lacey holding 1893, found 4 mastodon teeth
Abundant amount of native American artifacts that have been found in the Carmel area
People used to just walk out on the fields after a big rain and just pick artifacts up.
Surrounding the park we have finds from every historic time period, good chance that we will come across something
The first people of record here were Lenape, no actual record of the Miami living in the White River Territory

Conner's Town
Conner needed to have a license to be in Indian territory, well-suited for the fur trade
Village continued on the other side of the river, but the site was not resettled after the was of 1812
In 1818 sign Treaty of St. Mary's, Lenape have 3 years to relocate.

Charles Lacy set up a squatter camp across from Conner's Town on the Carmel side of the river. Originally it was believed that he settled in Horseshoe Prairie; There was a gentleman's agreement amount the horseshoe prairie that they wouldn't buy each others property if they had already built a cabin there. Lacy cultivated the same ground where the native Americans grew corn. He is now considered the first settler of Carmel. Since Lacy was not in Horseshoe, he didn't get bought out by Conner and was able to purchase his own land.
River Road was a Lenape trail pre-settlement; first road in Hamilton that was petitioned from Madison County to 96th

Lacy farm stayed in family until 1881, bought by Tuna Gerard, bought in 1920 John Owens and he ran a dairy farm on the property and had like the largest dairy herd. Then Eli Lilly bought it.
Conner Prairie has the archives for Conner Prairie farm

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Andy wants to be a part of the project in whatever way possible
Asked what Ball State will be doing

John Mendenhall was born 1844 - credits himself with getting the Monon built through Monon, planted all the shade trees along the early streets, talks about his grandfather Benjamin Mendenhall who had a very documented history with the Ketchums, there was a Pawnee indian that visited the family and then one day went west

Appendix 08: Elected Officials Meeting (04/14/2022)

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Elected Officals/Public Servents Meeting, 04/14
Started at about 4:45
Dave Haboush - Fire Department Director
Doug Callahan and Louanne Callahan - Clay Township Trustee
Jim Engledow - former Park Board member
MK
JB
MA
JR
NC

DC asked what percentage of the year is there standing water in that area?
CM - never really any standing water, drains so well, water dissipates almost immediately, 200 acres drain to the park

Haboush - will the boardwalk ever be underwater?
CM - no, should be out of the floodwater, boardwalk is street level, shouldn't be worried about any water reaching the boardwalk

Callahan - if the water gets that high, you better build your ark

DC - will see lots of people using the wellhouses to take family pictures and senior pictures
Will we try not to have people down in there?

No we will have the trail network system into the crater (if you will)

When it was conner prairie up there, old barns were there, crazy how it's changed, burned a few of those barns down

Paul Hensel might be someone to talk to about the history of Carmel, Hyram Hensel goes way back, when it used to be Delaware Township, when the covered bridge burned down

Doc and Sue Dillon - have also been here forever, Doc's great or great-great grandfather was on the first township board of clay, did a video with him

Been working on a Clay Township videos to record verbal history of Clay Township from people who have been living here for a long time, stop in the office and view the videos

Jerry Nichol, grandfather ran Conner Prairie, went to school in Carmel in the 50 and 60, did a video on Conner Prairie farm, helped out on the video
Is married to daughter of Phil and Nancy Hinshaw moved to Nashville and took antiques with her from Carmel, trying to convince Nancy to do a video

55 years at Conner Prairie

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DC: Harvest Church, that's not a silo, that's a corn crib for ears of corn, a silo would be 50 feet or up would have been completely enclosed and it would have fermented over time, difference between hay and straw, hay is heavy and straw is light

Haskett won't do a video but she might be a good person to talk to

DC - this site was always agriculture, Doc Dillon will tell you that he has no problem tearing old buildings down and putting new ones up

John Tag - Jim Engledow suggestion, born in Carmel
Peterson family ran the Lynnwood family farm, lived out there when his dad ran the form for Purdue

Will reach out to Haboush about emergency access

Engledow - having that extra parking at the church would help with

Debbie Gangsed executive director of CHHS, dad was Eric Clark and was principal at Carmel High School for years; her grandfather was a doctor

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THOMAS MARCUCCILLI NATURE PARK
MASTER PLAN MEETING SIGN IN SHEET

Location:	Wilfong Pavilion	**Date:**	4/14/2022
Meeting Title:	Elected Officials/Public Servants	**Time:**	4:30 PM

Name	Company/Organization	Email
Dave Haboush	Carmel Fire Dept	
Doug Callahan	Clay Twshp Trustee	
s/ Louanne Callahan	(wife)	
Jim Engledow	CCPR former Park Board	

Prepared by N. Carson 4/4/2022

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Meeting Notes

Appendix 09: Environmental Stewardship Partners Meeting (04/14/2022)

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Enviromental Stewardship Meeting, 04/14
Began about 1:10 PM
Brad Baldwin - IDNR
Daren Mindham - City of Carmel
Jill Hoffman - White River Alliance
Kevin Tungeskevik

Casey began by running through the presentation

Kevin spoke to plant species
Invasive species pressure was pretty low
Impressed by how relatively little
Teasle is one that is problematic in that area
Very unique parcel with lots of possibilities
The soils will decompose and release carbon, we will see the ground actually lower, will see the muck layer slowly shrink
Hydrology is disappearing into tiles
Wasn't squishy at all

Brad - certainly are species attracted to certain habitats, can help us figure out what animals would be attracted to the potential habitats

Brad suggested having the Eiteljorg staff help with the educational and storytelling aspects, tribal coordination

Brad - lots to explore, will do everthing we can to get through the things that are in our control, regular drain and hydrology
Everything sounds like compatible use, we are focused on restoring natural areas as well

Jill
Related to Kent - historically he has looked for regional retention possibilities, might get further in conversations if we talk about it as a regional detention
Uniqueness and water should drive the story, can connect to what happening at the river ecology center
Talk about why the wells are there, and why we chose this site for our water supply, water resources, we are the only with a deficit in Indiana - weave the water is a resource piece
Needs to be important threadline of the education
Access and circulation - if we open up the water and storage at the bottom, we are pinned in at the bottom and the neighbors might not like it, might need to get traffic and hardscape off the southern edge because the need for restoration space and for the legal drain, it makes sense for parking and accessibility to be located elsewhere besides the south edge

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Mounds Park, have not seen them in this part of the state

Casey - would like to work with this group on different types of tree species

Daren - that should be easy to give advice, will be a two second answer for us
200' clear zone for the wellheads - add that to the graphics, cannot have anything within those zones
How will we handle the perimeter? They are already encroaching all the way around, we need to make the decision, might want to use trees in the area to blocks views between park and neighbors

Jill - will have to master plan for if Kent releases the legal drain, then also if not; need to serve two masters until we can get Kent's buy in
Might be surprised how much water drains through there

The legal drain serves a relatively small drainage area

Brad - include in maintenance plan that we will maintain conveyance, won't allow water to back up

Jill - if we can't turn it into a Fen, what can we do that would still be meaningful? Add plants to benefit pollinators; or could use as education for the drainage tile system, historic drainage of wetlands, needs to still tell the story of the site
If we can't restore- if you could pick up the soil, what would be under there, excavate and show the drainage tiles, talk more about the infrastructure systems that make our current

Kevin - could still be unique or diff by planting a diff seed mix with a different plant community

Brad - indiana restoration plan approach isn't putting things back to the way it was, it is how to make it the best under the existing conditions

Kevin - water table has been brought down a lot, it would be a lot of work to restore it, it would be a lot larger than this site, the sand and gravel in the area also increases the drainage

Brad - hydrology has to be there in order to restore the fen

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THOMAS MARCUCCILLI NATURE PARK
MASTER PLAN MEETING SIGN IN SHEET

Location:	Wilfong Pavilion	**Date:**	4/14/2022
Meeting Title:	Environmental Stewardship Partners	**Time:**	1:00 PM

Name	Company/Organization	Email
Brad Baldwin	IDNR	
Daren Mindham	City of Carmel	
Jill Hoffman	White River Alliance	
Kevin Tungskevick	Ecologic	

Prepared by N. Carson 4/4/2022

Appendix 10: Working Group Meeting (04/14/2022)

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Working Group Meeting, 04/14
Mike Normand - Asst. Director of Rec & Facilities
Karen LaMere - Naturalist
Audrey Cooper - Parks & Natural Resources Coordinator
MK
JB
NC
JR
EM
MA

Mike N. - are there trees at the park currently?

A: There are a few, and far between, about 5 acres of woodland on the far east side and a smattering of other trees throughout the park

Karen reacted about the black oak, that is surprising

MK talked about working with BSU AAL to research the history and communicate and coordinate with tribes that are federally accredited and are known to be from this area, ask how they want to be involved

Karen - question on lighting - have we considered the effect of lighting on migrating birds, might want to coordinate with lights out Indianapolis, need a way to turn it off for a couple weeks during the peak migration periods - could use as a storytelling and educational opportunity

Audrey - is the plan to put the trail down in the bowl or on the ridge of the bowl, if someone is going down, how will we ensure that there are not erosion problems?

Karen - is it a steep drop?
Yes, 8-10' between street level and down, it feels like a bowl

Audrey - is grade just as steep by the wooded area?
Is a little more gradual in that area

Audrey - how long ago did they farm it?
MK - As recently as 1994 according to the aerials, legal drain going through there that is comprised of tiles
MA - it drains too well
MN - is there any water pooling?
Very free draining area, drains too well

KL - is it springy when you walk on it?
A little bit?

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CM - can use the sun and lasercut stone to do something like that and shine a story on the ground for people to read

MK send CM an email with some interp signage ideas

AC - low impact, minimalist interpretive signage, infrastructure and architecture could relate that as well

KL - need to involve the people that are there, look around you, can you find, imagine if you were here, you only get 30 seconds, 3 second glance, 30 second read, and maybe 3 minutes to read and consider if they stay

KL/MN - can we go visit the park site now?

MK gave direction where they can park and get onto the site to check it out

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Audrey - is the plan to keep it drained or bring water on site?
Depends on if we can participate in the IN SWMP program, need to determine if its been altered too much to do the restoration, would need to get legal drain released, even if we can't work INSWMP we can still work with the surveyor, MK would prefer to at least restore part of it to the wetland to where it used to be

KL - closest fens are in northern indiana, up close to ft wayne

MN asked if the wells were on opposite ends - confirmed they were and then discussed more about how the donation came about, progress on the wells
Is the church doing anything with the property now?
MK - no not right now, they want to utilize it

Karen - have you contacted the tribes yet? Things work on Indian time
Needing all the information by October would be a huge turnoff to the tribes
Making the commitment to do it the right way will go a long way
Need to be flexible with our timeline

AC - feedback from neighbors about the wellheads?
MK - sue finkam had a district meeting where they were discussed, if they were the original buyers they know that this was supposed to be a park
AC - the wellheads could look like its our fault, "why did you put this ugly thing in our backyard?" could be an opportunity to communicate well to the public that the wellheads are Carmel Utilities, you are getting a much better deal since we are working with utilities because the wellhouses will be much more beautiful than they would have gotten otherwise

AC - for the safety of the utilities, how bright does it need to be? Might attract an unpleasant crowd because of the light
MK - doing lots of research on the topic
CM - not lighting the path to deter that, recognize that people will explore the site and probably are now, we need to be conscious of blind spots as well for those same safety reasons
MK - we were very surprised that we haven't gotten any negative feedback about the lighting of the wellhouses
MN - imagine there is already a lot of light in that area from the gas station and street lights in the neighborhoods

KL - the artifacts used to be at Eagle Creek Park, Eli Lilly's entire collection of artifacts were housed at Eagle Creek Park, they were then all moved to the Eiteljorg
AC - Can use the photos on interp signage, could seen and identify which artifacts were from this site at the Eiteljorg and then use them on the interp signage

AC interp signage idea - have a way for there to be an audio recording, something on your phone, different voices telling the voices of the property, can't read it they can listen to it

KL - up at a place in Canada - they projected from the ceiling the words onto the rock and you could stand there and read the story

Meeting Notes

Appendix 11: Neighborhood Meeting (04/14/2022)

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Neighborhood Meeting, 04/14
25 People in attendance

Q: What are you going to do if the Church says no to putting the parking there? The only other option is parking in the neighborhoods and invading neighbor space.
MK something that we would have to consider. We will have a plan a, plan b, and so on.

Q: Based on passive parks in the Carmel area, how many people do we expect to be in this park on a daily basis?
MK: East Woods - has 20 spaces in parking lot and only it fills on a very nice weekend, otherwise 1-2 cars at most are there. Flowing Well gets more people even though it is passive use, it has the well that draws a lot of people to the park.

If we can't secure the parking, that will affect the amenities that we can put at the park

Q: questions about the person for who this park is named

Q: why didn't you call it a preserve? It might have attracted a different kind of personnel
MK: originally the request was to name it TMP, we asked to add nature to the name. we could have the conversation down the road to change the name to Thomas Marcuccilli nature park

Q: What is absolute bare minimum you are required to build according to statutes?
MK: picture of wellhead at 116th

Q: how much of the wellheads required 24 hour lighting, how will that lighting affect the neighbors?
MK: MKSK was brought in to make the wellhead look better, that would also act as a natural overlook of the park; pumphouse cannot be fully enclosed and for safety there needs to be a light on 24 hours a day, we made it very controlled and very soft, doing lots of research on kelvins and power of light so they don't attract wildlife,

Q: right on the edge of the park, spitting distance to the wellhead, personal preference would be to do as little as possible, no parking, no restrooms, no trails, etc. Felt that the whole process was very underhanded, when they purchased the property they were told that there would be no development there whatsoever. Lots of wildlife there, birds of prey, deer, coyote.

Q: are we going to have to leash our dogs on the park now?
MK: there is a leash law in Carmel, so if you're not on private property, you should have a leash anyway, but we won't be out there every day monitoring it

Q: going to create a lot of construction, huge challenge, hypothetical benefits, why are you doing this?
A: there is an identified need to have more park space in this area of Carmel, we are here to ask
A: there is an inherent need to have more park land, every 5 years we do a statistical survey, additional park land was identified as a need in this area, land is not easy to come by and is expensive, we go to where the land is, if this land was very desirable then it already would have been developed and there would be houses there

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Q: Isn't the area already a nature preserve?
A: no, it is not, and was never a nature preserve

Q: I know the land was donated to CCPR, was this become a nature preserve? Will this become a CCPR nature preserve? Are we the only ones that can handle this project?
A: there is no other agency that can manage this project, this is the appropriate agency to handle this project

Q: clarification on the wellheads, either way they are going to be improved, agree with what paul said it might have impact on noise levels, lift stations might cause a smell, don't like the slide number 5 with lots of people in the park; as a person that has lived here forever, create trash, teenagers, don't want to create trash and other nuisances, worried about the nuisance

C: definitely don't want toilets

C: the more active we make it, the more we are decreasing property values

C: Carmel utilities has identified that one of the wells, will need to come online in the next 2 years

C: separate area of concern is the planned development of conner prairie across the road, I have concerns about that. Is the development of this park being done in a vaccuum? Or is there coordination and discussion about developing this whole area? Is there encouragement for building this park by conner prairie?
A: there have been discussion with conner prairie and we are both keeping each other updated on what

C: Carmel Utilities needs to explain to this group why the wellheads were placed in the specific areas that they are, the lights and the wellhouses seem the most invasive part of the development, the south wellhead is the one that feels the most invasive
Make sure that sue finkam is in on that meeting, when there

We need to consider a different venue, need a single point of contact

Comments about not being able to get a hold of anyone that knows what is happening with this park, need to make sure that the MCC front desk knows what is going on with the projects and parks

Need to determine mowing boundaries especially along the southern edge of the property
Need to send letters to the neighbors that border the property, regarding boundary edges
Need to send presentation via email to all attendees that signed in

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----Email sent after meeting

To the presenters of the meeting on April 14, in Founders Park. Was is Casey & Paul?

My husband & I, Paul & Cathy Newport, attended an hour of the meeting yesterday. Sorry we had to leave for another commitment but we wanted to let Casey & Paul know how much we appreciated their presentation. We were impressed by all the research done and the thoughtfulness paid to anticipating the concerns & issues that some of our neighbors would raise. We live on the southwest corner of Community Dr & Antiquity across from the Barkers Canopy. We look forward to the possibilities that this nature park preserve will bring to our neighborhood. We believe that this property enhancement will be an added plus to the area. We appreciated the concerns that our neighbors shared concerning parking, lighting & the possibility of lesser rather than more being done to the park but felt that several of those issues you had addressed in your presentation. However, we were disappointed in their approach to voicing their concerns. We appreciated your professionalism in the handling of the portion of the meeting we attended & look forward to the future discussions concerning the creation of this nature park. Hopefully, they will be less contentious going forward.

Respectfully,

Paul & Cathy Newport
cbnewport@aol.com
765-729-5520

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THOMAS MARCUCCILLI NATURE PARK
MASTER PLAN MEETING SIGN IN SHEET

Location: Wilfong Pavilion **Date:** 4/14/2022
Meeting Title: Park Neighbors **Time:** 6:30 PM

Name	Company/Organization	Email
Frank Mutalla		Mrtaylor1@gmail.com
Paul Simpson		paul@maggiandpaul.com
Amy Harmon		[illegible]
John Harmon		" "
Billy SHANNON		WSHANNONJR@ME.com
Ryan Jones		Ryan.jones27@gmail.com
Matt Jones		m.w.wilde61@gmail.com
Kurt + Nancy Foley	The Grove Legacy	natfoley04378@aol.com
Paul + Cathy Newport	Grove Legacy	cbnewport@aol.com
Steve + ShelbiGorge	" "	shelbigeorge@gmail.com
Sharon Marshall		bscpmarsh@yahoo.com
Chris + Jill Trambach	prairie @ legacy	CHRIS.TRAMBACH@GMAIL.COM
Whitney + Steve Vogel	The Grove Resident	whitney.vogel@gmail.com
[illegible]	[illegible]	[illegible]
Sonny Beard	GROVE	BWW.REINDLE@YAHOO.COM
[illegible]	Legacy	Roadwarrior1@gmail.com
MIKE HANNIGAN	OVERLOOK	MIKESR1966@YAHOO.com
Shanell Whitney	Grove	shanellwhitney@aol.com

Prepared by N. Carson 4/4/2022

Appendix 12: Steering Committee Meeting (05/05/2022)

5/5/2022 Steering Committee Meeting Hybrid

Steve Horn primarily responsible for Harvest Church master planning process
Jessica Beer
Mark Westermeier
Sue Finkam

Church plan new building would face the park property
- Would have a predominance of glass facing the park property
- Have a space to have an amphitheater

Open to shared use parking
- Don't have definitive ideas
- HC took deference to big box retail
- There's a chasm of death that occurs between the parking lot and the building
  - There are very clear thoughts about safety and use
- Fire and access road required by fire department

There were some edges of their building that ended up being barely on bad soils, they even did tons of boring

Did HC do a lot of soil boring on the south? Casey asked Steve
They did some on the south, not a whole lot
- Most of what is on the south end is stockpiled for use at a later date
- Ask for those reports?

Mark asked how many miles of trails
- Outer section of trails is about 1.5 miles

Mark asked which tribes BSU AAL reached out to, NAT to circulate list with the recording of this meeting

Get with Kevin for a list of which federally recognized tribes he is contacting and reaching out to

Worry that during the summer anything that would have been floating will no longer be floating because the water will all be sucked out and down, they will no longer be ADA compliant either

Steve: normally parks close at dusk, do we find that there are safety concerns from the neighbors? Yes, definitely

THOMAS MARCUCCILLI NATURE PARK
MASTER PLAN
Steering Committee Meeting
May 5, 2022

Gathering nodes should be a variety of sizes, Sue likes 3 because there are not a lot of cut throughs, it is clean not a ton of stopping spots

Mark is not particularly concerned about the neighbors, some will love it and some will just move, and the people that move, then people will just move in to replace them because they want to live close to the park, parks tend to become self policed by the neighborhood, changes will be made as we figure out what is working or what is not working

Meeting Notes

Appendix 13: Neighborhood Meeting (08/17/2022)

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Neighborhood Meeting , 08/17
Began ~ 5:00 pm
With Michael Klitzing & Casey May

01:03:04 **Tom:** It's unclear where the drop off is (item K in the legend)

Appendix 14: Public Input Meeting (08/18/2022)

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Public Input Meeting , 08/18
Began ~ 6:00 pm
With Kurtis Baumgartner & Casey May

00:34:50 **Chris Trimbach:** Can you please let us know where the 170 parking spot number came from? That seems excessive for a "passive" park.

00:35:01 **Enzo Lundy (he/him):** Hello Casey! Could you repeat any questions from the in-person group for the Zoom people? I can't really hear what they're saying on your audio.

00:36:58 **MKSK Public:** The parking count in question for is shared with Harvest Church so the number has been conceptually based off of their potential need

00:39:14 **Enzo Lundy (he/him):** Are bikes accommodated in the current proposal, such as bike parking and wider trails?

00:42:15 **MKSK Public:** Currently the width of the trails is 10' to accommodate multiple modes of transportation. Of course, these dimensions are still being explored

01:04:23 **Enzo Lundy (he/him):** Very impressed with the outreach to tribes and neighbors so far! I believe telling the history of the previous peoples and land will be an essential asset for the future of Carmel!

01:06:06 **Enzo Lundy (he/him):** Since one of the goals of the park to connectivity, could you go over how the connection to the commercial dev. from surrounding neighborhoods? I'm thinking the connection between Cherry Creek and the commercial could be improved by a more direct route.

01:07:23 **Enzo Lundy (he/him):** Sorry, let me rewrite that question. What was the thought process behind the trail system and how does it better connect the surrounding neighborhoods and the commercial dev.?

01:11:14 **BBaldwin:** Could this have been developed with additional commercial or residential developments?

01:11:39 **BBaldwin:** ...if Carmel had not obtained the property, could a developer have developed it?

01:14:52 **Enzo Lundy (he/him):** Unfortunately I have to leave, but if possible, please send a link to the recording to those who registered online!

01:16:26 **MKSK Public:** The trail system was developed with several parameters including topography, soils, and accessibility. In regards to the surrounding connections these are expressing several means of pedestrian infrastructure.

01:18:17 **MKSK Public:** Regarding if this land could have been developed differently, that is something we would have no knowledge on given the site's current owner and vision

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01:19:42 **Alex Duran:** regarding the public art comment, in my opinion, I think it can be incorporated very nicely in the park. It does not have to be overwhelming and should not overreach the nature. But could be nice in the developed areas (parking lot, congregation areas)

01:20:08 **BBaldwin:** Point being, if there are concerns from adjacent property owners, the development of a nature park is better for the community, less intrusive, and ecologically preferable.

01:20:27 **MKSK Public:** That is very thoughtful and something we will consider!

01:25:17 **BBaldwin:** The removal of invasive species and the establishment of diverse natives is also a great aspect of this proposal. I would imagine that this park would increase property values while also highlighting the value of nature.

01:26:23 **BBaldwin:** The surrounding developments displaced more wildlife than a passive park would.

01:33:17 **BBaldwin:** That was solid foresight for Carmel to ensure this property would be a park and not developed when the surrounding area was rezoned (if that is what I am gathering)

01:37:25 **MKSK Public:** Yes, when the land was given to CCPR that was part of the agreement made and precisely what we are currently exploring!

01:43:27 **BBaldwin:** Great progress in the planning considerations, and community, native/ anthropologic and science involvement!

01:46:47 **MKSK Public:** Thank you, as we dive deeper into the design in the future we are sure to uncover more to consider

01:47:59 **MKSK Public:** The presentation had concluded but we will remain online to respond to any questions or comments

Appendix 15: CCPR Meeting (09/15/2022)

MKSK

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TMNP Survey Results / Next Steps Meeting , 09/15
Began ~ 9:00 am
With Michael Klitzing, Natalie Carson, Kurtis Baumgartnerk Jonathan Black, Casey May, and Saben Nusbaum

KB: Don't show restroom in wooded area and pull trails back a bit further.

MK: Pull parking along Community Drive. Show restroom and parking as location considered but based on feedback we ruled it out as a priority to include in master plan at this time.

CM: Safety around west restroom is a concern - move closer to road per feedback from Mark. Area is too secluded.

MK: Parking: as well as potential restrictive covenants and community feedback.
Drop Off: evaluated, but community feedback and other access points are likely sufficient. Keep a pedestrian overlook *near drop off location* for users. This location is a very visible place into the park but also a good place to park *cars*. In the back part of the master plan, show potential circulation patterns and include the drop off as something that can be considered if demand warrants it.

KB: Pull trails further inward in SW corner.

CM: *They* would need to be boardwalk.

MK: Constructible wise it is where it needs to be, don't want to move the trails from where they currently are.

CM: Do we need to cut back?

MK: Focus on phase-ability, we did ~ $5 million chunks, this is a good benchmark.
The more we pull trails into the center, the more we cut into habitat - what about the animals?
Consult more with wildlife experts as we work on construction documents.

CM: Put signage up where animals like to pass.

MK: Land bridges not going to happen.

CM: Need to set up another round table with Wells (Carmel Utilities) so we can discuss *Legacy* Wells so we can discuss *the* Wells - *they* will have 2 different structures now. They need to have well and electrical structures separate.

MK: South wellhead can still be anchor point to look into *the* heart of park.

CM: Will provide lots of examples of patterning in the master plan that can be used.
Need to figure out how to incorporate patterns into well buildings.
Service drive contractibility and route needs to be discussed.

MKSK

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CM: *An* option is Geoweb - floats over *the* landscape *and is a* load support system.
Could get away from huge excavation.
Could be useful for CCPR construction.
Meet with all parties first and [...]. John, MK, and CM.

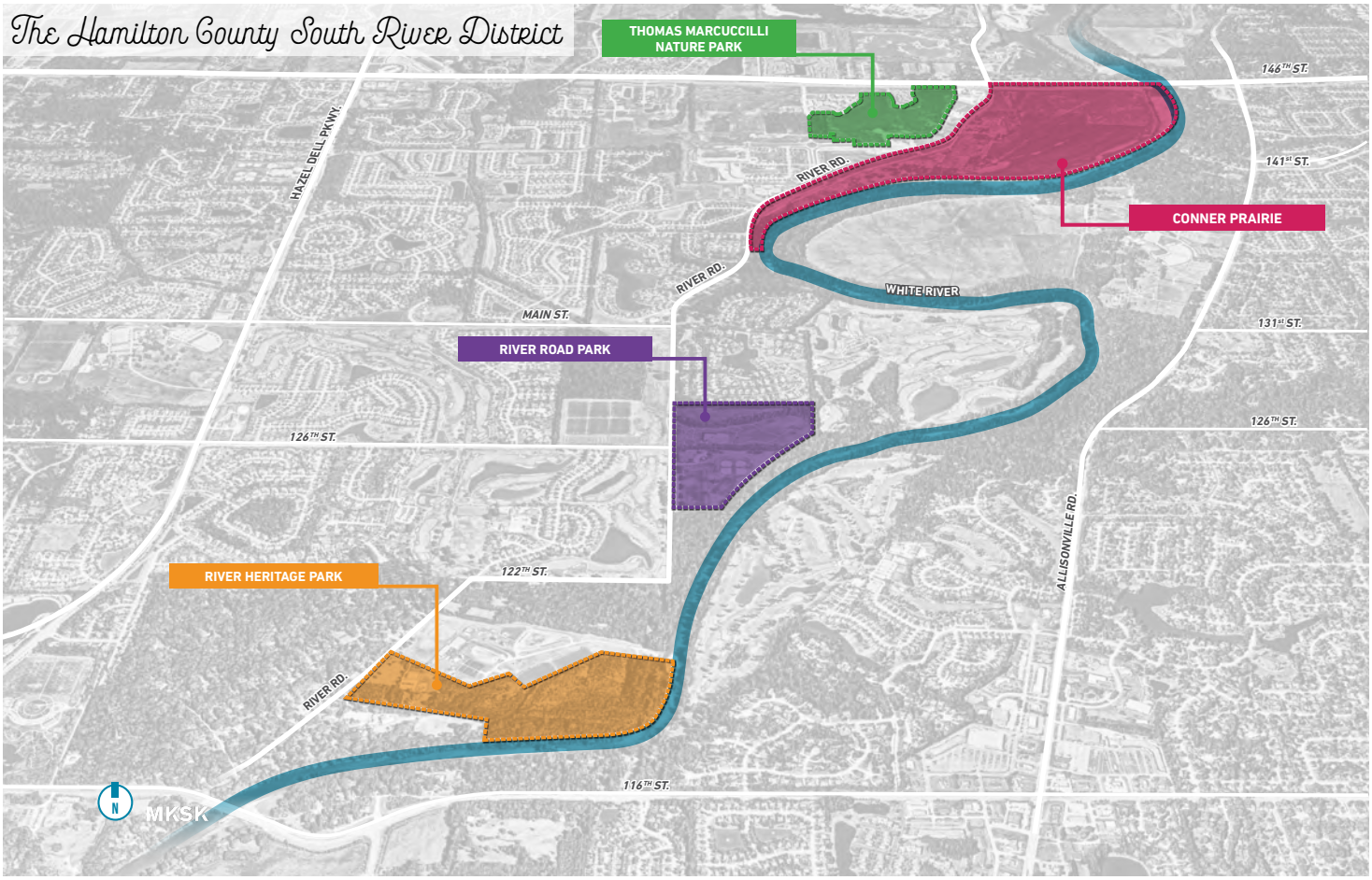
MK: Once we have final draft, should email to Steve for review.

CM: Send deliverable with phasing and survey data.

MK: When *we* present to *the* parkboard, use survey data to say here's what people said they'd want at this park. Here's why we didn't do that. Can talk about that and what the repeat requests are.

Analysis & Research

Appendix 16: Hamilton County South River District



Appendix 17: The Legacy Unit Development Plan

Illustration of Southwest Habitat

Appendix 18: Thomas Marcuccilli Nature Park - Historical Report

A. J. Wright, Historian
Carmel Clay Historical Society

Thomas Marcuccilli Nature Park – Historical Site Report

Prehistoric Findings

Ice Age fossils are rare in Carmel, but there was a significant find on the Lacy farm, part of which constitutes the northeast corner of the Thomas Marcuccilli Nature Park. In 1893, four mastodon teeth were discovered when a ditch was dug on the farm. The teeth from the upper jaw measured about eight inches across, and those from the lower jaw were about six inches. Two of the teeth weighed thirteen pounds.[1] In 1905, Joseph McDonald found part of a tooth from a mammoth in Vestal Ditch a mile west of the park site in what is now the Cherry Creek Estates subdivision.[2]

Residents have also collected artifacts from early Native Americans. Some date as far back as the Early Archaic period. Stone tools, such as arrowheads, hammers, tomahawks, whetstones and mortars and pestles, were once prevalent; hundreds, if not thousands, were found on Carmel's east side. Finds of this nature are rarer today, but they are still occasionally discovered. In 2017, a city engineer found a banner stone during the construction of a roundabout at Smoky Row Road and Gray Road. The artifact was thought to be as much as four thousand years old.[3] Archaeological finds suggest there was activity as far back as the Late Archaic period near the site of the nature park.

Lenape Site

The first people of record in what is now Carmel were the Lenape, also known as the Delaware Indians. At the time of first contact with Europeans in the early 1600s, the Lenape lived in the Delaware Valley near Philadelphia. Two centuries of European colonialism and American expansionism splintered the tribe, greatly diminished their population, and pushed them west into the Ohio River Valley. After an alliance of tribes was defeated in the Battle of Fallen Timbers in 1794, the Lenape ceded much of their land in Ohio and Pennsylvania to the United States. The Miami invited the displaced tribes to settle in their territory, allocating the area around White River to the Lenape.[4]

In August 1802, William Conner built a log trading post in a prairie on the east side of White River, where Conner Prairie is today.[5] A Lenape village developed around the trading post and came to be called Conner's Town. It extended across the river just east of the park site. Other Lenape villages in the area included Upper Delaware Town about two miles north of Conner's Town in what was known as the Horseshoe Prairie, Ketchum's Town along Cool Creek in present-day Carmel, and Lower Delaware Town, which was a half mile south of the Marion County line.[6]

During the War of 1812, Indiana Territorial Governor William Henry Harrison was concerned that the Lenape would be pulled into the conflict and give up their neutrality, so he moved the tribe from their villages along White River to an abandoned Shawnee village in Piqua, Ohio.[7] Many of the abandoned village sites along White River were burned to the ground during the war.[8] This was the fate of the village site that was located near the nature park. It was not resettled when the Lenape returned to Indiana.

The First Settler in Carmel

In 1818, John and William Conner influenced the Lenape into signing the treaty of St. Mary's in which the tribe relinquished its claim to the land along White River in exchange for a reservation west of the Mississippi River.[9] The tribe was given three years to vacate the land, after which it was opened for settlement. However, pioneers began to establish squatter settlements soon after the treaty was signed. Some settled in the prairies around William Conner's trading post.

George Shirts and his family were the first to arrive in what is now Hamilton County. They settled in Conner's Town in March 1819.[10] Later that month, Charles Lacy became the first to settle in what is now Carmel when he set up camp on the remnants of the Lenape village site on the west bank of White River opposite Conner's Town. That spring, he planted a crop of corn in a field the Lenape had cultivated for the same purpose.[11] He built a cabin and brought his wife Mary and their eight children to the site in September.[12] The northeast corner of the park site was entered by Charles Lacy in September 1822. The remainder of the park site was entered by Bethel Dunning and Benjamin Blythe in 1834 and 1835.

River Road

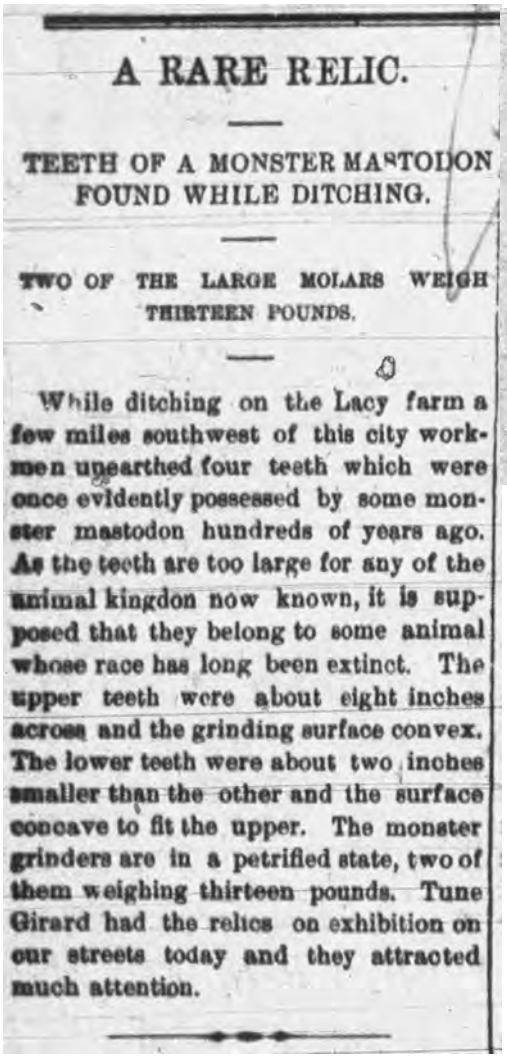
River Road was originally a Lenape trail that connected Barbara Burget's trading post on the Marion County line to the Upper Delaware Town in what came to be called the Horseshoe Prairie.[13] This trail was also part of the first county road petitioned in August 1823. The road commenced at the Madison County border just north of White River, crossed the river at Strawtown, and followed the path of the Lenape trail past Lacy's farm to Burget's trading post.[14] Parts of Hazel Dell Parkway, 116th Street and River Road follow the path of this two hundred year old road.

Later use of the Site

The Lacy farm remained in the Lacy family until Tunis Gerard purchased it in 1881.[15] Gerard sold the farm around the turn of the century. Around 1920, John Owen purchased about four hundred acres that included the old Lacy farm and the park site and operated Owen Dairies, Inc. Before the company dissolved in 1935, it had the largest herd of dairy cows in the county.[16]

In 1934 Eli Lilly purchased farms on the east and west side of White River, including the original Conner homestead and Owen's dairy, which he transformed into a horse, grain and hog farm. Lilly's massive farm covered about fifteen hundred acres and employed twenty-two full-time farmhands, many of whom lived in residences on the property. Lilly kept carpenters on staff year-round to keep the buildings and fences in good repair. The farm continued in operation on the west side of the river until the 1990s.

Plat maps dating back as far as 1866 and aerials from 1936 to the present indicate that there were no buildings on the park site. There were dwellings east of the site along River Road in the nineteenth century, and farm buildings during the Owen Dairy and Conner Prairie Farm years, but these were outside the boundaries of the park. It would be a significant discovery worthy of further investigation if a foundation is uncovered during site work for the park.



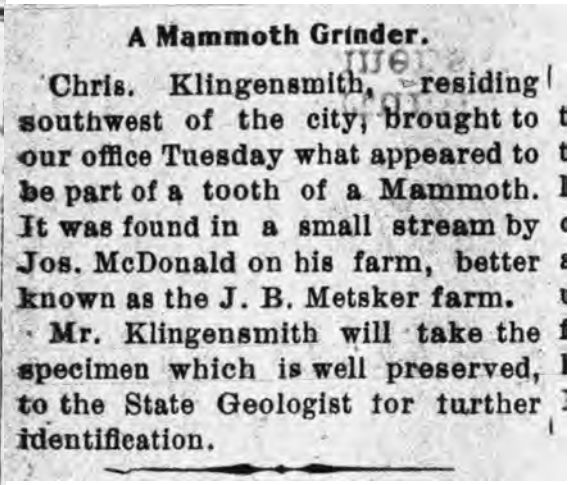
A RARE RELIC.

TEETH OF A MONSTER MASTODON FOUND WHILE DITCHING.

TWO OF THE LARGE MOLARS WEIGH THIRTEEN POUNDS.

While ditching on the Lacy farm a few miles southwest of this city workmen unearthed four teeth which were once evidently possessed by some monster mastodon hundreds of years ago. As the teeth are too large for any of the animal kingdon now known, it is supposed that they belong to some animal whose race has long been extinct. The upper teeth were about eight inches across and the grinding surface convex. The lower teeth were about two inches smaller than the other and the surface concave to fit the upper. The monster grinders are in a petrified state, two of them weighing thirteen pounds. Tune Girard had the relics on exhibition on our streets today and they attracted much attention.

Noblesville Democrat. 27 Oct 1893, pg. 8.

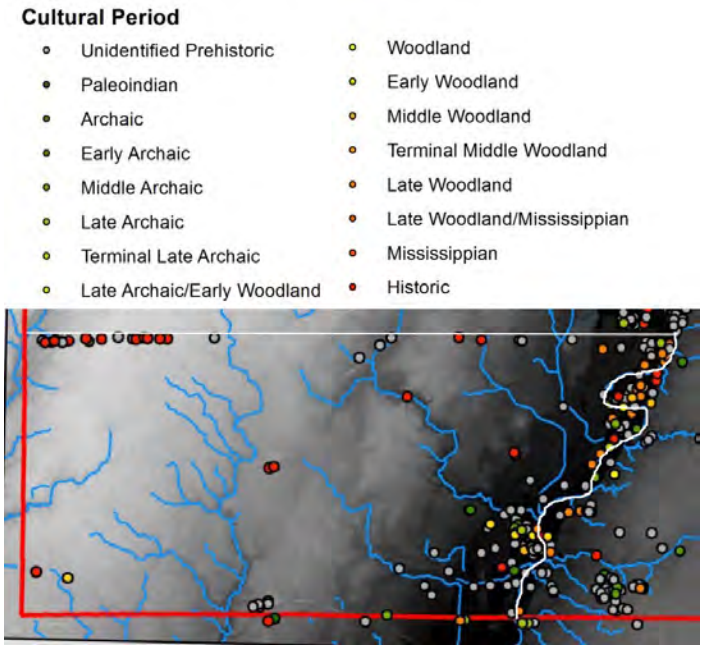


A Mammoth Grinder.

Chris. Klingensmith, residing southwest of the city, brought to our office Tuesday what appeared to be part of a tooth of a Mammoth. It was found in a small stream by Jos. McDonald on his farm, better known as the J. B. Metsker farm.

Mr. Klingensmith will take the specimen which is well preserved, to the State Geologist for further identification.

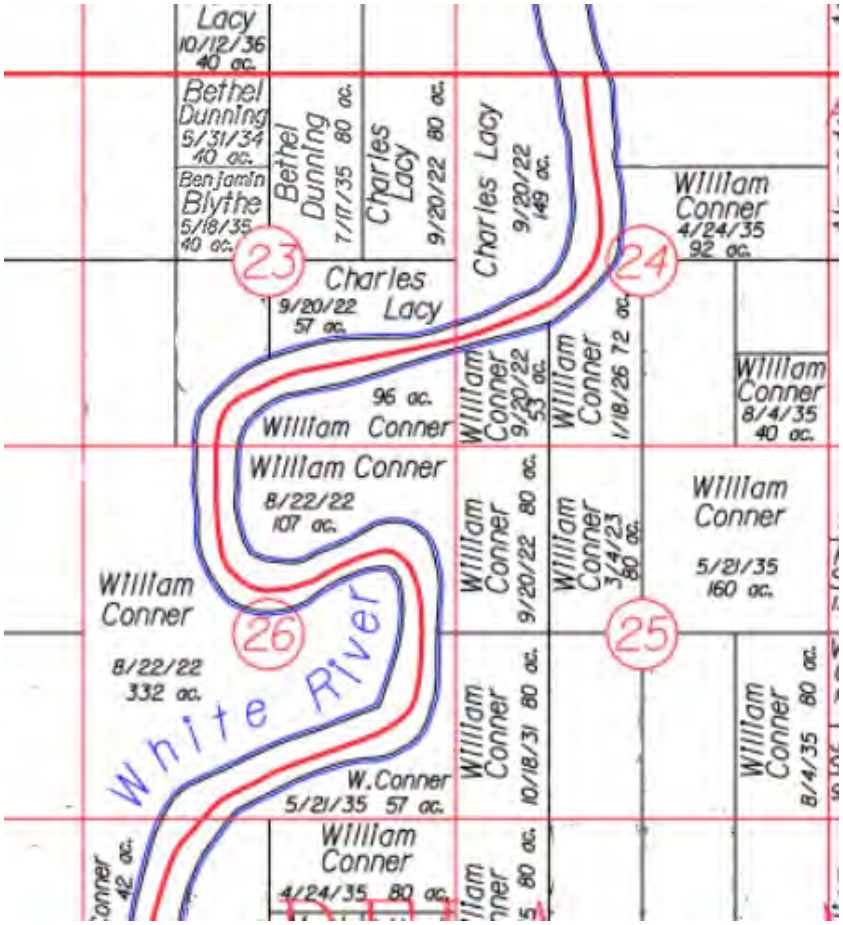
Hamilton County Ledger. 23 Jun 1905, p. 8.



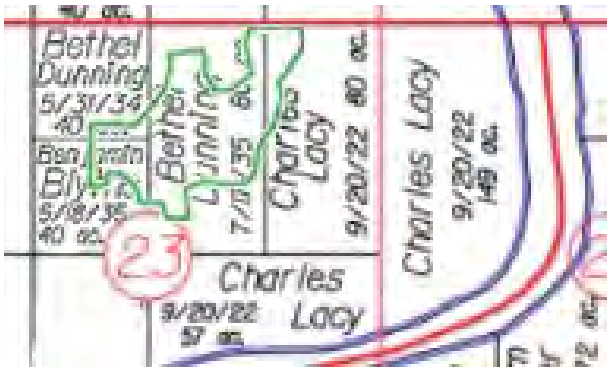
Archeological survey of Clay Township.

Park site on the archaeological survey.

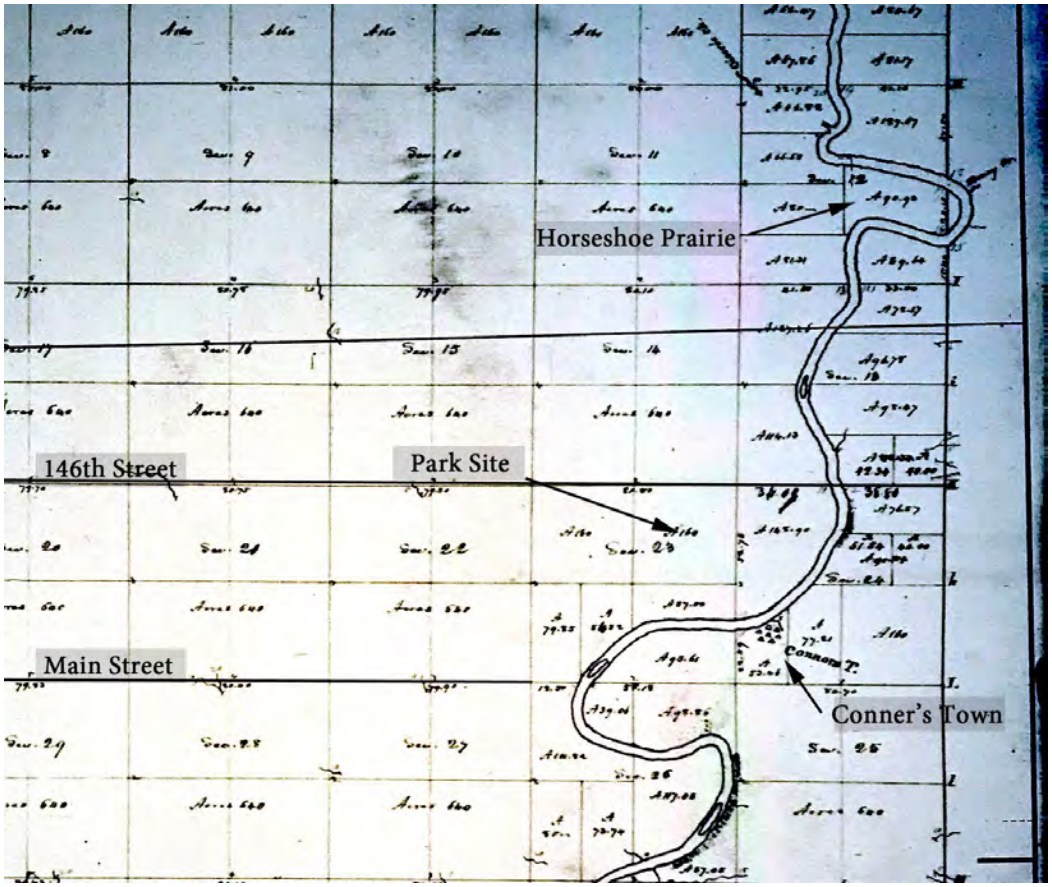
Appendix 18: Thomas Marcuccilli Nature Park - Historical Report



Original land grant map.

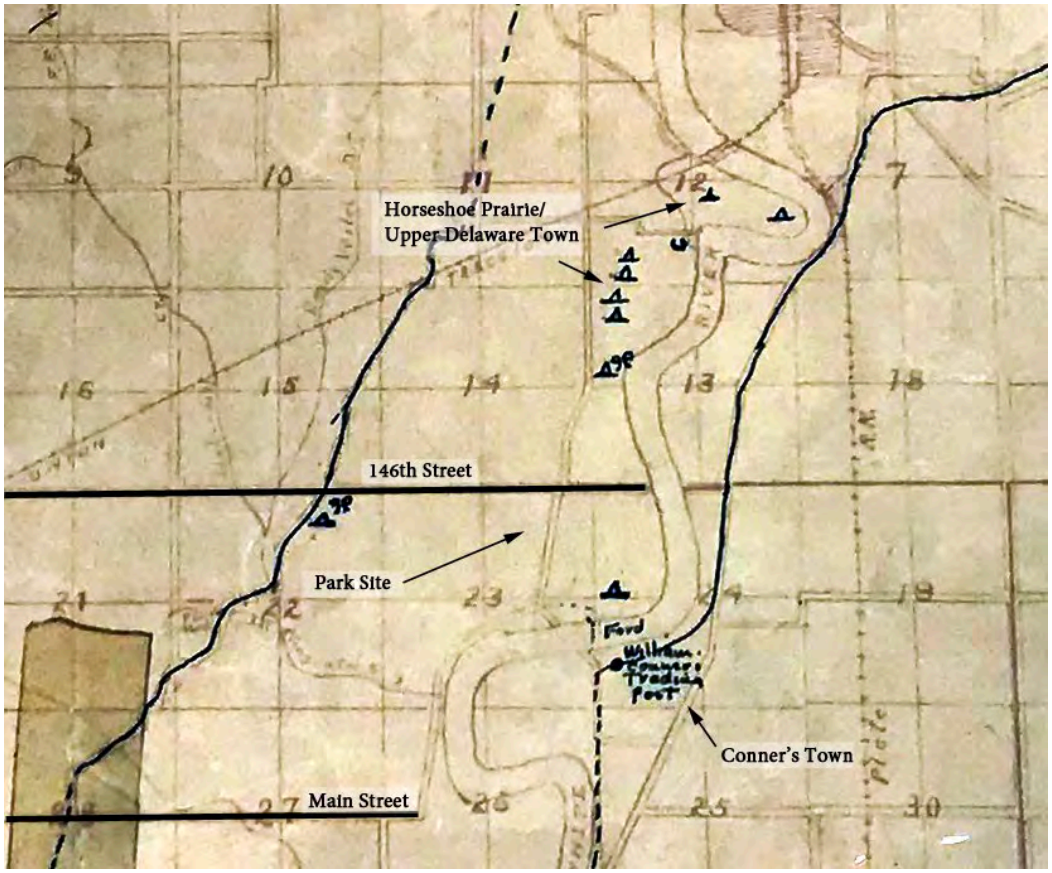


Original land grant map with park site.



This is the original land from 1820. The surveyor marked Conner's Town.

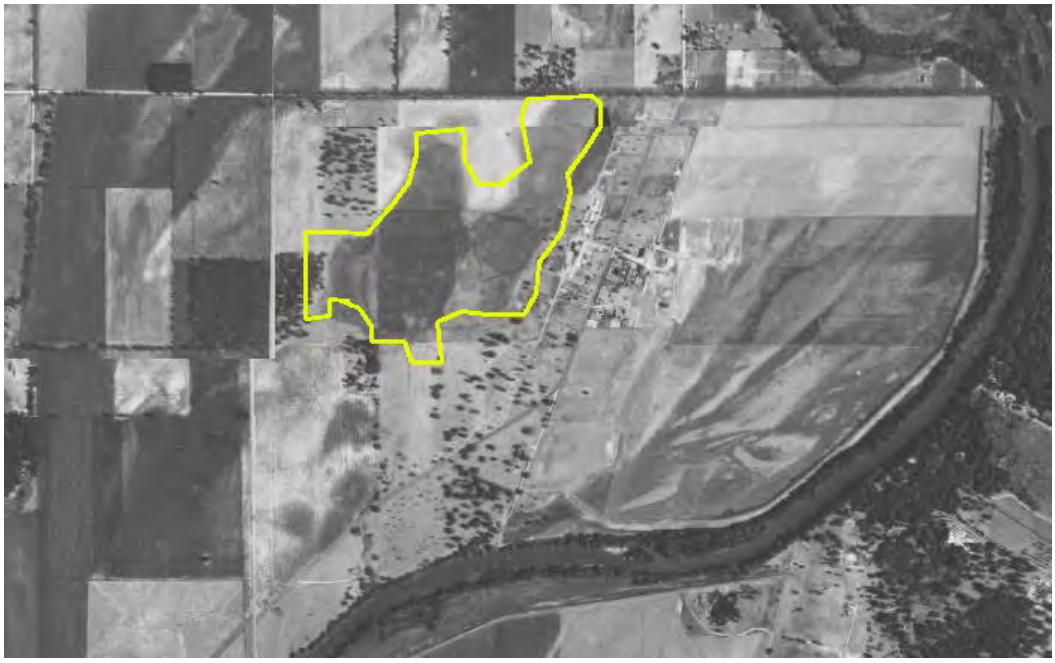
Appendix 18: Thomas Marcuccilli Nature Park - Historical Report



This is an archaeological survey of Hamilton County conducted in 1930. The archaeologist marked the site of Conner's trading post, the village on the park site and Upper Delaware Town by the Horseshoe Prairie.

2021 aerial showing the boundaries of the original Lacy holdings in relation to the park site.

Appendix 18: Thomas Marcuccilli Nature Park - Historical Report



1941 aerial of the park site. There were some farm buildings along River Road, but the park site was undeveloped.

1956 aerial of the park site.

[1] "A Rare Relic." *Noblesville Democrat.* 27 Oct 1893, p. 8.
[2] "A Mammoth Grinder." *Hamilton County Ledger.* 23 Jun 1905, p. 8.
[3] Aasen, Adam. "Artifact Found at Roundabout Site." *Current in Carmel.* 11 Jul 2017, p. 6.
[4] Weslager, C. A. *The Delaware Indian Westward Migration.* Middle Atlantic, 1978, pp. 48-52.
[5] Fletcher, Rev. J. C. "Early Days." *Indianapolis News.* 11 May 1881, p. 2.
[6] For more information on the Lenape village, see Wright, A. J. *Ketchum's Town,* Carmel Clay Historical Society, 2018.
[7] Weslager, C. A. *The Delaware Indian Westward Migration* 68-69.
[8] Eggan, Frederick R. *Report of Work Done on Archaeological Survey August 11-25, 1930.* 24 Aug, 1930, p. 6. Glenn A. Black Laboratory of Archaeology, Indiana University, Bloomington, IN; "The Voice of the People." *Indianapolis News.* 2 Apr 1896, p. 8; Dillon, John B. *A history of Indiana from its earliest exploration by Europeans to the close of the territorial government in 1816: comprehending a history of the discovery, settlement, and civil and military affairs of the territory of the U.S. northwest of the river Ohio, and a general view of the progress of public affairs in Indiana from 1816 to 1856.* Bingham & Doughty, 1859, pp. 524-525; Shirts, Augustus Finch. *A History of the Formation, Settlement and Development of Hamilton County, Indiana, from the Year 1818 to the Close of the Civil War.* 1901, p. 17.
[9] Thompson 104-107.
[10] Shirts, Augustus Finch. *A History of the Formation, Settlement and Development of Hamilton County, Indiana, from the Year 1818 to the Close of the Civil War.* 1901, pp. 23-24; Haines, John F. *History of Hamilton County, Indiana: Her People, Industries and Institutions*. Bowens, 1915, p. 9.
[11] "Another Pioneer Gone." *Hamilton County Democrat.* 9 Jan 1903, p. 1.
[12] U.S. Census Bureau. "Schedule of the whole number of persons within the division allotted to John Maxwell by the Marshal of the District (or Territory) of Indiana." Delaware, Indiana. 1820, p. 25.
[13] Thompson, Charles N. 204.
[14] Hamilton County Commissioners' Record Book A. August 1823, pp. 8-11. Hamilton County Commissioners' Office, Noblesville, IN.
[15] "Town Items." *Noblesville Ledger.* 1 Feb 1881, p. 4.
[16] "Thirty Head of Ayrshires at Owen Farm." *Noblesville Daily Ledger.* 6 Jul 1934, p. 1.; "Dissolution of Owen Dairies." *Noblesville Daily Ledger.* 18 Dec 1935, p. 5.

Analysis & Research

Appendix 19: Eco Logic March Assessment Report

Invasive Plant Mapping and Plant Community Assessment for Thomas Marcuccilli Park

Prepared for Carmel Clay Parks and Recreation

by

Kevin Tungesvick
Senior Ecologist

Eco Logic LLC
8685 West Vernal Pike
Bloomington, IN 47404

March 1, 2022

Introduction and Summary

Location and Features

Thomas Marcuccilli Park is a new park located south of 146th Street and west of River Road. This park is approximately 61 total acres. It contains an approximately 3-acre woodlot on the west side while most of the remaining portion of the park is currently in various stages of old field succession mostly on muck soil types. An extensive system of drainage tile has thoroughly drained the wetland that formerly existed on the site. No remnants of the original wetland vegetation were found in the survey.

Summary of Plant Community and Invasive Plant Mapping

The field work for this assessment was performed on Monday February 21, 2022. It involved walking transects through each plant community recording locations and densities of invasive plants at approximately 650 GPS points. Points were also taken at the boundaries of the plant communities. The character, quality, and characteristic species of each plant community were also noted during the mapping.

These GPS points were downloaded onto the Geographic Information System (GIS) program to indicate the locations of the invasive species on maps. Where an invasive was widespread within a community, a polygon was drawn outlining similar densities of that species. A total of 15 species of invasive plants were located and recorded on the maps. The current plant communities were also mapped and described.

Results

This park contains an unusually large deposit of muck soils for central Indiana. Muck soils typically form in central Indiana when groundwater saturates an area resulting in the formation of a wetland such as a marsh, fen, or sedge meadow. Over time the roots and crowns of the vegetation build up a thick layer of organic material in the anoxic saturated substrate, resulting in the formation of muck soils. Since the hydrology of this wetland has been destroyed by drainage, the muck soil will decompose over time with exposure to the atmosphere resulting in a loss of carbon storage in the soil, an unfortunate result of draining wetlands.

The 3-acre woodland is the only remnant native plant community remaining on the property. All the open areas of the property are dominated by weedy and early successional species except for some small areas where prairie has been established Given the logistical issues of attempting to restore the wetland hydrology without damaging the wellhead infrastructure or jeopardizing the surrounding developments, installation of prairie over the entire open area of the park is the best option since the muck provides a poor substrate for tree establishment.

Invasive species pressure was not as heavy as one might expect for an area largely dominated by old field vegetation. The muck soil was mostly dominated by an unidentifiable member of the mustard family as indicated by deteriorated dead stems and small basal rosettes. A return visit will be made in

early summer to identify this species of mustard and further evaluate the plant communities. Patches of invasive species such as reed canary grass and teasel were found in the muck soils, but most of the typical woody invasive species were only found around the edges of the property and in the small woodlot.

Summary of Bear Creek Plant Communities

Mature Second Growth Mesic Woodland

The woodlands contain a variety of tree species characteristic of mesic woods in central Indiana including black walnut, hackberry, shagbark hickory, northern red oak, and sugar maple. The understory contains tree sapling along with bristly greenbriar (*Smilax tamoides*), and easter wahoo (*Euonymous atropurpureus*). The common invasive species in the parcel are Amur honeysuckle (*Lonicera maackii*) and wintercreeper (*Euonymus fortunei*). Isolated specimens of multiflora rose (*Rosa multiflora*) and privet (*Ligustrum spp*) were also present.

Natural area value – 3

Buffer value - 2

Habitat value – 3

Early Successional Woodlands

This is an area of medium to large tree saplings to the east of the mature second growth woodland. The primary constituents are black walnut, hackberry, green ash, and cottonwood. Invasive species present in this area include Siberian elm (*Ulmus pumila*) and callery pear (*Pyrus calleryana*).

Natural area value – 1

Buffer value - 3

Habitat value - 1

Prairie Planting

A prairie planting is present in a strip on the northwest and west sides of the open field. Species present from the seed mix include big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), Indian grass (*Sorghastrum nutans*), prairie dock (*Silphium terebinthinacium*), bergamot (*Monarda fistulosa*), stiff goldenrod (*Solidago rigida*), Riddelli's goldenrod (*Solidago riddellii*), wild senna (*Senna hebecarpa*), prairie dropseed (*Sporobolus heterolepis*), and rosinweed (*Silphium integrifolium*). This planting varies in its quality, which is best in the area east of the woodlot.

Natural area value - 0

Buffer value - 1

Habitat value - 2

General Old Field Vegetation

This area contains a mix of weedy native and non-native species typical of old field habitats. Native species include common milkweed (*Asclepias syriaca*), stinging nettle (*Urtica gracilis*), common evening primrose (*Oenothera biennis*), Canada goldenrod (*Solidago canadensis*), and grass-leaved goldenrod (*Euthamia graminifolia*). Non-native species include common teasel (*Dipsacus fullonum*), tall fescue (*Schedonorus arundinaceus*), smooth brome (*Bromus inermis*), reed canary grass (*Phalaris arundicnaceus*) common mullein (*Verbascum thapsus*), and yellow rocket (*Barbarea vulgaris*). Of the non-native species, the teasel and reed canary grass are considered the most invasive.

Natural area value – 0

Buffer value - 1

Habitat value - 1

Stormwater Basins

A large stormwater basin is located in the southcentral portion of the property. A seed mix was sown in this basin containing species including cupplant (*Siphium perfoliatum*), switchgrass (*Panicum virgatum*), redtop (*Agrostis alba*), and prairie cordgrass (*Spartina pectinata*). Patches of invasive reed canary grass are also present.

A basin in the northeast portion of the property contains a dense stand of cattails. Finally, a horseshoe-shaped basin surrounds the development in the north central portion of the property. It shows little evidence of any seeding and is occupied by a mix of old field vegetation and some cattails in the wettest areas.

Natural area value - 0

Buffer value – 2

Habitat value - 1

Muck Plant Community

The large central portion of the property is a natural basin characterized by deep deposits of muck soils. Most of this area has been covered by a species in the mustard family (*Brassicaceae*) as evidenced by the deteriorated remains from the 2021 growing season and small green rosettes on the soil surface. The remains were insufficient to identify it to genus or species, so a return trip will be made in early summer to identify it and further evaluate the plant communities during the growing season. The only other common species in this area were copses of common elderberry (*Sambucus canadensis*), and thick stands of stinging nettles. Numerous tile blowouts and collapsed areas are present in this area and make

walking and the use of vehicles hazardous. Restoration and maintenance of this area will best be accomplished utilizing tracked vehicles due to the uneven terrain.

Natural area value – 0

Buffer value - 1

Habitat value - 1

Definitions

1. Natural areas value – Does the parcel represent a remnant natural area with intact soil profiles, intact plant communities and conservative species with a high fidelity for remnants?

2. Buffer value – Does the parcel serves as a buffer for an area deemed as a remnant natural area in question 1? Does it buffer a stream or body of water to filter runoff and absorb nutrients?

3. Habitat value – Does the parcel have value as habitat for indigenous fauna, particularly declining groups such as amphibians, native pollinators, grassland birds, or forest interior bird

Invasive Plants Present in the Surveyed Area

Trees

Callery pear (Pyrus calleryana)

This highly invasive tree is widely scattered in the old field habitats with a concentrated population near the northeastern corner of the woodlot. Just off the property along 46th street is a large population in the right-of-way near the northeastern portion of the property (not mapped). Treatment should be a high priority.

White mulberry (Morus alba)

This common invasive tree is widely scattered in the old field and prairie areas of the property. A greater concentration occurs along an old fencerow in the southeast portion of the property. Treatment should be a medium priority

Tree of heaven (Ailanthus alitssima)

Isolated specimens of this invasive tree occur in old field habitat on the property. Treatment should be a medium priority.

Siberian elm (Ulmus pumila)

A few small to medium-sized individuals occur at the edge of the early successional woods in the western portion of the property. Treatment should be a medium priority.

Black Locust (Robinia pseudoacacia)

This tree is native further south but spreads aggressively in open habitat. A couple of trees are present at the southwestern corner of the woodlot. Since they are not shade tolerant, they represent little threat to the woodlands, however if they seed into the nearby old field, they could spread rapidly. Treatment should be a medium priority.

Shrubs

Amur honeysuckle (Lonicera maackii)

This highly invasive shrubs exist at low levels throughout the woodlot with scattered denser patches along the edges. Isolated specimens are present in the old field habitats. Treatment should be a high priority.

Multiflora rose (Rosa multiflora)

A few specimens of this thorny invasive shrub are present along the edges of the woodlot. Treatment would be a medium priority

Privet (Ligustrum spp)

A single specimen of this invasive shrub was found in the woodlot. Treatment should be a low priority.

Groundcovers and Herbaceous Plants

Wintercreeper (Euonymus fortunei)

This vining groundcover flowers and fruits when it climbs trees. Several patches are present in the woodlot. Treatment should be a high priority.

Reed canary grass (Phalaris arundinacea)

This highly invasive grass occurs in several patches in the old field habitats. It is the most problematic herbaceous invasive plant of the open areas of the park. Treatment should be a high priority.

Poison Hemlock (Conium maculatum)

This aggressive toxic biennial spreads rapidly by seed in disturbed soil profiles. Treatment should be a high priority.

Common Teasel (Dipsacus fullonum)

This invasive biennial is widespread in the old field habitats. Treatment should be a high priority.

Canada Thistle (Cirsium arvense)

This rhizomatous perennial was found around the outlet of the southern stormwater basin. It likely occurs elsewhere, however the plants were badly deteriorated in late winter, and therefore easily overlooked. Treatment should be a medium priority.

Common Reed (Phragmites australis)

This large rhizomatous grass occurs in a few isolated locations on the property. It is likely to be a significant problem in moist areas. Treatment should be a medium priority.

Hybrid cattails (Typha X glauca)

Cattails are restricted to the wettest areas of the stormwater basins. They are unlikely to spread anywhere else on the property due to a lack of hydrology. Treatment should be a low priority.

Figure 1: Large northern red oak in the woodlot

Figure 2: Prairie dropseed in the prairie planting

Figure 3: A successful portion of the prairie planting

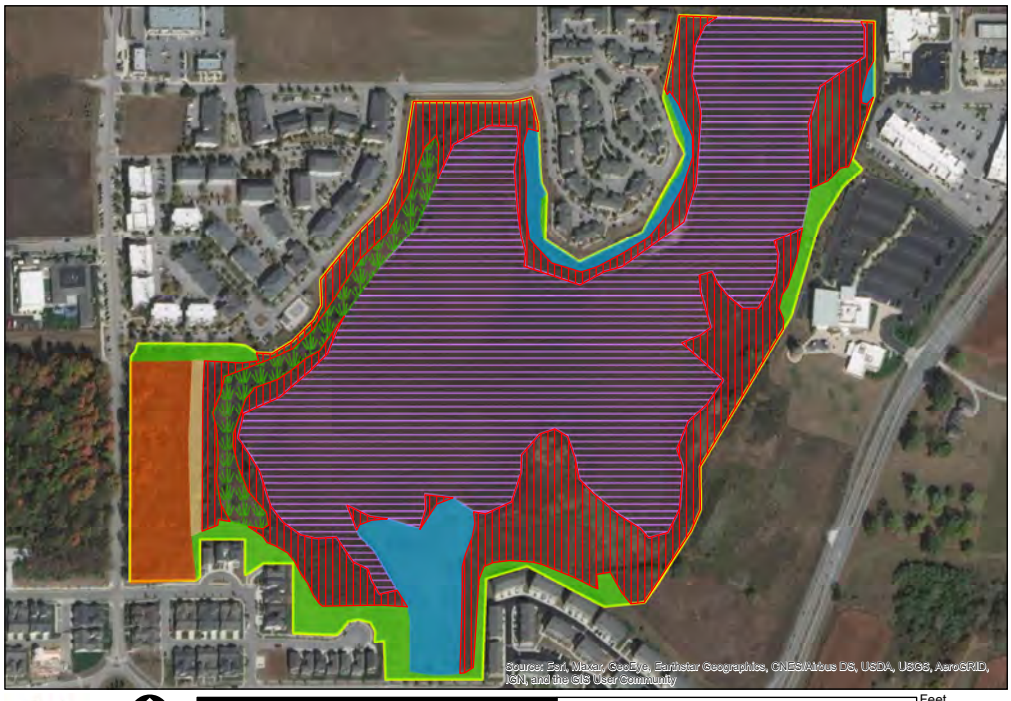
Appendix 19: Eco Logic March Assessment Report

Figure 4: Typical muck soil

Figure 5: Drainage tile blowout

Figure 6: Basal rosette of unknown mustard species

Thomas Marcuccilli Park Plant Communities

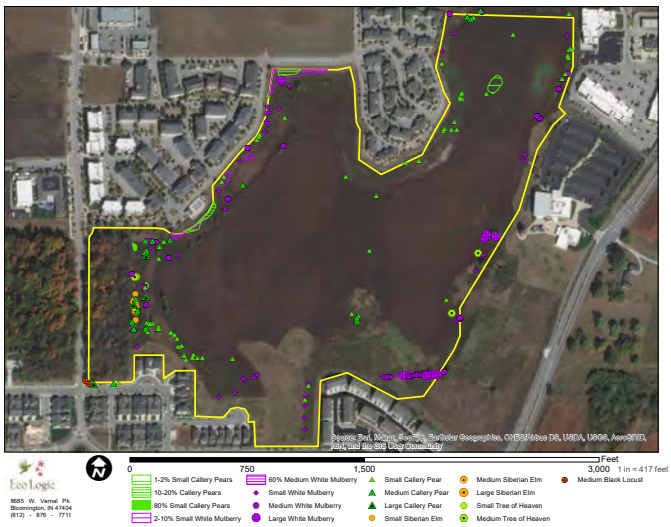


Eco Logic
8685 W. Vernal Pk.
Bloomington, IN 47404
(812) - 876 - 7711

0 750 1,500 3,000 Feet 1 in = 417 feet

- Mature 2nd Growth Mesic Woodland
- Young Successional Woodland
- General Old-field Vegetation
- Prairie Planting
- Muck Plant Community
- Storm Water Basins
- Lawn Areas

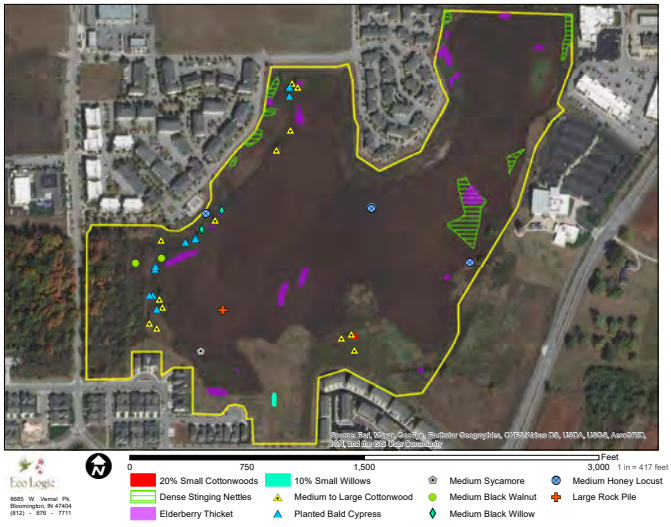
Thomas Marcuccilli Park Invasive Trees



Thomas Marcuccilli Park Invasive Shrubs

Thomas Marcuccilli Park Invasive Groundcovers and Herbaceous Plants

Thomas Marcuccilli Park Native Trees in Open Areas and other Notable Plant Populations



Analysis & Research

Appendix 20: Eco Logic June Assessment Report

Plant Community Growing Season Update for Thomas Marcuccilli Park

Prepared for Carmel Clay Parks and Recreation

by

Kevin Tungesvick
Senior Ecologist

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Prairie Dropseed in the prairie planting

June 16, 2022

Eco Logic

Thomas Marcuccilli Nature Park Plant Community Updates

Mature Second Growth Mesic Woodland

This visit allowed a detailed inventory of the herbaceous layer not possible during the late winter survey. The herbaceous layer is dominated by native species typical of second growth woodlands with a history of disturbances such as logging and grazing. Common graminoid components include early wild rye (*Elymus macgregorii*), burreed sedge (*Carex sparganioides*), grass sedge (*Carex jamesii*), and common wood sedge (*Carex blanda*). Common forbs included smooth solomon's seal (*Polygonatum biflorum*), largeleaf waterleaf (*Hydrophyllum macrophyllum*), clustered black snakeroot (*Sanicula odorata*), common blue violet (*Viola sororia*), prairie trillium (*Trillium recurvatum*), mayapple (*Podophyllum peltatum*), white snakeroot (*Ageratina altissima*), jumpseed (*Persicaria virginiana*), enchanter's nightshade (*Circaea canadensis*), Solomon's plume (*Maianthemum racemosum*), and white aven's (*Geum canadense*). A few patches of the invasive garlic mustard (*Alliaria petiolata*) are present along the western margin of the woodlot.

Early Successional Woodlands

No significant updates to this area. The herbaceous layer is sparse in the mostly shaded areas and resembles the old field habitats in the more open areas.

Prairie Planting

The prairie planting varies in diversity with the southwestern portions generally more diverse than the northeastern portions. Prairie graminoid species present include big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), Indian grass (*Sorghastrum nutans*), and prairie dropseed (*Sporobolus heterolepis*). The forb community is relatively diverse and includes foxglove beardtongue (*Penstemon digitalis*), bergamot (*Monarda fistulosa*), wild senna (*Senna hebecarpa*), prairie dock (*Silphium terebinthinaceum*), rosinweed (*Silphium integrifolium*), Riddell's goldenrod (*Solidago riddellii*), stiff goldenrod (*Solidago rigida*), black-eyed susan (*Rudbeckia hirta*), dense blazing star (*Liatris spicata*), mountain mint (*Pycnanthemum virginianum*), yellow coneflower (*Ratibida pinnata*), common evening primrose (*Oenothera biennis*), sawtooth sunflower (*Helianthus grosseserratus*), white false indigo (*Baptisia alba*), hairy beardtongue (*Penstemon hirsutus*), western sunflower (*Helianthus occidentalis*), lanceleaf coreopsis (*Coreopsis lanceolata*), pale purple coneflower (*Echinacea pallida*), purple prairie clover (*Dalea purpurea*), narrowleaf mountain mint (*Pycnanthemum tenuifolium*), butterfly weed (*Asclepias tuberosa*), wild quinine (*Parthenium integrifolium*), plains coreopsis (*Coreopsis palmata*), rattlesnake master (*Eryngium yuccifolium*), tall ironweed (*Vernonia altissima*), New England aster (*Symphyotrichum novae-angliae*), sweet black-eyed susan (*Rudbeckia subtomentosa*), and showy black-eyed susan (*Rudbeckia sullivantii*). This community appears quite healthy despite a lack of maintenance and is an excellent example of a potential plant community in the muck soil areas of the park where the hydrology cannot be restored.

Figure 1: Prairie planting with flowering foxglove beardtongue

General Old Field Vegetation

The addition of nodding thistle (*Carduus nutans*), crownvetch (*Securigera varia*), sweet clover (*Melilotus spp*), and more Canada thistle (*Cirsium arvense*) are the noteworthy updates to the invasive plant presence in this area.

Stormwater Basins

There is little new to describe in the south basin except an increase in the coverage of reed canary grass (*Phalaris arundinacea*) and Canada thistle. The horseshoe-shaped north basins show a large increase in the number and coverage of herbaceous invasive species especially Canada thistle, musk thistle, and crownvetch. These basins and the surrounding berms have the worst concentration of invasive species on the property. Since the berms are also elevated and have excellent views across the property, this may be an area to focus public use including paved paths with mown buffers and tree plantings.

Muck Plant Community

This growing season evaluation revealed the two dominant plant species to be native common ragweed (*Ambrosia artemisiifolia*) and the non-native field pennycress *(Thlapsi arvense*) which is the mustard

species mentioned in the late winter report. Other common weedy natives include hedge bindweed (*Calystegia sepium*), common milkweed (*Asclepias syriaca*), cleavers (*Galium aparine*), wild potato vine *(Ipomoea pandurata*), Pennsylvania smartweed (*Persicaria pensylvanica*), stinging nettle (*Urtica gracilis*), and common evening primrose (*Oenothera biennis*). An assortment of old field weeds and Eurasian grasses described in the old field description in the late winter report are present in scattered patches mostly along the edges of this area. Aggressive native prairie forbs such as bergamot and wild senna are seeding into the muck areas adjacent to the prairie planting.

Additional Herbaceous Invasive Species found During the June Survey

Canada Thistle (Cirsium arvense)

While this plant was found during the late winter survey, much additional coverage was evident at the time of the June survey including patches both north and south of the large muck deposit. Treatment should be a high priority.

Figure 2: Nodding thistle

Nodding thistle (Carduus nutans)

This large invasive biennial thistle was found in numerous locations along the boundary of the old field and muck plant communities. It is an aggressive invader of open old field habitats. Treatment should be a high priority.

Sweet Clover (Melilotus spp)

These biennial legumes are common in old field habitats and were found on the berm around the storm water basins in the northern section of the park. They can be uniquely problematic in prairie plantings that are managed with prescribed fire as their seed is stimulated to germinate by the heat of fire. Treatment should be a medium priority.

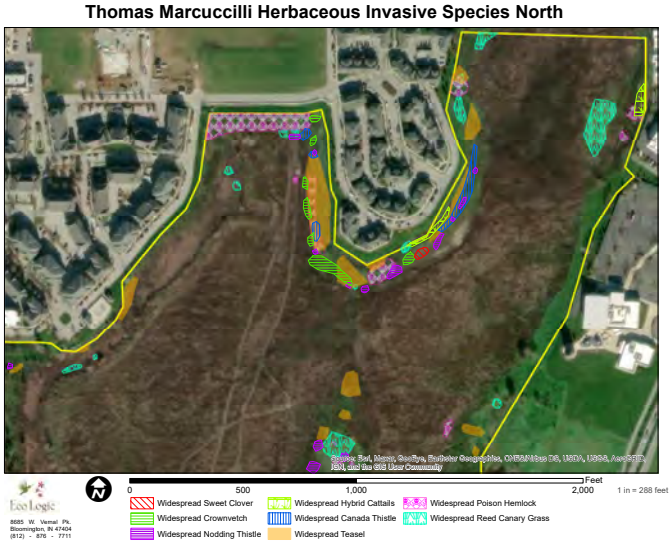
Crownvetch (Securigera varia)

This invasive groundcover has formed large patches in several places along the berm in old field habitats adjacent to the horseshoe-shaped storm water basin in the northern section of the property. It is a highly problematic species in prairie plantings since the lush spring growth tends to smother prairie plants. Treatment should be a high priority.

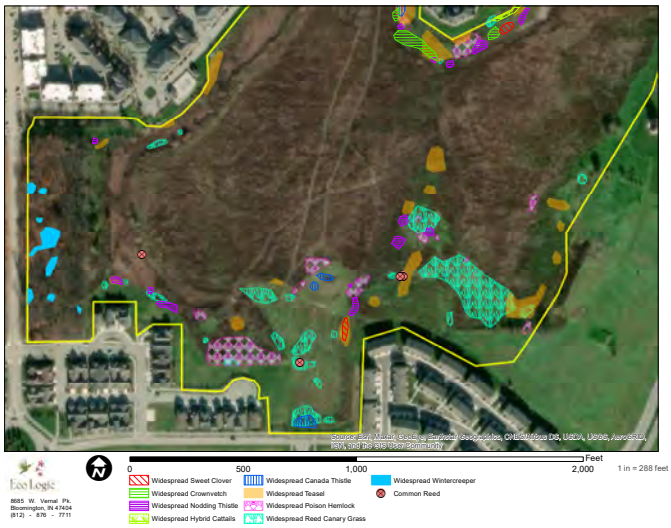
Figure 3: Nodding thistle and poison hemlock on the berm around the north stormwater basins

Figure 4: Muck community showing common ragweed in the lower left with wild senna from the prairie in the center

Thomas Marcuccilli Herbaceous Invasive Species North



Thomas Marcuccilli Herbaceous Invasive Species South



Analysis & Research

Appendix 21: Web Soil Survey

United States Department of Agriculture

NRCS

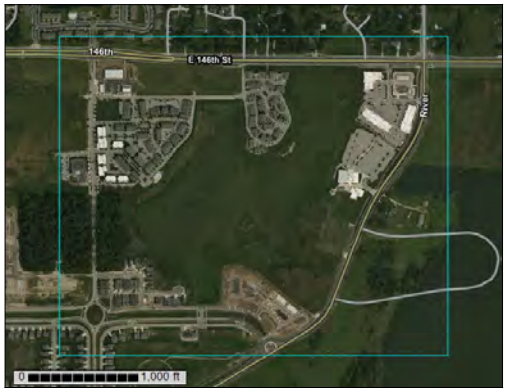
Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Hamilton County, Indiana

Thomas Marcuccilli Nature Park



June 21, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Analysis & Research

Appendix 21: Web Soil Survey

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Hamilton County, Indiana
Survey Area Data: Version 22, Sep 9, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 1, 2018—Sep 30, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
FnA	Fox loam, 0 to 2 percent slopes	5.3	2.3%
FnB2	Fox loam, 2 to 6 percent slopes, eroded	3.0	1.3%
FxC3	Fox clay loam, 8 to 18 percent slopes, severely eroded	8.3	3.5%
Ho	Houghton muck	3.5	1.5%
OcA	Ockley silt loam, 0 to 2 percent slopes	31.7	13.6%
OcB2	Ockley silt loam, 2 to 6 percent slopes, eroded	2.7	1.2%
Pa	Palms muck	39.9	17.1%
Pt	Pits	0.0	0.0%
Ro	Ross loam, 0 to 2 percent slopes, occasionally flooded	0.8	0.3%
UhdAN	Urban land-Houghton muck complex, 0 to 2 percent slopes, drained	12.3	5.3%
We	Westland silty clay loam, 0 to 2 percent slopes	0.1	0.1%
YfpB2	Fox loam-Urban land complex, 2 to 6 percent slopes, eroded	14.0	6.0%
YfpD3	Fox clay loam-Urban land complex, 8 to 18 percent slopes, severely eroded	18.4	7.9%
YoxA	Ockley silt loam-Urban land complex, 0 to 2 percent slopes	78.0	33.3%
YoxB2	Ockley silt loam-Urban land complex, 2 to 6 percent slopes, eroded	5.3	2.3%
YpkAN	Palms muck-Urban land complex, 0 to 2 percent slopes	2.8	1.2%
YsnA	Sleeth loam-Urban land complex, 0 to 2 percent slopes	1.9	0.8%
YwqA	Westland silty clay loam-Urban land complex, 0 to 2 percent slopes	5.7	2.4%
Totals for Area of Interest		**234.1**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas

shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Hamilton County, Indiana

FnA—Fox loam, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: 2t68b
Elevation: 340 to 1,000 feet
Mean annual precipitation: 37 to 46 inches
Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 145 to 180 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Fox and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fox

Setting
Landform: Stream terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy outwash over sandy and gravelly outwash

Typical profile
Ap - 0 to 8 inches: loam
Bt1 - 8 to 22 inches: clay loam
Bt2 - 22 to 33 inches: gravelly clay loam
2C - 33 to 79 inches: very gravelly sand

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: 30 to 45 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 55 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.9 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: B
Ecological site: F111AY015IN - Dry Outwash Upland
Hydric soil rating: No

Minor Components

Ockley
Percent of map unit: 14 percent
Landform: Stream terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F111AY015IN - Dry Outwash Upland
Hydric soil rating: No

Westland, drained
Percent of map unit: 4 percent
Landform: Swales on stream terraces, depressions on stream terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave
Across-slope shape: Concave
Ecological site: R111AY016IN - Outwash Mollisol
Hydric soil rating: Yes

Whitaker
Percent of map unit: 2 percent
Landform: Stream terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F111AY014IN - Outwash Upland
Hydric soil rating: No

FnB2—Fox loam, 2 to 6 percent slopes, eroded

Map Unit Setting
National map unit symbol: 2w55z
Elevation: 490 to 1,150 feet
Mean annual precipitation: 37 to 46 inches
Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 145 to 180 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Fox, eroded, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Analysis & Research

Appendix 21: Web Soil Survey

Description of Fox, Eroded

Setting
Landform: Stream terraces, till plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Loamy outwash over sandy and gravelly outwash

Typical profile
Ap - 0 to 8 inches: loam
Bt1 - 8 to 18 inches: loam
Bt2 - 18 to 25 inches: sandy loam
Bt3 - 25 to 36 inches: gravelly sandy loam
2C - 36 to 79 inches: stratified very gravelly loamy coarse sand to gravelly sand to sand

Properties and qualities
Slope: 2 to 6 percent
Depth to restrictive feature: 32 to 39 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 45 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.9 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Ecological site: F111AY015IN - Dry Outwash Upland
Hydric soil rating: No

Minor Components

Ockley
Percent of map unit: 8 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F111AY015IN - Dry Outwash Upland
Hydric soil rating: No

Fox, till substratum
Percent of map unit: 6 percent
Landform: Stream terraces on till plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread

Down-slope shape: Linear, convex
Across-slope shape: Linear
Ecological site: F111AY015IN - Dry Outwash Upland
Hydric soil rating: No

Westland, drained
Percent of map unit: 6 percent
Landform: Depressions on stream terraces, swales on stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex, concave, linear
Across-slope shape: Linear, concave
Ecological site: R111AY016IN - Outwash Mollisol
Hydric soil rating: Yes

FxC3—Fox clay loam, 8 to 18 percent slopes, severely eroded

Map Unit Setting
National map unit symbol: 5d9x
Elevation: 720 to 980 feet
Mean annual precipitation: 36 to 42 inches
Mean annual air temperature: 49 to 52 degrees F
Frost-free period: 175 to 185 days
Farmland classification: Not prime farmland

Map Unit Composition
Fox, severely eroded, and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fox, Severely Eroded

Setting
Landform: Terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy outwash over sandy and gravelly outwash

Typical profile
H1 - 0 to 7 inches: clay loam
H2 - 7 to 28 inches: clay loam
H3 - 28 to 60 inches: very gravelly coarse sand

Properties and qualities
Slope: 8 to 18 percent
Depth to restrictive feature: 20 to 40 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 55 percent
Available water supply, 0 to 60 inches: Low (about 4.3 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: F111AY015IN - Dry Outwash Upland
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

Ho—Houghton muck

Map Unit Setting
National map unit symbol: 5db0
Elevation: 720 to 980 feet
Mean annual precipitation: 36 to 42 inches
Mean annual air temperature: 49 to 52 degrees F
Frost-free period: 175 to 185 days
Farmland classification: Not prime farmland

Map Unit Composition
Houghton, drained, and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Houghton, Drained

Setting
Landform: Depressions on outwash plains
Landform position (two-dimensional): Toeslope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Herbaceous organic material

Typical profile
Oa1 - 0 to 60 inches: muck

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 6.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 10 percent
Available water supply, 0 to 60 inches: Very high (about 23.9 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Ecological site: R111AY003IN - Deep Muck
Other vegetative classification: Mixed/Transitional (Mixed Native Vegetation)
Hydric soil rating: Yes

OcA—Ockley silt loam, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: 2t4ld
Elevation: 600 to 1,250 feet
Mean annual precipitation: 37 to 45 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 145 to 180 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Ockley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ockley

Setting
Landform: Stream terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess over loamy outwash over sandy and gravelly outwash

Typical profile
Ap - 0 to 10 inches: silt loam
BA - 10 to 15 inches: silt loam
Bt1 - 15 to 18 inches: silt loam
Bt2 - 18 to 37 inches: clay loam
2Bt3 - 37 to 49 inches: gravelly sandy clay loam
3C - 49 to 79 inches: stratified very gravelly coarse sand to gravelly loamy coarse sand

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: 40 to 72 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 50 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.8 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B
Ecological site: F111AY015IN - Dry Outwash Upland
Hydric soil rating: No

Minor Components

Wawaka
Percent of map unit: 5 percent
Landform: Till plains on outwash plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F111AY015IN - Dry Outwash Upland
Hydric soil rating: No

Fox
Percent of map unit: 5 percent
Landform: Outwash terraces
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F111AY015IN - Dry Outwash Upland
Hydric soil rating: No

Digby
Percent of map unit: 3 percent
Landform: Outwash plains, glacial drainage channels
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear, concave
Ecological site: F111AY014IN - Outwash Upland
Hydric soil rating: No

Haney
Percent of map unit: 2 percent
Landform: Outwash plains, glacial drainage channels
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear, concave
Ecological site: F111AY014IN - Outwash Upland
Hydric soil rating: No

OcB2—Ockley silt loam, 2 to 6 percent slopes, eroded

Map Unit Setting
National map unit symbol: 2t4lq
Elevation: 400 to 1,180 feet
Mean annual precipitation: 37 to 46 inches
Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 155 to 180 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Ockley, eroded, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ockley, Eroded

Setting
Landform: Stream terraces
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loess over loamy outwash over sandy and gravelly outwash

Typical profile
Ap - 0 to 8 inches: silt loam
BA - 8 to 15 inches: silt loam
Bt1 - 15 to 18 inches: silt loam
2Bt2 - 18 to 37 inches: clay loam
2Bt3 - 37 to 49 inches: gravelly sandy clay loam
3C - 49 to 79 inches: stratified very gravelly coarse sand to extremely gravelly loamy coarse sand

Properties and qualities
Slope: 2 to 6 percent
Depth to restrictive feature: 40 to 72 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 50 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.8 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Ecological site: F111AY015IN - Dry Outwash Upland
Hydric soil rating: No

Minor Components

Westland
Percent of map unit: 5 percent
Landform: Depressions on stream terraces, swales on stream terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: R111AY016IN - Outwash Mollisol
Hydric soil rating: Yes

Ockley, eroded, till substratum
Percent of map unit: 5 percent
Landform: Stream terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F111AY015IN - Dry Outwash Upland
Hydric soil rating: No

Sleeth
Percent of map unit: 5 percent
Landform: Channels on stream terraces, stream terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Ecological site: F111AY014IN - Outwash Upland
Hydric soil rating: No

Pa—Palms muck

Map Unit Setting
National map unit symbol: 5dbd
Elevation: 720 to 980 feet
Mean annual precipitation: 36 to 42 inches
Mean annual air temperature: 49 to 52 degrees F
Frost-free period: 175 to 185 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Palms, drained, and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Palms, Drained

Setting
Landform: Depressions on till plains, depressions on terraces
Landform position (two-dimensional): Toeslope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Herbaceous organic material over loamy till

Typical profile
Oa1 - 0 to 29 inches: muck
H2 - 29 to 60 inches: clay loam

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 1.00 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 60 percent
Available water supply, 0 to 60 inches: Very high (about 17.2 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Ecological site: R111AY001IN - Mineral Muck
Other vegetative classification: Mixed/Transitional (Mixed Native Vegetation)
Hydric soil rating: Yes

Pt—Pits

Map Unit Setting
National map unit symbol: 5dbh
Elevation: 720 to 980 feet
Mean annual precipitation: 36 to 42 inches
Mean annual air temperature: 49 to 52 degrees F
Frost-free period: 175 to 185 days
Farmland classification: Not prime farmland

Map Unit Composition
Pits: 90 percent
Minor components: 3 percent

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Appendix 21: Web Soil Survey

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pits

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Other vegetative classification: Mixed/Transitional (Mixed Native Vegetation)
Hydric soil rating: No

Minor Components

Water

Percent of map unit: 3 percent
Hydric soil rating: No

Ro—Ross loam, 0 to 2 percent slopes, occasionally flooded

Map Unit Setting

National map unit symbol: 2w564
Elevation: 540 to 1,010 feet
Mean annual precipitation: 37 to 45 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 145 to 180 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Ross and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ross

Setting

Landform: Flood-plain steps
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium

Typical profile

Ap - 0 to 23 inches: loam
Bw - 23 to 54 inches: loam
C - 54 to 79 inches: loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 45 to 54 inches
Frequency of flooding: OccasionalNone
Frequency of ponding: None
Calcium carbonate, maximum content: 20 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 11.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B
Ecological site: F111DY004IN - Dry Alluvium
Hydric soil rating: No

Minor Components

Sloan

Percent of map unit: 5 percent
Landform: Flood-plain steps, backswamps, meander scars
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: F111DY003IN - Wet Alluvium
Hydric soil rating: Yes

Genesee

Percent of map unit: 5 percent
Landform: Natural levees on flood-plain steps
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: F111DY004IN - Dry Alluvium
Hydric soil rating: No

Eel

Percent of map unit: 5 percent
Landform: Flood-plain steps
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F111DY004IN - Dry Alluvium
Hydric soil rating: No

UhdAN—Urban land-Houghton muck complex, 0 to 2 percent slopes, drained

Map Unit Setting

National map unit symbol: 2y47w
Elevation: 700 to 1,040 feet

Mean annual precipitation: 36 to 46 inches
Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 145 to 185 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 60 percent
Houghton, drained, and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Houghton, Drained

Setting

Landform: Depressions on outwash plains
Landform position (two-dimensional): Toeslope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Herbaceous organic material

Typical profile

Oa1 - 0 to 60 inches: muck

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 6.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 10 percent
Available water supply, 0 to 60 inches: Very high (about 23.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Ecological site: R111AY003IN - Deep Muck
Other vegetative classification: Mixed/Transitional (Mixed Native Vegetation)
Hydric soil rating: Yes

We—Westland silty clay loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2t4m1
Elevation: 400 to 1,000 feet
Mean annual precipitation: 37 to 46 inches
Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 155 to 180 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Westland, drained, and similar soils: 70 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Westland, Drained

Setting

Landform: Depressions on stream terraces, swales on stream terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Loess over loamy outwash over sandy and gravelly outwash

Typical profile

Ap - 0 to 10 inches: silty clay loam
Btg1 - 10 to 21 inches: silty clay loam
2Btg2 - 21 to 37 inches: clay loam
2BCg - 37 to 47 inches: loam
3Cg - 47 to 79 inches: stratified extremely gravelly coarse sand to coarse sand to gravelly loamy coarse sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 40 to 60 inches to strongly contrasting textural stratification
Drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 55 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B/D
Ecological site: R111AY016IN - Outwash Mollisol
Hydric soil rating: Yes

Minor Components

Mahalaland, drained

Percent of map unit: 15 percent
Landform: Terraces, outwash terraces, depressions on terraces, swales on terraces, flats on terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Hydric soil rating: Yes

Treaty, drained
Percent of map unit: 9 percent
Landform: Till plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: F111AY007IN - Till Depression Flatwood
Other vegetative classification: Mixed/Transitional (Mixed Native Vegetation)
Hydric soil rating: Yes

Sleeth
Percent of map unit: 6 percent
Landform: Stream terraces, outwash terraces
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F111AY014IN - Outwash Upland
Hydric soil rating: No

YfIB2—Fox loam-Urban land complex, 2 to 6 percent slopes, eroded

Map Unit Setting
National map unit symbol: 2w57r
Elevation: 700 to 1,040 feet
Mean annual precipitation: 37 to 46 inches
Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 145 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition
Fox, eroded, and similar soils: 55 percent
Urban land: 30 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fox, Eroded

Setting
Landform: Stream terraces, till plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Loamy outwash over sandy and gravelly outwash

Typical profile
Ap - 0 to 8 inches: loam
Bt1 - 8 to 18 inches: loam

Bt2 - 18 to 25 inches: sandy loam
Bt3 - 25 to 36 inches: gravelly sandy loam
2C - 36 to 79 inches: stratified very gravelly loamy coarse sand to gravelly sand to sand

Properties and qualities
Slope: 2 to 6 percent
Depth to restrictive feature: 32 to 39 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 45 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.9 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Ecological site: F111AY015IN - Dry Outwash Upland
Hydric soil rating: No

Minor Components

Ockley
Percent of map unit: 5 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F111AY015IN - Dry Outwash Upland
Hydric soil rating: No

Westland, drained
Percent of map unit: 3 percent
Landform: Depressions on stream terraces, swales on stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear, convex
Across-slope shape: Concave, linear
Ecological site: R111AY016IN - Outwash Mollisol
Hydric soil rating: Yes

Fox, till substratum
Percent of map unit: 2 percent
Landform: Stream terraces on till plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear, convex
Across-slope shape: Linear
Ecological site: F111AY015IN - Dry Outwash Upland
Hydric soil rating: No

YfpD3—Fox clay loam-Urban land complex, 8 to 18 percent slopes, severely eroded

Map Unit Setting
National map unit symbol: 2y8lp
Elevation: 700 to 1,040 feet
Mean annual precipitation: 36 to 46 inches
Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 145 to 185 days
Farmland classification: Not prime farmland

Map Unit Composition
Fox, severely eroded, and similar soils: 70 percent
Urban land: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fox, Severely Eroded

Setting
Landform: Terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy outwash over sandy and gravelly outwash

Typical profile
H1 - 0 to 7 inches: clay loam
H2 - 7 to 28 inches: clay loam
H3 - 28 to 60 inches: very gravelly coarse sand

Properties and qualities
Slope: 8 to 18 percent
Depth to restrictive feature: 20 to 40 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 55 percent
Available water supply, 0 to 60 inches: Low (about 4.3 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: F111AY015IN - Dry Outwash Upland

Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

YoxA—Ockley silt loam-Urban land complex, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: 2w58d
Elevation: 600 to 1,250 feet
Mean annual precipitation: 37 to 46 inches
Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 145 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition
Ockley and similar soils: 55 percent
Urban land: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ockley

Setting
Landform: Stream terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess over loamy outwash over sandy and gravelly outwash

Typical profile
Ap - 0 to 10 inches: silt loam
BA - 10 to 15 inches: silt loam
Bt1 - 15 to 18 inches: silt loam
Bt2 - 18 to 37 inches: clay loam
2Bt3 - 37 to 49 inches: gravelly sandy clay loam
3C - 49 to 79 inches: stratified very gravelly coarse sand to gravelly loamy coarse sand

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: 40 to 72 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 50 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.8 inches)

Analysis & Research

Appendix 21: Web Soil Survey

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B
Ecological site: F111AY015IN - Dry Outwash Upland
Hydric soil rating: No

Minor Components

Digby
Percent of map unit: 5 percent
Landform: Outwash plains, glacial drainage channels
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear, concave
Ecological site: F111AY014IN - Outwash Upland
Hydric soil rating: No

Wawaka
Percent of map unit: 5 percent
Landform: Till plains on outwash plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F111AY015IN - Dry Outwash Upland
Hydric soil rating: No

Fox
Percent of map unit: 3 percent
Landform: Outwash terraces
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F111AY015IN - Dry Outwash Upland
Hydric soil rating: No

Haney
Percent of map unit: 2 percent
Landform: Glacial drainage channels, outwash plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Concave, linear
Ecological site: F111AY014IN - Outwash Upland
Hydric soil rating: No

YoxB2—Ockley silt loam-Urban land complex, 2 to 6 percent slopes, eroded

Map Unit Setting
National map unit symbol: 2w58f
Elevation: 400 to 1,180 feet
Mean annual precipitation: 37 to 46 inches
Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 145 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition
Ockley, eroded, and similar soils: 55 percent
Urban land: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ockley, Eroded

Setting
Landform: Stream terraces
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loess over loamy outwash over sandy and gravelly outwash

Typical profile
Ap - 0 to 8 inches: silt loam
BA - 8 to 15 inches: silt loam
Bt1 - 15 to 18 inches: silt loam
2Bt2 - 18 to 37 inches: clay loam
2Bt3 - 37 to 49 inches: gravelly sandy clay loam
3C - 49 to 79 inches: stratified very gravelly coarse sand to extremely gravelly loamy coarse sand

Properties and qualities
Slope: 2 to 6 percent
Depth to restrictive feature: 40 to 72 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 50 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water supply, 0 to 60 inches: Moderate (about 8.8 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Ecological site: F111AY015IN - Dry Outwash Upland
Hydric soil rating: No

Minor Components

Sleeth
Percent of map unit: 5 percent
Landform: Channels on stream terraces, stream terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Ecological site: F111AY014IN - Outwash Upland
Hydric soil rating: No

Westland
Percent of map unit: 5 percent
Landform: Depressions on stream terraces, swales on stream terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: R111AY016IN - Outwash Mollisol
Hydric soil rating: Yes

Ockley, eroded, till substratum
Percent of map unit: 5 percent
Landform: Stream terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F111AY015IN - Dry Outwash Upland
Hydric soil rating: No

YpkAN—Palms muck-Urban land complex, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: 2w58k
Elevation: 700 to 1,040 feet
Mean annual precipitation: 36 to 46 inches
Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 145 to 185 days
Farmland classification: Not prime farmland

Map Unit Composition
Palms, drained, and similar soils: 70 percent
Urban land: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Palms, Drained

Setting
Landform: Depressions on till plains, depressions on terraces
Landform position (two-dimensional): Toeslope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Herbaceous organic material over loamy till

Typical profile
Oa1 - 0 to 29 inches: muck
H2 - 29 to 60 inches: clay loam

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 1.00 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 60 percent
Available water supply, 0 to 60 inches: Very high (about 17.2 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Ecological site: R111AY001IN - Mineral Muck
Other vegetative classification: Mixed/Transitional (Mixed Native Vegetation)
Hydric soil rating: Yes

YsnA—Sleeth loam-Urban land complex, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: 2w58w
Elevation: 680 to 1,040 feet
Mean annual precipitation: 36 to 46 inches
Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 145 to 185 days
Farmland classification: Not prime farmland

Map Unit Composition
Sleeth and similar soils: 65 percent

Urban land: 30 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sleeth

Setting
Landform: Outwash plains, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy outwash over sandy and gravelly outwash

Typical profile
H1 - 0 to 17 inches: loam
H2 - 17 to 27 inches: clay loam
H3 - 27 to 48 inches: gravelly clay loam
H4 - 48 to 60 inches: stratified gravelly coarse sand

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: 20 to 60 inches to strongly contrasting textural stratification
Drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 6 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 55 percent
Available water supply, 0 to 60 inches: Moderate (about 8.1 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B/D
Ecological site: F111AY014IN - Outwash Upland
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

Minor Components

Poorly drained aquents
Percent of map unit: 3 percent
Landform: Drainageways
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: Yes

Westland
Percent of map unit: 2 percent
Landform: Depressions
Ecological site: R111AY016IN - Outwash Mollisol
Other vegetative classification: Mixed/Transitional (Mixed Native Vegetation)
Hydric soil rating: Yes

YwqA—Westland silty clay loam-Urban land complex, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: 2y47r
Elevation: 400 to 1,040 feet
Mean annual precipitation: 37 to 46 inches
Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 145 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition
Westland, drained, and similar soils: 55 percent
Urban land: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Westland, Drained

Setting
Landform: Depressions on stream terraces, swales on stream terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Loess over loamy outwash over sandy and gravelly outwash

Typical profile
Ap - 0 to 10 inches: silty clay loam
Btg1 - 10 to 21 inches: silty clay loam
2Btg2 - 21 to 37 inches: clay loam
2BCg - 37 to 47 inches: loam
3Cg - 47 to 79 inches: stratified extremely gravelly coarse sand to coarse sand to gravelly loamy coarse sand

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: 40 to 60 inches to strongly contrasting textural stratification
Drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 55 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.8 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B/D
Ecological site: R111AY016IN - Outwash Mollisol
Hydric soil rating: Yes

Minor Components

Mahalaland, drained
Percent of map unit: 10 percent
Landform: Terraces, outwash terraces, depressions on terraces, swales on terraces, flats on terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Hydric soil rating: Yes

Treaty, drained
Percent of map unit: 3 percent
Landform: Till plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: F111AY007IN - Till Depression Flatwood
Other vegetative classification: Mixed/Transitional (Mixed Native Vegetation)
Hydric soil rating: Yes

Sleeth
Percent of map unit: 2 percent
Landform: Stream terraces, outwash terraces
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F111AY014IN - Outwash Upland
Hydric soil rating: No

Soil Information for All Uses

Suitabilities and Limitations for Use

The Suitabilities and Limitations for Use section includes various soil interpretations displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each interpretation.

Water Management

Water Management interpretations are tools for evaluating the potential of the soil in the application of various water management practices. Example interpretations include pond reservoir area, embankments, dikes, levees, and excavated ponds.

Infiltration Systems, Deep

Deep infiltration systems are stormwater management practices that are placed 3 to 5 feet in the ground, depending on the application. These systems include rain gardens, bioretention basins, and infiltration basins. They slow the movement of stormwater to surface waters and also filter a significant portion of pollutants from the stormwater. The fundamental function of these systems is to hold the runoff generated from the first 1 inch of rainfall during a 24-hour storm preceded by 48 hours of no measurable precipitation. There should be little or no ponding at the surface. The water should infiltrate into the surrounding soil in 24 to 48 hours. Only that part of the soil between depths of 24 and 80 inches is evaluated.

The ratings are based on the soil properties that affect infiltration of the stormwater, construction and maintenance of the system, and public safety and health. Saturated hydraulic conductivity (Ksat), depth to a water table, ponding, depth to bedrock or a cemented pan, and flooding affect the transmission of rainwater. Stones and boulders, ice, and bedrock or a cemented pan interfere with installation. Subsidence interferes with installation and maintenance. Excessive slope may cause lateral seepage and surfacing of the water in downslope areas. Some slopes may become unstable and move upon addition of water.

Some soils are underlain by loose sand and gravel or fractured bedrock at a depth of less than 4 feet below the bottom of the system. In these soils the deep infiltration

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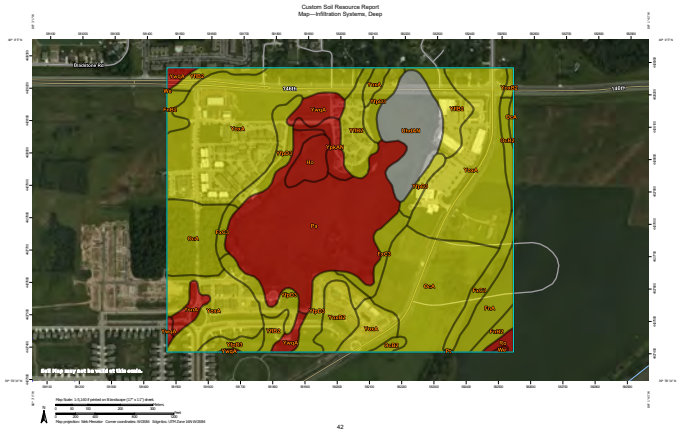
system may not adequately filter the stormwater, particularly if the adsorptive capacity of the soil below the system is low. As a result, the ground water may become contaminated. In areas underlain by limestone, solution channels and subsequent subsidence may damage adjacent infrastructure. Also, areas underlain by limestone may be subject to ground-water contamination.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified infiltration system. "Not limited" indicates that the soil has features that are very favorable for the specified system. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified system.

The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified system. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the specified system (1.00) and the point at which the soil feature is not a limitation (0.00).

The accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer lists the map unit components. These components are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as the one indicated for the map unit. The percent composition of each component in a particular map unit is shown to help the user better understand the percentage of each map unit that has the rating indicated. Other components with different ratings may occur in each map unit. The complete ratings list for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- Severely limited
- Somewhat limited
- Not limited
- Not rated or not available

Soil Rating Lines
- Severely limited
- Somewhat limited
- Not limited
- Not rated or not available

Soil Rating Points
- Severely limited
- Somewhat limited
- Not limited
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Hamilton County, Indiana
Survey Area Data: Version 22, Sep 9, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 1, 2018—Sep 30, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Tables—Infiltration Systems, Deep

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
FnA	Fox loam, 0 to 2 percent slopes	Somewhat limited	Fox (80%)	Adsorptive capacity (0.25)	5.3	2.3%
			Ockley (14%)	Adsorptive capacity (0.25)		
				Vegetation establishment (0.16)		
FnB2	Fox loam, 2 to 6 percent slopes, eroded	Somewhat limited	Fox, eroded (80%)	Adsorptive capacity (0.25)	3.0	1.3%
				Vegetation establishment (0.07)		
				Slope (0.01)		
			Ockley (8%)	Adsorptive capacity (0.25)		
				Vegetation establishment (0.16)		
				Slope (0.01)		
FxC3	Fox clay loam, 8 to 18 percent slopes, severely eroded	Somewhat limited	Fox, severely eroded (100%)	Slope (0.79)	8.3	3.5%
				Vegetation establishment (0.32)		
				Adsorptive capacity (0.25)		
Ho	Houghton muck	Severely limited	Houghton, drained (100%)	Wetness (1.00)	3.5	1.5%
				Vegetation establishment (0.50)		
				Adsorptive capacity (0.24)		
OcA	Ockley silt loam, 0 to 2 percent slopes	Somewhat limited	Ockley (85%)	Adsorptive capacity (0.25)	31.7	13.6%
				Vegetation establishment (0.16)		
			Fox (5%)	Adsorptive capacity (0.25)		
				Slope (0.01)		
				Vegetation establishment (0.01)		
OcB2	Ockley silt loam, 2 to 6 percent slopes, eroded	Somewhat limited	Ockley, eroded (85%)	Adsorptive capacity (0.25)	2.7	1.2%

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Vegetation establishment (0.16)		
				Slope (0.01)		
Pa	Palms muck	Severely limited	Palms, drained (100%)	Wetness (1.00)	39.9	17.1%
				Water movement (0.92)		
				Vegetation establishment (0.50)		
				Adsorptive capacity (0.25)		
Pt	Pits	Not rated	Pits (90%)		0.0	0.0%
			Water (3%)			
Ro	Ross loam, 0 to 2 percent slopes, occasionally flooded	Severely limited	Ross (85%)	Wetness (1.00)	0.8	0.3%
				Flooding (0.50)		
				Water movement (0.42)		
				Vegetation establishment (0.05)		
			Sloan (5%)	Wetness (1.00)		
				Water movement (0.67)		
				Flooding (0.50)		
				Vegetation establishment (0.09)		
			Eel (5%)	Wetness (1.00)		
				Flooding (0.50)		
				Vegetation establishment (0.00)		
UhdAN	Urban land-Houghton muck complex, 0 to 2 percent slopes, drained	Not rated	Urban land (60%)		12.3	5.3%
We	Westland silty clay loam, 0 to 2 percent slopes	Severely limited	Westland, drained (70%)	Wetness (1.00)	0.1	0.1%
				Adsorptive capacity (0.23)		
				Vegetation establishment (0.12)		
			Mahalaland, drained (15%)	Wetness (1.00)		
				Adsorptive capacity (0.24)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Vegetation establishment (0.01)		
			Treaty, drained (9%)	Wetness (1.00)		
				Water movement (1.00)		
				Vegetation establishment (0.00)		
			Sleeth (6%)	Wetness (1.00)		
				Adsorptive capacity (0.24)		
				Vegetation establishment (0.05)		
YflB2	Fox loam-Urban land complex, 2 to 6 percent slopes, eroded	Somewhat limited	Fox, eroded (55%)	Adsorptive capacity (0.25)	14.0	6.0%
				Vegetation establishment (0.07)		
				Slope (0.01)		
			Ockley (5%)	Adsorptive capacity (0.25)		
				Vegetation establishment (0.16)		
				Slope (0.01)		
YfpD3	Fox clay loam-Urban land complex, 8 to 18 percent slopes, severely eroded	Somewhat limited	Fox, severely eroded (70%)	Slope (0.79)	18.4	7.9%
				Vegetation establishment (0.32)		
				Adsorptive capacity (0.25)		
YoxA	Ockley silt loam-Urban land complex, 0 to 2 percent slopes	Somewhat limited	Ockley (55%)	Adsorptive capacity (0.25)	78.0	33.3%
				Vegetation establishment (0.16)		
			Fox (3%)	Adsorptive capacity (0.25)		
				Slope (0.01)		
				Vegetation establishment (0.01)		
YoxB2	Ockley silt loam-Urban land complex, 2 to 6 percent slopes, eroded	Somewhat limited	Ockley, eroded (55%)	Adsorptive capacity (0.25)	5.3	2.3%

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Vegetation establishment (0.16)		
				Slope (0.01)		
YpkAN	Palms muck-Urban land complex, 0 to 2 percent slopes	Severely limited	Palms, drained (70%)	Wetness (1.00)	2.8	1.2%
				Water movement (0.92)		
				Vegetation establishment (0.50)		
				Adsorptive capacity (0.25)		
YsnA	Sleeth loam-Urban land complex, 0 to 2 percent slopes	Severely limited	Sleeth (65%)	Wetness (1.00)	1.9	0.8%
				Water movement (0.42)		
				Adsorptive capacity (0.25)		
YwqA	Westland silty clay loam-Urban land complex, 0 to 2 percent slopes	Severely limited	Westland, drained (55%)	Wetness (1.00)	5.7	2.4%
				Adsorptive capacity (0.23)		
				Vegetation establishment (0.12)		
			Mahalaland, drained (10%)	Wetness (1.00)		
				Adsorptive capacity (0.24)		
				Vegetation establishment (0.01)		
			Treaty, drained (3%)	Wetness (1.00)		
				Water movement (1.00)		
				Vegetation establishment (0.00)		
			Sleeth (2%)	Wetness (1.00)		
				Adsorptive capacity (0.24)		
				Vegetation establishment (0.05)		
Totals for Area of Interest					**234.1**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Somewhat limited	166.9	71.3%
Severely limited	54.8	23.4%

Rating	Acres in AOI	Percent of AOI
Null or Not Rated	12.4	5.3%
Totals for Area of Interest	**234.1**	**100.0%**

Rating Options—Infiltration Systems, Deep

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Infiltration Systems, Shallow

Shallow infiltration systems are stormwater management practices that are placed 1 to 3 feet in the ground, depending on the application. These systems include pervious pavement, buffer strips, filter strips, and vegetated swales. They slow the movement of stormwater to surface waters and also filter a significant portion of pollutants from the stormwater. The fundamental function of these systems is to hold the runoff generated by an area, such as a parking lot, from the first 1 inch of rainfall during a 24-hour storm preceded by 48 hours of no measurable precipitation. There should be little or no ponding at the surface. The water should infiltrate into the surrounding soil in 24 to 48 hours. Only that part of the soil between depths of 24 and 80 inches is evaluated.

The ratings are based on the soil properties that affect infiltration of the stormwater, construction and maintenance of the system, and public safety and health. Saturated hydraulic conductivity (Ksat), depth to a water table, ponding, depth to bedrock or a cemented pan, and flooding affect the transmission of rainwater. Stones and boulders, ice, and bedrock or a cemented pan interfere with installation. Subsidence interferes with installation and maintenance. Excessive slope may cause lateral seepage and surfacing of the water in downslope areas. Some slopes may become unstable and move upon addition of water.

Soils underlain by loose sand and gravel or fractured bedrock at a depth of less than 4 feet below the bottom of the system may adversely affect water quality and public health. In these soils the shallow infiltration system may not adequately filter the stormwater, particularly if the adsorptive capacity of the soil below the system is low. As a result, the ground water may become contaminated. In areas underlain by limestone, solution channels and subsequent subsidence may damage adjacent infrastructure. Also, areas underlain by limestone may be subject to ground-water contamination.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified infiltration system. "Not limited" indicates that the soil has features that are very favorable for the specified system. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified system. The limitations can be overcome or

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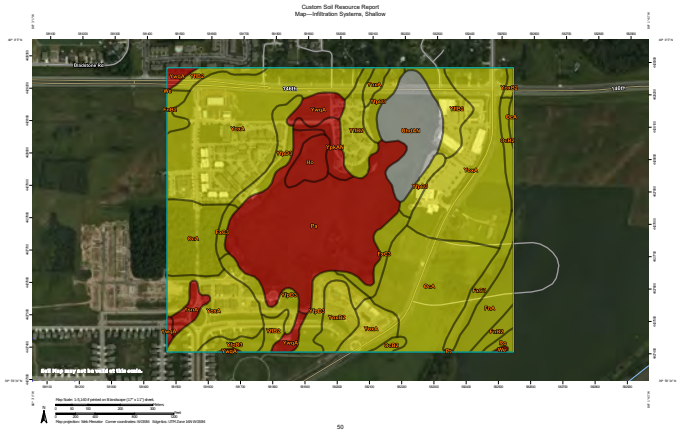
minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified system. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the specified system (1.00) and the point at which the soil feature is not a limitation (0.00).

The accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer lists the map unit components. These components are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as the one listed for the map unit. The percent composition of each component in a particular map unit is shown to help the user better understand the percentage of each map unit that has the rating indicated. Other components with different ratings may occur in each map unit.

The complete ratings list for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- Severely limited
- Somewhat limited
- Not limited
- Not rated or not available

Soil Rating Lines
- Severely limited
- Somewhat limited
- Not limited
- Not rated or not available

Soil Rating Points
- Severely limited
- Somewhat limited
- Not limited
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Hamilton County, Indiana
Survey Area Data: Version 22, Sep 9, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 1, 2018—Sep 30, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Tables—Infiltration Systems, Shallow

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
FnA	Fox loam, 0 to 2 percent slopes	Somewhat limited	Fox (80%)	Adsorptive capacity (0.25)	5.3	2.3%
			Ockley (14%)	Vegetation establishment (0.16)		
				Adsorptive capacity (0.07)		
FnB2	Fox loam, 2 to 6 percent slopes, eroded	Somewhat limited	Fox, eroded (80%)	Adsorptive capacity (0.25)	3.0	1.3%
				Vegetation establishment (0.07)		
				Slope (0.01)		
			Ockley (8%)	Vegetation establishment (0.16)		
				Adsorptive capacity (0.07)		
				Slope (0.01)		
FxC3	Fox clay loam, 8 to 18 percent slopes, severely eroded	Somewhat limited	Fox, severely eroded (100%)	Slope (0.79)	8.3	3.5%
				Vegetation establishment (0.32)		
				Adsorptive capacity (0.25)		
Ho	Houghton muck	Severely limited	Houghton, drained (100%)	Wetness (1.00)	3.5	1.5%
				Vegetation establishment (0.50)		
OcA	Ockley silt loam, 0 to 2 percent slopes	Somewhat limited	Ockley (85%)	Vegetation establishment (0.16)	31.7	13.6%
				Adsorptive capacity (0.07)		
			Fox (5%)	Adsorptive capacity (0.25)		
				Slope (0.01)		
				Vegetation establishment (0.01)		
OcB2	Ockley silt loam, 2 to 6 percent slopes, eroded	Somewhat limited	Ockley, eroded (85%)	Vegetation establishment (0.16)	2.7	1.2%
				Adsorptive capacity (0.05)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Slope (0.01)		
Pa	Palms muck	Severely limited	Palms, drained (100%)	Wetness (1.00)	39.9	17.1%
				Water movement (0.92)		
				Vegetation establishment (0.50)		
Pt	Pits	Not rated	Pits (90%)		0.0	0.0%
			Water (3%)			
Ro	Ross loam, 0 to 2 percent slopes, occasionally flooded	Somewhat limited	Ross (85%)	Wetness (0.61)	0.8	0.3%
				Flooding (0.50)		
				Water movement (0.42)		
				Vegetation establishment (0.05)		
			Genesee (5%)	Flooding (0.50)		
				Vegetation establishment (0.18)		
UhdAN	Urban land-Houghton muck complex, 0 to 2 percent slopes, drained	Not rated	Urban land (60%)		12.3	5.3%
We	Westland silty clay loam, 0 to 2 percent slopes	Severely limited	Westland, drained (70%)	Wetness (1.00)	0.1	0.1%
				Vegetation establishment (0.12)		
			Mahalaland, drained (15%)	Wetness (1.00)		
				Adsorptive capacity (0.04)		
				Vegetation establishment (0.01)		
			Treaty, drained (9%)	Wetness (1.00)		
				Water movement (1.00)		
				Vegetation establishment (0.00)		
			Sleeth (6%)	Wetness (1.00)		
				Adsorptive capacity (0.14)		
				Vegetation establishment (0.05)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
YflB2	Fox loam-Urban land complex, 2 to 6 percent slopes, eroded	Somewhat limited	Fox, eroded (55%)	Adsorptive capacity (0.25)	14.0	6.0%
				Vegetation establishment (0.07)		
				Slope (0.01)		
			Ockley (5%)	Vegetation establishment (0.16)		
				Adsorptive capacity (0.07)		
				Slope (0.01)		
YfpD3	Fox clay loam-Urban land complex, 8 to 18 percent slopes, severely eroded	Somewhat limited	Fox, severely eroded (70%)	Slope (0.79)	18.4	7.9%
				Vegetation establishment (0.32)		
				Adsorptive capacity (0.25)		
YoxA	Ockley silt loam-Urban land complex, 0 to 2 percent slopes	Somewhat limited	Ockley (55%)	Vegetation establishment (0.16)	78.0	33.3%
				Adsorptive capacity (0.07)		
			Fox (3%)	Adsorptive capacity (0.25)		
				Slope (0.01)		
				Vegetation establishment (0.01)		
YoxB2	Ockley silt loam-Urban land complex, 2 to 6 percent slopes, eroded	Somewhat limited	Ockley, eroded (55%)	Vegetation establishment (0.16)	5.3	2.3%
				Adsorptive capacity (0.05)		
				Slope (0.01)		
YpkAN	Palms muck-Urban land complex, 0 to 2 percent slopes	Severely limited	Palms, drained (70%)	Wetness (1.00)	2.8	1.2%
				Water movement (0.92)		
				Vegetation establishment (0.50)		
YsnA	Sleeth loam-Urban land complex, 0 to 2 percent slopes	Severely limited	Sleeth (65%)	Wetness (1.00)	1.9	0.8%
				Water movement (0.42)		
				Adsorptive capacity (0.03)		
YwqA	Westland silty clay loam-	Severely limited	Westland, drained (55%)	Wetness (1.00)	5.7	2.4%

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
	Urban land complex, 0 to 2 percent slopes			Vegetation establishment (0.12)		
			Mahalaland, drained (10%)	Wetness (1.00)		
				Adsorptive capacity (0.04)		
				Vegetation establishment (0.01)		
			Treaty, drained (3%)	Wetness (1.00)		
				Water movement (1.00)		
				Vegetation establishment (0.00)		
			Sleeth (2%)	Wetness (1.00)		
				Adsorptive capacity (0.14)		
				Vegetation establishment (0.05)		
Totals for Area of Interest					**234.1**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Somewhat limited	167.7	71.6%
Severely limited	54.0	23.1%
Null or Not Rated	12.4	5.3%
Totals for Area of Interest	**234.1**	**100.0%**

Rating Options—Infiltration Systems, Shallow

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Health Properties

Soil health is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans. This folder contains information on soil properties that are important indicators of soil health.

Soil Health - Available Water Capacity

Available water capacity (AWC) refers to the quantity of water that the soil is capable of storing for use by plants. It is expressed in centimeters of water per centimeter of soil for each soil layer.

Significance:

Available water capacity is an indicator of a soil's ability to retain water and make it sufficiently available for plant use. In areas where daily rainfall is insufficient to meet plant needs, the capacity of soil to store water is very important (USDA-NRCS, 2008). Water held in the soil is needed to sustain plants between rainfall or irrigation events and provide a buffer against periods of water deficit. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure, with corrections for salinity and rock fragments. Available water capacity determinations are used to develop water budgets, predict droughtiness, design and operate irrigation systems, design drainage systems, protect water resources, and predict yields (Lowery et al., 1996). They also are an important factor in the choice of plants or crops to be grown. The available water capacity can be increased by applying soil management that maximizes the soil's inherent capacity to store water. Improving soil structure and ameliorating compacted zones can improve both the storage capacity of the soil itself and increase the depth to which plant roots can penetrate.

Factors Affecting Available Water Capacity:

Inherent factors.—Available water capacity is affected by soil texture, amount of rock fragments, and a soil's depth and layers. It is primarily controlled by soil texture and structure. Soils with higher silt contents generally have higher available water capacities, while sandy soils have the lowest available water capacities. Rock fragments reduce a soil's available water capacity proportionate to their volume,

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Appendix 21: Web Soil Survey

unless the rocks are porous. Soil depth and root-restricting layers affect the total available water capacity since they can limit the volume of soil available for root growth.

Dynamic factors.—Available water capacity is affected by soil organic matter, compaction, and salt concentrations. Organic matter can increase a soil's capacity to store water, on average, equivalent to its weight in available water (Libohova et al., 2018). Indirectly, organic matter improves soil structure and aggregate stability, resulting in increased pore size and volume. These soil improvements result in increased infiltration and movement of water through the soil. Greater amounts of water entering the soil can then be used by plant roots. Compaction reduces the available water capacity by reducing the total pore volume. Soils with high salt concentrations have a reduced available water capacity. Solutes in soil water attract water (osmotic potential), making it difficult for plant roots to extract or uptake the water.

Measurement:

Available water capacity is determined in the lab by measuring the water content at field capacity (33 kPa) and wilting point (1500 kPa) and calculating the difference (Soil Survey Staff, 2014). Pressure plates or membranes are used to bring the soil sample to a desired matric potential (33 kPa or 1500 kPa). When at equilibrium, the soil sample is removed and dried to determine its water content.

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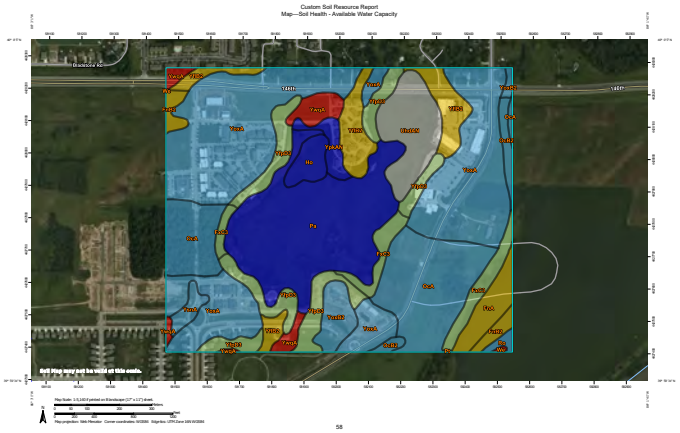
U.S. Department of Agriculture, Natural Resources Conservation Service. 2008. Soil quality indicators—Available water capacity.



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- <= 0.13
- > 0.13 and <= 0.16
- > 0.16 and <= 0.19
- > 0.19 and <= 0.22
- > 0.22 and <= 0.40
- Not rated or not available

Soil Rating Lines
- <= 0.13
- > 0.13 and <= 0.16
- > 0.16 and <= 0.19
- > 0.19 and <= 0.22
- > 0.22 and <= 0.40
- Not rated or not available

Soil Rating Points
- <= 0.13
- > 0.13 and <= 0.16
- > 0.16 and <= 0.19
- > 0.19 and <= 0.22
- > 0.22 and <= 0.40
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Hamilton County, Indiana
Survey Area Data: Version 22, Sep 9, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 1, 2018—Sep 30, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Soil Health - Available Water Capacity

Map unit symbol	Map unit name	Rating (centimeters per centimeter)	Acres in AOI	Percent of AOI
FnA	Fox loam, 0 to 2 percent slopes	0.16	5.3	2.3%
FnB2	Fox loam, 2 to 6 percent slopes, eroded	0.16	3.0	1.3%
FxC3	Fox clay loam, 8 to 18 percent slopes, severely eroded	0.19	8.3	3.5%
Ho	Houghton muck	0.40	3.5	1.5%
OcA	Ockley silt loam, 0 to 2 percent slopes	0.22	31.7	13.6%
OcB2	Ockley silt loam, 2 to 6 percent slopes, eroded	0.22	2.7	1.2%
Pa	Palms muck	0.40	39.9	17.1%
Pt	Pits		0.0	0.0%
Ro	Ross loam, 0 to 2 percent slopes, occasionally flooded	0.22	0.8	0.3%
UhdAN	Urban land-Houghton muck complex, 0 to 2 percent slopes, drained		12.3	5.3%
We	Westland silty clay loam, 0 to 2 percent slopes	0.13	0.1	0.1%
YfB2	Fox loam-Urban land complex, 2 to 6 percent slopes, eroded	0.16	14.0	6.0%
YfpD3	Fox clay loam-Urban land complex, 8 to 18 percent slopes, severely eroded	0.19	18.4	7.9%
YoxA	Ockley silt loam-Urban land complex, 0 to 2 percent slopes	0.22	78.0	33.3%
YoxB2	Ockley silt loam-Urban land complex, 2 to 6 percent slopes, eroded	0.22	5.3	2.3%
YpkAN	Palms muck-Urban land complex, 0 to 2 percent slopes	0.40	2.8	1.2%
YsnA	Sleeth loam-Urban land complex, 0 to 2 percent slopes	0.22	1.9	0.8%
YwqA	Westland silty clay loam-Urban land complex, 0 to 2 percent slopes	0.13	5.7	2.4%
Totals for Area of Interest			**234.1**	**100.0%**

Rating Options—Soil Health - Available Water Capacity

Units of Measure: centimeters per centimeter

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Soil Health - Organic Matter

Organic matter percent is the weight of decomposed plant, animal, and microbial residues exclusive of non-decomposed plant and animal residues. It is expressed as a percentage, by weight, of the soil material that is less than 2 mm in diameter.

Significance:

Soil organic matter (SOM) influences the physical, chemical, and biological properties of soils far more than suggested by its relatively small proportion in most soils. The organic fraction influences plant growth through its influence on these soil properties. It encourages soil aggregation, especially macroaggregation, increases porosity, and lowers bulk density. Because the soil structure is improved, water infiltration rates increase. SOM has a high capacity to adsorb and exchange cations and is important to pesticide binding. It furnishes energy to microorganisms in the soil. As SOM is decomposed by soil microbes, it releases nitrogen, phosphorous, sulfur, and many micronutrients, which become available for plant growth. SOM is a heterogeneous, dynamic substance that varies in particle size, carbon content, decomposition rate, and turnover time. In general, the content of SOM is highest at the surface—where plant, animal, and microbial residue inputs are greatest—and decreases with depth.

Total organic carbon (TOC) is the carbon (C) stored in SOM. Total organic carbon is also referred to as soil organic carbon (SOC) in the scientific literature. Organic carbon enters the soil through the decomposition of plant and animal residues, root exudates, and living and dead microorganisms. Inorganic carbon is common in calcareous soils in the form of calcium and magnesium carbonates. In calcareous soils, the content of inorganic carbon can exceed TOC.

Factors Affecting Content of SOM and SOC:

Inherent factors - Soil texture, parent material, drainage, climate, and time affect accumulation of SOM. Soils that are rich in clay have greater capacity to protect SOM from decomposition by stabilizing substances that bind to clay surfaces. The formation of soil aggregates—enabled by the presence of clay, aluminum and iron oxides, fungal hyphae, bacterial exudates (carbohydrates), and fine roots—protects SOM from microbial decomposition. Extractable aluminum and allophanes, which are present in volcanic soils, can react with SOM to form compounds that are stable

and resist microbial decomposition. Warm temperatures increase decomposition rates of SOM. High mean annual precipitation increases accumulation rates of SOM by stimulating the production of plant biomass.

Loss of SOM through erosion results in SOM variations along slope gradients. Areas of level topography tend to have much more SOM than areas with other slope classes. Both elevation and topographic gradients affect local climate, vegetation distribution, and soil properties. They also affect associated biogeochemical processes, including SOM dynamics. Analysis of factors affecting C in the conterminous United States indicates that the effects of land use, topography (elevation and slope), and mean annual precipitation on SOM are more obvious than the effects of mean annual temperature. However, when other variables are highly restricted, SOM content clearly declines with increasing temperature.

Dynamic factors - Dynamic gains and losses in SOM are due primarily to management decisions in combination with climate and microbial influences. Accumulation of SOM is controlled by the rate of C mineralization, the amount and stage of decomposition of plant residues, and the addition of organic amendments to soil.

Soil organic carbon comprises approximately 52 to 58% of the SOM and is the main source of energy for soil microorganisms. The C within plant residues, particulate organic matter, and soil microbial biomass is generally considered to be within the active pool of SOM. The emergent view of SOM focuses on microbial access to SOM and includes an emphasis on the need to manage C flows rather than discrete C pools. During decomposition of SOM, energy and nutrients are released and utilized by plant roots and soil biota. Recognizing that SOM is a continuum of decomposition products is a first step in designing management strategies for renewing SOM sources throughout the year.

Soil aggregates of various sizes and stabilities can act as sites at which SOM is physically protected from decomposition and C mineralization. Soil disturbance and aggregate destruction increase biodegradation of SOM. Aggregates are readily broken apart by tillage operations.

Crop residues incorporated into or left on the soil surface reduce erosion and the losses of SOM associated with sediment. In acidic soils, applications of lime increase plant productivity, microbial activity, organic matter decomposition, and CO2 release.

The diversity of the soil microbial population affects SOM. For example, while soil bacteria and some fungi participate in SOM loss by mineralizing C compounds, other fungi, such as mycorrhizae, facilitate stabilization and physical protection by aggregating SOM with clay and minerals. SOM is better protected from degradation within aggregates than in free-form.

Relationship to Soil Function:

SOM is one of the most important soil constituents. It affects plant growth by improving aggregate stability, soil structure, water availability, and nutrient cycling. SOM fractions in the active pool, described above, are the main source of energy

and nutrients for soil microorganisms, which mediate nutrient cycling in the soil. Biochemically stable SOM participates in aggregate stability and in holding capacity for nutrients and water.

Microaggregates are formed by mineral interactions with iron and aluminum oxides and are generally considered an inherent soil characteristic. They are, however, impacted by current and past management. Fine roots, fungal hyphae, and organic carbon compounds, such as complex sugars (carbohydrates) and proteins (also referred to as glues), bind mineral particles and microaggregates together to form macroaggregates that are still porous enough to allow air, water, and plant roots to move through the soil.

An increase in SOM leads to greater biological diversity and activity in the soil, thus increasing biological control of plant diseases and pests.

Problems Associated with Low Organic Matter Levels:

Low levels of SOM result in energy-source shortages and thereby lowered levels of microbial biomass, activity, and nutrient mineralization. In noncalcareous soils, aggregate stability, infiltration, drainage, and airflow are also reduced. Scarcity of SOM results in less diversity in soil biota and a risk of disruption to the food chain equilibrium. This disruption can cause disturbance in the soil environment (e.g., increased plant pests and diseases and accumulation of toxic substances).

Improving SOM Levels:

An estimated 4.4x10 to the 9th power tons of C have been lost from soils of the United States due to traditional farming practices. Most of this carbon was SOC. Nearly half of the SOM has been lost from many agricultural soils. Other farming practices, such as no-till and cover cropping (especially when used together), can stop losses of SOM and even lead to increases. Continuous application of manure and compost can increase SOM. Burning, harvesting, or otherwise removing plant residues decreases SOM.

Measurement:

SOM is measured in the laboratory by determining total carbon (TC) content using either dry or wet-dry combustion. Current analytical methods do not distinguish between decomposed and nondecomposed residues, so soil is first sieved to 2 mm to remove as much of the recognizable plant material as possible. If no carbonates are present, TC is considered to be the same as TOC (or SOC). For calcareous soils, soil inorganic carbon in the form carbonates must also be measured and then subtracted from the TC to determine TOC content. Results are given as the percent TOC in dry soil. To convert percent TOC to percent SOM, multiply the TOC percentage by 1.724. To convert percent SOM to percent TOC, divide the SOM percentage by 1.724. Note that this value continues to be debated by researchers with possible values ranging from 1.4 to 2.5 (Pribyl, 2010). A conversion factor of 2 has been suggested for this database but has not yet been adopted. Detailed procedures for measurement of SOM are outlined in 'Soil Survey Investigations Report No. 42, Kellogg Soil Survey Laboratory Methods Manual, Version 5.0,' (Soil Survey Staff, 2014).

Many soil testing laboratories use a 'loss on ignition' method to estimate soil organic matter. The estimate produced by this method must be correlated to analytical TOC measurements for each area to improve accuracy. The loss on ignition method can provide a good indication of the trend in SOM content within a field. It is important to note that temperature and timing used for the loss on ignition approach vary across labs and can influence results. Thus, comparisons should be made using only results from within a given lab.

Currently, no standard method exists to measure TOC in the field. Attempts have been made to develop charts that match color to TOC content, but the correlation is better within soil landscapes and only for limited soils. Near-infrared spectroscopy has been tested for measuring C directly in the field, but it is expensive and sensitive to moisture content.

Estimates:

Color and feel are soil characteristics that can be used to estimate SOM content. Color comparisons in areas of similar parent materials and textures can be correlated with laboratory data and thereby enable a soil scientist to make field estimates. In general, darker colors or black indicate the presence of higher amounts of organic matter. The contrast of color between the A horizon and subsurface horizons is also a good indicator. Sandy soils tend to look darker with a lower content of SOM. In general, lower numbers for hue, value, and chroma (in the Munsell soil color system) tend to be associated with darker soil colors that are attributed to higher content of SOM, soil moisture, or both.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A 'representative' value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

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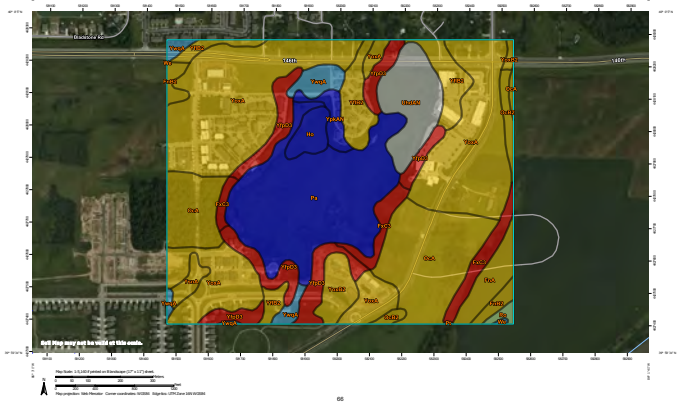

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- <= 0.75
- > 0.75 and <= 2.00
- > 2.00 and <= 4.00
- > 4.00 and <= 6.00
- > 6.00 and <= 65.00
- Not rated or not available

Soil Rating Lines
- <= 0.75
- > 0.75 and <= 2.00
- > 2.00 and <= 4.00
- > 4.00 and <= 6.00
- > 6.00 and <= 65.00
- Not rated or not available

Soil Rating Points
- <= 0.75
- > 0.75 and <= 2.00
- > 2.00 and <= 4.00
- > 4.00 and <= 6.00
- > 6.00 and <= 65.00
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Hamilton County, Indiana
Survey Area Data: Version 22, Sep 9, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 1, 2018—Sep 30, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Soil Health - Organic Matter

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
FnA	Fox loam, 0 to 2 percent slopes	2.00	5.3	2.3%
FnB2	Fox loam, 2 to 6 percent slopes, eroded	1.50	3.0	1.3%
FxC3	Fox clay loam, 8 to 18 percent slopes, severely eroded	0.75	8.3	3.5%
Ho	Houghton muck	65.00	3.5	1.5%
OcA	Ockley silt loam, 0 to 2 percent slopes	2.00	31.7	13.6%
OcB2	Ockley silt loam, 2 to 6 percent slopes, eroded	1.50	2.7	1.2%
Pa	Palms muck	65.00	39.9	17.1%
Pt	Pits		0.0	0.0%
Ro	Ross loam, 0 to 2 percent slopes, occasionally flooded	4.00	0.8	0.3%
UhdAN	Urban land-Houghton muck complex, 0 to 2 percent slopes, drained		12.3	5.3%
We	Westland silty clay loam, 0 to 2 percent slopes	6.00	0.1	0.1%
YfB2	Fox loam-Urban land complex, 2 to 6 percent slopes, eroded	1.50	14.0	6.0%
YfpD3	Fox clay loam-Urban land complex, 8 to 18 percent slopes, severely eroded	0.75	18.4	7.9%
YoxA	Ockley silt loam-Urban land complex, 0 to 2 percent slopes	2.00	78.0	33.3%
YoxB2	Ockley silt loam-Urban land complex, 2 to 6 percent slopes, eroded	1.50	5.3	2.3%
YpkAN	Palms muck-Urban land complex, 0 to 2 percent slopes	65.00	2.8	1.2%
YsnA	Sleeth loam-Urban land complex, 0 to 2 percent slopes	2.00	1.9	0.8%
YwqA	Westland silty clay loam-Urban land complex, 0 to 2 percent slopes	6.00	5.7	2.4%
Totals for Area of Interest			**234.1**	**100.0%**

Rating Options—Soil Health - Organic Matter

Units of Measure: percent

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Soil Health - Surface Texture

Soil texture, or how the soil looks and feels, is determined by the size and proportion of the particles (clay, silt, and sand) that make up the mineral fraction. There are 12 USDA textural classes (e.g., sandy loam, silty clay).

Significance:

The textural class of a soil is its most fundamental inherent characteristic that changes little over time (van Es et al., 2016). Its role in soil health studies is to inform the interpretation of most of the soil health indicators. Numerous soil properties are influenced by texture, including drainage, water-holding capacity, water movement through soil, infiltration, susceptibility to erosion, organic matter content, cation-exchange capacity, pH buffering capacity, and aeration. Soil texture also influences soil fertility, root growth, and plant vigor.

Factors Affecting Soil Surface Texture:

Inherent factors.—The nature and composition of the soil parent material greatly influences the particle-size distribution, or texture. Weathering of rocks and soil materials also affect the soil texture. Clays typically form over long periods of time through gradual chemical weathering. Freeze-thaw action can break apart rocks and gradually reduce the particle size of soil materials over time. Translocation of soil particles (e.g., clay) within the profile and between layers can alter the soil texture. Additions of particles by wind or water also affect the soil texture.

Dynamic factors.—Soil texture is altered little by management practices if the soil remains in place. Accelerated erosion by wind or water can remove the topsoil, exposing a subsoil with a different texture. Deposition of eroded materials can alter the texture of the surface soil. Deposition can be natural or anthropogenic (due to human activity). Land leveling and alteration (e.g., terracing) can change the soil texture.

Measurement:

The feel method is a crude method by which one can broadly judge the classes of soil texture. The lab methods involve removal of organic matter from a soil sample,

the dispersion of the soil sample into single particles, and then the separation of sand through sieving. Clay is determined through sedimentation based on Stoke's law. The full procedure is described in the Kellogg Soil Survey Laboratory Methods Manual (Soil Survey Staff, 2014).

References:

Soil Survey Staff. 2014. Kellogg Soil Survey Laboratory methods manual. Soil Survey Investigations Report No. 42, Version 5.0. R. Burt and Soil Survey Staff (eds.). U.S. Department of Agriculture, Natural Resources Conservation Service.

van Es, H., R. Schindelbeck, A. Ristow, K. Kurtz, and L. Fennell. 2016. Soil texture. Soil Health Manual Series. Fact Sheet No. 16-04. School of Integrative Plant Sciences, Cornell University, NY.

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- Clay loam
- Loam
- Muck
- Silt loam
- Silty clay loam
- Not rated or not available

Soil Rating Lines
- Clay loam
- Loam
- Muck
- Silt loam
- Silty clay loam
- Not rated or not available

Soil Rating Points
- Clay loam
- Loam
- Muck
- Silt loam
- Silty clay loam
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Hamilton County, Indiana
Survey Area Data: Version 22, Sep 9, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 1, 2018—Sep 30, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Analysis & Research

Appendix 21: Web Soil Survey

Table—Soil Health - Surface Texture

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
FnA	Fox loam, 0 to 2 percent slopes	Loam	5.3	2.3%
FnB2	Fox loam, 2 to 6 percent slopes, eroded	Loam	3.0	1.3%
FxC3	Fox clay loam, 8 to 18 percent slopes, severely eroded	Clay loam	8.3	3.5%
Ho	Houghton muck	Muck	3.5	1.5%
OcA	Ockley silt loam, 0 to 2 percent slopes	Silt loam	31.7	13.6%
OcB2	Ockley silt loam, 2 to 6 percent slopes, eroded	Silt loam	2.7	1.2%
Pa	Palms muck	Muck	39.9	17.1%
Pt	Pits		0.0	0.0%
Ro	Ross loam, 0 to 2 percent slopes, occasionally flooded	Loam	0.8	0.3%
UhdAN	Urban land-Houghton muck complex, 0 to 2 percent slopes, drained		12.3	5.3%
We	Westland silty clay loam, 0 to 2 percent slopes	Silty clay loam	0.1	0.1%
YfB2	Fox loam-Urban land complex, 2 to 6 percent slopes, eroded	Loam	14.0	6.0%
YfpD3	Fox clay loam-Urban land complex, 8 to 18 percent slopes, severely eroded	Clay loam	18.4	7.9%
YoxA	Ockley silt loam-Urban land complex, 0 to 2 percent slopes	Silt loam	78.0	33.3%
YoxB2	Ockley silt loam-Urban land complex, 2 to 6 percent slopes, eroded	Silt loam	5.3	2.3%
YpkAN	Palms muck-Urban land complex, 0 to 2 percent slopes	Muck	2.8	1.2%
YsnA	Sleeth loam-Urban land complex, 0 to 2 percent slopes	Loam	1.9	0.8%
YwqA	Westland silty clay loam-Urban land complex, 0 to 2 percent slopes	Silty clay loam	5.7	2.4%
Totals for Area of Interest			**234.1**	**100.0%**

Rating Options—Soil Health - Surface Texture

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

AASHTO Group Classification (Surface)

AASHTO group classification is a system that classifies soils specifically for geotechnical engineering purposes that are related to highway and airfield construction. It is based on particle-size distribution and Atterberg limits, such as liquid limit and plasticity index. This classification system is covered in AASHTO Standard No. M 145-82. The classification is based on that portion of the soil that is smaller than 3 inches in diameter.

The AASHTO classification system has two general classifications: (i) granular materials having 35 percent or less, by weight, particles smaller than 0.074 mm in diameter and (ii) silt-clay materials having more than 35 percent, by weight, particles smaller than 0.074 mm in diameter. These two divisions are further subdivided into seven main group classifications, plus eight subgroups, for a total of fifteen for mineral soils. Another class for organic soils is used.

For each soil horizon in the database one or more AASHTO Group Classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A-1
- A-1-a
- A-1-b
- A-2
- A-2-4
- A-2-5
- A-2-6
- A-2-7
- A-3
- A-4
- A-5
- A-6
- A-7
- A-7-5
- A-7-6
- A-8
- Not rated or not available

Soil Rating Lines
- A-1
- A-1-a
- A-1-b
- A-2
- A-2-4
- A-2-5
- A-2-6
- A-2-7
- A-3
- A-4
- A-5
- A-6
- A-7
- A-7-5
- A-7-6
- A-8
- Not rated or not available

Soil Rating Points
- A-1
- A-1-a
- A-1-b
- A-2
- A-2-4
- A-2-5
- A-2-6
- A-2-7
- A-3
- A-4
- A-5
- A-6

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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Survey Area Data: Version 22, Sep 9, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 1, 2018—Sep 30, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—AASHTO Group Classification (Surface)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
FnA	Fox loam, 0 to 2 percent slopes	A-6	5.3	2.3%
FnB2	Fox loam, 2 to 6 percent slopes, eroded	A-4	3.0	1.3%
FxC3	Fox clay loam, 8 to 18 percent slopes, severely eroded	A-6	8.3	3.5%
Ho	Houghton muck	A-8	3.5	1.5%
OcA	Ockley silt loam, 0 to 2 percent slopes	A-4	31.7	13.6%
OcB2	Ockley silt loam, 2 to 6 percent slopes, eroded	A-4	2.7	1.2%
Pa	Palms muck	A-8	39.9	17.1%
Pt	Pits		0.0	0.0%
Ro	Ross loam, 0 to 2 percent slopes, occasionally flooded	A-4	0.8	0.3%
UhdAN	Urban land-Houghton muck complex, 0 to 2 percent slopes, drained		12.3	5.3%
We	Westland silty clay loam, 0 to 2 percent slopes	A-7-5	0.1	0.1%
YfB2	Fox loam-Urban land complex, 2 to 6 percent slopes, eroded	A-4	14.0	6.0%
YfpD3	Fox clay loam-Urban land complex, 8 to 18 percent slopes, severely eroded	A-6	18.4	7.9%
YoxA	Ockley silt loam-Urban land complex, 0 to 2 percent slopes	A-4	78.0	33.3%
YoxB2	Ockley silt loam-Urban land complex, 2 to 6 percent slopes, eroded	A-4	5.3	2.3%
YpkAN	Palms muck-Urban land complex, 0 to 2 percent slopes	A-8	2.8	1.2%
YsnA	Sleeth loam-Urban land complex, 0 to 2 percent slopes	A-4	1.9	0.8%
YwqA	Westland silty clay loam-Urban land complex, 0 to 2 percent slopes	A-7-5	5.7	2.4%
Totals for Area of Interest			**234.1**	**100.0%**

Rating Options—AASHTO Group Classification (Surface)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

AASHTO Group Index

The AASHTO Group Index is a refinement to the seven major groups of the AASHTO soil classification system. According to

this system, soil is classified into seven major groups: A -I through A-7. Soils classified into groups A-1, A-2. and A-3 are granular materials of which 35% or less of the particles pass through the No. 200 sieve. Soils of which more than 35% pass through the No. 200 sieve are classified into groups A-4, A-5, A-6, and A-7. These soils are mostly silt and clay-type materials.

The classifications system is based on the following criteria:

1. Grain size

a. Gravel ; fraction passing the 75-mm(3-in.) sieve and retained on the No. 10 (2-mm) U.S. sieve

b. sand: fraction passing the No. 10 (2-mm) U.S. sieve and retained on the No.200 (0.075-mm) U.S. sieve

c. Silt and clay: fraction passing the No. 200 U.S. sieve

2. Plasticity The term silty is applied when the fine fractions of the soil have a plasticity index of 10 or less. The term clayey is applied when the fine fractions have a plasticity index of 11 or more.

3. If cobbles and boulders (size larger than 75 mm) are encountered, they are excluded from the portion of the soil sample from which classification is made.

To evaluate the quality of a soil as a highway subgrade material, one must also incorporate a number called the group index (GI) with the groups and subgroups of the soil. This index is written in parentheses after the group or subgroup designation.

The group index is given by the equation:

GI = (F200-35)[0.2+ 0.005(LL- 40)] + 0.01(.F200-15)(PI- 10)

where:

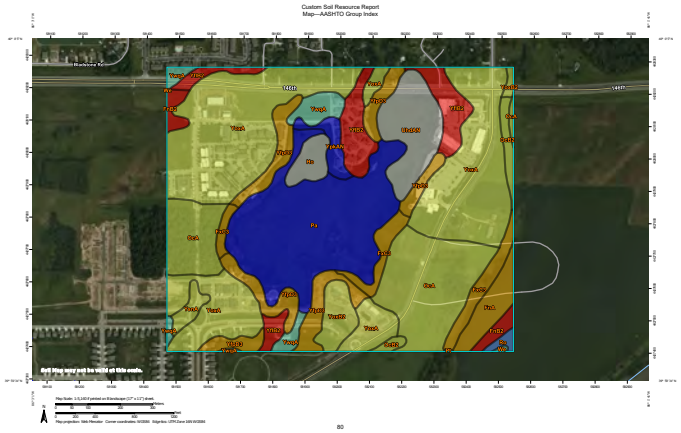
F200 = percentage passing through the No. 200 sieve

LL — liquid limit

PI : plasticity index

The group index is used typically to refine an AASHTO class but in the soil survey database is often used as a standalone soil attribute.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.



Analysis & Research

Appendix 21: Web Soil Survey

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Rating Polygons
  - <= 1
  - > 1 and <= 2
  - > 2 and <= 3
  - > 3 and <= 4
  - > 4 and <= 5
  - > 5 and <= 13
  - Not rated or not available
- Soil Rating Lines
  - <= 1
  - > 1 and <= 2
  - > 2 and <= 3
  - > 3 and <= 4
  - > 4 and <= 5
  - > 5 and <= 13
  - Not rated or not available
- Soil Rating Points
  - <= 1
  - > 1 and <= 2
  - > 2 and <= 3
  - > 3 and <= 4
  - > 4 and <= 5
  - > 5 and <= 13
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Hamilton County, Indiana
Survey Area Data: Version 22, Sep 9, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 1, 2018—Sep 30, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—AASHTO Group Index

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
FnA	Fox loam, 0 to 2 percent slopes	2	5.3	2.3%
FnB2	Fox loam, 2 to 6 percent slopes, eroded	1	3.0	1.3%
FxC3	Fox clay loam, 8 to 18 percent slopes, severely eroded	2	8.3	3.5%
Ho	Houghton muck		3.5	1.5%
OcA	Ockley silt loam, 0 to 2 percent slopes	3	31.7	13.6%
OcB2	Ockley silt loam, 2 to 6 percent slopes, eroded	3	2.7	1.2%
Pa	Palms muck	13	39.9	17.1%
Pt	Pits		0.0	0.0%
Ro	Ross loam, 0 to 2 percent slopes, occasionally flooded	5	0.8	0.3%
UhdAN	Urban land-Houghton muck complex, 0 to 2 percent slopes, drained		12.3	5.3%
We	Westland silty clay loam, 0 to 2 percent slopes	4	0.1	0.1%
YflB2	Fox loam-Urban land complex, 2 to 6 percent slopes, eroded	1	14.0	6.0%
YfpD3	Fox clay loam-Urban land complex, 8 to 18 percent slopes, severely eroded	2	18.4	7.9%
YoxA	Ockley silt loam-Urban land complex, 0 to 2 percent slopes	3	78.0	33.3%
YoxB2	Ockley silt loam-Urban land complex, 2 to 6 percent slopes, eroded	3	5.3	2.3%
YpkAN	Palms muck-Urban land complex, 0 to 2 percent slopes	13	2.8	1.2%
YsnA	Sleeth loam-Urban land complex, 0 to 2 percent slopes	3	1.9	0.8%
YwqA	Westland silty clay loam-Urban land complex, 0 to 2 percent slopes	4	5.7	2.4%
Totals for Area of Interest			**234.1**	**100.0%**

Rating Options—AASHTO Group Index

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

Water Features

Water Features include ponding frequency, flooding frequency, and depth to water table.

Flooding Frequency Class

Flooding is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent.

"None" means that flooding is not probable. The chance of flooding is nearly 0 percent in any year. Flooding occurs less than once in 500 years.

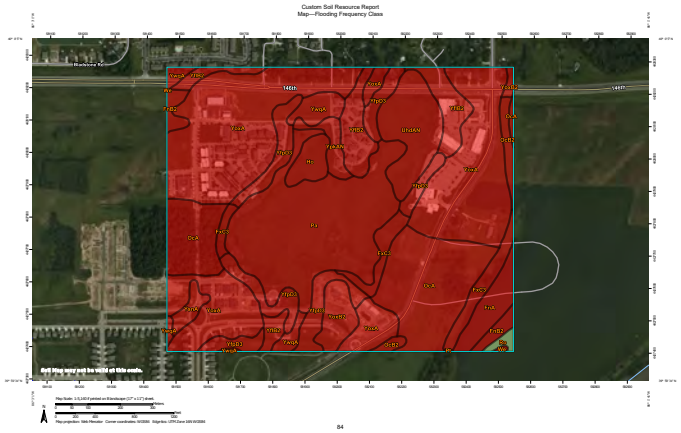
"Very rare" means that flooding is very unlikely but possible under extremely unusual weather conditions. The chance of flooding is less than 1 percent in any year.

"Rare" means that flooding is unlikely but possible under unusual weather conditions. The chance of flooding is 1 to 5 percent in any year.

"Occasional" means that flooding occurs infrequently under normal weather conditions. The chance of flooding is 5 to 50 percent in any year.

"Frequent" means that flooding is likely to occur often under normal weather conditions. The chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year.

"Very frequent" means that flooding is likely to occur very often under normal weather conditions. The chance of flooding is more than 50 percent in all months of any year.



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Rating Polygons
  - None
  - Very Rare
  - Rare
  - Occasional
  - Common
  - Frequent
  - Very Frequent
  - Not rated or not available
- Soil Rating Lines
  - None
  - Very Rare
  - Rare
  - Occasional
  - Common
  - Frequent
  - Very Frequent
  - Not rated or not available
- Soil Rating Points
  - None
  - Very Rare
  - Rare
  - Occasional
  - Common
  - Frequent
  - Very Frequent
  - Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

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Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Hamilton County, Indiana
Survey Area Data: Version 22, Sep 9, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 1, 2018—Sep 30, 2018

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Table—Flooding Frequency Class

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
FnA	Fox loam, 0 to 2 percent slopes	None	5.3	2.3%
FnB2	Fox loam, 2 to 6 percent slopes, eroded	None	3.0	1.3%
FxC3	Fox clay loam, 8 to 18 percent slopes, severely eroded	None	8.3	3.5%
Ho	Houghton muck	None	3.5	1.5%
OcA	Ockley silt loam, 0 to 2 percent slopes	None	31.7	13.6%
OcB2	Ockley silt loam, 2 to 6 percent slopes, eroded	None	2.7	1.2%
Pa	Palms muck	None	39.9	17.1%
Pt	Pits	None	0.0	0.0%
Ro	Ross loam, 0 to 2 percent slopes, occasionally flooded	Occasional	0.8	0.3%
UhdAN	Urban land-Houghton muck complex, 0 to 2 percent slopes, drained	None	12.3	5.3%
We	Westland silty clay loam, 0 to 2 percent slopes	None	0.1	0.1%
YfB2	Fox loam-Urban land complex, 2 to 6 percent slopes, eroded	None	14.0	6.0%
YfpD3	Fox clay loam-Urban land complex, 8 to 18 percent slopes, severely eroded	None	18.4	7.9%
YoxA	Ockley silt loam-Urban land complex, 0 to 2 percent slopes	None	78.0	33.3%
YoxB2	Ockley silt loam-Urban land complex, 2 to 6 percent slopes, eroded	None	5.3	2.3%
YpkAN	Palms muck-Urban land complex, 0 to 2 percent slopes	None	2.8	1.2%
YsnA	Sleeth loam-Urban land complex, 0 to 2 percent slopes	None	1.9	0.8%
YwqA	Westland silty clay loam-Urban land complex, 0 to 2 percent slopes	None	5.7	2.4%
Totals for Area of Interest			**234.1**	**100.0%**

Rating Options—Flooding Frequency Class

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: More Frequent

Beginning Month: January

Ending Month: December

Ponding Frequency Class

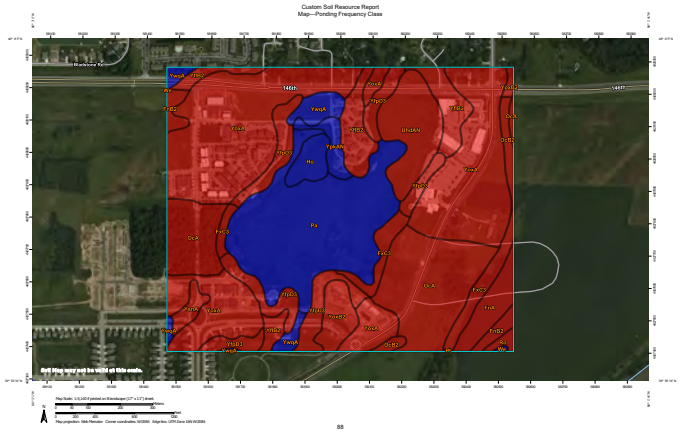
Ponding is standing water in a closed depression. The water is removed only by deep percolation, transpiration, or evaporation or by a combination of these processes. Ponding frequency classes are based on the number of times that ponding occurs over a given period. Frequency is expressed as none, rare, occasional, and frequent.

"None" means that ponding is not probable. The chance of ponding is nearly 0 percent in any year.

"Rare" means that ponding is unlikely but possible under unusual weather conditions. The chance of ponding is nearly 0 percent to 5 percent in any year.

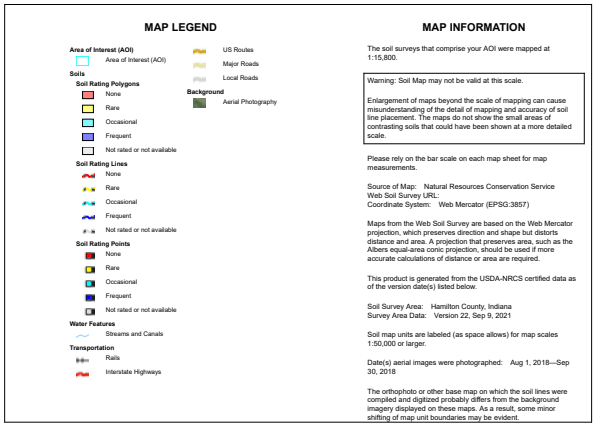
"Occasional" means that ponding occurs, on the average, once or less in 2 years. The chance of ponding is 5 to 50 percent in any year.

"Frequent" means that ponding occurs, on the average, more than once in 2 years. The chance of ponding is more than 50 percent in any year.



Analysis & Research

Appendix 21: Web Soil Survey



Table—Ponding Frequency Class

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
FnA	Fox loam, 0 to 2 percent slopes	None	5.3	2.3%
FnB2	Fox loam, 2 to 6 percent slopes, eroded	None	3.0	1.3%
FxC3	Fox clay loam, 8 to 18 percent slopes, severely eroded	None	8.3	3.5%
Ho	Houghton muck	Frequent	3.5	1.5%
OcA	Ockley silt loam, 0 to 2 percent slopes	None	31.7	13.6%
OcB2	Ockley silt loam, 2 to 6 percent slopes, eroded	None	2.7	1.2%
Pa	Palms muck	Frequent	39.9	17.1%
Pt	Pits	None	0.0	0.0%
Ro	Ross loam, 0 to 2 percent slopes, occasionally flooded	None	0.8	0.3%
UhdAN	Urban land-Houghton muck complex, 0 to 2 percent slopes, drained	None	12.3	5.3%
We	Westland silty clay loam, 0 to 2 percent slopes	Frequent	0.1	0.1%
YfB2	Fox loam-Urban land complex, 2 to 6 percent slopes, eroded	None	14.0	6.0%
YfpD3	Fox clay loam-Urban land complex, 8 to 18 percent slopes, severely eroded	None	18.4	7.9%
YoxA	Ockley silt loam-Urban land complex, 0 to 2 percent slopes	None	78.0	33.3%
YoxB2	Ockley silt loam-Urban land complex, 2 to 6 percent slopes, eroded	None	5.3	2.3%
YpkAN	Palms muck-Urban land complex, 0 to 2 percent slopes	Frequent	2.8	1.2%
YsnA	Sleeth loam-Urban land complex, 0 to 2 percent slopes	None	1.9	0.8%
YwqA	Westland silty clay loam-Urban land complex, 0 to 2 percent slopes	Frequent	5.7	2.4%
Totals for Area of Interest			**234.1**	**100.0%**

Rating Options—Ponding Frequency Class

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: More Frequent

Beginning Month: January

Ending Month: December

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Glossary

Many of the terms relating to landforms, geology, and geomorphology are defined in more detail in the following National Soil Survey Handbook link: "National Soil Survey Handbook."

ABC soil

A soil having an A, a B, and a C horizon.

Ablation till

Loose, relatively permeable earthy material deposited during the downwasting of nearly static glacial ice, either contained within or accumulated on the surface of the glacier.

AC soil

A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil

The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil

Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil

A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvial cone

A semiconical type of alluvial fan having very steep slopes. It is higher, narrower, and steeper than a fan and is composed of coarser and thicker layers of material deposited by a combination of alluvial episodes and (to a much lesser degree) landslides (debris flow). The coarsest materials tend to be concentrated at the apex of the cone.

Alluvial fan

A low, outspread mass of loose materials and/or rock material, commonly with gentle slopes. It is shaped like an open fan or a segment of a cone. The material was deposited by a stream at the place where it issues from a narrow mountain valley or upland valley or where a tributary stream is near or at its junction with the main stream. The fan is steepest near its apex, which points upstream, and slopes gently and convexly outward (downstream) with a gradual decrease in gradient.

Alluvium

Unconsolidated material, such as gravel, sand, silt, clay, and various mixtures of these, deposited on land by running water.

Alpha,alpha-dipyridyl

A compound that when dissolved in ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction implies reducing conditions and the likely presence of redoximorphic features.

Animal unit month (AUM)

The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Aquic conditions

Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Argillic horizon

A subsoil horizon characterized by an accumulation of illuvial clay.

Arroyo

The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in unconsolidated material. It is usually dry but can be transformed into a temporary watercourse or short-lived torrent after heavy rain within the watershed.

Aspect

The direction toward which a slope faces. Also called slope aspect.

Association, soil

A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity)

The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low: 0 to 3
Low: 3 to 6
Moderate: 6 to 9
High: 9 to 12
Very high: More than 12

Backslope

The position that forms the steepest and generally linear, middle portion of a hillslope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below.

Backswamp

A flood-plain landform. Extensive, marshy or swampy, depressed areas of flood plains between natural levees and valley sides or terraces.

Badland

A landscape that is intricately dissected and characterized by a very fine drainage network with high drainage densities and short, steep slopes and narrow interfluves. Badlands develop on surfaces that have little or no vegetative cover overlying unconsolidated or poorly cemented materials (clays, silts, or sandstones) with, in some cases, soluble minerals, such as gypsum or halite.

Bajada

A broad, gently inclined alluvial piedmont slope extending from the base of a mountain range out into a basin and formed by the lateral coalescence of a series of alluvial fans. Typically, it has a broadly undulating transverse profile, parallel to the mountain front, resulting from the convexities of component fans. The term is generally restricted to constructional slopes of intermontane basins.

Basal area

The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

Base saturation

The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Base slope (geomorphology)

A geomorphic component of hills consisting of the concave to linear (perpendicular to the contour) slope that, regardless of the lateral shape, forms an apron or wedge at the bottom of a hillside dominated by colluvium and slope-wash sediments (for example, slope alluvium).

Bedding plane

A planar or nearly planar bedding surface that visibly separates each successive layer of stratified sediment or rock (of the same or different lithology)

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from the preceding or following layer; a plane of deposition. It commonly marks a change in the circumstances of deposition and may show a parting, a color difference, a change in particle size, or various combinations of these. The term is commonly applied to any bedding surface, even one that is conspicuously bent or deformed by folding.

Bedding system

A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock

The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography

A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bench terrace

A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum

Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Blowout (map symbol)

A saucer-, cup-, or trough-shaped depression formed by wind erosion on a preexisting dune or other sand deposit, especially in an area of shifting sand or loose soil or where protective vegetation is disturbed or destroyed. The adjoining accumulation of sand derived from the depression, where recognizable, is commonly included. Blowouts are commonly small.

Borrow pit (map symbol)

An open excavation from which soil and underlying material have been removed, usually for construction purposes.

Bottom land

An informal term loosely applied to various portions of a flood plain.

Boulders

Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breaks

A landscape or tract of steep, rough or broken land dissected by ravines and gullies and marking a sudden change in topography.

Breast height

An average height of 4.5 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

Brush management

Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Butte

An isolated, generally flat-topped hill or mountain with relatively steep slopes and talus or precipitous cliffs and characterized by summit width that is less than the height of bounding escarpments; commonly topped by a caprock of resistant material and representing an erosion remnant carved from flat-lying rocks.

Cable yarding

A method of moving felled trees to a nearby central area for transport to a processing facility. Most cable yarding systems involve use of a drum, a pole, and wire cables in an arrangement similar to that of a rod and reel used for fishing. To reduce friction and soil disturbance, felled trees generally are reeled in while one end is lifted or the entire log is suspended.

Calcareous soil

A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche

A general term for a prominent zone of secondary carbonate accumulation in surficial materials in warm, subhumid to arid areas. Caliche is formed by both geologic and pedologic processes. Finely crystalline calcium carbonate forms a nearly continuous surface-coating and void-filling medium in geologic (parent) materials. Cementation ranges from weak in nonindurated forms to very strong in indurated forms. Other minerals (e.g., carbonates, silicate, and sulfate) may occur as accessory cements. Most petrocalcic horizons and some calcic horizons are caliche.

California bearing ratio (CBR)

The load-supporting capacity of a soil as compared to that of standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Canopy

The leafy crown of trees or shrubs. (See Crown.)

Canyon

A long, deep, narrow valley with high, precipitous walls in an area of high local relief.

Capillary water

Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena

A sequence, or “chain,” of soils on a landscape that formed in similar kinds of parent material and under similar climatic conditions but that have different characteristics as a result of differences in relief and drainage.

Cation

An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity

The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Catsteps

See Terracettes.

Cement rock

Shaly limestone used in the manufacture of cement.

Channery soil material

Soil material that has, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Chemical treatment

Control of unwanted vegetation through the use of chemicals.

Chiseling

Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Cirque

A steep-walled, semicircular or crescent-shaped, half-bowl-like recess or hollow, commonly situated at the head of a glaciated mountain valley or high on the side of a mountain. It was produced by the erosive activity of a mountain glacier. It commonly contains a small round lake (tarn).

Clay

As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions

See Redoximorphic features.

Clay film

A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Clay spot (map symbol)

A spot where the surface texture is silty clay or clay in areas where the surface layer of the soils in the surrounding map unit is sandy loam, loam, silt loam, or coarser.

Claypan

A dense, compact subsoil layer that contains much more clay than the overlying materials, from which it is separated by a sharply defined boundary. The layer restricts the downward movement of water through the soil. A claypan is commonly hard when dry and plastic and sticky when wet.

Climax plant community

The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil

Sand or loamy sand.

Cobble (or cobblestone)

A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material

Material that has 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

COLE (coefficient of linear extensibility)

See Linear extensibility.

Colluvium

Unconsolidated, unsorted earth material being transported or deposited on side slopes and/or at the base of slopes by mass movement (e.g., direct gravitational action) and by local, unconcentrated runoff.

Complex slope

Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil

A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Concretions

See Redoximorphic features.

Conglomerate

A coarse grained, clastic sedimentary rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system

Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage

A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil

Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."

Contour stripcropping

Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section

The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat)

A type of limnic layer composed predominantly of fecal material derived from aquatic animals.

Corrosion (geomorphology)

A process of erosion whereby rocks and soil are removed or worn away by natural chemical processes, especially by the solvent action of running water, but also by other reactions, such as hydrolysis, hydration, carbonation, and oxidation.

Corrosion (soil survey interpretations)

Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop

A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Crop residue management

Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cropping system

Growing crops according to a planned system of rotation and management practices.

Cross-slope farming

Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown

The upper part of a tree or shrub, including the living branches and their foliage.

Cryoturbate

A mass of soil or other unconsolidated earthy material moved or disturbed by frost action. It is typically coarser than the underlying material.

Cuesta

An asymmetric ridge capped by resistant rock layers of slight or moderate dip (commonly less than 15 percent slopes); a type of homocline produced by differential erosion of interbedded resistant and weak rocks. A cuesta has a long, gentle slope on one side (dip slope) that roughly parallels the inclined beds; on the other side, it has a relatively short and steep or cliff like slope (scarp) that cuts through the tilted rocks.

Culmination of the mean annual increment (CMAI)

The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age, the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

Cutbanks cave

The walls of excavations tend to cave in or slough.

Decreasers

The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing

Postponing grazing or resting grazing land for a prescribed period.

Delta

A body of alluvium having a surface that is fan shaped and nearly flat; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Dense layer

A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depression, closed (map symbol)

A shallow, saucer-shaped area that is slightly lower on the landscape than the surrounding area and that does not have a natural outlet for surface drainage.

Depth, soil

Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Desert pavement

A natural, residual concentration or layer of wind-polished, closely packed gravel, boulders, and other rock fragments mantling a desert surface. It forms where wind action and sheetwash have removed all smaller particles or where rock fragments have migrated upward through sediments to the surface. It typically protects the finer grained underlying material from further erosion.

Diatomaceous earth

A geologic deposit of fine, grayish siliceous material composed chiefly or entirely of the remains of diatoms.

Dip slope

A slope of the land surface, roughly determined by and approximately conforming to the dip of the underlying bedrock.

Diversion (or diversion terrace)

A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Divided-slope farming

A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

Drainage class (natural)

Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained*. These classes are defined in the "Soil Survey Manual."

Drainage, surface

Runoff, or surface flow of water, from an area.

Drainageway

A general term for a course or channel along which water moves in draining an area. A term restricted to relatively small, linear depressions that at some time move concentrated water and either do not have a defined channel or have only a small defined channel.

Draw

A small stream valley that generally is shallower and more open than a ravine or gulch and that has a broader bottom. The present stream channel may appear inadequate to have cut the drainageway that it occupies.

Drift

A general term applied to all mineral material (clay, silt, sand, gravel, and boulders) transported by a glacier and deposited directly by or from the ice or transported by running water emanating from a glacier. Drift includes unstratified material (till) that forms moraines and stratified deposits that form outwash plains, eskers, kames, varves, and glaciofluvial sediments. The term is generally applied to Pleistocene glacial deposits in areas that no longer contain glaciers.

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Drumlin

A low, smooth, elongated oval hill, mound, or ridge of compact till that has a core of bedrock or drift. It commonly has a blunt nose facing the direction from which the ice approached and a gentler slope tapering in the other direction. The longer axis is parallel to the general direction of glacier flow. Drumlins are products of streamline (laminar) flow of glaciers, which molded the subglacial floor through a combination of erosion and deposition.

Duff

A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Dune

A low mound, ridge, bank, or hill of loose, windblown granular material (generally sand), either barren and capable of movement from place to place or covered and stabilized with vegetation but retaining its characteristic shape.

Earthy fill

See Mine spoil.

Ecological site

An area where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. An ecological site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other ecological sites in kind and/or proportion of species or in total production.

Eluviation

The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation

A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Eolian deposit

Sand-, silt-, or clay-sized clastic material transported and deposited primarily by wind, commonly in the form of a dune or a sheet of sand or loess.

Ephemeral stream

A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation

A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion

The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (accelerated)

Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Erosion (geologic)

Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion pavement

A surficial lag concentration or layer of gravel and other rock fragments that remains on the soil surface after sheet or rill erosion or wind has removed the finer soil particles and that tends to protect the underlying soil from further erosion.

Erosion surface

A land surface shaped by the action of erosion, especially by running water.

Escarpment

A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Most commonly applied to cliffs produced by differential erosion. Synonym: scarp.

Escarpment, bedrock (map symbol)

A relatively continuous and steep slope or cliff, produced by erosion or faulting, that breaks the general continuity of more gently sloping land surfaces. Exposed material is hard or soft bedrock.

Escarpment, nonbedrock (map symbol)

A relatively continuous and steep slope or cliff, generally produced by erosion but in some places produced by faulting, that breaks the continuity of more gently sloping land surfaces. Exposed earthy material is nonsoil or very shallow soil.

Esker

A long, narrow, sinuous, steep-sided ridge of stratified sand and gravel deposited as the bed of a stream flowing in an ice tunnel within or below the ice (subglacial) or between ice walls on top of the ice of a wasting glacier and left

behind as high ground when the ice melted. Eskers range in length from less than a kilometer to more than 160 kilometers and in height from 3 to 30 meters.

Extrusive rock

Igneous rock derived from deep-seated molten matter (magma) deposited and cooled on the earth's surface.

Fallow

Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fan remnant

A general term for landforms that are the remaining parts of older fan landforms, such as alluvial fans, that have been either dissected or partially buried.

Fertility, soil

The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat)

The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity

The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fill slope

A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil

Sandy clay, silty clay, or clay.

Firebreak

An area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

First bottom

An obsolete, informal term loosely applied to the lowest flood-plain steps that are subject to regular flooding.

Flaggy soil material

Material that has, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone

A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain

The nearly level plain that borders a stream and is subject to flooding unless protected artificially.

Flood-plain landforms

A variety of constructional and erosional features produced by stream channel migration and flooding. Examples include backswamps, flood-plain splays, meanders, meander belts, meander scrolls, oxbow lakes, and natural levees.

Flood-plain splay

A fan-shaped deposit or other outspread deposit formed where an overloaded stream breaks through a levee (natural or artificial) and deposits its material (commonly coarse grained) on the flood plain.

Flood-plain step

An essentially flat, terrace-like alluvial surface within a valley that is frequently covered by floodwater from the present stream; any approximately horizontal surface still actively modified by fluvial scour and/or deposition. May occur individually or as a series of steps.

Fluvial

Of or pertaining to rivers or streams; produced by stream or river action.

Foothills

A region of steeply sloping hills that fringes a mountain range or high-plateau escarpment. The hills have relief of as much as 1,000 feet (300 meters).

Footslope

The concave surface at the base of a hillslope. A footslope is a transition zone between upslope sites of erosion and transport (shoulders and backslopes) and downslope sites of deposition (toeslopes).

Forb

Any herbaceous plant not a grass or a sedge.

Forest cover

All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type

A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragipan

A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Genesis, soil

The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai

Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

Glaciofluvial deposits

Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur in the form of outwash plains, valley trains, deltas, kames, eskers, and kame terraces.

Glaciolacustrine deposits

Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are bedded or laminated.

Gleyed soil

Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Graded stripcropping

Growing crops in strips that grade toward a protected waterway.

Grassed waterway

A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel

Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravel pit (map symbol)

An open excavation from which soil and underlying material have been removed and used, without crushing, as a source of sand or gravel.

Gravelly soil material

Material that has 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Gravelly spot (map symbol)

A spot where the surface layer has more than 35 percent, by volume, rock fragments that are mostly less than 3 inches in diameter in an area that has less than 15 percent rock fragments.

Green manure crop (agronomy)

A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water

Water filling all the unblocked pores of the material below the water table.

Gully (map symbol)

A small, steep-sided channel caused by erosion and cut in unconsolidated materials by concentrated but intermittent flow of water. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage whereas a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard bedrock

Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hard to reclaim

Reclamation is difficult after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Hardpan

A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Head slope (geomorphology)

A geomorphic component of hills consisting of a laterally concave area of a hillside, especially at the head of a drainageway. The overland waterflow is converging.

Hemic soil material (mucky peat)

Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-residue crops

Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill

A generic term for an elevated area of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline. Slopes are generally more than 15 percent. The distinction between a hill and a mountain is arbitrary and may depend on local usage.

Hillslope

A generic term for the steeper part of a hill between its summit and the drainage line, valley flat, or depression floor at the base of a hill.

Horizon, soil

A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the “Soil Survey Manual.” The major horizons of mineral soil are as follows:

O horizon: An organic layer of fresh and decaying plant residue.

L horizon: A layer of organic and mineral limnic materials, including coprogenous earth (sedimentary peat), diatomaceous earth, and marl.

A horizon: The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon: The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon: The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon: The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon: Soft, consolidated bedrock beneath the soil.

R layer: Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

M layer: A root-limiting subsoil layer consisting of nearly continuous, horizontally oriented, human-manufactured materials.

W layer: A layer of water within or beneath the soil.

Humus

The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups

Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties include depth to a seasonal high water table, the infiltration rate, and depth to a layer that significantly restricts the downward movement of water. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Igneous rock

Rock that was formed by cooling and solidification of magma and that has not been changed appreciably by weathering since its formation. Major varieties include plutonic and volcanic rock (e.g., andesite, basalt, and granite).

Illuviation

The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Appendix 21: Web Soil Survey

Impervious soil

A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers

Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration

The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity

The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate

The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate

The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Very low: Less than 0.2
Low: 0.2 to 0.4
Moderately low: 0.4 to 0.75
Moderate: 0.75 to 1.25
Moderately high: 1.25 to 1.75
High: 1.75 to 2.5
Very high: More than 2.5

Interfluve

A landform composed of the relatively undissected upland or ridge between two adjacent valleys containing streams flowing in the same general direction. An elevated area between two drainageways that sheds water to those drainageways.

Interfluve (geomorphology)

A geomorphic component of hills consisting of the uppermost, comparatively level or gently sloping area of a hill; shoulders of backwearing hillslopes can narrow the upland or can merge, resulting in a strongly convex shape.

Intermittent stream

A stream, or reach of a stream, that does not flow year-round but that is commonly dry for 3 or more months out of 12 and whose channel is generally below the local water table. It flows only during wet periods or when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders

On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Iron depletions

See Redoximorphic features.

Irrigation

Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin: Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Border: Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Controlled flooding: Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation: Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle): Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow: Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler: Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation: Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding: Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame

A low mound, knob, hummock, or short irregular ridge composed of stratified sand and gravel deposited by a subglacial stream as a fan or delta at the margin of a melting glacier; by a supraglacial stream in a low place or hole on the surface of the glacier; or as a ponded deposit on the surface or at the margin of stagnant ice.

Karst (topography)

A kind of topography that formed in limestone, gypsum, or other soluble rocks by dissolution and that is characterized by closed depressions, sinkholes, caves, and underground drainage.

Knoll

A small, low, rounded hill rising above adjacent landforms.

Ksat

See Saturated hydraulic conductivity.

Lacustrine deposit

Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake plain

A nearly level surface marking the floor of an extinct lake filled by well sorted, generally fine textured, stratified deposits, commonly containing varves.

Lake terrace

A narrow shelf, partly cut and partly built, produced along a lakeshore in front of a scarp line of low cliffs and later exposed when the water level falls.

Landfill (map symbol)

An area of accumulated waste products of human habitation, either above or below natural ground level.

Landslide

A general, encompassing term for most types of mass movement landforms and processes involving the downslope transport and outward deposition of soil and rock materials caused by gravitational forces; the movement may or may not involve saturated materials. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones

Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Lava flow (map symbol)

A solidified, commonly lobate body of rock formed through lateral, surface outpouring of molten lava from a vent or fissure.

Leaching

The removal of soluble material from soil or other material by percolating water.

Levee (map symbol)

An embankment that confines or controls water, especially one built along the banks of a river to prevent overflow onto lowlands.

Linear extensibility

Refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. Linear extensibility is used to determine the shrink-swell potential of soils. It is an expression of the volume change between the water content of the clod at $^{1}/_{3}$- or $^{1}/_{10}$-bar tension (33kPa or 10kPa tension) and oven dryness. Volume change is influenced by the amount and type of clay minerals in the soil. The volume change is the percent change for the whole soil. If it is expressed as a fraction, the resulting value is COLE, coefficient of linear extensibility.

Liquid limit

The moisture content at which the soil passes from a plastic to a liquid state.

Loam

Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess

Material transported and deposited by wind and consisting dominantly of silt-sized particles.

Low strength

The soil is not strong enough to support loads.

Low-residue crops

Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Marl

An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal proportions; formed primarily under freshwater lacustrine conditions but also formed in more saline environments.

Marsh or swamp (map symbol)

A water-saturated, very poorly drained area that is intermittently or permanently covered by water. Sedges, cattails, and rushes are the dominant vegetation in marshes, and trees or shrubs are the dominant vegetation in swamps. Not used in map units where the named soils are poorly drained or very poorly drained.

Mass movement

A generic term for the dislodgment and downslope transport of soil and rock material as a unit under direct gravitational stress.

Masses

See Redoximorphic features.

Meander belt

The zone within which migration of a meandering channel occurs; the flood-plain area included between two imaginary lines drawn tangential to the outer bends of active channel loops.

Meander scar

A crescent-shaped, concave or linear mark on the face of a bluff or valley wall, produced by the lateral erosion of a meandering stream that impinged upon and undercut the bluff.

Meander scroll

One of a series of long, parallel, close-fitting, crescent-shaped ridges and troughs formed along the inner bank of a stream meander as the channel migrated laterally down-valley and toward the outer bank.

Mechanical treatment

Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil

Very fine sandy loam, loam, silt loam, or silt.

Mesa

A broad, nearly flat topped and commonly isolated landmass bounded by steep slopes or precipitous cliffs and capped by layers of resistant, nearly horizontal rocky material. The summit width is characteristically greater than the height of the bounding escarpments.

Metamorphic rock

Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement at depth in the earth's crust. Nearly all such rocks are crystalline.

Mine or quarry (map symbol)

An open excavation from which soil and underlying material have been removed and in which bedrock is exposed. Also denotes surface openings to underground mines.

Mine spoil

An accumulation of displaced earthy material, rock, or other waste material removed during mining or excavation. Also called earthy fill.

Mineral soil

Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage

Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area

A kind of map unit that has little or no natural soil and supports little or no vegetation.

Miscellaneous water (map symbol)

Small, constructed bodies of water that are used for industrial, sanitary, or mining applications and that contain water most of the year.

Moderately coarse textured soil

Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil

Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon

A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Moraine

In terms of glacial geology, a mound, ridge, or other topographically distinct accumulation of unsorted, unstratified drift, predominantly till, deposited primarily by the direct action of glacial ice in a variety of landforms. Also, a general term for a landform composed mainly of till (except for kame moraines, which are composed mainly of stratified outwash) that has been deposited by a glacier. Some types of moraines are disintegration, end, ground, kame, lateral, recessional, and terminal.

Morphology, soil

The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil

Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Mountain

A generic term for an elevated area of the land surface, rising more than 1,000 feet (300 meters) above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can

occur as a single, isolated mass or in a group forming a chain or range. Mountains are formed primarily by tectonic activity and/or volcanic action but can also be formed by differential erosion.

Muck

Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mucky peat

See Hemic soil material.

Mudstone

A blocky or massive, fine grained sedimentary rock in which the proportions of clay and silt are approximately equal. Also, a general term for such material as clay, silt, claystone, siltstone, shale, and argillite and that should be used only when the amounts of clay and silt are not known or cannot be precisely identified.

Munsell notation

A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Natric horizon

A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

Neutral soil

A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nodules

See Redoximorphic features.

Nose slope (geomorphology)

A geomorphic component of hills consisting of the projecting end (laterally convex area) of a hillside. The overland waterflow is predominantly divergent. Nose slopes consist dominantly of colluvium and slope-wash sediments (for example, slope alluvium).

Nutrient, plant

Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter

Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low: Less than 0.5 percent
Low: 0.5 to 1.0 percent
Moderately low: 1.0 to 2.0 percent
Moderate: 2.0 to 4.0 percent
High: 4.0 to 8.0 percent
Very high: More than 8.0 percent

Outwash

Stratified and sorted sediments (chiefly sand and gravel) removed or "washed out" from a glacier by meltwater streams and deposited in front of or beyond the end moraine or the margin of a glacier. The coarser material is deposited nearer to the ice.

Outwash plain

An extensive lowland area of coarse textured glaciofluvial material. An outwash plain is commonly smooth; where pitted, it generally is low in relief.

Paleoterrace

An erosional remnant of a terrace that retains the surface form and alluvial deposits of its origin but was not emplaced by, and commonly does not grade to, a present-day stream or drainage network.

Pan

A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material

The unconsolidated organic and mineral material in which soil forms.

Peat

Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped

An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedisediment

A layer of sediment, eroded from the shoulder and backslope of an erosional slope, that lies on and is being (or was) transported across a gently sloping erosional surface at the foot of a receding hill or mountain slope.

Pedon

The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Analysis & Research

Appendix 21: Web Soil Survey

Percolation

The movement of water through the soil.

Perennial water (map symbol)

Small, natural or constructed lakes, ponds, or pits that contain water most of the year.

Permafrost

Ground, soil, or rock that remains at or below 0 degrees C for at least 2 years. It is defined on the basis of temperature and is not necessarily frozen.

pH value

A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Phase, soil

A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

Piping

Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Pitting

Pits caused by melting around ice. They form on the soil after plant cover is removed.

Plastic limit

The moisture content at which a soil changes from semisolid to plastic.

Plasticity index

The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plateau (geomorphology)

A comparatively flat area of great extent and elevation; specifically, an extensive land region that is considerably elevated (more than 100 meters) above the adjacent lower lying terrain, is commonly limited on at least one side by an abrupt descent, and has a flat or nearly level surface. A comparatively large part of a plateau surface is near summit level.

Playa

The generally dry and nearly level lake plain that occupies the lowest parts of closed depressions, such as those on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation and runoff. Playa deposits are fine grained and may or may not have a high water table and saline conditions.

Plinthite

The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. It commonly appears as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on repeated wetting and drying, especially if it is exposed also to heat from the sun. In a moist soil, plinthite can be cut with a spade. It is a form of laterite.

Plowpan

A compacted layer formed in the soil directly below the plowed layer.

Ponding

Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded

Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Pore linings

See Redoximorphic features.

Potential native plant community

See Climax plant community.

Potential rooting depth (effective rooting depth)

Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning

Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil

The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil

A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use

Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and

promotes the accumulation of litter and mulch necessary to conserve soil and water.

Rangeland

Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Reaction, soil

A measure of acidity or alkalinity of a soil, expressed as pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid: Less than 3.5
Extremely acid: 3.5 to 4.4
Very strongly acid: 4.5 to 5.0
Strongly acid: 5.1 to 5.5
Moderately acid: 5.6 to 6.0
Slightly acid: 6.1 to 6.5
Neutral: 6.6 to 7.3
Slightly alkaline: 7.4 to 7.8
Moderately alkaline: 7.9 to 8.4
Strongly alkaline: 8.5 to 9.0
Very strongly alkaline: 9.1 and higher

Red beds

Sedimentary strata that are mainly red and are made up largely of sandstone and shale.

Redoximorphic concentrations

See Redoximorphic features.

Redoximorphic depletions

See Redoximorphic features.

Redoximorphic features

Redoximorphic features are associated with wetness and result from alternating periods of reduction and oxidation of iron and manganese compounds in the soil. Reduction occurs during saturation with water, and oxidation occurs when the soil is not saturated. Characteristic color patterns are created by these processes. The reduced iron and manganese ions may be removed from a soil if vertical or lateral fluxes of water occur, in which case there is no iron or manganese precipitation in that soil. Wherever the iron and manganese are oxidized and precipitated, they form either soft masses or hard concretions or nodules. Movement of iron and manganese as a result of redoximorphic processes in a soil may result in redoximorphic features that are defined as follows:

1. Redoximorphic concentrations.—These are zones of apparent accumulation of iron-manganese oxides, including:
   A. Nodules and concretions, which are cemented bodies that can be removed from the soil intact. Concretions are distinguished from nodules on the basis of internal organization. A concretion typically has concentric layers that are visible to the naked eye. Nodules do not have visible organized internal structure; *and*
   B. Masses, which are noncemented concentrations of substances within the soil matrix; *and*
   C. Pore linings, i.e., zones of accumulation along pores that may be either coatings on pore surfaces or impregnations from the matrix adjacent to the pores.
2. Redoximorphic depletions.—These are zones of low chroma (chromas less than those in the matrix) where either iron-manganese oxides alone or both iron-manganese oxides and clay have been stripped out, including:
   A. Iron depletions, i.e., zones that contain low amounts of iron and manganese oxides but have a clay content similar to that of the adjacent matrix; *and*
   B. Clay depletions, i.e., zones that contain low amounts of iron, manganese, and clay (often referred to as silt coatings or skeletans).
3. Reduced matrix.—This is a soil matrix that has low chroma *in situ* but undergoes a change in hue or chroma within 30 minutes after the soil material has been exposed to air.

Reduced matrix

See Redoximorphic features.

Regolith

All unconsolidated earth materials above the solid bedrock. It includes material weathered in place from all kinds of bedrock and alluvial, glacial, eolian, lacustrine, and pyroclastic deposits.

Relief

The relative difference in elevation between the upland summits and the lowlands or valleys of a given region.

Residuum (residual soil material)

Unconsolidated, weathered or partly weathered mineral material that accumulated as bedrock disintegrated in place.

Rill

A very small, steep-sided channel resulting from erosion and cut in unconsolidated materials by concentrated but intermittent flow of water. A rill generally is not an obstacle to wheeled vehicles and is shallow enough to be smoothed over by ordinary tillage.

Riser

The vertical or steep side slope (e.g., escarpment) of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural, steplike landforms, such as successive stream terraces.

Road cut

A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments

Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rock outcrop (map symbol)

An exposure of bedrock at the surface of the earth. Not used where the named soils of the surrounding map unit are shallow over bedrock or where "Rock outcrop" is a named component of the map unit.

Root zone

The part of the soil that can be penetrated by plant roots.

Runoff

The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil

A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Saline spot (map symbol)

An area where the surface layer has an electrical conductivity of 8 mmhos/cm more than the surface layer of the named soils in the surrounding map unit. The surface layer of the surrounding soils has an electrical conductivity of 2 mmhos/cm or less.

Sand

As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone

Sedimentary rock containing dominantly sand-sized particles.

Sandy spot (map symbol)

A spot where the surface layer is loamy fine sand or coarser in areas where the surface layer of the named soils in the surrounding map unit is very fine sandy loam or finer.

Sapric soil material (muck)

The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saturated hydraulic conductivity (Ksat)

The ease with which pores of a saturated soil transmit water. Formally, the proportionality coefficient that expresses the relationship of the rate of water movement to hydraulic gradient in Darcy's Law, a law that describes the rate of water movement through porous media. Commonly abbreviated as "Ksat." Terms describing saturated hydraulic conductivity are:

Very high: 100 or more micrometers per second (14.17 or more inches per hour)

High: 10 to 100 micrometers per second (1.417 to 14.17 inches per hour)

Moderately high: 1 to 10 micrometers per second (0.1417 inch to 1.417 inches per hour)

Moderately low: 0.1 to 1 micrometer per second (0.01417 to 0.1417 inch per hour)

Low: 0.01 to 0.1 micrometer per second (0.001417 to 0.01417 inch per hour)

Very low: Less than 0.01 micrometer per second (less than 0.001417 inch per hour).

To convert inches per hour to micrometers per second, multiply inches per hour by 7.0572. To convert micrometers per second to inches per hour, multiply micrometers per second by 0.1417.

Saturation

Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Scarification

The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Sedimentary rock

A consolidated deposit of clastic particles, chemical precipitates, or organic remains accumulated at or near the surface of the earth under normal low temperature and pressure conditions. Sedimentary rocks include consolidated equivalents of alluvium, colluvium, drift, and eolian, lacustrine, and marine deposits. Examples are sandstone, siltstone, mudstone, claystone, shale, conglomerate, limestone, dolomite, and coal.

Sequum

A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil

A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Severely eroded spot (map symbol)

An area where, on the average, 75 percent or more of the original surface layer has been lost because of accelerated erosion. Not used in map units in which "severely eroded," "very severely eroded," or "gullied" is part of the map unit name.

Shale

Sedimentary rock that formed by the hardening of a deposit of clay, silty clay, or silty clay loam and that has a tendency to split into thin layers.

Sheet erosion

The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Short, steep slope (map symbol)

A narrow area of soil having slopes that are at least two slope classes steeper than the slope class of the surrounding map unit.

Shoulder

The convex, erosional surface near the top of a hillslope. A shoulder is a transition from summit to backslope.

Shrink-swell

The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Shrub-coppice dune

A small, streamlined dune that forms around brush and clump vegetation.

Side slope (geomorphology)

A geomorphic component of hills consisting of a laterally planar area of a hillside. The overland waterflow is predominantly parallel. Side slopes are dominantly colluvium and slope-wash sediments.

Silica

A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio

The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt

As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone

An indurated silt having the texture and composition of shale but lacking its fine lamination or fissility; a massive mudstone in which silt predominates over clay.

Similar soils

Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Sinkhole (map symbol)

A closed, circular or elliptical depression, commonly funnel shaped, characterized by subsurface drainage and formed either by dissolution of the surface of underlying bedrock (e.g., limestone, gypsum, or salt) or by collapse of underlying caves within bedrock. Complexes of sinkholes in carbonate-rock terrain are the main components of karst topography.

Site index

A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Slickensides (pedogenic)

Grooved, striated, and/or glossy (shiny) slip faces on structural peds, such as wedges; produced by shrink-swell processes, most commonly in soils that have a high content of expansive clays.

Slide or slip (map symbol)

A prominent landform scar or ridge caused by fairly recent mass movement or descent of earthy material resulting from failure of earth or rock under shear stress along one or several surfaces.

Slope

The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Appendix 21: Web Soil Survey

Slope alluvium

Sediment gradually transported down the slopes of mountains or hills primarily by nonchannel alluvial processes (i.e., slope-wash processes) and characterized by particle sorting. Lateral particle sorting is evident on long slopes. In a profile sequence, sediments may be distinguished by differences in size and/or specific gravity of rock fragments and may be separated by stone lines. Burnished peds and sorting of rounded or subrounded pebbles or cobbles distinguish these materials from unsorted colluvial deposits.

Slow refill

The slow filling of ponds, resulting from restricted water transmission in the soil.

Slow water movement

Restricted downward movement of water through the soil. See Saturated hydraulic conductivity.

Sodic (alkali) soil

A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Sodic spot (map symbol)

An area where the surface layer has a sodium adsorption ratio that is at least 10 more than that of the surface layer of the named soils in the surrounding map unit. The surface layer of the surrounding soils has a sodium adsorption ratio of 5 or less.

Sodicity

The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^{+} to $Ca^{++} + Mg^{++}$. The degrees of sodicity and their respective ratios are:

Slight: Less than 13:1
Moderate: 13-30:1
Strong: More than 30:1

Sodium adsorption ratio (SAR)

A measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration.

Soft bedrock

Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil

A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief and by the passage of time.

Soil separates

Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand: 2.0 to 1.0
Coarse sand: 1.0 to 0.5
Medium sand: 0.5 to 0.25
Fine sand: 0.25 to 0.10
Very fine sand: 0.10 to 0.05
Silt: 0.05 to 0.002
Clay: Less than 0.002

Solum

The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Spoil area (map symbol)

A pile of earthy materials, either smoothed or uneven, resulting from human activity.

Stone line

In a vertical cross section, a line formed by scattered fragments or a discrete layer of angular and subangular rock fragments (commonly a gravel- or cobble-sized lag concentration) that formerly was draped across a topographic surface and was later buried by additional sediments. A stone line generally caps material that was subject to weathering, soil formation, and erosion before burial. Many stone lines seem to be buried erosion pavements, originally formed by sheet and rill erosion across the land surface.

Stones

Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony

Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stony spot (map symbol)

A spot where 0.01 to 0.1 percent of the soil surface is covered by rock fragments that are more than 10 inches in diameter in areas where the surrounding soil has no surface stones.

Strath terrace

A type of stream terrace; formed as an erosional surface cut on bedrock and thinly mantled with stream deposits (alluvium).

Stream terrace

One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream; represents the remnants of an abandoned flood plain, stream bed, or valley floor produced during a former state of fluvial erosion or deposition.

Stripcropping

Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

Structure, soil

The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are:

Platy: Flat and laminated
Prismatic: Vertically elongated and having flat tops
Columnar: Vertically elongated and having rounded tops
Angular blocky: Having faces that intersect at sharp angles (planes)
Subangular blocky: Having subrounded and planar faces (no sharp angles)
Granular: Small structural units with curved or very irregular faces

Structureless soil horizons are defined as follows:

Single grained: Entirely noncoherent (each grain by itself), as in loose sand
Massive: Occurring as a coherent mass

Stubble mulch

Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil

Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling

Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum

The part of the soil below the solum.

Subsurface layer

Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow

The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Summit

The topographically highest position of a hillslope. It has a nearly level (planar or only slightly convex) surface.

Surface layer

The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil

The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Talus

Rock fragments of any size or shape (commonly coarse and angular) derived from and lying at the base of a cliff or very steep rock slope. The accumulated mass of such loose broken rock formed chiefly by falling, rolling, or sliding.

Taxadjuncts

Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

Terminal moraine

An end moraine that marks the farthest advance of a glacier. It typically has the form of a massive arcuate or concentric ridge, or complex of ridges, and is underlain by till and other types of drift.

Terrace (conservation)

An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field

generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geomorphology)

A steplike surface, bordering a valley floor or shoreline, that represents the former position of a flood plain, lake, or seashore. The term is usually applied both to the relatively flat summit surface (tread) that was cut or built by stream or wave action and to the steeper descending slope (scarp or riser) that has graded to a lower base level of erosion.

Terracettes

Small, irregular steplike forms on steep hillslopes, especially in pasture, formed by creep or erosion of surficial materials that may be induced or enhanced by trampling of livestock, such as sheep or cattle.

Texture, soil

The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer

Otherwise suitable soil material that is too thin for the specified use.

Till

Dominantly unsorted and nonstratified drift, generally unconsolidated and deposited directly by a glacier without subsequent reworking by meltwater, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders; rock fragments of various lithologies are embedded within a finer matrix that can range from clay to sandy loam.

Till plain

An extensive area of level to gently undulating soils underlain predominantly by till and bounded at the distal end by subordinate recessional or end moraines.

Tilth, soil

The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toeslope

The gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear and are constructional surfaces forming the lower part of a hillslope continuum that grades to valley or closed-depression floors.

Topsoil

The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements

Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Tread

The flat to gently sloping, topmost, laterally extensive slope of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural steplike landforms, such as successive stream terraces.

Tuff

A generic term for any consolidated or cemented deposit that is 50 percent or more volcanic ash.

Upland

An informal, general term for the higher ground of a region, in contrast with a low-lying adjacent area, such as a valley or plain, or for land at a higher elevation than the flood plain or low stream terrace; land above the footslope zone of the hillslope continuum.

Valley fill

The unconsolidated sediment deposited by any agent (water, wind, ice, or mass wasting) so as to fill or partly fill a valley.

Variegation

Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve

A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Very stony spot (map symbol)

A spot where 0.1 to 3.0 percent of the soil surface is covered by rock fragments that are more than 10 inches in diameter in areas where the surface of the surrounding soil is covered by less than 0.01 percent stones.

Water bars

Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering

All physical disintegration, chemical decomposition, and biologically induced changes in rocks or other deposits at or near the earth's surface by atmospheric or biologic agents or by circulating surface waters but involving essentially no transport of the altered material.

Well graded

Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wet spot (map symbol)

A somewhat poorly drained to very poorly drained area that is at least two drainage classes wetter than the named soils in the surrounding map unit.

Wilting point (or permanent wilting point)

The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow

The uprooting and tipping over of trees by the wind.

Appendix 22: Geotechnical Engineering Report

Terracon GeoReport

Geotechnical Engineering Report

Carmel Legacy Wells 25 and 26
Carmel, Indiana
June 2, 2022
Terracon Project No. CJ215308

Prepared for:
Jones & Henry Engineers, Ltd
Carmel, Indiana

Prepared by:
Terracon Consultants, Inc.
Indianapolis, Indiana

Environmental ■ Facilities ■ Geotechnical ■ Materials

June 2, 2022

Terracon GeoReport

Jones & Henry Engineers, Ltd
1980 East 116th Street, Suite 260
Carmel, Indiana 46032

Attn: Mr. Phillip D. Teague, P.E.
E: pteague@jheng.com

Re: Geotechnical Engineering Report
Carmel Legacy Wells 25 and 26
Carmel, Indiana
Terracon Project No. CJ215308

Dear Mr. Teague

In accordance with your request, we have completed our Geotechnical Engineering evaluation for the referenced project. This evaluation was performed in general accordance with Terracon Proposal No. PCJ215308 Rev 1. This report presents the results of our subsurface exploratory and laboratory testing programs and provides geotechnical recommendations concerning earthwork and the design and construction of foundations.

We have enjoyed working with you on this project. If you have any questions concerning this report or require further assistance, feel free to contact us.

Sincerely,
Terracon Consultants, Inc.

Tanner Hill, P.E.
Project Engineer

Terracon Consultants, Inc. 7770 West New York Street Indianapolis, Indiana 46214
P (317) 273 1690 F (317) 273 2250 terracon.com

Environmental ■ Facilities ■ Geotechnical ■ Materials

REPORT TOPICS

Note: This report was originally delivered in a web-based format. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

Geotechnical Engineering Report
Carmel Legacy Wells 25 and 26
146th Street and River Road
Carmel, Indiana
Terracon Project No. CJ215308
June 2, 2022

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed well improvements and water force main to be located at along the south side of 146th Street and approximately ¼ miles west of the intersection at River Road in Carmel, Indiana. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface conditions
- Groundwater conditions
- Site preparation and earthwork
- Foundation design and construction
- Dewatering considerations
- Seismic site classification per IBC
- Pavement considerations
- Lateral earth pressures
- Force main considerations

The geotechnical engineering Scope of Services for this project included the advancement of eight test borings to depths ranging from approximately 35 to 100 ft below existing site grades.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs and/or as separate graphs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	■ The project site is located south of 146th street and about ¼ mile west of River Road, Indiana. ■ Approximate center of project area is located near: ○ Latitude: 39.995 ○ Longitude: -86.0417 ■ See Site Location.
Existing Improvements	Undeveloped.
Current Ground Cover	Vegetation and weeds.
Existing Topography (from the Indiana Map GIS system)	Ground surface elevations at the boring locations ranged from about El. 744 to 752.
Geology[1]	The project area is located in the northwestern portion of the New Castle Till Plains and Drainageways physiographic region. New Castle Till Plains and Drainageways consists of Till plains of low relief crossed by many major tunnel-valleys. The bedrock near the project area consists predominantly of dolomite with other lithologies including limestone, sandstone and gypsum. The quaternary geology is associated with outwash from the Wisconsinian age. A review of publicly-available water well information from Indiana Department of Natural Resources (IDNR) indicates the bedrock is typically near 70 to 200 ft below the surface within about 1 mile of the project area.

1. Based on information obtained from the Indiana Geological and Water Survey (IGWS).

PROJECT DESCRIPTION

Our understanding of the project is as follows:

Item	Description
Information Provided	Information for the project was provided by Phillip D. Teague of Jones & Henry Engineers, Ltd (J&H) via electronic mail. ■ Scope of Work ■ Site Plan dated December 2019 ■ Plan and Profile Sta. 0+00 thru 10+00 dated December 2019 ■ Plan and Profile Sta. 10+00 thru 20+00 dated December 2019 ■ Cross Sections A-A' and B-B' ■ Preliminary Geotechnical Engineering Study prepared by The Schneider Corporation dated August 19, 2005. ■ Preliminary Subsurface Investigation & Site Evaluation prepared by Alt & Witzig Engineering, Inc. dated June 28, 2007 and June 26, 2008. ■ Wetland Delineation Report prepared by Williams Creek Consulting dated July 2005. ■ Record of Water Well – Well 25 and Well 26
Project Description	We understand the development will include the following: ■ The installation of about 1,775 lineal foot of water force main. The force main pipe is preliminary planned with inverts generally in the range of 7 to 14 ft below the existing ground surface and will be 16 in. in diameter ■ The improvement of two existing wells. The improvements to the existing wells are planned to include the following: ○ Associated well observation platforms ○ Associated utility platforms ○ Associated underground concrete valve vaults ○ Pedestrian walkways to observation platforms ○ Vehicle access road
Below-Grade Structures	We understand the improvements will include below grade vertical walls for utility vaults.
Maximum Loads	Structural loading information was not provided at the time of this report.
Grading/Slopes	A site grading plan was not provided. Based on our observations of the site and our understanding of the project, we assume up to 1 to 2 ft of cut/fill will be required to achieve finished grades.
Estimated Start of Construction	The construction schedule was not available at the time of this report.

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at

each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the GeoModel can be found in the **Figures** section of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
	Topsoil	
1	**Organic Soil**	Peat: soft; black; Sand with organic matter; black; loose
2	**Sand**	With varying amounts of silt and gravel; brown and gray; medium dense to dense
3	**Sand**	With varying amounts of gravel; brown and gray; dense to very dense
4	**Silty Clay**[1]	Soft to stiff; gray

1. Soft to medium stiff cohesive soils were observed in Boring B-3 near a depth 8 to 12½ below existing grade.

The project is located within an area mapped to contain peat (primarily consist of highly compressible organic soils) per the National Cooperative Soil Survey. A map of the extends of the mapped peat area is shown in the **Figures** section. A summary of peat and soils with organic matter observed in the test borings is provided in the table below.

Exploratory Location	Soil Type	Approximate Depth (ft)	Approximate Moisture Content (%)	Organic Content (%)
B-1	Peat	1 – 4	139	34
B-3	Peat	0 – 8	79 to 309	30
B-5	Silty Sand	1 – 6½	31 to 51	16.1
B-8	Peat	1 – 4	25	23

It should be noted that all borings were performed in areas mapped to contain organic soils. However, organic soils were not observed at Borings B-2, B-4, B-6, and B-7. Understandably, this report does not reflect variations in subsurface conditions between or beyond the boring locations. Therefore, variations in these conditions can be expected.

Groundwater level observations were made during and at the completion of the sampling process. The observed groundwater levels are noted on the borings logs and are summarized below.

Boring Number	Approximate Groundwater Depth (ft) [1]	
	During Drilling	At Completion
B-1	9	No water encountered
B-2	11	3

Boring Number	Approximate Groundwater Depth (ft) [1]	
	During Drilling	At Completion
B-3	11	5
B-4	11	5
B-5	9	No water encountered
B-6	15	5
B-7	16	No water encountered
B-8	11	No water encountered

1. Below the existing ground surface.

A review of the *Soil Survey of Hamilton County, Indiana* indicates that the soils in the project area are prone to a seasonal high water level (i.e., perched) near the surface to about 4½ ft below the surface. As additional input, a review of publicly available water well information from the Indiana Map GIS system (https://maps.indiana.edu) indicated the groundwater level is typically near 8 to 30 ft below the surface at Indiana Department of Natural Resources (IDNR) well sites (Well Reference Nos.: 121710, 414494, 414498, and 432510) located within about 2-miles of the project area.

It should be recognized that groundwater levels will fluctuate due to changes in precipitation, infiltration, surface run-off, and other hydrogeological factors. 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.

GEOTECHNICAL OVERVIEW

Based on our review of the information obtained from the exploratory locations, the subsurface conditions are suitable for support of the proposed development provided the subgrade is prepared as discussed herein. As stated previously, organic soils were observed in Borings B-1, B-3, B-5, and B-8 within the upper 4 to 8 ft of the surface. In addition, soft to medium stiff cohesive soils were observed near depths of about 8 to 12½ ft below existing grade in Boring B-3. Undercutting and replacing of the organic soils and soft soils should be anticipated where encountered below foundations and walkways. Undercutting to depths of up to 8 to 12½ ft should be anticipated to reach suitable soils in some areas during construction. In lieu of undercutting, consideration could also be given to aggregate piers. Additional discussion and recommendations regarding design and construction are provided in the following paragraphs.

Terracon should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; proofrolling; placement and compaction of structural fill; removal of the peat and other unsuitable soils below foundations, backfilling of excavations; and for construction of foundations.

Appendix 22: Geotechnical Engineering Report

The General Comments section provides an understanding of the report limitations.

EARTHWORK

Earthwork is anticipated to include clearing and grubbing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations.

Site Preparation

Areas of Non-Organic Soils

1. In at-grade areas and where fill is necessary, we recommend the removal of all topsoil within the limits of the proposed construction. Based on the test boring logs, the topsoil was observed to be about 6 to 13 in. in thickness. However, the thickness of the surficial conditions will vary. In our opinion, these removal activities should extend a minimum of 5 ft beyond the limits of the proposed construction.
2. Following these excavation and removal activities, we anticipate granular soils to predominantly be exposed. We recommend that proper site drainage be provided at the time of construction (via the use of ditches and/or piping) and only stripping of the surface conditions in those areas which will be immediately developed.
3. We recommend that underground utilities in conflict with the proposed construction be appropriately abandoned or relocated. Where utilities are relocated, we recommend that the resulting excavations be backfilled as recommended in the Fill Compaction Requirements section of this report.
4. Because subgrades will deteriorate when exposed to excessive moisture and repeated construction traffic, traversing over the completed subgrades should be avoided.
5. We recommend that the Geotechnical Engineer be on-site during construction to evaluate the subgrade conditions following topsoil removal.
6. Following these activities, we recommend the exposed soil subgrades be evaluated via proof-rolling using a large, self-propelled vibratory drum compactor in a static mode with a drum weight of at least 12,000 pounds. Where cohesive soil subgrades are encountered, the subgrade should be proofrolled with an adequately loaded vehicle such as a fully loaded tandem-axle dump truck.
7. Where yielding areas are delineated and are not improved with moisture conditioning and compaction, they should be undercut and replaced with structural fill. If removal and replacement is unfeasible due to the depth of the yielding soil and where grades permit, it may be beneficial to stabilize the subgrade with No. 2 crushed aggregate [Indiana Department of Transportation (INDOT) Standard Specifications, 2018, Section 904.03(e)]

worked into the subgrade or a combination of crushed aggregate (e.g., INDOT No. 53 coarse aggregate) and a bi-axial geogrid.
8. Typically, the final decision regarding stabilization is made at the time of construction based on actual conditions and site grades. However, it should be noted that during certain times of the year (i.e., cooler temperatures and high humidity and/or precipitation), stabilization of the existing subgrade is likely to be required. As such, we recommend quantities for excavation and replacement with structural fill be included in the construction documents to address the subgrade as necessary.

Areas of Organic Soils

Based on our review of the National Cooperative Soil Survey and the test borings, organic soil (peat) is anticipated to be present in several areas across the site. These soils typically extended to depths of about 4 to 8 ft below the ground surface. The top of these strata is generally anticipated to be observed within the upper 1 ft of the surface.

Approximate mapped areas of peat (primarily consist of highly compressible organic soils) per the National Cooperative Soil Survey are shown in the Figures section. In our opinion, subgrade improvement consisting of excavation and replacement with structural fill will be required in these areas. Undercuts of up to 8 ft should be anticipated during foundation construction. Other options such as aggregate piers can be considered as an alternative to undercutting and replacement. However, the vary nature of a geotechnical evaluation is such that uncertainty of the exact extents of unsuitable subgrade conditions requires the final decision regarding improvement of the subgrade be made at the time of construction based on the observed conditions. We recommend the borings logs be used for the purpose of developing quantities for the improvement as discussed.

The final decision regarding stabilization should be made at the time of construction, based on the actual observed conditions after removal of the surficial elements and results of the proofroll.

Fill Material Types

Fill required to achieve design grade should be classified as structural fill and general fill. Structural fill is material used below, or within 10 ft of structures, pavements or constructed slopes. General fill is material used to achieve grade outside of these areas. Earthen materials used for structural and general fill should meet the following material property requirements:

Soil Type [1]	USCS Classification	Acceptable Fill Designation
Low Plasticity Cohesive	CL, CL-ML	Structural or General
High Plasticity Cohesive [2]	CH, MH	General

Soil Type [1]	USCS Classification	Acceptable Fill Designation
Granular	GW, SP, GM, GC, SW, SP, SM, SC	Structural or General
On-Site Soils	CL-ML, SP-SM SM, SP	Structural or General
	PT	General[3]

1. Structural and general fill should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.
2. Not observed in the test borings. If present, soils classified as CH or MH should not be used within 2 ft below the base of footings and 1 ft below finished grade in other structural fill areas.
3. The peat soils are not suitable for reuse as structural fill due to the presence of organic matter. The peat soils can be considered for use as general fill, provided settlement of the backfill is tolerable.

Fill Compaction Requirements

Structural and general fill should meet the following compaction requirements.

Item	Recommendation	
Fill Designation	**Structural Fill**	**General Fill**
Maximum Lift Thickness [1, 2]	8 in. or less in loose thickness when heavy, self-propelled compaction equipment is used. 4 in. in loose thickness when hand guided equipment (i.e., jumping jack or plate compactor) is used.	
Minimum Compaction Requirements [1, 2]	95 percent of the modified Proctor density (ASTM D 1557)	90 percent of the modified Proctor density (ASTM D 1557)
Water Content Range	±2% of optimum	

1. The acceptable thickness of loose lifts of fill and/or number of passes required by the compaction equipment to achieve compaction to the density recommended in this report will be a function of the type of compaction equipment and techniques used, the soil type, as well as proper control of the soil moisture content and the season in which construction takes place.
2. Periodic field density tests performed by the Geotechnical Engineer during fill placement are recommended to determine the adequacy of the compaction effort.

Construction Observation and Testing

The earthwork efforts should be observed by the Geotechnical Engineer. This observation should include documentation of adequate removal of vegetation and topsoil, proofrolling, and remediation of areas delineated by the proofroll to require stabilization.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. If unanticipated conditions are encountered, the Geotechnical

Engineer should recommend stabilization options or removal and replacement with compacted structural fill.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

SHALLOW FOUNDATIONS

As indicated previously, organic soils were observed near the anticipated foundation grade at Borings B-1, B-3, B-5, and B-8. Where organic soils are observed at the foundation grade, we recommend these soils be undercut to suitable soils. In addition, softer cohesive soils were observed in Boring B-5 near a depth of 8 to 12½ ft below existing grade. As such, undercuts of up to 8 to 12½ ft below the surface are anticipated. Following the undercutting, we recommend the foundation grade be reestablished with lean concrete, structural fill, or foundations can be lowered to suitable soils. Alternatively, soil improvement consisting of aggregate piers could be considered for support of the improvements. Aggregate piers are discussed later.

Where granular soils are observed at the foundation subgrade, we recommend the foundation subgrade be compacted in-place with a vibratory plate compactor prior to placing concrete due to potential disturbance of granular soils during excavation.

Provided the subgrades are prepared and fill placed in accordance with the recommendations noted in Earthwork, the following design parameters are applicable for shallow foundations.

Design Parameters – Compressive Loads

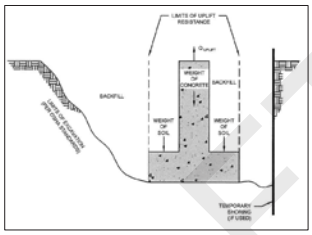
Item	Description
Maximum Net Allowable Bearing pressure for naturally occurring soils [1]	3,000 psf
Required Bearing Stratum [2, 3]	Granular – Loose or better native sands or Structural fill Bearing stratum should be observed by the Geotechnical Engineer.
Minimum Foundation Dimensions	Columns: 30 in. wide Continuous: 18 in. wide
Minimum Embedment below Finished Grade [4]	36 in.
Estimated Total Settlement from Structural Loads [2, 5]	Not anticipated to exceed 1 in.

Item	Description
Estimated Differential Settlement [2, 5]	Not anticipated to exceed ½ in.

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Maximum net allowable bearing pressure based on a Factor of Safety (FS) = 3.
2. Soft soils should be removed and replaced with compacted structural fill, or the foundations could be lowered to a suitable bearing stratum. Structural fill should meet the USCS classification and compaction requirements provided in the **Earthwork** section of this report. If very loose soils are encountered during foundation excavation activities that are not able to be compacted in-place, the foundation should be lowered to a suitable bearing stratum.
3. Where granular soils are observed at the foundation subgrade, we recommend the foundation subgrade be compacted in-place with a vibratory plate compactor prior to placing concrete due to potential disturbance of granular soils during excavation.
4. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal ft of the structure.
5. Settlements were estimated assuming relatively light to moderate structural loads, and our experience with similar construction. Actual settlements will depend on actual loads and construction methods.

Design Parameters – Uplift Loads

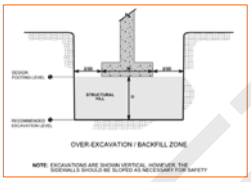
In addition to downward forces, the effects of uplift loads should also be considered for the well platform. Considering perched groundwater, we recommend using a groundwater level near a depth of 4½ ft below grade. As illustrated on the sketch below, the weight of the foundation in addition to the weight of the soil above the exterior portion of the foundation can be considered to provide the necessary resistance to the uplift forces. The maximum allowable uplift capacity should be taken as the sum of the effective weight of soil plus the dead weight of the foundation divided by an appropriate factor of safety. In this case, we recommend that an effective unit weight of the soil of 120 pcf be utilized for this purpose. This unit weight should be reduced to 58 pcf for portions of the backfill or natural soils below the groundwater elevation.



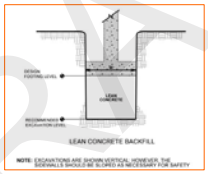
Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil prior to placing concrete. Concrete should be placed soon after excavating to reduce the risk of disturbance to the soil. Alternatively, a mud mat of lean concrete could be placed over the bearing surface after compacting with a plate compactor to protect the foundation subgrade from disturbance and to provide a working platform. Care should be taken to reduce changes in the moisture content of the bearing soils during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

As stated previously, organic soils and soft soils (similar to these observed at various locations in the exploratory locations) should be removed and replaced with compacted structural fill, or the foundations could be lowered to a suitable bearing stratum. Where undercutting is required beneath proposed foundations, the excavation should be widened beyond the footing width a distance equal to ⅔ of the depth of undercut to provide for a uniform stress distribution as illustrated on the sketch below. We recommend compacted granular fill be utilized to reestablish undercut foundation grades (in lieu of cohesive soil fill) due to its ease of placement/compaction as compared to cohesive soils.



Consideration could also be given to the use of lean concrete in undercut areas extending to bear directly on deeper suitable soils as illustrated on the sketch below. We recommend a contingency be included in the contract to account for undercutting and fill placement and compaction as needed to address poor foundation subgrade conditions.



Additional Construction Considerations

Based on the groundwater depths observed during our exploration and our review of the *Soil Survey of Hamilton County, Indiana*, and publicly available water well information, dewatering as a result of perched groundwater infiltration during shallow foundation construction may be needed. If surface water run-off or trapped/perched water enters foundation excavations, we anticipate that removal of the water can likely be performed by using a pump and filtered sump. In addition, all excavations should conform with Occupational Safety and Health Administration (OSHA) requirements. The contractor is solely responsible for excavation safety.

AGGREGATE PIERS

Due to the depth of organic soils in some areas, another option for the support of shallow foundations is to utilize conventionally designed and reinforced spread footings which are partially supported on properly installed aggregate piers. The aggregate pier not only allows for the use of shallow foundations using conventional methods, but also allows for some improvement of the soils within the project area due to the construction methods involved in placing these elements. Aggregate piers are constructed by drilling holes within the shallow foundation footprint, and then compacting the holes with crushed stone to form a dense aggregate pier. The shallow footings are then constructed directly on the aggregate pier reinforced subgrade using conventional construction methods.

We recommend the aggregate piers be installed by extending the piers below the organic soils and in the medium dense granular soils typically observed below depths of about 4 to 12½ below existing grades. Based on our experience, an allowable soil bearing pressure on the order of 5,000 to 7,000 psf is anticipated for piers established in the medium dense granular soils. However, the actual allowable bearing pressure will be determined by the foundation company, and our estimate should only be considered as a guide.

EXISTING WELL CASING CONSIDERATIONS

We understand that designers are considering utilizing the existing well casings to resist structural loads. Well 25 and Well 26 were installed by Reynolds, Inc. in November 2008. The Record of Water Well for each well are shown in the **Supporting Information**. Based on our observations of the well records, the construction details consisted of:

- Depth of Well: 120 ft
- Borehole diameter: 42 inches
- Casing material: Steel
- Casing diameter: 30 inches
- Casing wall thickness: ½ inch

The conditions around the casing typically consist of 50 ft of a sanitary seal underlain by gravel pack to the maximum depth of the well (120 ft). Based on our review of the installation logs and observations of the boring logs, we recommend the resistance values provided below for the existing well casings.

Surrounding Material	Depth Interval [1] (ft)	Allowable Skin Resistance (psf)
Sanitary Seal	0 - 50	400
Gravel Pack	50 - 120	500

1. Depth below existing grade.

SEISMIC CONSIDERATIONS

The Site Classification is required to determine the Seismic Design Category for a structure. Based on our observations, it is our opinion the subsurface conditions most closely resemble a Site Class D. Note that the Site Class is based on the upper 100 ft of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the international building code (IBC), and our exploratory activities extended to a depth of about 100 ft. Geophysical testing may be performed to obtain a more favorable site class.

PAVEMENT CONSIDERATIONS

Subgrade materials below the topsoil at the site typically consist of loose to medium dense granular soils. An exception to this will be observed at the areas of organic soils observed throughout the site. It is expected that the proposed site grades will be established near the existing site grades using structural fill material similar to these subgrade soils to level the planned access road areas.

Provided the subgrade is prepared and fill placed in accordance with the recommendations noted in **Earthwork**, the existing soils or structural fill should provide adequate support for the pavement. An exception to this is where the organic soils are observed. These soils will require improvement consisting of removal and replacement with structural fill. For this condition, we recommend the information summarized in the table below be considered for pavement design.

SOIL PARAMETERS FOR PAVEMENT ANALYSIS AND DESIGN	
California Bearing Ratio (CBR)[1]	8
Design Soil Type	Sand (SP)

1. Based on experience with similar soils.

Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature

pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the granular subbase.

Pavement Maintenance

Preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

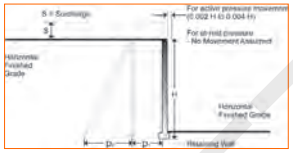
- Final grade adjacent to paved areas should slope down from the edges at a minimum 2 percent.
- Subgrade and pavement surfaces should have a minimum 2 percent slope to promote proper surface drainage.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.

LATERAL EARTH PRESSURES

We understand that below grade vertical walls of both flexible and rigid type are being considered by designers for possible below grade vaults and/or new utilities. The wall types, wall heights, and locations were not available at the time of this report.

Design Parameters

The earth pressures will be influenced by the structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown in the diagram below. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement and is commonly used for walls restrained at the top. For design of retaining walls, we recommend the parameters provided below.



Lateral Earth Pressure Design Parameters				
Earth Pressure Condition [1]	Backfill Type [2]	Earth Pressure Coefficient [2]	Surcharge Pressure [3, 4, 5] (psf)	Equivalent Fluid Pressure [3, 5] (pcf)
Active (K_a)	Clean well-graded granular soil	0.28	(0.28)S	35
At-Rest (K_o)	Clean well-graded granular soil	0.44	(0.44)S	55

1. For active earth pressure, the wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. For passive earth pressure, the wall must move horizontally to mobilize resistance.
2. These values assume uniform horizontal backfill, compacted to at least 95 percent of the modified Proctor density (ASTM D 1557), rendering a maximum unit weight of 125 pcf (granular).
3. No safety factor is included in these values.
4. Uniform surcharge, where S is the surcharge pressure in psf.
5. Loading from heavy equipment is not included.

We recommend backfill placed against below grade walls consist of clean well-graded granular soils. For the lateral earth pressure design parameters for the granular soil provided above to be valid, we recommend that clean well-graded granular backfill extend horizontally behind the wall a distance of at least ½ the height of the wall. Compaction of backfill within 3 ft of the walls should be performed with a hand guided compactor to avoid over-stressing the walls.

FORCE MAIN CONSIDERATIONS

It is understood that the force main is generally planned to be installed using conventional cut-and-cover techniques with planned inverts established up to 14 ft below the existing grade. Based on information obtained at the boring locations, the subgrade at the invert is generally anticipated to consist of medium dense granular soils. However, instances of organic soils may be observed at the planned inverts. Note that groundwater is anticipated to be present near or above the planned inverts along a majority of the alignment.

Dewatering and Excavation

Based on the groundwater conditions and soil types observed at the boring locations, dewatering will be necessary during the construction of the force main. The soil conditions along the alignment are primarily anticipated to consist of granular soils. Within the granular soils, dewatering is anticipated to consist of the use of multiple deep wells, well points, and/or sump pits outside the limits of the excavation. It should be noted that the sands observed at the test borings will flow if excavated in the wet. This will cause poor subgrade conditions for support of the force main. We recommend that the groundwater level be lowered a depth of 2 ft below the planned invert prior to the excavation activities.

The intent of our evaluation was to provide geotechnical design-related recommendations for the new force main. The scope of this evaluation was not to provide dewatering recommendations for contractors. Dewatering is a responsibility of the contractor based on their means and methods and considers the requirements of subgrade preparation discussed herein. It may be necessary for the dewatering contractor to obtain additional subsurface information to assist with the design of their dewatering plan. The effectiveness of the subgrade preparation activities discussed below will be directly dependent on the adequacy of the contactor's dewatering efforts.

All excavations should comply with OSHA standards. Stockpiled soil should not be placed adjacent to the excavation. In addition, proper site drainage is recommended to help minimize unwanted surface water runoff into excavations during the construction process.

Cut-and-Cover

As previously mentioned, the condition of the subgrade will be a function of the care and workmanship of the contractor in protecting the subgrade from water. The following subgrade preparation recommendations are provided assuming the subgrade has been dewatered prior to excavation, where necessary. We recommend that the granular soils be compacted via several passes of a vibratory plate compactor. As stated previously, organic soils may be observed at or near the subgrade along portions of the alignment. If organic soils are observed, we recommend that the force main subgrades be undercut a maximum of 2 ft and grade be reestablished by placing an open-graded crushed aggregate such as INDOT No. 5 stone. To reduce the potential for softening of the subgrade soils and additional undercutting, it is recommended that the construction activities be scheduled such that the force main subgrade is undercut, then reestablished as soon as practical. This will require having all backfill materials present during the excavation activities.

Bedding and Backfill

In areas where the pipe crosses beneath pavement or other utilities (settlement sensitive areas), granular fill is recommended for backfill. This is because of their ease of compaction as compared to cohesive soils which reduces the risk of settlement. In addition, periodic field density tests and

observations by the Geotechnical Engineer are recommended during backfill placement to verify the adequacy of compactive effort. We recommend the following material properties and compaction requirements for the bedding material and soils used for structural backfill surrounding the pipe elements:

Item	Recommendation
Soil Type[1]	Granular soil satisfying a USCS symbol of SP, SW, SW-SM, SP-SM, GP, GW[2]
Maximum Lift Thickness	4 in. in loose thickness
Minimum Compaction Requirements	95 percent of the modified Proctor density (ASMT D 1557) at the base of the excavation, for bedding material, and soils used for structural backfill surrounding the pipe elements.
	90 percent of the modified Proctor density (ASMT D 1557) in other areas, provided some settlement of the backfill is tolerable.

1. The use of cohesive soils for backfill above the pipe, if considered, should be limited to areas outside of the pavement, other utilities, and non-settlement sensitive areas.
2. The soils classified using these designations at the test borings are anticipated to be suitable for this purpose. However, we recommend imported granular fill be planned. A significant quantity of backfill could be required if the excavation slopes are laid back.

In addition, we recommend that the pipe manufacturer be contacted to discuss special bedding and backfill requirements.

CORROSIVITY

Corrosivity tests were performed on samples collected at some of the boring locations. The corrosivity test results may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with various underground materials which will be used for project construction. The location of the samples and the test results are included in our results of corrosion analysis included in the appendix of this report.

Results of the sulfate testing indicate samples of the on-site soils tested classify as S0 according to Table 19.3.1.1 of Section 318 of the American Concrete Institute (ACI) Building Code Requirements for Structural Concrete. Concrete should be designed in accordance with the provisions of the ACI Building Code Requirements for Structural Concrete, Section 318, Chapter 19.

As stated previously, these test results are provided to assist in determining the type and degree of corrosion protection that may be required. We recommend that a certified corrosion engineer be employed to determine the need for corrosion protection and to design appropriate protective measures, if required.

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Carmel Legacy Wells 25 and 26 ■ Carmel, Indiana
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GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations 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. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services 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.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

FIGURES

Contents:

GEOMODEL
Carmel Legacy Wells 25 and 26 ■ Carmel, Indiana
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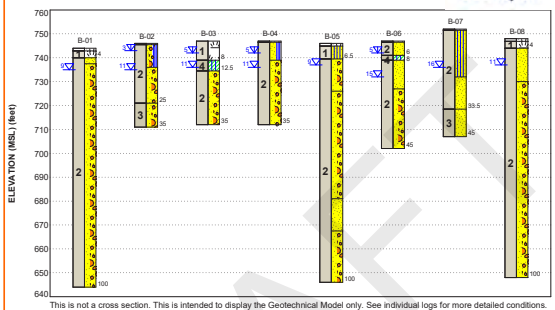

This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Organic Soil	Peat; Soft; black; Sand with organic matter: black; loose
2	Sand	With varying amounts of silt and gravel; brown and gray; medium dense to dense
3	Sand	With varying amounts of gravel; brown and gray; dense to very dense
4	Silty Clay	Soft to stiff; gray

LEGEND

Topsoil
Peat
Poorly-graded Sand
Poorly-graded Sand with Gravel
Poorly-graded Sand with Silt and Gravel
Silty Clay
Poorly-graded Sand with Silt
Silty Sand

First Water Observation
Second Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

Analysis & Research

Appendix 22: Geotechnical Engineering Report

MAPPED PEAT AREAS
Carmel Legacy Wells 25 and 26 ■ Carmel, Indiana
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ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Approximate Boring Depth	Planned Location
2	100 ft	Associated well structures
2	45 ft	Associated well structures
3	35 ft	Associated well structures
1	100 ft	Water force main

Boring Layout and Elevations: The exploratory locations were staked in the field by Terracon personnel using hand held GPS equipment referencing locations provided by J&H. Furthermore, ground surface elevations at the boring locations were estimated using topographic information obtained from the Indiana Map GIS System. A topographic survey of the exploratory locations was outside the scope of this exploration. If precise locations and elevations are desired, we recommend a licensed surveyor be retained to provide ground surface elevations.

Subsurface Exploration Procedures: We advanced the borings using ATV-mounted equipment and hollow stem augers. Up to eight samples were obtained in the upper 20 ft of each boring and at 5-ft intervals thereafter. In the split-spoon sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. Following the completion of our exploratory activities, the boreholes were backfilled with auger cuttings and cement-bentonite grout to the surface.

The sampling depths, penetration distances, and other sampling information were recorded on the field logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification. Our exploration team prepares field logs as part of the drilling operations. These field logs include visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples.

Laboratory Testing

Soil samples were reviewed by a geotechnical engineer who assigned laboratory tests. Soil classifications on the boring logs are in general accordance with the Unified Soil Classification System (USCS). Further details regarding the classification system are provided in **Supporting Information**. After classifying the samples, the following laboratory testing program was performed:

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- Hand penetrometer readings (i.e., q_p, which provide an indication of the shear strength characteristics of cohesive-type soils);
- Natural moisture content tests (W%);
- Grain size distribution;
- Atterberg limit determinations;
- Loss on ignition (LOI); and
- Corrosivity testing
  - pH analysis
  - Sulfate, chloride, and sulfide content
  - Oxidation-Reduction potential
  - Total Salts
  - Electrical resistivity.

Laboratory testing of the soil samples was performed in general accordance with applicable ASTM standard procedures. Upon completion of our laboratory testing program, boring logs were prepared and are provided in the attachments. The results of these tests are included on the test boring logs and/or laboratory test reports. It should be mentioned that the boring logs represent the approximate boundary between soil types; although the transitions may actually be gradual.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Note: All attachments are one page unless noted above.

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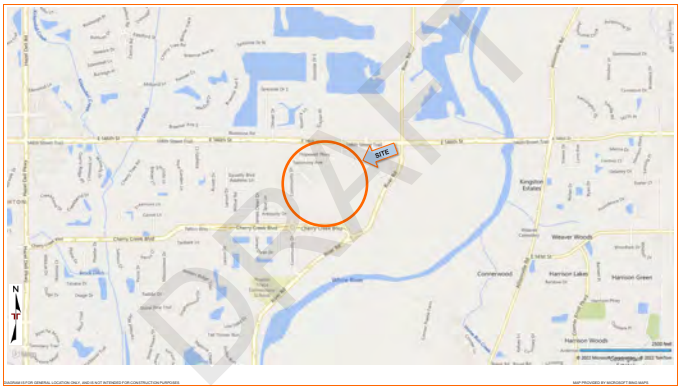
Carmel Legacy Wells 25 and 26 x Carmel, Indiana
June 2, 2022 ■ Terracon Project No. CJ215308



EXPLORATION PLAN
Carmel Legacy Wells 25 and 26 x Carmel, Indiana
June 2, 2022 ■ Terracon Project No. CJ215308

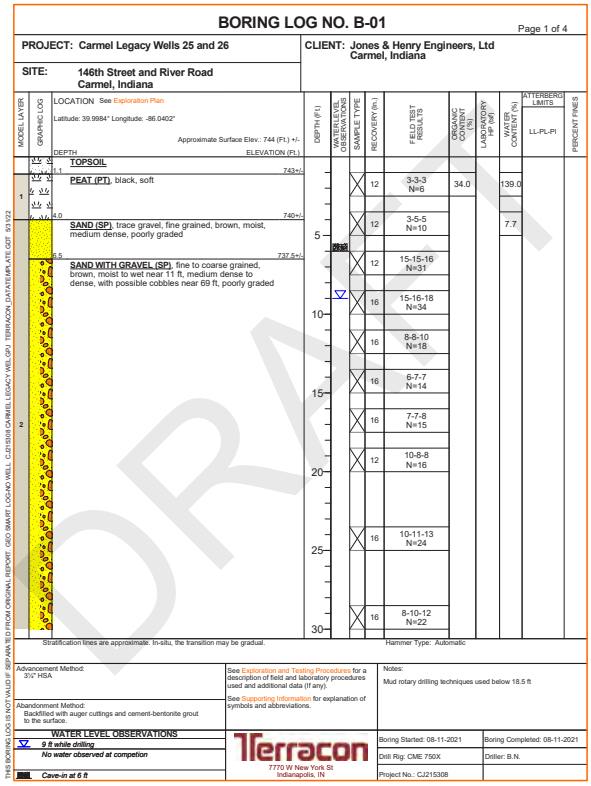
EXPLORATION RESULTS

Contents:

Note: All attachments are one page unless noted above.

Analysis & Research

Appendix 22: Geotechnical Engineering Report



BORING LOG NO. B-01 Page 1 of 4

PROJECT: Carmel Legacy Wells 25 and 26
CLIENT: Jones & Henry Engineers, Ltd, Carmel, Indiana
SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan
Latitude: 39.9984° Longitude: -86.0402°
Approximate Surface Elev.: 744 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
0.0	744+/-	**TOPSOIL**
1.1	743+/-	
		PEAT (PT), black, soft
4.0	740+/-	
		SAND (SP), trace gravel, fine grained, brown, moist, medium dense, poorly graded
6.5	737.5+/-	
		SAND WITH GRAVEL (SP), fine to coarse grained, brown, moist to wet near 11 ft, medium dense to dense, with possible cobbles near 69 ft, poorly graded

DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	ORGANIC CONTENT (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0	12	3-3-3 N=6	34.0		139.0		
5	12	3-5-5 N=10			7.7		
	12	15-15-16 N=31					
10	16	15-16-18 N=34					
	16	8-8-10 N=18					
15	16	6-7-7 N=14					
	16	7-7-8 N=15					
20	12	10-8-8 N=16					
25	16	10-11-13 N=24					
30	16	8-10-12 N=22					

Stratification lines are approximate. In-situ, the transition may be gradual. Hammer Type: Automatic

Advancement Method: 3½" HSA
Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.

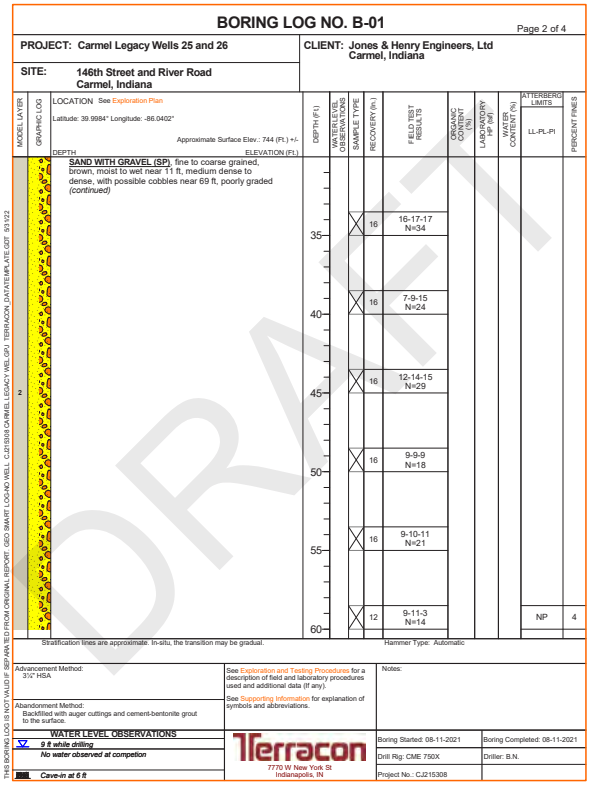
See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.

Notes: Mud rotary drilling techniques used below 18.5 ft

WATER LEVEL OBSERVATIONS
9 ft while drilling
No water observed at competion
Cave-in at 6 ft

Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-11-2021 | Boring Completed: 08-11-2021
Drill Rig: CME 750X | Driller: B.N.
Project No.: CJ215308



BORING LOG NO. B-01 Page 2 of 4

PROJECT: Carmel Legacy Wells 25 and 26
CLIENT: Jones & Henry Engineers, Ltd, Carmel, Indiana
SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan
Latitude: 39.9984° Longitude: -86.0402°
Approximate Surface Elev.: 744 (Ft.) +/-

SAND WITH GRAVEL (SP), fine to coarse grained, brown, moist to wet near 11 ft, medium dense to dense, with possible cobbles near 69 ft, poorly graded *(continued)*

DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	ORGANIC CONTENT (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
35	16	16-17-17 N=34					
40	16	7-9-15 N=24					
45	16	12-14-15 N=29					
50	16	9-9-9 N=18					
55	16	9-10-11 N=21					
60	12	9-11-3 N=14				NP	4

Stratification lines are approximate. In-situ, the transition may be gradual. Hammer Type: Automatic

Advancement Method: 3½" HSA
Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.

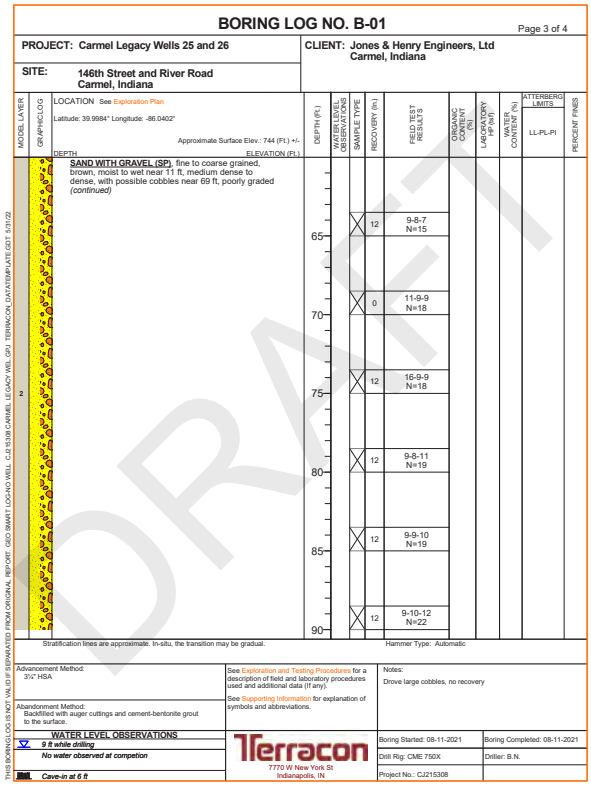
See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
9 ft while drilling
No water observed at competion
Cave-in at 6 ft

Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-11-2021 | Boring Completed: 08-11-2021
Drill Rig: CME 750X | Driller: B.N.
Project No.: CJ215308



BORING LOG NO. B-01 Page 3 of 4

PROJECT: Carmel Legacy Wells 25 and 26
CLIENT: Jones & Henry Engineers, Ltd, Carmel, Indiana
SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan
Latitude: 39.9984° Longitude: -86.0402°
Approximate Surface Elev.: 744 (Ft.) +/-

SAND WITH GRAVEL (SP), fine to coarse grained, brown, moist to wet near 11 ft, medium dense to dense, with possible cobbles near 69 ft, poorly graded *(continued)*

DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	ORGANIC CONTENT (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
65	12	9-8-7 N=15					
70	0	11-9-9 N=18					
75	12	16-9-9 N=18					
80	12	9-8-11 N=19					
85	12	9-9-10 N=19					
90	12	9-10-12 N=22					

Stratification lines are approximate. In-situ, the transition may be gradual. Hammer Type: Automatic

Advancement Method: 3½" HSA
Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.

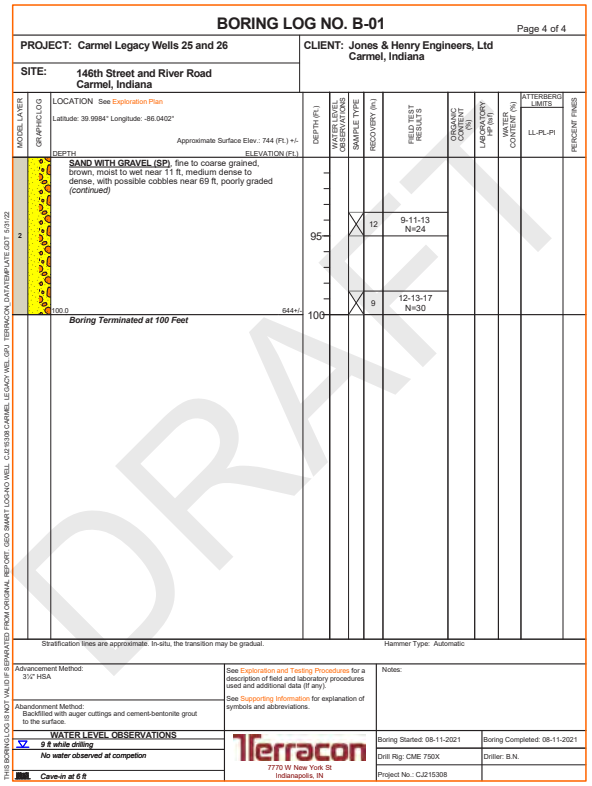
See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.

Notes: Drove large cobbles, no recovery

WATER LEVEL OBSERVATIONS
9 ft while drilling
No water observed at competion
Cave-in at 6 ft

Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-11-2021 | Boring Completed: 08-11-2021
Drill Rig: CME 750X | Driller: B.N.
Project No.: CJ215308



BORING LOG NO. B-01 Page 4 of 4

PROJECT: Carmel Legacy Wells 25 and 26
CLIENT: Jones & Henry Engineers, Ltd, Carmel, Indiana
SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan
Latitude: 39.9984° Longitude: -86.0402°
Approximate Surface Elev.: 744 (Ft.) +/-

SAND WITH GRAVEL (SP), fine to coarse grained, brown, moist to wet near 11 ft, medium dense to dense, with possible cobbles near 69 ft, poorly graded *(continued)*

DEPTH	ELEVATION (Ft.)	Description
100.0	644+/-	***Boring Terminated at 100 Feet***

DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	ORGANIC CONTENT (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
95	12	9-11-13 N=24					
100	9	12-13-17 N=30					

Stratification lines are approximate. In-situ, the transition may be gradual. Hammer Type: Automatic

Advancement Method: 3½" HSA
Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.

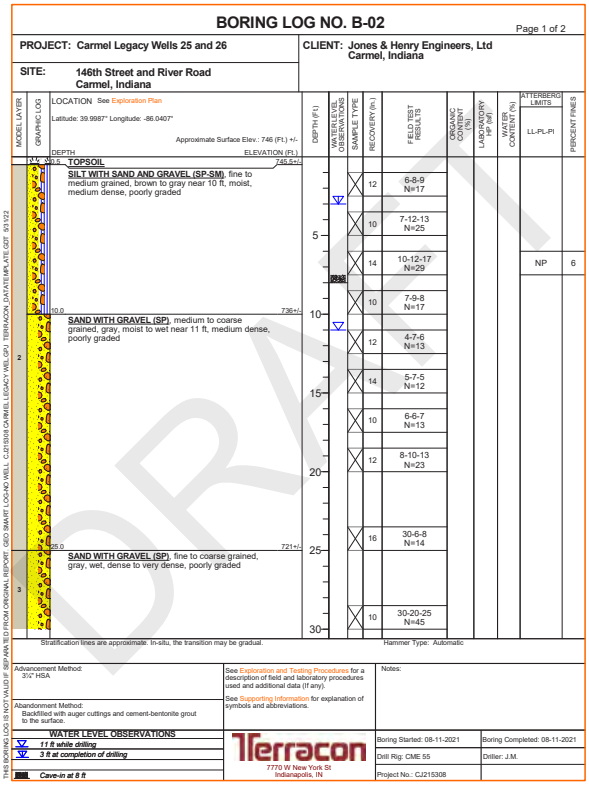
See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
9 ft while drilling
No water observed at competion
Cave-in at 6 ft

Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-11-2021 | Boring Completed: 08-11-2021
Drill Rig: CME 750X | Driller: B.N.
Project No.: CJ215308



BORING LOG NO. B-02

Page 1 of 2

PROJECT: Carmel Legacy Wells 25 and 26
CLIENT: Jones & Henry Engineers, Ltd, Carmel, Indiana
SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan
Latitude: 39.9987° Longitude: -86.0407°
Approximate Surface Elev.: 746 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	MODEL LAYER	GRAPHIC LOG	DESCRIPTION
0.5	745.5+/-	1		**TOPSOIL**
		2		**SILT WITH SAND AND GRAVEL (SP-SM)**, fine to medium grained, brown to gray near 10 ft, moist, medium dense, poorly graded
10.0	736+/-			
		2		**SAND WITH GRAVEL (SP)**, medium to coarse grained, gray, moist to wet near 11 ft, medium dense, poorly graded
25.0	721+/-	3		**SAND WITH GRAVEL (SP)**, fine to coarse grained, gray, wet, dense to very dense, poorly graded

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ORGANIC CONTENT (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5			12	6-8-9 N=17					
			10	7-12-13 N=25					
			14	10-12-17 N=29				NP	6
10			10	7-9-8 N=17					
			12	4-7-6 N=13					
15			14	5-7-5 N=12					
			10	6-6-7 N=13					
20			12	8-10-13 N=23					
25			16	30-6-8 N=14					
30			10	30-20-25 N=45					

Stratification lines are approximate. In-situ, the transition may be gradual. Hammer Type: Automatic

Advancement Method: 3½" HSA
Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.

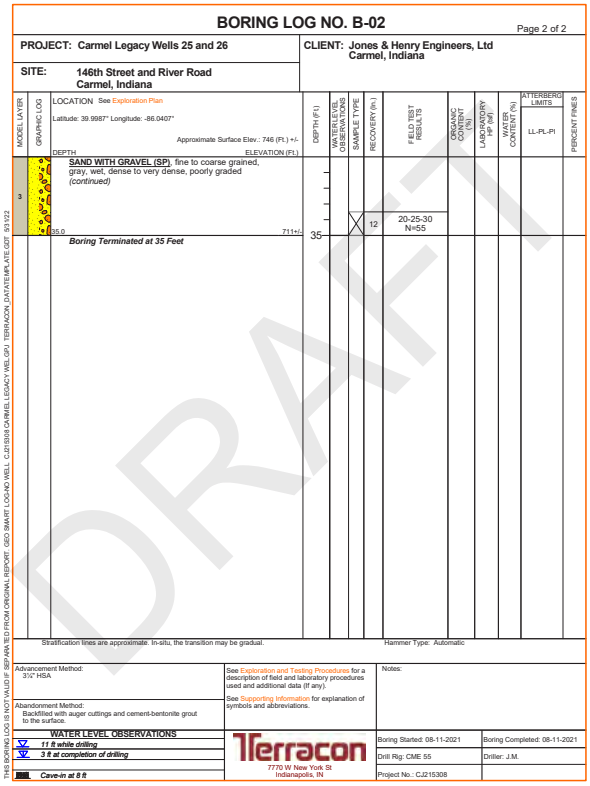
Notes:

WATER LEVEL OBSERVATIONS
11 ft while drilling
3 ft at completion of drilling
Cave-in at 8 ft

Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-11-2021 | Boring Completed: 08-11-2021
Drill Rig: CME 55 | Driller: J.M.
Project No.: CJ215308

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG AND WELL C:\JS\08\CARMEL LEGACY WELL.GPJ TERRACON_DATATEMPLATE.GDT 5/3/22



BORING LOG NO. B-02

Page 2 of 2

PROJECT: Carmel Legacy Wells 25 and 26
CLIENT: Jones & Henry Engineers, Ltd, Carmel, Indiana
SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan
Latitude: 39.9987° Longitude: -86.0407°
Approximate Surface Elev.: 746 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	MODEL LAYER	GRAPHIC LOG	DESCRIPTION
		3		**SAND WITH GRAVEL (SP)**, fine to coarse grained, gray, wet, dense to very dense, poorly graded *(continued)*
35.0	711+/-			***Boring Terminated at 35 Feet***

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ORGANIC CONTENT (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
35			12	20-25-30 N=55					

Stratification lines are approximate. In-situ, the transition may be gradual. Hammer Type: Automatic

Advancement Method: 3½" HSA
Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
11 ft while drilling
3 ft at completion of drilling
Cave-in at 8 ft

Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-11-2021 | Boring Completed: 08-11-2021
Drill Rig: CME 55 | Driller: J.M.
Project No.: CJ215308

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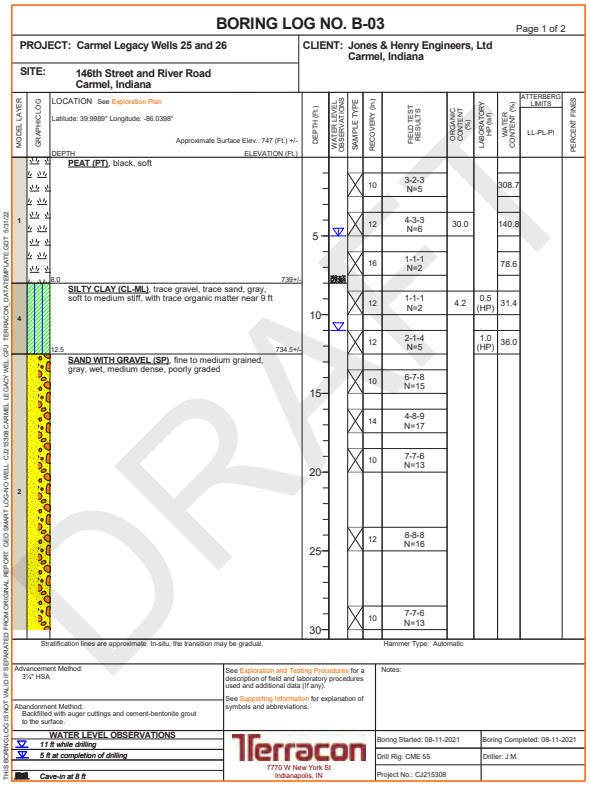


BORING LOG NO. B-03

Page 1 of 2

PROJECT: Carmel Legacy Wells 25 and 26
CLIENT: Jones & Henry Engineers, Ltd, Carmel, Indiana
SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan
Latitude: 39.9989° Longitude: -86.0398°
Approximate Surface Elev.: 747 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	MODEL LAYER	GRAPHIC LOG	DESCRIPTION
		1		**PEAT (PT)**, black, soft
8.0	739+/-			
		4		**SILTY CLAY (CL-ML)**, trace gravel, trace sand, gray, soft to medium stiff, with trace organic matter near 9 ft
12.5	734.5+/-			
		2		**SAND WITH GRAVEL (SP)**, fine to medium grained, gray, wet, medium dense, poorly graded

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ORGANIC CONTENT (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5			10	3-2-3 N=5			308.7		
			12	4-3-3 N=6	30.0		140.8		
			16	1-1-1 N=2			78.6		
10			12	1-1-1 N=2	4.2	0.5 (HP)	31.4		
			12	2-1-4 N=5		1.0 (HP)	36.0		
15			10	6-7-8 N=15					
			14	4-8-9 N=17					
20			10	7-7-6 N=13					
25			12	8-8-8 N=16					
30			10	7-7-6 N=13					

Stratification lines are approximate. In-situ, the transition may be gradual. Hammer Type: Automatic

Advancement Method: 3½" HSA
Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.

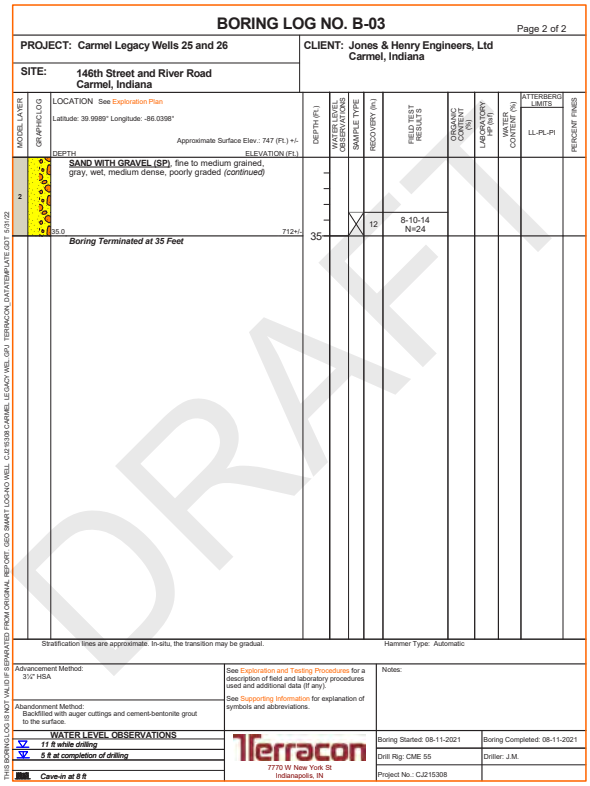
Notes:

WATER LEVEL OBSERVATIONS
11 ft while drilling
5 ft at completion of drilling
Cave-in at 8 ft

Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-11-2021 | Boring Completed: 08-11-2021
Drill Rig: CME 55 | Driller: J.M.
Project No.: CJ215308

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG AND WELL C:\JS\08\CARMEL LEGACY WELL.GPJ TERRACON_DATATEMPLATE.GDT 5/3/22



BORING LOG NO. B-03

Page 2 of 2

PROJECT: Carmel Legacy Wells 25 and 26
CLIENT: Jones & Henry Engineers, Ltd, Carmel, Indiana
SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan
Latitude: 39.9989° Longitude: -86.0398°
Approximate Surface Elev.: 747 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	MODEL LAYER	GRAPHIC LOG	DESCRIPTION
		2		**SAND WITH GRAVEL (SP)**, fine to medium grained, gray, wet, medium dense, poorly graded *(continued)*
35.0	712+/-			***Boring Terminated at 35 Feet***

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ORGANIC CONTENT (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
35			12	8-10-14 N=24					

Stratification lines are approximate. In-situ, the transition may be gradual. Hammer Type: Automatic

Advancement Method: 3½" HSA
Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
11 ft while drilling
5 ft at completion of drilling
Cave-in at 8 ft

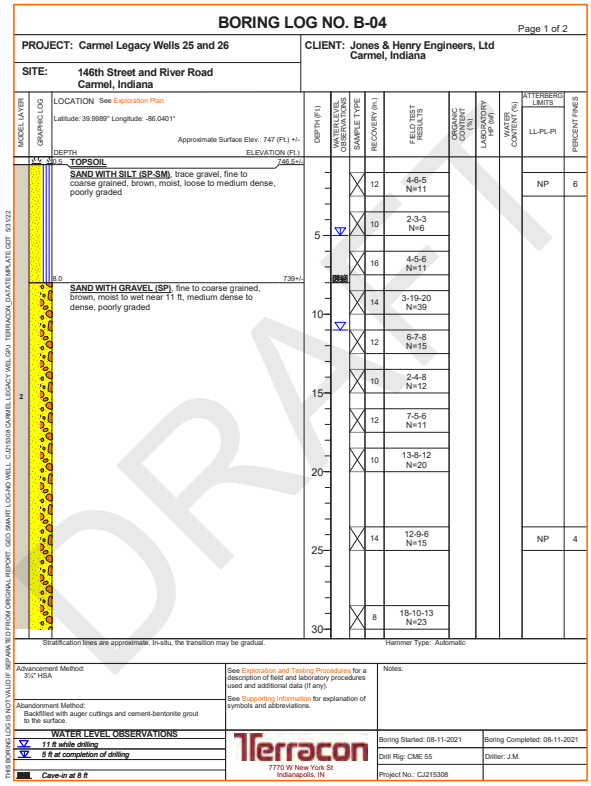
Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-11-2021 | Boring Completed: 08-11-2021
Drill Rig: CME 55 | Driller: J.M.
Project No.: CJ215308

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG AND WELL C:\JS\08\CARMEL LEGACY WELL.GPJ TERRACON_DATATEMPLATE.GDT 5/3/22

Analysis & Research

Appendix 22: Geotechnical Engineering Report



BORING LOG NO. B-04 Page 1 of 2

PROJECT: Carmel Legacy Wells 25 and 26
CLIENT: Jones & Henry Engineers, Ltd, Carmel, Indiana
SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan
Latitude: 39.9989° Longitude: -86.0401°
Approximate Surface Elev.: 747 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	
0.5	746.5+/-	**TOPSOIL**
8.0	739+/-	**SAND WITH SILT (SP-SM)**, trace gravel, fine to coarse grained, brown, moist, loose to medium dense, poorly graded
		SAND WITH GRAVEL (SP), fine to coarse grained, brown, moist to wet near 11 ft, medium dense to dense, poorly graded

Depth (Ft.)	Recovery (In.)	Field Test Results	Organic Content (%)	Laboratory HP (tsf)	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
5	12	4-6-5 N=11				NP	6
	10	2-3-3 N=6					
	16	4-5-6 N=11					
10	14	3-19-20 N=39					
	12	6-7-8 N=15					
	10	2-4-8 N=12					
15	12	7-5-6 N=11					
	10	13-8-12 N=20					
20	14	12-9-6 N=15				NP	4
25	8	18-10-13 N=23					
30							

Stratification lines are approximate. In-situ, the transition may be gradual. Hammer Type: Automatic

Advancement Method: 3½" HSA
Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.
See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Notes:

WATER LEVEL OBSERVATIONS
11 ft while drilling
5 ft at completion of drilling
Cave-in at 8 ft

Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-11-2021 | Boring Completed: 08-11-2021
Drill Rig: CME 55 | Driller: J.M.
Project No.: CJ215308

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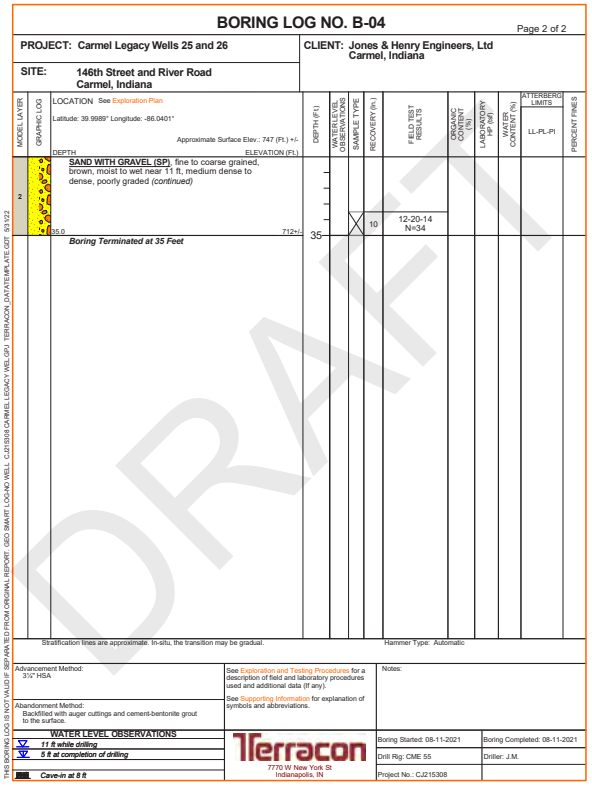


BORING LOG NO. B-04 Page 2 of 2

PROJECT: Carmel Legacy Wells 25 and 26
CLIENT: Jones & Henry Engineers, Ltd, Carmel, Indiana
SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan
Latitude: 39.9989° Longitude: -86.0401°
Approximate Surface Elev.: 747 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	
35.0	712+/-	**SAND WITH GRAVEL (SP)**, fine to coarse grained, brown, moist to wet near 11 ft, medium dense to dense, poorly graded *(continued)*
		Boring Terminated at 35 Feet

Depth (Ft.)	Recovery (In.)	Field Test Results	Organic Content (%)	Laboratory HP (tsf)	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
35	10	12-20-14 N=34					

Stratification lines are approximate. In-situ, the transition may be gradual. Hammer Type: Automatic

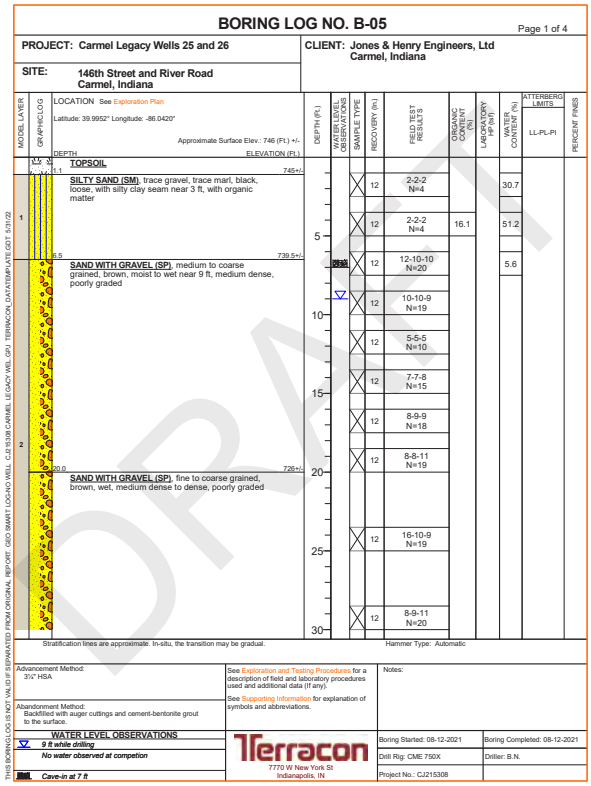
Advancement Method: 3½" HSA
Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.
See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Notes:

WATER LEVEL OBSERVATIONS
11 ft while drilling
5 ft at completion of drilling
Cave-in at 8 ft

Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-11-2021 | Boring Completed: 08-11-2021
Drill Rig: CME 55 | Driller: J.M.
Project No.: CJ215308

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-HO WELL C:\2153\08\CARMEL LEGACY WEL.GPJ TERRACON_DATATEMP.GDT 5/3/22



BORING LOG NO. B-05 Page 1 of 4

PROJECT: Carmel Legacy Wells 25 and 26
CLIENT: Jones & Henry Engineers, Ltd, Carmel, Indiana
SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan
Latitude: 39.9952° Longitude: -86.0420°
Approximate Surface Elev.: 746 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	
1.1	745+/-	**TOPSOIL**
6.5	739.5+/-	**SILTY SAND (SM)**, trace gravel, trace marl, black, loose, with silty clay seam near 3 ft, with organic matter
20.0	726+/-	**SAND WITH GRAVEL (SP)**, medium to coarse grained, brown, moist to wet near 9 ft, medium dense, poorly graded
		SAND WITH GRAVEL (SP), fine to coarse grained, brown, wet, medium dense to dense, poorly graded

Depth (Ft.)	Recovery (In.)	Field Test Results	Organic Content (%)	Laboratory HP (tsf)	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
5	12	2-2-2 N=4			30.7		
	12	2-2-2 N=4	16.1		51.2		
	12	12-10-10 N=20			5.6		
10	12	10-10-9 N=19					
	12	5-5-5 N=10					
15	12	7-7-8 N=15					
	12	8-9-9 N=18					
20	12	8-8-11 N=19					
25	12	16-10-9 N=19					
30	12	8-9-11 N=20					

Stratification lines are approximate. In-situ, the transition may be gradual. Hammer Type: Automatic

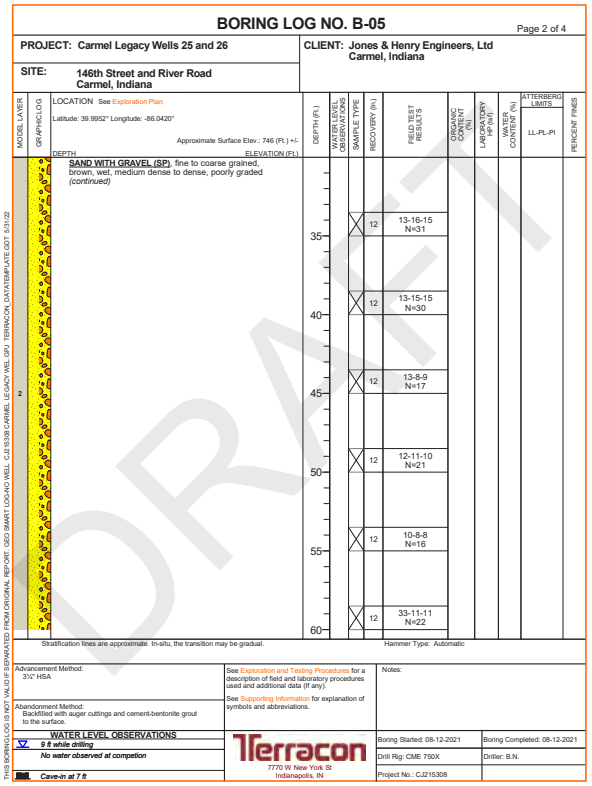
Advancement Method: 3½" HSA
Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.
See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Notes:

WATER LEVEL OBSERVATIONS
9 ft while drilling
No water observed at competion
Cave-in at 7 ft

Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-12-2021 | Boring Completed: 08-12-2021
Drill Rig: CME 750X | Driller: B.N.
Project No.: CJ215308

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-HO WELL C:\2153\08\CARMEL LEGACY WEL.GPJ TERRACON_DATATEMP.GDT 5/3/22



BORING LOG NO. B-05 Page 2 of 4

PROJECT: Carmel Legacy Wells 25 and 26
CLIENT: Jones & Henry Engineers, Ltd, Carmel, Indiana
SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan
Latitude: 39.9952° Longitude: -86.0420°
Approximate Surface Elev.: 746 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	
		SAND WITH GRAVEL (SP), fine to coarse grained, brown, wet, medium dense to dense, poorly graded *(continued)*

Depth (Ft.)	Recovery (In.)	Field Test Results	Organic Content (%)	Laboratory HP (tsf)	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
35	12	13-16-15 N=31					
40	12	13-15-15 N=30					
45	12	13-8-9 N=17					
50	12	12-11-10 N=21					
55	12	10-8-8 N=16					
60	12	33-11-11 N=22					

Stratification lines are approximate. In-situ, the transition may be gradual. Hammer Type: Automatic

Advancement Method: 3½" HSA
Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.
See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Notes:

WATER LEVEL OBSERVATIONS
9 ft while drilling
No water observed at competion
Cave-in at 7 ft

Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-12-2021 | Boring Completed: 08-12-2021
Drill Rig: CME 750X | Driller: B.N.
Project No.: CJ215308

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-HO WELL C:\2153\08\CARMEL LEGACY WEL.GPJ TERRACON_DATATEMP.GDT 5/3/22

BORING LOG NO. B-05

Page 3 of 4

PROJECT: Carmel Legacy Wells 25 and 26
CLIENT: Jones & Henry Engineers, Ltd, Carmel, Indiana
SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan
Latitude: 39.9952° Longitude: -86.0420°
Approximate Surface Elev.: 746 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	FIELD TEST RESULTS	RECOVERY (In.)	SAMPLE TYPE
		SAND WITH GRAVEL (SP), fine to coarse grained, brown, wet, medium dense to dense, poorly graded *(continued)*		
65.0	681+/-		12	
		15-15-18 N=33		
		SAND (SP), trace gravel, fine to medium grained, brown, wet, medium dense, poorly graded		
			12	
		8-8-8 N=16		
			12	
		9-9-14 N=23		
78.5	667.5+/-		12	
		SAND WITH GRAVEL (SP), fine to medium grained, brown, wet, medium dense to dense, poorly graded		
		15-15-15 N=30		
			12	
		21-21-20 N=41		
			12	
		15-11-11 N=22		

Stratification lines are approximate. In-situ, the transition may be gradual.
Hammer Type: Automatic

Advancement Method: 3½" HSA
Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.
See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Notes:

WATER LEVEL OBSERVATIONS
9 ft while drilling
No water observed at competion
Cave-in at 7 ft

Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-12-2021 | Boring Completed: 08-12-2021
Drill Rig: CME 750X | Driller: B.N.
Project No.: CJ215308

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-HO WELL C:\JS\SVN\CARMEL LEGACY WELL.GPJ TERRACON_DATATEMPLATE.GDT 5/3/22

BORING LOG NO. B-05

Page 4 of 4

PROJECT: Carmel Legacy Wells 25 and 26
CLIENT: Jones & Henry Engineers, Ltd, Carmel, Indiana
SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan
Latitude: 39.9952° Longitude: -86.0420°
Approximate Surface Elev.: 746 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	FIELD TEST RESULTS	RECOVERY (In.)	SAMPLE TYPE
		SAND WITH GRAVEL (SP), fine to medium grained, brown, wet, medium dense to dense, poorly graded *(continued)*		
		11-13-13 N=26	12	
100.0	646+/-		12	
		7-8-10 N=18		
		Boring Terminated at 100 Feet		

Stratification lines are approximate. In-situ, the transition may be gradual.
Hammer Type: Automatic

Advancement Method: 3½" HSA
Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.
See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Notes:

WATER LEVEL OBSERVATIONS
9 ft while drilling
No water observed at competion
Cave-in at 7 ft

Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-12-2021 | Boring Completed: 08-12-2021
Drill Rig: CME 750X | Driller: B.N.
Project No.: CJ215308

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BORING LOG NO. B-06

Page 1 of 2

PROJECT: Carmel Legacy Wells 25 and 26
CLIENT: Jones & Henry Engineers, Ltd, Carmel, Indiana
SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan
Latitude: 39.9948° Longitude: -86.0416°
Approximate Surface Elev.: 747 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	FIELD TEST RESULTS	RECOVERY (In.)	SAMPLE TYPE	ORGANIC CONTENT (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
0.5	746.5+/-	**TOPSOIL**						
		SAND (SP), trace gravel, fine to medium grained, medium dense, with trace organic matter, poorly graded						
		11-10-11 N=21	18					
		9-11-12 N=23	15		5.9		17.5	
6.0	741+/-							
		SILTY CLAY (CL-ML), trace gravel, trace sand, gray, stiff				1.0 (HP)		27-22-5
		7-6-13 N=19	13					
8.0	739+/-							
		SAND (SP), trace gravel, fine to coarse grained, brown, moist to wet near 15 ft, medium dense, poorly graded						
		8-12-4 N=16	18					
		5-8-10 N=18	15					
		9-9-8 N=17	12					
		6-9-11 N=20	18					
		25-14-15 N=29	18					
20.0	727+/-							
		SAND WITH GRAVEL (SP), fine to coarse grained, gray, wet, medium dense to dense, poorly graded						
		30-13-19 N=32	17					
		5-9-22 N=31	18					

Stratification lines are approximate. In-situ, the transition may be gradual.
Hammer Type: Automatic

Advancement Method: 3½" HSA
Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.
See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Notes:

WATER LEVEL OBSERVATIONS
15 ft while drilling
5 ft at completion of drilling
Cave-in at 7 ft

Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-10-2021 | Boring Completed: 08-10-2021
Drill Rig: CME 55 | Driller: J.M.
Project No.: CJ215308

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BORING LOG NO. B-06

Page 2 of 2

PROJECT: Carmel Legacy Wells 25 and 26
CLIENT: Jones & Henry Engineers, Ltd, Carmel, Indiana
SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan
Latitude: 39.9948° Longitude: -86.0416°
Approximate Surface Elev.: 747 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	FIELD TEST RESULTS	RECOVERY (In.)	SAMPLE TYPE
		SAND WITH GRAVEL (SP), fine to coarse grained, gray, wet, medium dense to dense, poorly graded *(continued)*		
		6-12-20 N=32	16	
		7-15-24 N=39	14	
45.0	702+/-			
		8-12-20 N=32	12	
		Boring Terminated at 45 Feet		

Stratification lines are approximate. In-situ, the transition may be gradual.
Hammer Type: Automatic

Advancement Method: 3½" HSA
Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.
See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.
Notes:

WATER LEVEL OBSERVATIONS
15 ft while drilling
5 ft at completion of drilling
Cave-in at 7 ft

Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-10-2021 | Boring Completed: 08-10-2021
Drill Rig: CME 55 | Driller: J.M.
Project No.: CJ215308

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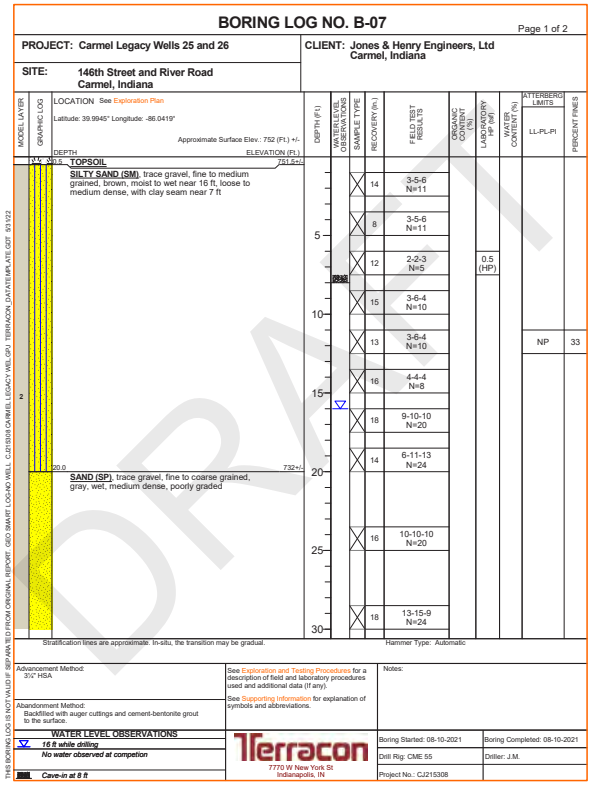
Analysis & Research

Appendix 22: Geotechnical Engineering Report



BORING LOG NO. B-07 Page 1 of 2

PROJECT: Carmel Legacy Wells 25 and 26 | **CLIENT:** Jones & Henry Engineers, Ltd, Carmel, Indiana

SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan

Latitude: 39.9945° Longitude: -86.0419°

Approximate Surface Elev.: 752 (Ft.) +/-

DEPTH | ELEVATION (Ft.)

0.0 752+/- **TOPSOIL**

SILTY SAND (SM), trace gravel, fine to medium grained, brown, moist to wet near 16 ft, loose to medium dense, with clay seam near 7 ft

20.0 732+/- **SAND (SP)**, trace gravel, fine to coarse grained, gray, wet, medium dense, poorly graded

DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5	14	3-5-6 N=11				
	8	3-5-6 N=11				
	12	2-2-3 N=5	0.5 (HP)			
10	15	3-6-4 N=10				
	13	3-6-4 N=10			NP	33
15	16	4-4-4 N=8				
	18	9-10-10 N=20				
20	14	6-11-13 N=24				
25	16	10-10-10 N=20				
30	18	13-15-9 N=24				

Stratification lines are approximate. In-situ, the transition may be gradual. Hammer Type: Automatic

Advancement Method: 3½" HSA

Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

16 ft while drilling

No water observed at competion

Cave-in at 8 ft

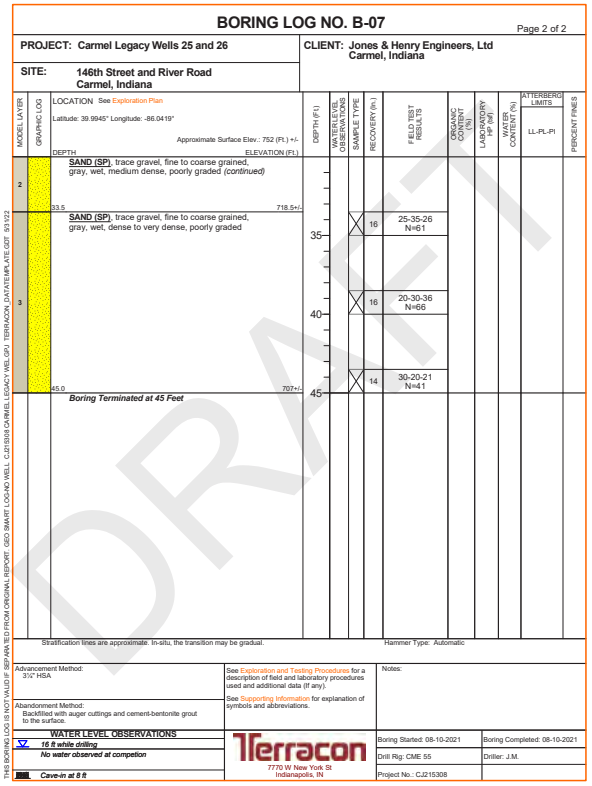
Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-10-2021 | Boring Completed: 08-10-2021

Drill Rig: CME 55 | Driller: J.M.

Project No.: CJ215308

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG AO WELL C:\2019\9\CARMEL LEGACY WEL.GPJ TERRACON_DATATEMPLATE.GDT 5/3/22



BORING LOG NO. B-07 Page 2 of 2

PROJECT: Carmel Legacy Wells 25 and 26 | **CLIENT:** Jones & Henry Engineers, Ltd, Carmel, Indiana

SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan

Latitude: 39.9945° Longitude: -86.0419°

Approximate Surface Elev.: 752 (Ft.) +/-

DEPTH | ELEVATION (Ft.)

SAND (SP), trace gravel, fine to coarse grained, gray, wet, medium dense, poorly graded *(continued)*

33.5 718.5+/- **SAND (SP)**, trace gravel, fine to coarse grained, gray, wet, dense to very dense, poorly graded

45.0 707+/- ***Boring Terminated at 45 Feet***

DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	ORGANIC CONTENT (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
35	16	25-35-26 N=61					
40	16	20-30-36 N=66					
45	14	30-20-21 N=41					

Stratification lines are approximate. In-situ, the transition may be gradual. Hammer Type: Automatic

Advancement Method: 3½" HSA

Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

16 ft while drilling

No water observed at competion

Cave-in at 8 ft

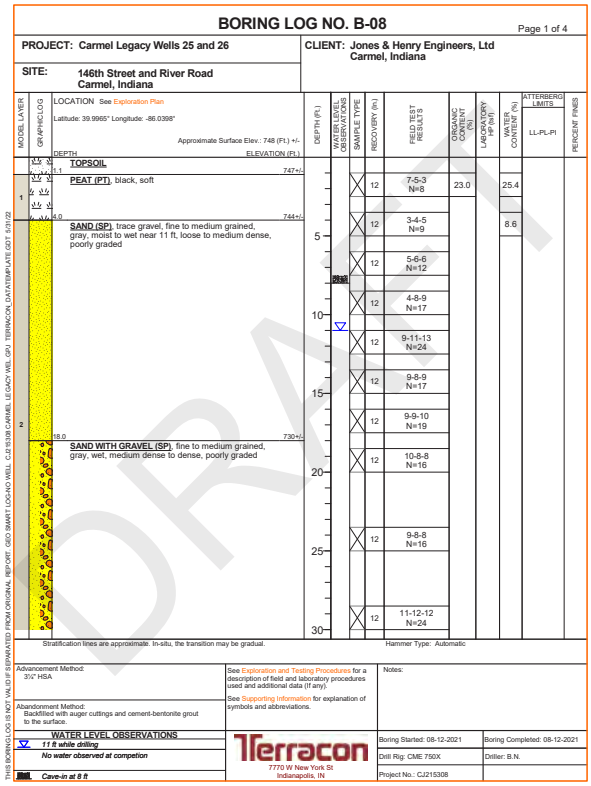
Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-10-2021 | Boring Completed: 08-10-2021

Drill Rig: CME 55 | Driller: J.M.

Project No.: CJ215308

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG AO WELL C:\2019\9\CARMEL LEGACY WEL.GPJ TERRACON_DATATEMPLATE.GDT 5/3/22



BORING LOG NO. B-08 Page 1 of 4

PROJECT: Carmel Legacy Wells 25 and 26 | **CLIENT:** Jones & Henry Engineers, Ltd, Carmel, Indiana

SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan

Latitude: 39.9965° Longitude: -86.0398°

Approximate Surface Elev.: 748 (Ft.) +/-

DEPTH | ELEVATION (Ft.)

0.0 747+/- **TOPSOIL**

1.1 **PEAT (PT)**, black, soft

4.0 744+/- **SAND (SP)**, trace gravel, fine to medium grained, gray, moist to wet near 11 ft, loose to medium dense, poorly graded

18.0 730+/- **SAND WITH GRAVEL (SP)**, fine to medium grained, gray, wet, medium dense to dense, poorly graded

DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	ORGANIC CONTENT (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5	12	7-5-3 N=8	23.0		25.4		
	12	3-4-5 N=9			8.6		
	12	5-6-6 N=12					
10	12	4-8-9 N=17					
	12	9-11-13 N=24					
15	12	9-8-9 N=17					
	12	9-9-10 N=19					
20	12	10-8-8 N=16					
25	12	9-8-8 N=16					
30	12	11-12-12 N=24					

Stratification lines are approximate. In-situ, the transition may be gradual. Hammer Type: Automatic

Advancement Method: 3½" HSA

Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

11 ft while drilling

No water observed at competion

Cave-in at 8 ft

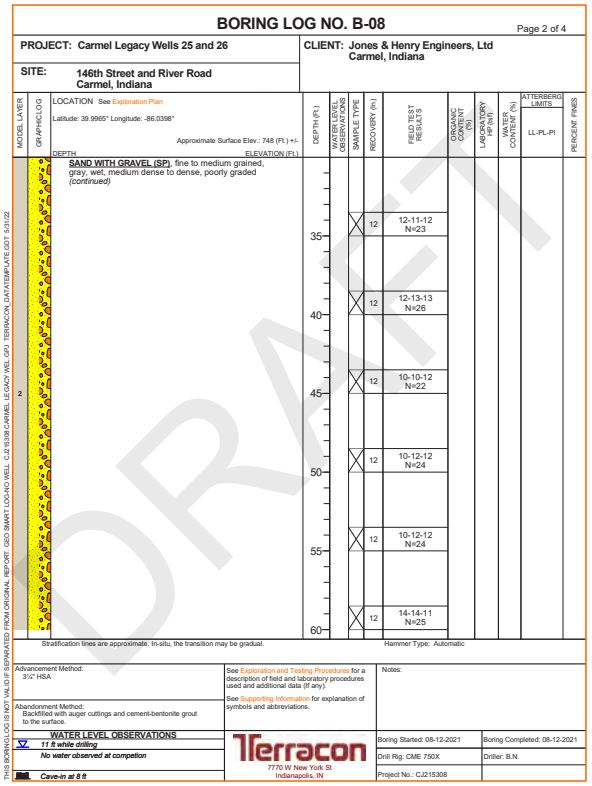
Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-12-2021 | Boring Completed: 08-12-2021

Drill Rig: CME 750X | Driller: B.N.

Project No.: CJ215308

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG AO WELL C:\2019\9\CARMEL LEGACY WEL.GPJ TERRACON_DATATEMPLATE.GDT 5/3/22



BORING LOG NO. B-08 Page 2 of 4

PROJECT: Carmel Legacy Wells 25 and 26 | **CLIENT:** Jones & Henry Engineers, Ltd, Carmel, Indiana

SITE: 146th Street and River Road, Carmel, Indiana

LOCATION See Exploration Plan

Latitude: 39.9965° Longitude: -86.0398°

Approximate Surface Elev.: 748 (Ft.) +/-

DEPTH | ELEVATION (Ft.)

SAND WITH GRAVEL (SP), fine to medium grained, gray, wet, medium dense to dense, poorly graded *(continued)*

DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	ORGANIC CONTENT (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
35	12	12-11-12 N=23					
40	12	12-13-13 N=26					
45	12	10-10-12 N=22					
50	12	10-12-12 N=24					
55	12	10-12-12 N=24					
60	12	14-14-11 N=25					

Stratification lines are approximate. In-situ, the transition may be gradual. Hammer Type: Automatic

Advancement Method: 3½" HSA

Abandonment Method: Backfilled with auger cuttings and cement-bentonite grout to the surface.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

11 ft while drilling

No water observed at competion

Cave-in at 8 ft

Terracon, 7770 W New York St, Indianapolis, IN

Boring Started: 08-12-2021 | Boring Completed: 08-12-2021

Drill Rig: CME 750X | Driller: B.N.

Project No.: CJ215308

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG AO WELL C:\2019\9\CARMEL LEGACY WEL.GPJ TERRACON_DATATEMPLATE.GDT 5/3/22

BORING LOG NO. B-08

Page 3 of 4

PROJECT: Carmel Legacy Wells 25 and 26

CLIENT: Jones & Henry Engineers, Ltd
Carmel, Indiana

SITE: 146th Street and River Road
Carmel, Indiana

LOCATION See Exploration Plan

Latitude: 39.9965° Longitude: -86.0398°

Approximate Surface Elev.: 748 (Ft.) +/-

DEPTH ELEVATION (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ORGANIC CONTENT (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2		65			12	7-5-7 N=12					
		70			12	9-10-10 N=20					
		75			12	9-9-9 N=18					
		80			12	10-10-10 N=20					
		85			12	10-11-11 N=22					
		90			12	12-13-15 N=28					

SAND WITH GRAVEL (SP), fine to medium grained, gray, wet, medium dense to dense, poorly graded
(continued)

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA

Abandonment Method:
Backfilled with auger cuttings and cement-bentonite grout to the surface.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *11 ft while drilling*
No water observed at competion
▬ *Cave-in at 8 ft*

Terracon
7770 W New York St
Indianapolis, IN

Boring Started: 08-12-2021 | Boring Completed: 08-12-2021
Drill Rig: CME 750X | Driller: B.N.
Project No.: CJ215308

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT: GEO SMART LOG-HD WELL CJ215308 CARMEL LEGACY WELL.GPJ TERRACON_DATATEMPLATE.GDT 9/3/22

BORING LOG NO. B-08

Page 4 of 4

PROJECT: Carmel Legacy Wells 25 and 26

CLIENT: Jones & Henry Engineers, Ltd
Carmel, Indiana

SITE: 146th Street and River Road
Carmel, Indiana

LOCATION See Exploration Plan

Latitude: 39.9965° Longitude: -86.0398°

Approximate Surface Elev.: 748 (Ft.) +/-

DEPTH ELEVATION (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ORGANIC CONTENT (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2		95			12	13-12-14 N=26					
		100			12	9-19-20 N=39					

SAND WITH GRAVEL (SP), fine to medium grained, gray, wet, medium dense to dense, poorly graded
(continued)

100.0 648+/-

Boring Terminated at 100 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA

Abandonment Method:
Backfilled with auger cuttings and cement-bentonite grout to the surface.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *11 ft while drilling*
No water observed at competion
▬ *Cave-in at 8 ft*

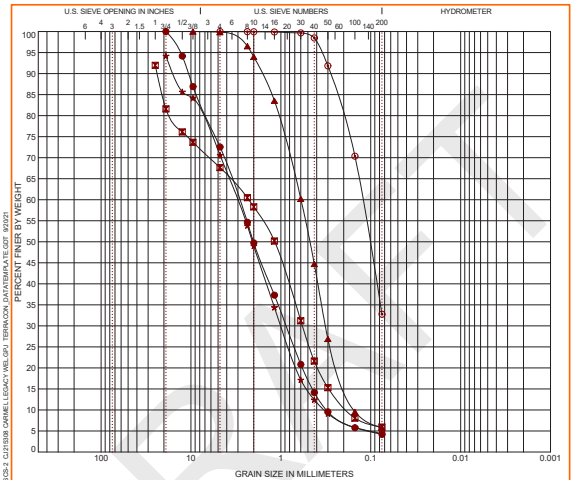
Terracon
7770 W New York St
Indianapolis, IN

Boring Started: 08-12-2021 | Boring Completed: 08-12-2021
Drill Rig: CME 750X | Driller: B.N.
Project No.: CJ215308

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT: GEO SMART LOG-HD WELL CJ215308 CARMEL LEGACY WELL.GPJ TERRACON_DATATEMPLATE.GDT 9/3/22

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
B-01	58.5 - 60	POORLY GRADED SAND with GRAVEL (SP)		NP	NP	NP	0.85	9.38
B-02	6 - 7.5	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)		NP	NP	NP	0.80	12.61
B-04	1 - 2.5	POORLY GRADED SAND with SILT (SP-SM)		NP	NP	NP	1.11	3.91
B-04	23.5 - 25	POORLY GRADED SAND with GRAVEL (SP)		NP	NP	NP	0.98	9.29
B-07	11 - 12.5	SILTY SAND (SM)		NP	NP	NP		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
B-01	58.5 - 60	19	2.909	0.874	0.31	0.0	27.5	68.3		4.2	
B-02	6 - 7.5	25	2.275	0.575	0.18		24.3	61.7		5.9	
B-04	1 - 2.5	9.5	0.597	0.319	0.153	0.0	0.1	94.1		5.7	
B-04	23.5 - 25	19	3.052	0.993	0.329		23.6	66.2		4.4	
B-07	11 - 12.5	4.75	0.124			0.0	0.0	67.2		32.8	

PROJECT: Carmel Legacy Wells 25 and 26

SITE: 146th Street and River Road
Carmel, IN

Terracon
7770 W New York St
Indianapolis, IN

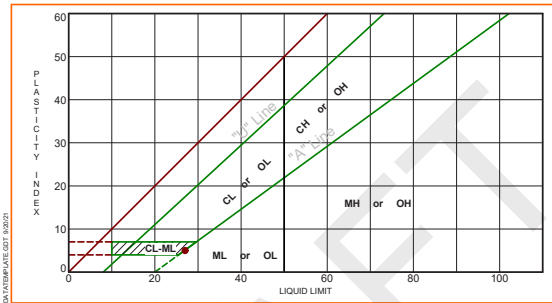
PROJECT NUMBER: CJ215308

CLIENT: Jones & Henry Engineers, Ltd
Carmel, IN

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT: GRAIN SIZE: UB GS-2 CJ215308 CARMEL LEGACY WELL.GPJ TERRACON_DATATEMPLATE.GDT 9/20/21

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
B-06	6 - 7.5	27	22	5		CL-ML	SILTY CLAY

PROJECT: Carmel Legacy Wells 25 and 26

SITE: 146th Street and River Road
Carmel, IN

Terracon
7770 W New York St
Indianapolis, IN

PROJECT NUMBER: CJ215308

CLIENT: Jones & Henry Engineers, Ltd
Carmel, IN

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT: ATTERBERG LIMITS CJ215308 CARMEL LEGACY WELL.GPJ TERRACON_DATATEMPLATE.GDT 9/20/21

Analysis & Research

Appendix 22: Geotechnical Engineering Report

CHEMICAL LABORATORY TEST REPORT

Project Number: CJ215308
Report Date: 09/15/21

Terracon
2640 12th Street SW
Cedar Rapids, Iowa 52404
(319) 366-8321

Client	Project
Jones & Henry Engineers, Ltd	Carmel Legacy Wells 25 and 26

Sample Submitted By: Terracon:Indianapolis **Date Received:** 9/12/2021 Lab No.: 06-Cedar Rapids

Results of Corrosivity Analysis

Sample Number	SS-3	SS-2	SS-1
Sample Location	B-1	B-4	B-6
Sample Depth (ft.)	6.0-7.5	3.5-5.0	1.0-2.5
pH Analysis, ASTM G 51	9.25	9.14	9.48
Water Soluble Sulfate (SO4), ASTM C 1580 (mg/kg)	46	96	86
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil	Nil
Chlorides, ASTM D 512, (mg/kg)	80	90	68
Total Salts, AWWA 2520 B, (mg/kg)	784	592	430
Red-OX ASTM G 200 (mV)	+510	+522	+483
Resistivity, ASTM G-57, (ohm-cm)	6600	7390	8300

Analyzed By: Chris Scott

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

GENERAL NOTES

Terracon GeoReport

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING
Shelby Tube
Split Spoon

WATER LEVEL
Water Initially Encountered
Water Level After a Specified Period of Time
Water Level After a Specified Period of Time
Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

N	Standard Penetration Test Resistance (Blows/Ft.)
(HP)	Hand Penetrometer
(T)	Torvane
(DCP)	Dynamic Cone Penetrometer
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength Qu, (tsf)	Standard Penetration or N-Value Blows/Ft.
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

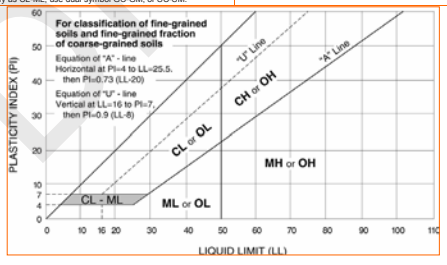
Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Terracon GeoReport

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]	GW	Well-graded gravel [F]
			$Cu < 4$ and/or $[Cc<1$ or $Cc>3.0]$ [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]	SW	Well-graded sand [I]
			$Cu < 6$ and/or $[Cc<1$ or $Cc>3.0]$ [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A"	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [K, L, M, N] / Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [K, L, M, P] / Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.
[E] $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.



RECORD OF WATER WELL
State Form 35680 (R5 / 9-04)

Driller--Mail complete record in 30 days to:
INDIANA DEPT. OF NATURAL RESOURCES
Division of Water
402 W. Washington St., Rm. W264
Indianapolis, IN 46204-2641
(877) 928-3755 toll-free or (317) 232-4160

County Permit Number
DNR Variance Number
Include if applicable

Fill in completely

WELL LOCATION

County where drilled	Civil township name	Township number (N-S)	Range number (E-W)	Section
Hamilton	Clay	18N	4E	23

Driving directions to the well location (include trip origin, street & road names, intersecting roads, and compass directions). Show well address below and subdivision in box at lower right. There is space for a map on the reverse side.
I-465 north to Allisonville Road, go north to 146th street turn west, go to River Road, turn south.Go appox. 3/4 mile and well on west side of road in open field. Well #24.

UTM Northing
UTM Easting
Datum ☐ NAD 27 ☐ NAD 83
GPS used
Subdivision name & lot number (if applicable)

Well address:

If drilled for water supply, this well is: X First well on property ☐ Replacement well ☐ Additional well on property ☐ Dry hole

OWNER - CONTRACTOR

Well owner--name City of Carmel	Address (number and street, city, state, ZIP code) 760 3rd Avenue S.W., Suite 110, Carmel, Indiana 46032	Telephone number 317-571-2443
Building contractor--name	Address (number and street, city, state, ZIP code)	Telephone number
Drilling contractor--name Reynolds, Inc.	Address (number and street, city, state, ZIP code) 4520 N. State Road 37, Orleans, IN 47452	Telephone number 812-865-3232
Equipment operator--name Mike Burton	License number of operator 1540	Date of well completion October 31, 2008

CONSTRUCTION DETAILS

Use of well
☐ Home
X Public supply
☐ Industrial / commercial
☐ Livestock
☐ Irrigation
☐ Monitoring / environ.
☐ Test hole
Other:

Drilling method
☐ Rotary
☐ Reverse rotary
☐ Cable tool
☐ Jet
X Bucket / bore
☑ Auger (including HSA)
☐ Direct push
Other:

Type of pump
☐ Submersible
☐ Shallow-well jet
☐ Deep-well jet
X No pump installed
Other:

Pump depth setting (feet)

Total depth of well (feet)	120	Borehole diameter (in.)	42	Gravel pack inserted	X Yes ☐ No
Casing length (feet)	106	Casing diameter (in.)	30	Casing material	☐ PVC X Steel
Screen length (feet)	14	Screen diameter (in.)	30	Screen material	☐ PVC ☐ Steel
Screen slot size	200	Water quality (clear, odor, etc.)	clear & no odor	Other: stainless steel	

WELL CAPACITY TEST

Test method	Static level below surface	Gallons per min.	Hours tested	Drawdown (change in level)
☐ Air ☐ Bailing X Pumping	8.07 feet	2109	24	13.93 feet

GROUTING

Grout material	Grout depth from	to
neat cement	0	50

Installation method: tremie
No. of bags used:
Quantity: 13.5 cyds

WELL ABANDONMENT

Sealing material
Depth filled from to
Installation method
No. of bags used

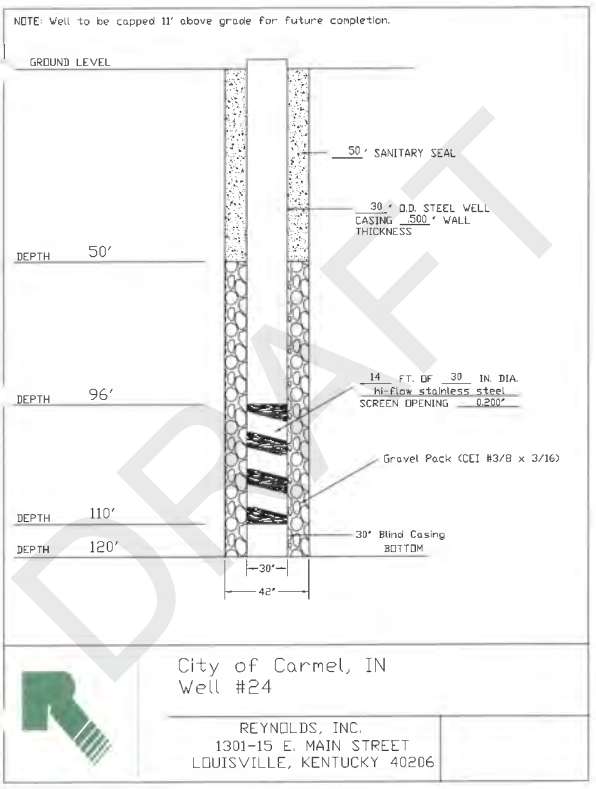
WELL LOG

FORMATIONS: Type of material	From (feet)	To (feet)
Topsoil	0	3
Clay	3	10
Gray Sandy Clay with Gravel	10	25
Course Sand & Gravel	25	30
Course Sand & Large Gravel	30	38
Course Sand & Gravel with Clay Seams	38	50
Course Sand & Gravel	50	85
Course Sand & Large Gravel	85	113
Clay with Gravel	113	120

Additional space for well log and comments on reverse side

I hereby swear or affirm, under the penalties for perjury, that the information submitted herewith is, to the best of my knowledge and belief, true, accurate, and complete.

Signature of drilling contractor or authorized representative MUST BE SIGNED OR STAMPED: Mike Burton
Date: 11-11-08



City of Carmel, IN
Well #24

REYNOLDS, INC.
1301-15 E. MAIN STREET
LOUISVILLE, KENTUCKY 40206

RECORD OF WATER WELL
State Form 35680 (R5 / 9-04)

Driller--Mail complete record in 30 days to:
INDIANA DEPT. OF NATURAL RESOURCES
Division of Water
402 W. Washington St., Rm. W264
Indianapolis, IN 46204-2641
(877) 928-3755 toll-free or (317) 232-4160

County Permit Number
DNR Variance Number
Include if applicable

Fill in completely

WELL LOCATION

County where drilled	Civil township name	Township number (N-S)	Range number (E-W)	Section
Hamilton	Clay	18N	4E	23

Driving directions to the well location (include trip origin, street & road names, intersecting roads, and compass directions). Show well address below and subdivision in box at lower right. There is space for a map on the reverse side.
I-465 north to Allisonville Road, go north to 146th street turn west, go east River Road. Go appox. 1/4 mile and well on south side of road in open field. Well #25.

UTM Northing
UTM Easting
Datum ☐ NAD 27 ☐ NAD 83
GPS used
Subdivision name & lot number (if applicable)

Well address:

If drilled for water supply, this well is: ☐ First well on property ☐ Replacement well X Additional well on property ☐ Dry hole

OWNER - CONTRACTOR

Well owner--name City of Carmel	Address (number and street, city, state, ZIP code) 760 3rd Avenue S.W., Suite 110, Carmel, Indiana 46032	Telephone number 317-571-2443
Building contractor--name	Address (number and street, city, state, ZIP code)	Telephone number
Drilling contractor--name Reynolds, Inc.	Address (number and street, city, state, ZIP code) 4520 N. State Road 37, Orleans, IN 47452	Telephone number 812-865-3232
Equipment operator--name Mike Burton	License number of operator 1540	Date of well completion November 7, 2008

CONSTRUCTION DETAILS

Use of well
☐ Home
X Public supply
☐ Industrial / commercial
☐ Livestock
☐ Irrigation
☐ Monitoring / environ.
☐ Test hole
Other:

Drilling method
☐ Rotary
☐ Reverse rotary
☐ Cable tool
☐ Jet
X Bucket / bore
☐ Auger (including HSA)
☐ Direct push
Other:

Type of pump
☐ Submersible
☐ Shallow-well jet
☐ Deep-well jet
X No pump installed
Other:

Pump depth setting (feet)

Total depth of well (feet)	120	Borehole diameter (in.)	42	Gravel pack inserted	X Yes ☐ No
Casing length (feet)	102	Casing diameter (in.)	30	Casing material	☐ PVC X Steel
Screen length (feet)	18	Screen diameter (in.)	30	Screen material	☐ PVC ☐ Steel
Screen slot size	200 & 80	Water quality (clear, odor, etc.)	clear & no odor	Other: stainless steel	

WELL CAPACITY TEST

Test method	Static level below surface	Gallons per min.	Hours tested	Drawdown (change in level)
☐ Air ☐ Bailing X Pumping	9.82 feet	2109	24	16.35 feet

GROUTING

Grout material	Grout depth from	to
neat cement	0	50

Installation method: tremie
No. of bags used:
Quantity: 13.5 cyds

WELL ABANDONMENT

Sealing material
Depth filled from to
Installation method
No. of bags used

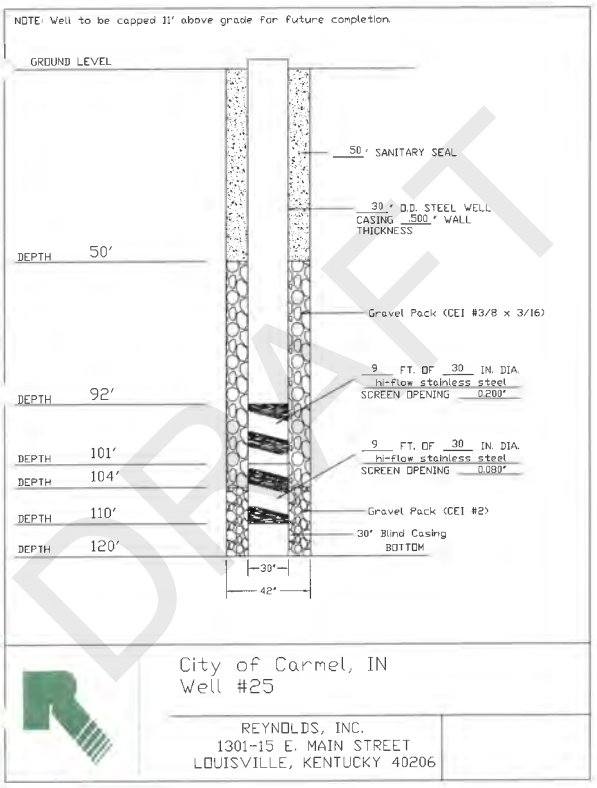
WELL LOG

FORMATIONS: Type of material	From (feet)	To (feet)
Topsoil	0	4
Fine Sand & Gravel	4	18
Fine Sand	18	22
Fine to Course Sand & Gravel	22	49
Clay with Large Rocks	49	51
Course Sand & Gravel with Clay Seams	51	116
Large Boulders & Clay	116	120

Additional space for well log and comments on reverse side

I hereby swear or affirm, under the penalties for perjury, that the information submitted herewith is, to the best of my knowledge and belief, true, accurate, and complete.

Signature of drilling contractor or authorized representative MUST BE SIGNED OR STAMPED: Mike Burton
Date: 11-11-08



City of Carmel, IN
Well #25

REYNOLDS, INC.
1301-15 E. MAIN STREET
LOUISVILLE, KENTUCKY 40206

Analysis & Research

Appendix 23: List of Tribes

Absentee Shawnee Tribe of Indians, Oklahoma
Bad River Band of the Lake Superior Tribe of Chippewa Indians of the Bad River Reservation, Wisconsin
Bay Mills Indian Community, Michigan
Bois Forte Band (Nett Lake) of the Minnesota Chippewa Tribe, Minnesota:
Chippewa-Cree Indians of the Rocky Boy's Reservation, Montana
Citizen Potawatomi Nation, Oklahoma
Delaware Nation
Delaware Tribe of Indians
Eastern Shawnee Tribe of Oklahoma
Fond du Lac Band of the Minnesota Chippewa Tribe, Minnesota
Forest County Potawatomi Community, Wisconsin
Grand Portage Band of the Minnesota Chippewa Tribe, Minnesota
Grand Traverse Band of Ottawa and Chippewa Indians, Michigan
Gun Lake Tribe
Hannahville Indian Community, Michigan
Kaw Nation, Oklahoma
Keweenaw Bay Indian Community, Michigan
Kickapoo Traditional Tribe of Texas
Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas
Kickapoo Tribe of Oklahoma
Lac Courte Oreilles Band of Lake Superior Chippewa Indians of Wisconsin
Lac du Flambeau Band of Lake Superior Chippewa Indians of the Lac du Flambeau Reservation of Wisconsin
Lac Vieux Desert Band of Lake Superior Chippewa Indians, Michigan
Leech Lake Band of the Minnesota Chippewa Tribe, Minnesota
Miami Tribe of Oklahoma
Mille Lacs Band of the Minnesota Chippewa Tribe, Minnesota
Minnesota Chippewa Tribe, Minnesota (Grand Portage)
Nottawaseppi Huron Band of the Potawatomi
Omaha Tribe of Nebraska
Ottawa Tribe of Oklahoma
Peoria Tribe of Indians of Oklahoma
Pokagon Band of Potawatomi Indians
Ponca Tribe of Indians of Nebraska
Ponca Tribe of Indians of Oklahoma
Prairie Band of Potawatomi Nation, Kansas
Quapaw Tribe of Oklahoma
Red Cliff Band of Lake Superior Chippewa Indians of Wisconsin
Red Lake Band of Chippewa Indians, Minnesota
Sac and Fox Nation of Missouri in Kansas Nebraska
Sac and Fox Nation, Oklahoma
Sac and Fox Tribe of Mississippi
Saginaw Chippewa Indian Tribe of Michigan
Sault Ste. Marie Tribe of Chippewa Indians of Michigan
Seneca Nation of Indians
Seneca-Cayuga Tribe of Oklahoma
Shawnee Tribe
Sokaogon Chippewa Community, Wisconsin

St. Croix Chippewa Indians of Wisconsin
Stockbridge-Munsee Community Band of Mohican Indians
The Osage Nation
Tonawanda Band of Seneca Indians of New York
Turtle Mountain Band of Chippewa Indians of North Dakota
Tuscarora Nation
White Earth Band of Minnesota Chippewa Tribe, Minnesota
Wyandotte Nation, Oklahoma

Appendix 24: Wetland Delineation Report

WETLAND DELINEATION REPORT

NAI OLYMPIA PARTNERS

EARLHAM COLLEGE PROPERTY

SOUTHWEST OF RIVER ROAD AND EAST 146TH STREET

HAMILTON COUNTY, INDIANA

Prepared for:
NAI Olympia Partners
320 North Meridian Street
Suite 700
Indianapolis, IN 46204

Prepared by:
Williams Creek Consulting
919 North East Street
Indianapolis, IN 46202
317.423.0690

NAI OLYMPIA PARTNERS
COMMERCIAL REAL ESTATE SERVICES. WORLDWIDE.

WILLIAMS CREEK CONSULTING

3.1.3 County Soil Surveys

WCC reviewed the information provided in the NRCS *Soil Survey of Hamilton County, Indiana* that is relevant to the study site. The soil surveys provide a 1:1320 (in:ft) scale aerial photograph on which distinct soil unit boundaries are identified. The eleven soil units classified on site are Fox clay loam, 8 to 18 percent slopes, severely eroded (FxC3); Fox loam, 2 to 6 percent slopes, eroded (FnB2); Hennepin loam, 25 to 50 percent slopes (HeF); Houghton muck (Ho); Miami silt loam, 0 to 2 percent slopes (MmA); Miami silt loam, 2 to 6 percent slopes, eroded (MmB2); Ockley silt loam 0 to 2 percent slopes (OcA); Ockley silt loam 2 to 6 percent slopes, eroded (OcB2); Palms muck (Pa); Sleeth loam (St); and Westland silty clay loam (We). Other information contained within the soil survey may be used to further characterize the site. Figure 4 presents a copy of the soil survey sheets for the site.

3.1.4 Aerial Photography

Aerial photographs provide a visual overview of the site and can provide information to assist in identifying land use practices, terrain, drainage, vegetated areas, wetlands, habitats, etc. Certain features such as variegated soil patterns for instance, may suggest the presence of wetlands. Figure 5 provides a copy of a spring 2004 photograph.

3.2 Site Investigation

A Williams Creek staff scientist conducted a site investigation on April 27, 2005. The study site is approximately 476 acres. The majority of the study site consists of agricultural fields, pasturelands, a farmstead and small woodlots.

Photographs of the site were collected to document current site conditions, and to provide a visual record of wetlands and "waters of the U.S.", if any, present at the time of inspection (Appendix B).

Routine Wetland Determination Data Forms (Data Forms) are completed in the field to document representative site conditions. A paired Data Form is prepared for each data station that represents any wetland or upland areas identified while onsite. Copies of the Data Forms are included in Appendix A.

Two wetlands were identified during the site investigation for this property. A detailed description of the wetlands is as follows. Additional data points were recorded in other areas within the project boundary.

3.2.1 Wetland A – *(3.7 Acres)*

This wetland community is located in the northeastern portion of the study area and is classified as an emergent wetland.

Wetland Data Points

A-1

This sample station was located in the eastern portion of the wetland, and the dominant vegetation present at this station is reed canary grass (*Phalaris arundinacea,* FACW+). The dominant plant species present in this community are hydrophytic, which meets the vegetation criterion.

The soil profile was inspected by manual excavation of a test pit within the wetland boundary. Examination of the soil profile within the wetland area revealed a matrix color of 10YR 2/1 to a depth of 16 inches, meeting the hydric soil criterion. Evidence of hydrology for this wetland area included saturated soil at less than 12 inches and the FAC-Neutral test. Since all three criteria were met, this area qualifies as a wetland.

A-3

This sample station was located in the southern portion of the wetland, and the dominant vegetation present at this station is reed canary grass (FACW+). The dominant plant species present in this community are hydrophytic, which meets the vegetation criterion.

The soil profile was inspected by manual excavation of a test pit within the wetland boundary. Examination of the soil profile within the wetland area revealed a matrix color of 10YR 2/1 to a depth of 16 inches, meeting the hydric soil criterion. Evidence of hydrology for this wetland area included saturated soil at less than 12 inches and the FAC-Neutral test. Since all three criteria were met, this area qualifies as a wetland.

The wetland appears to be within the 100 year floodplain and may be considered jurisdictional by the USACE.

Upland Data Points

A-2

This sample station was located adjacent to sample station A-1, and the dominant vegetation present at this station is field sow thistle (*Sonchus arvensis*, FAC-), reed canary grass (FACW+), and tall goldenrod (*Solidago altissima,* FACU). The dominant plant species present in this community are not hydrophytic, therefore it does not meet the vegetation criterion.

The soil profile was inspected by manual excavation of a test pit. Examination of the soil profile revealed a matrix color of 10YR 2/1 to a depth of 16 inches, meeting the hydric soil criterion. No hydrology indicators were noted for this area. Since all three criteria were not met, this area does not qualify as a wetland.

A-4

This sample station was located adjacent to sample station A-3, and the dominant vegetation present at this station is reed canary grass (FACW+), common blue violet (*Viola sororia*, UPL), and tall goldenrod (FACU*)*. The dominant plant species present in this community are not hydrophytic, therefore not meeting the vegetation criterion.

The soil profile was inspected by manual excavation of a test pit. Examination of the soil profile revealed a matrix color of 10YR 2/1 to a depth of 16 inches, meeting the hydric soil criterion. Evidence of hydrology for this area was saturated soil at less than 12 inches. Since all three criteria were not met, this area does not qualify as a wetland.

3.2.2 Wetland B – *(0.2 Acres) Class 1*

This wetland community is located in the south-central portion of the study area and is classified as a shrub/scrub wetland. Identification was made in an atypical situation as the wetland had been burned with the agricultural field.

Wetland Data Points

B-1

This sample station was located in the northwestern portion of the wetland, and the dominant vegetation present at this station is reed canary grass (FACW+) and buttonbush (*Cephalanthus occidentalis*, OBL). The dominant plant species present in this community are hydrophytic, which meets the vegetation criterion.

The soil profile was inspected by manual excavation of a test pit within the wetland boundary. Examination of the soil profile within the wetland area revealed a matrix color of 10YR 3/1 to a depth of 16 inches, meeting the hydric soil criterion. Evidence of hydrology for this wetland area included saturated soil at less than 12 inches and the FAC-Neutral test. Since all three criteria were met, this area qualifies as a wetland.

B-3

This sample station was located in the southern portion of the wetland, and the dominant vegetation present at this station is reed canary grass (FACW+). The dominant plant species present in this community are hydrophytic, which meets the vegetation criterion.

The soil profile was inspected by manual excavation of a test pit within the wetland boundary. Examination of the soil profile within the wetland area revealed a matrix color of 10YR 3/1 to a depth of 16 inches, meeting the hydric soil criterion. Evidence of hydrology for this wetland area included oxidized root channels and the FAC-Neutral test. Since all three criteria were met, this area qualifies as a wetland.

The wetland *does not* appear to have a hydrological connection to a "waters of the U.S."; therefore it would be considered jurisdictional by the IDEM.

Upland Data Points

B-2

This sample station was located adjacent to sample point B-1, and the dominant vegetation present at this station is corn (*Zea mays*, UPL). The dominant plant species present in this community are not hydrophytic, therefore not meeting the vegetation criterion.

The soil profile was inspected by manual excavation of a test pit. Examination of the soil profile revealed a matrix color of 10YR 3/1 to a depth of 16 inches, meeting the hydric soil criterion. There was no evidence of hydrology for this area. Since all three criteria were not met, this area does not qualify as a wetland.

B-4
This sample station was located adjacent to sample point B-3, and the dominant vegetation present at this station is reed canary grass (FACW+), multiflora rose (*Rosa multiflora*, FACU) and common pokeweed (*Phytolacca americana*, FAC-). The dominant plant species present in this community are not hydrophytic, therefore not meeting the vegetation criterion.

The soil profile was inspected by manual excavation of a test pit. Examination of the soil profile within the upland area revealed a matrix color of 10YR 3/1 to a depth of 16 inches, meeting the hydric soil criterion. There was no evidence of hydrology for this area. Since all three criteria were not met, this area does not qualify as a wetland.

3.2.3 Other Data Points
Other data points were sampled throughout the study area to further characterize the site.

DP-1
This data point was located in the eastern portion of the study site. The vegetation at this location was dominated by Kentucky fescue (*Festuca arundinacea,* FACU+), not meeting the hydrophytic vegetation criterion.

Examination of the soil profile from this pit revealed a soil matrix color of 10YR 2/1 to a depth of 16 inches, meeting the hydric soil criterion. There was no evidence of hydrology for this area. This area does not qualify as wetland.

DP-2
This data point was located in the northeastern portion of the study site. The vegetation at this location was dominated by corn (UPL), not meeting the hydrophytic vegetation criterion.

Examination of the soil profile from this pit revealed a soil matrix color of 10YR 2/1 to a depth of 16 inches, meeting the hydric soil criterion. There was no evidence of hydrology for this area. This area does not qualify as wetland.

DP-3
This data point was located in the north-central portion of the study site. The vegetation at this location was dominated by corn (UPL), not meeting the hydrophytic vegetation criterion.

Examination of the soil profile from this pit revealed a soil matrix color of 10YR 2/1 to a depth of 16 inches, meeting the hydric soil criterion. There was no evidence of hydrology for this area. This area does not qualify as wetland.

DP-4
This data point was located in the west-central portion of the study site. The vegetation at this location was dominated by hackberry (*Celtis occidentalis*, FAC-), wild ginger (*Asarum canadense*, UPL), burdock (*Articum lappa*, UPL), and bedstraw (*Galium aparine*, FACU), not meeting the hydrophytic vegetation criterion.

Examination of the soil profile from this pit revealed a soil matrix color of 10YR 3/3 to a depth of 16 inches, not meeting the hydric soil criterion. There was no evidence of hydrology for this area. This area does not qualify as wetland.

DP-5
This data point was located in the western portion of the study site. The vegetation at this location was dominated by smooth brome (*Bromus inermis*, UPL) not meeting the hydrophytic vegetation criterion.

Examination of the soil profile from this pit revealed a soil matrix color of 10YR 3/2 to a depth of 16 inches, not meeting the hydric soil criterion. There was no evidence of hydrology for this area. This area does not qualify as wetland.

DP-6
This data point was located in the western portion of the study site. The vegetation at this location was dominated by smooth brome (UPL) and reed canary grass (FACW+), not meeting the hydrophytic vegetation criterion.

Examination of the soil profile from this pit revealed a soil matrix color of 10YR 4/3 to a depth of 16 inches, not meeting the hydric soil criterion. There was no evidence of hydrology for this area. This area does not qualify as wetland.

DP-7
This data point was located in the west-central portion of the study site. The vegetation at this location was dominated by honey locust (*Gleditsia triacanthos*, FAC), Canada thistle (*Cirsium arvense*, FACU), smooth brome (UPL), and Queen Anne's Lace (*Daucus carota*, UPL), not meeting the hydrophytic vegetation criterion.

Examination of the soil profile from this pit revealed a soil matrix color of 10YR 4/3 to a depth of 16 inches, not meeting the hydric soil criterion. There was no evidence of hydrology for this area. This area does not qualify as wetland and is a vegetated swale with no "ordinary high water mark."

DP-8
This data point was located in the western portion of the study site. The vegetation at this location was dominated by hackberry (FAC-) and Kentucky fescue (FACU+), not meeting the vegetation criterion.

Examination of the soil profile from this pit revealed a soil matrix color of 10YR 4/3 to a depth of 16 inches, not meeting the hydric soil criterion. There was no evidence of hydrology for this area. This area does not qualify as wetland and is a vegetated swale with no "ordinary high water mark."

DP-9
This data point was located in the northern portion of the study site. The vegetation at this location was dominated by reed canary grass (FACW+), wood nettle (*Lamium purpureum,* UPL), field sow thistle (FAC-), garlic mustard (*Alliaria petiolata*, FAC), and black walnut (*Juglans nigra*, FACU), not meeting the hydrophytic vegetation criterion.

Examination of the soil profile from this pit revealed a soil matrix color of 10YR 3/2 to a depth of 16 inches, not meeting the hydric soil criterion. This area does not meet the hydrology requirements. This area does not qualify as wetland.

DP-10
This data point was located in the central portion of the study site. The vegetation at this location was dominated by hackberry (FAC-), Kentucky fescue (FACU+), false mermaid (*Floerkea proserpinacoides*, FAC+), moonseed (*Menispermum canadense*, FAC), and bedstraw (FACU), not meeting the hydrophytic vegetation criterion.

Examination of the soil profile from this pit revealed a soil matrix color of 10YR 3/1 to a depth of 12 inches and 10YR 4/3 from a depth of 12 inches to 16 inches, meeting the hydric soil criterion. There was no evidence of hydrology for this area. This area does not qualify as wetland.

DP-11
This data point was located in the central portion of the study site. The vegetation at this location was dominated by black walnut (FACU), hop hornbeam (*Ostrya virginiana*, FACU-), mayapple (*Podophyllum peltatum*, FACU), bedstraw (FACU), and Solomon's seal (*Polygonatum biflorum,* FACU), not meeting the hydrophytic vegetation criterion.

Examination of the soil profile from this pit revealed a soil matrix color of 10YR 3/2 to a depth of 7 inches and 10YR 5/4 from a depth of 7 inches to 16 inches, not meeting the hydric soil criterion. There was no evidence of hydrology for this area. This area does not qualify as wetland.

DP-12
This data point was located in the northern portion of the study site. The vegetation at this location was dominated by corn (UPL), not meeting the hydrophytic vegetation criterion.

Examination of the soil profile from this pit revealed a soil matrix color of 10YR 2/1 to a depth of 16 inches, meeting the hydric soil criterion. There was no evidence of hydrology for this area. This area does not qualify as wetland.

DP-13
This data point was located in the northern portion of the study site. The vegetation at this location was dominated by common dandelion (*Taraxacum officinale*, FACU), red clover (*Trifolium pratense*, FACU+), and Kentucky fescue (FACU+), not meeting the hydrophytic vegetation criterion.

Examination of the soil profile from this pit revealed a soil matrix color of 10YR 3/2 to a depth of 16 inches, not meeting the hydric soil criterion. There was no evidence of hydrology for this area. This area does not qualify as wetland and is a vegetated swale with no "ordinary high water mark."

DP-14
This data point was located in the northern portion of the study site. The vegetation at this location was dominated by common dandelion (FACU), Canada thistle (FACU), red clover (FACU+), catnip (FAC-), and Kentucky fescue (FACU+), not meeting the hydrophytic vegetation criterion.

Examination of the soil profile from this pit revealed a soil matrix color of 10YR 3/2 to a depth of 16 inches, not meeting the hydric soil criterion. There was no evidence of hydrology for this area. This area does not qualify as wetland.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Williams Creek Consulting, Inc. performed a wetland and "waters of the U.S." delineation for the site located west of River Road and south of East 146th Street, Hamilton County, Indiana, for evidence of wetlands and other jurisdictional waters. The site was inspected on April 27, 2005.

Based on the criteria established by the USACE 1987 manual, one emergent and one shrub/scrub wetlands were located within the study site boundary. The cumulative wetland area is approximately 3.9 acres. Wetland A appears to be within the 100 year floodplain and may be considered jurisdictional by the USACE. Wetland B does not appear to be hydrologically connected to a "waters of the U.S." and may only be jurisdictional by the IDEM. If proposed development will impact any of the aforementioned wetlands, then WCC recommends that this report be sent to the Corps of Engineers and the IDEM for a jurisdictional determination.

Any proposed activities for USACE jurisdictional wetlands or "waters of the U.S." over 0.1 of an acre will require a Section 404 and Section 401 Water Quality Certification Permit through the USACE and IDEM. If 0.1 or less impacts are proposed then a notification to the IDEM will be required.

Any proposed activities for isolated wetlands or "waters of the state" will be evaluated on a case-by-case basis to determine the Class of the wetland. Permitting and mitigation ratios are dependant on the class of the wetland.

According to the FEMA/FIRM map portions of the property are within the 100 year and 500 year floodplain respectively. Permitting may be required through the Hamilton County Drainage Board and/or the Indiana Department of Natural Resources.

Appendix 24: Wetland Delineation Report

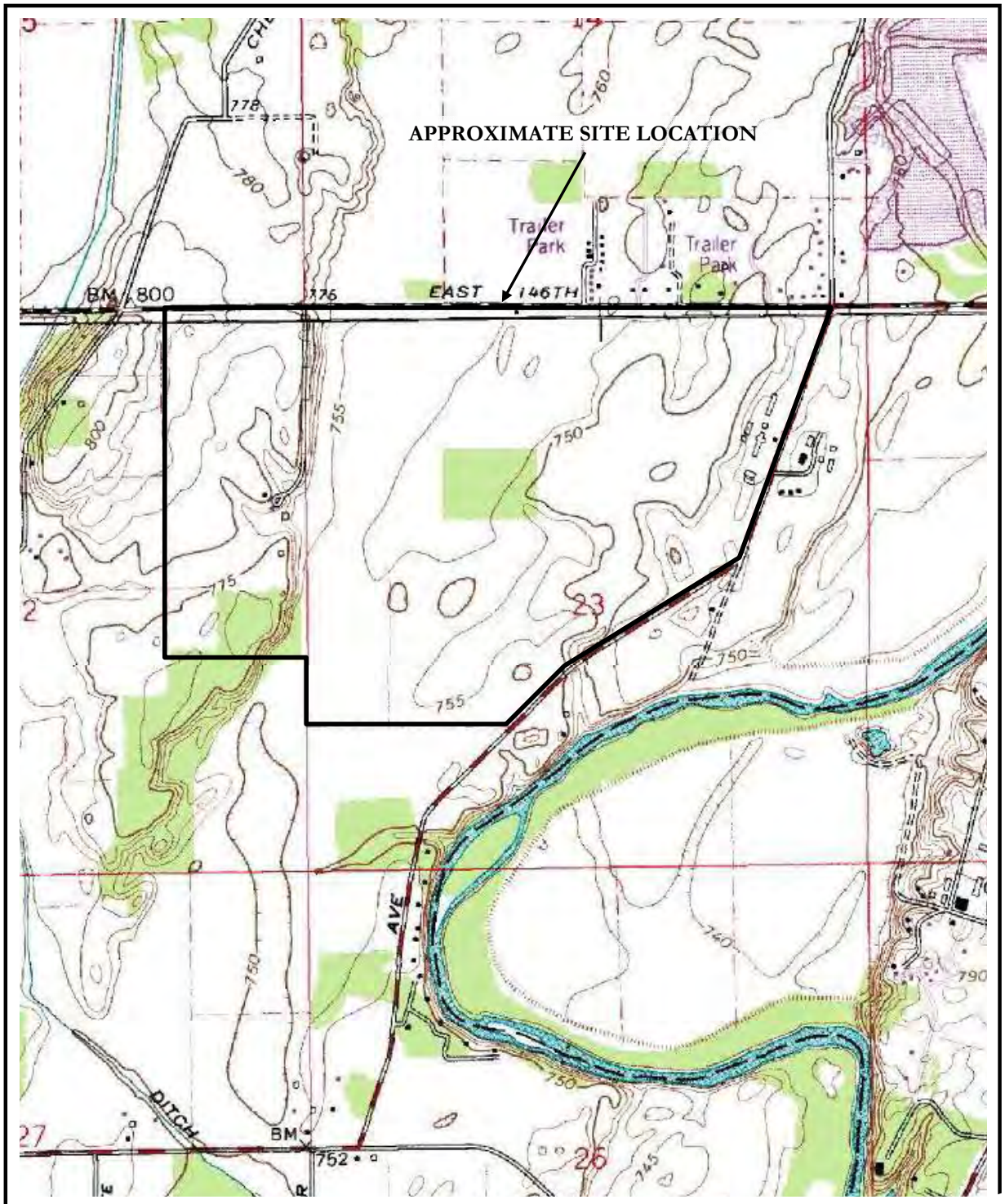
FIGURES

NAI OLYMPIA PARTNERS

EARLHAM COLLEGE PROPERTY

SOUTHWEST OF RIVER ROAD AND EAST 146TH STREET

HAMILTON COUNTY, INDIANA



WILLIAMS CREEK CONSULTING

Babeca Building
919 N. East Street
Indianapolis, Indiana
46202
Tel: 317-423-0690
Fax: 317-423-0696

N

1"≈1300'

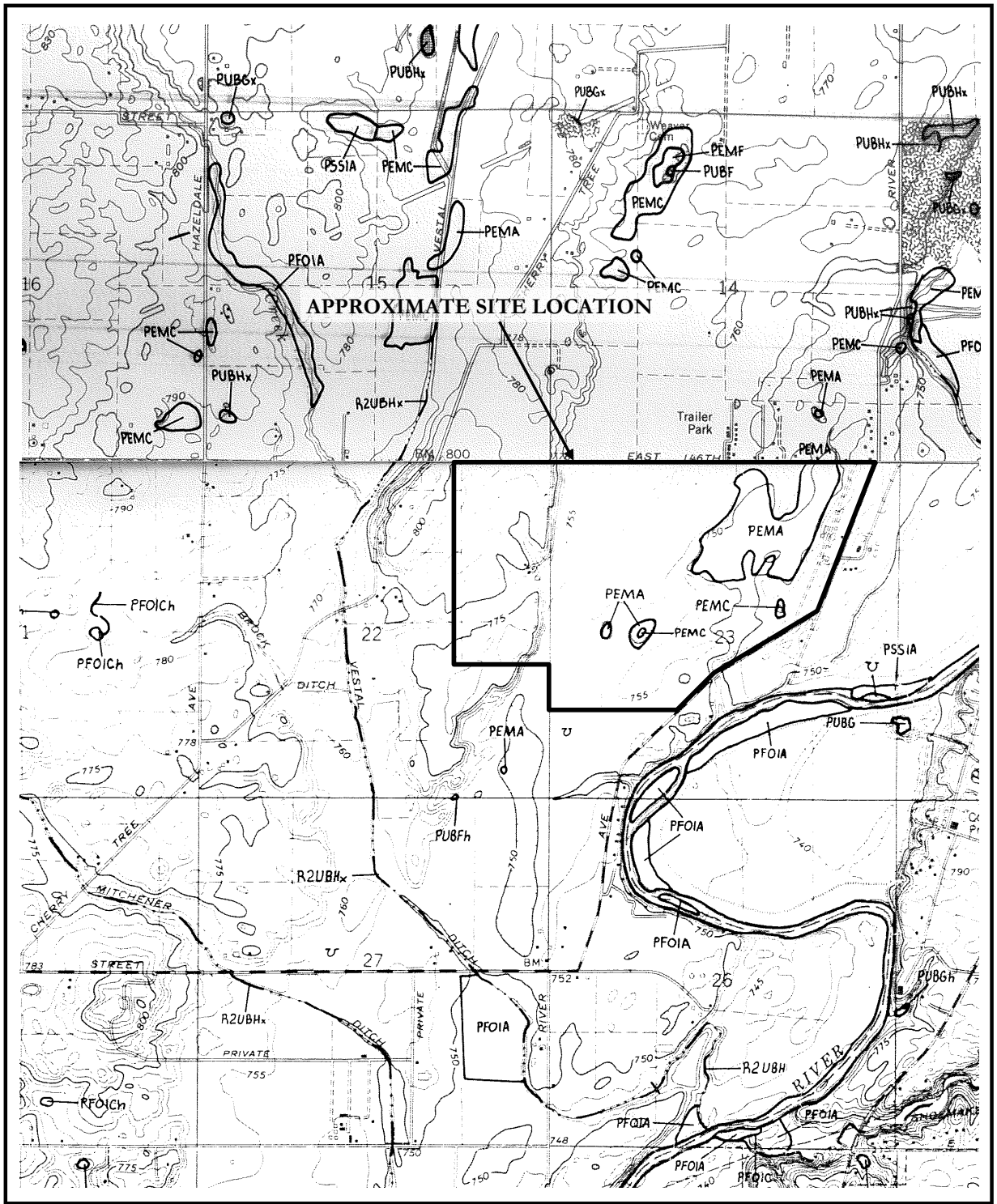
FIGURE #1
USGS TOPOGRAPHIC MAP
(Fishers Quadrangle)
Earlham College Property
Hamilton County, I[illegible]

Prepared for:

NAT[illegible]

Analysis & Research

Appendix 24: Wetland Delineation Report



WILLIAMS CREEK CONSULTING	Babeca Building 919 N. East Street Indianapolis, Indiana 46202 Tel: 317-423-0690 Fax: 317-423-0696	N 1"≈2000'	FIGURE # 2 NATIONAL WETLANDS INVENTORY (Fishers Quadrangle) Earlham College Property Hamilton County, Indiana	Prepared for: NAI Olympia Partners Project No. NAIO-25-001 Date: July 2005	

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Appendix 24: Wetland Delineation Report

SUBSYSTEM — **P - PALUSTRINE**

CLASS	RB--ROCK BOTTOM	UB--UNCONSOLIDATED BOTTOM	AB-AQUATIC BED	US--UNCONSOLIDATED SHORE	ML--MOSS-LICHEN	EM--EMERGENT	SS--SCRUB-SHRUB	FO--FORESTED	OW-OPEN WATER/ Unknown
Bottom									
Subclass	1 Bedrock 2 Rubble 3 Mud 4 Organic	1 Cobble-Gravel 2 Sand	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 Unknown Submergent 6 Unknown Surface	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	1 Moss 2 Lichen	1 Persistent 2 Nonpersistent	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 Deciduous 7 Evergreen	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6Deciduous 7 Evergreen	

MODIFIERS

In order to more adequately describe wetland and deepwater habitats one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

WATER REGIME

Non-Tidal

A Temporarily Flooded
B Saturated
C Seasonally Flooded
D Seasonally Flooded/ Well Drained
E Seasonally Flooded/ Saturated
F Semipermanently Flooded
G Intermittently Exposed

Tidal

H Permanently Flooded
J Intermittently Flooded
K Artificially Flooded
W Intermittently Flooded/Temporary
Y Saturated/Semipermanent/ Seasonal
Z Intermittently Exposed/Permanent
U Unknown

CoastalHalinityInlandSalinitypHModifiersfor

K Artificially Flooded
L Subtidal
M Irregularly Exposed
N Regularly Flooded
P Irregularly Flooded

*S Temporary-Tidal
*R Seasonal-Tidal
*T Semipermanent -Tidal
V Permanent -Tidal
U Unknown

*These water regimes are only used in tidally influenced, freshwater systems.

WATER CHEMISTRY

1 Hyperhaline
2 Euhaline
3 Mixohaline (Brackish)
4 Polyhaline
5 Mesohaline
6 Oligohaline
0 Fresh

7 Hypersaline
8 Eusaline
9 Mixosaline
0 Fresh

all Fresh Water

a Acid
t Circumneutral
i Alkaline

SOIL

g Organic
n Mineral

SPECIAL MODIFIERS

b Beaver
d Partially Drained/Ditched
f Farmed
h Diked/Impounded
r Artificial Substrate
s Spoil
x Excavated

WILLIAMS CREEK CONSULTING

Babeca Building
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Indianapolis, Indiana 46202
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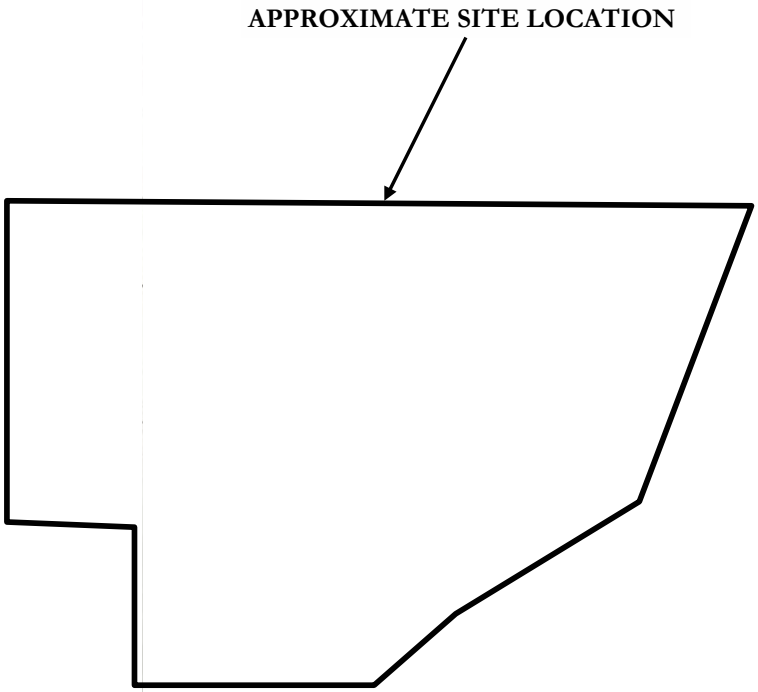
FIGURE # 3
KEY TO NATIONAL WETLANDS INVENTORY MAP

Earlham College Property
Hamilton County, Indiana

Prepared for:
NAI Olympia Partners

Project No.
NAIO-25-001

Date:
July 2005



FxC3 Fox clay loam, 8 to 18 percent slopes, severely eroded
Fn B2 Fox loam, 2 to 6 percent slopes, eroded
HeF Hennepin loam, 25 to 50 percent slopes
Ho Houghton muck
MmA Miami silt loam 0 to 2 percent slopes
MmB2 Miami silt loam, 2 to 6 percent slopes, eroded
OcA Ockley silt loam, 0 to 2 percent slopes
OcB2 Ockley silt loam, 2 to 6 percent slopes, eroded
Pa Palms muck
St Sleeth loam
We Westland silty clay loam

WILLIAMS CREEK CONSULTING

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46202
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Fax: 317-423-0696

N

1"=1320'

FIGURE # 4
HAMILTON COUNTY
SOIL SURVEY (SHEETS 45/46)
Earlham College Property
Hamilton County, Indiana

Prepared for:
NAI Olympia Partners

Project No.
NAIO-25-001

Date:
July 2005

Analysis & Research

Appendix 24: Wetland Delineation Report

WILLIAMS CREEK CONSULTING

Babeca Building
919 N. East Street
Indianapolis, Indiana
46202
Tel: 317-423-0690
Fax: 317-423-0696

N

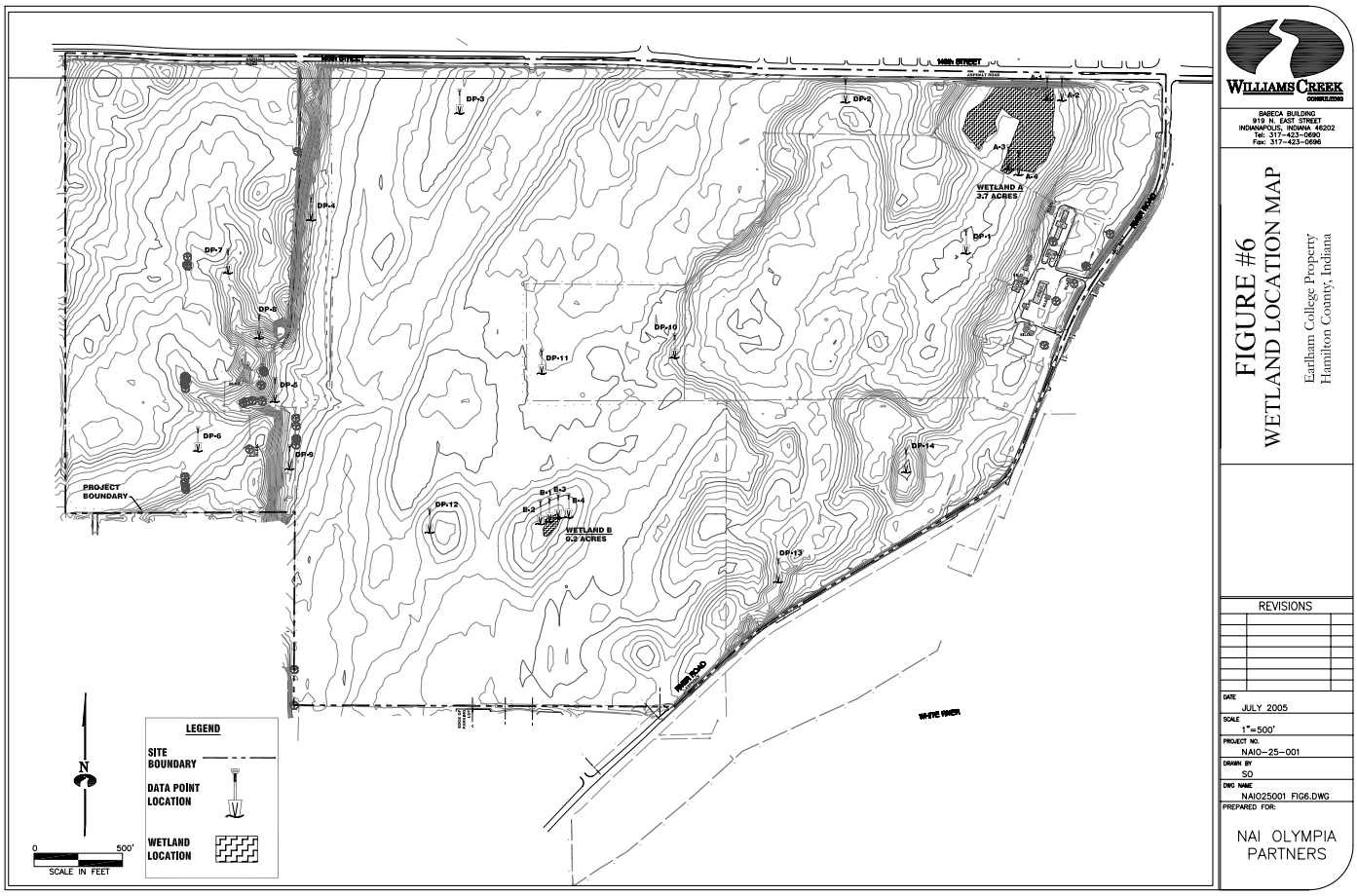
1"≈1000'

FIGURE # 5
AERIAL PHOTOGRAPH
2004 Hamilton County GIS
Earlham College Property
Hamilton County, Indiana

Prepared for:
NAI Olympia Partners

Project No.
NAIO-25-001

Date:
July 2005



WILLIAMS CREEK
BABECA BUILDING
919 N. EAST STREET
INDIANAPOLIS, INDIANA 46202
Tel: 317-423-0690
Fax: 317-423-0696

FIGURE #6
WETLAND LOCATION MAP

Earlham College Property
Hamilton County, Indiana

REVISIONS

DATE	JULY 2005
SCALE	1"=500'
PROJECT NO.	NAIO-25-001
DRAWN BY	SO
DWG NAME	NAIO25001 FIG6.DWG
PREPARED FOR:	NAI OLYMPIA PARTNERS

Appendix 24: Wetland Delineation Report

APPENDIX A

WETLAND DATA FORMS

NAI OLYMPIA PARTNERS

EARLHAM COLLEGE PROPERTY

SOUTHWEST OF RIVER ROAD AND EAST 146TH STREET

HAMILTON COUNTY, INDIANA

Site:	Earlham College	Date:	04/27/05
Client:	NAI Olympia Partners	County:	Hamilton
Investigator:	S. Shaw and S. O'Brien	State:	Indiana

WETLAND Station # A-1

Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No
Potential Problem Area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Phalaris arundinacea*	Herb	FACW+
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 100%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water:	None
Depth to Free Water:	10"
Depth to Saturated Soil:	0"

Primary Indicators		Secondary Indicators	
	Inundated		Oxidized Root Channels
X	Saturated <12"		Water-Stained Leaves
	Water Marks		Local Soil Survey Data
	Sediment Deposit	X	FAC-Neutral Test
	Drainage Patterns		Other (Explain in Remarks)

Remarks: Buttressing Trees

Soils

Map Unit Name: Houghton muck (Ho)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 2/1		Muck

HYDRIC SOIL INDICATORS

	Histosol		Concretions
	Histic Epipedon		Organic Content/Sandy Soils
	Sulfidic Odor		Organic Streaking/Sandy Soils
	Aquic Moisture Reg.		Local Hydric Soils List
	Gleyed		National Hydric Soils List
X	Low Chroma		Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	X Yes	No
Wetland Hydrology Present?	X Yes	No
Hydric Soils Present?	X Yes	No
Sampling Point Within a wetland?	X Yes	No

Remarks:

UPLAND Station # A-2

Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No
Potential Problem area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Sonchus arvensis*	Herb	FAC-
2.	*Phalaris arundinacea*	Herb	FACW+
3.	*Solidago altissima*	Herb	FACU
4.			
5.			
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 33%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water:	None
Depth to Free Water:	>16"
Depth to Saturated Soil:	14"

Primary Indicators		Secondary Indicators	
	Inundated		Oxidized Root Channels
	Saturated <12"		Water-Stained Leaves
	Water Marks		Local Soil Survey Data
	Sediment Deposit		FAC-Neutral Test
	Drainage Patterns		Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Fox loam (FnB2)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 2/1		Loam

HYDRIC SOIL INDICATORS

	Histosol		Concretions
	Histic Epipedon		Organic Content/Sandy Soils
	Sulfidic Odor		Organic Streaking/Sandy Soils
	Aquic Moisture Reg.		Local Hydric Soils List
	Gleyed		National Hydric Soils List
X	Low Chroma		Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	Yes	X No
Wetland Hydrology Present?	Yes	X No
Hydric Soils Present?	X Yes	No
Sampling Point Within a wetland?	Yes	X No

Remarks:

Appendix 24: Wetland Delineation Report

APPENDIX A

WETLAND DATA FORMS

NAI OLYMPIA PARTNERS

EARLHAM COLLEGE PROPERTY

SOUTHWEST OF RIVER ROAD AND EAST 146TH STREET

HAMILTON COUNTY, INDIANA

Site:	Earlham College	Date:	04/27/05
Client:	NAI Olympia Partners	County:	Hamilton
Investigator:	S. Shaw and S. O'Brien	State:	Indiana

WETLAND Station # A-1

Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No
Potential Problem Area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Phalaris arundinacea*	Herb	FACW+
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 100%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water:	None
Depth to Free Water:	10"
Depth to Saturated Soil:	0"

Primary Indicators	Secondary Indicators
___ Inundated	___ Oxidized Root Channels
X Saturated <12"	___ Water-Stained Leaves
___ Water Marks	___ Local Soil Survey Data
___ Sediment Deposit	X FAC-Neutral Test
___ Drainage Patterns	___ Other (Explain in Remarks)

Remarks: Buttressing Trees

Soils

Map Unit Name: Houghton muck (Ho)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 2/1		Muck

HYDRIC SOIL INDICATORS

___ Histosol	___ Concretions
___ Histic Epipedon	___ Organic Content/Sandy Soils
___ Sulfidic Odor	___ Organic Streaking/Sandy Soils
___ Aquic Moisture Reg.	___ Local Hydric Soils List
___ Gleyed	___ National Hydric Soils List
X Low Chroma	___ Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	X Yes	___ No
Wetland Hydrology Present?	X Yes	___ No
Hydric Soils Present?	X Yes	___ No
Sampling Point Within a wetland?	X Yes	___ No

Remarks:

UPLAND Station # A-2

Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No
Potential Problem area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Sonchus arvensis*	Herb	FAC-
2.	*Phalaris arundinacea*	Herb	FACW+
3.	*Solidago altissima*	Herb	FACU
4.			
5.			
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 33%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water:	None
Depth to Free Water:	>16"
Depth to Saturated Soil:	14"

Primary Indicators	Secondary Indicators
___ Inundated	___ Oxidized Root Channels
___ Saturated <12"	___ Water-Stained Leaves
___ Water Marks	___ Local Soil Survey Data
___ Sediment Deposit	___ FAC-Neutral Test
___ Drainage Patterns	___ Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Fox loam (FnB2)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 2/1		Loam

HYDRIC SOIL INDICATORS

___ Histosol	___ Concretions
___ Histic Epipedon	___ Organic Content/Sandy Soils
___ Sulfidic Odor	___ Organic Streaking/Sandy Soils
___ Aquic Moisture Reg.	___ Local Hydric Soils List
___ Gleyed	___ National Hydric Soils List
X Low Chroma	___ Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	___ Yes	X No
Wetland Hydrology Present?	___ Yes	X No
Hydric Soils Present?	X Yes	___ No
Sampling Point Within a wetland?	___ Yes	X No

Remarks:

Appendix 24: Wetland Delineation Report

Site:	Earlham College	Date:	04/27/05
Client:	NAI Olympia Partners	County:	Hamilton
Investigator:	S. Shaw and S. O'Brien	State:	Indiana

WETLAND Station # A-3

Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No
Potential Problem Area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Phalaris arundinacea*	Herb	FACW+
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 100%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water:	None
Depth to Free Water:	5"
Depth to Saturated Soil:	0"

Primary Indicators	Secondary Indicators
___ Inundated	___ Oxidized Root Channels
X Saturated <12"	___ Water-Stained Leaves
___ Water Marks	___ Local Soil Survey Data
___ Sediment Deposit	X FAC-Neutral Test
___ Drainage Patterns	___ Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Houghton muck (Ho)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 2/1		Muck

HYDRIC SOIL INDICATORS

___ Histosol	___ Concretions
___ Histic Epipedon	___ Organic Content/Sandy Soils
___ Sulfidic Odor	___ Organic Streaking/Sandy Soils
___ Aquic Moisture Reg.	___ Local Hydric Soils List
___ Gleyed	___ National Hydric Soils List
X Low Chroma	___ Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	X Yes	___ No
Wetland Hydrology Present?	X Yes	___ No
Hydric Soils Present?	X Yes	___ No
Sampling Point Within a wetland?	X Yes	___ No

Remarks:

UPLAND Station # A-4

Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No
Potential Problem area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Phalaris arundinacea*	Herb	FACW+
2.	*Viola sororia*	Herb	UPL
3.	*Solidago altissima*	Herb	FACU
4.			
5.			
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 33%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water:	None
Depth to Free Water:	15"
Depth to Saturated Soil:	10"

Primary Indicators	Secondary Indicators
___ Inundated	___ Oxidized Root Channels
X Saturated <12"	___ Water-Stained Leaves
___ Water Marks	___ Local Soil Survey Data
___ Sediment Deposit	___ FAC-Neutral Test
___ Drainage Patterns	___ Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Houghton muck (Ho)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 2/1		Muck

HYDRIC SOIL INDICATORS

___ Histosol	___ Concretions
___ Histic Epipedon	___ Organic Content/Sandy Soils
___ Sulfidic Odor	___ Organic Streaking/Sandy Soils
___ Aquic Moisture Reg.	___ Local Hydric Soils List
___ Gleyed	___ National Hydric Soils List
X Low Chroma	___ Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	___ Yes	X No
Wetland Hydrology Present?	X Yes	___ No
Hydric Soils Present?	X Yes	___ No
Sampling Point Within a wetland?	___ Yes	X No

Remarks:

Site:	Earlham College	Date:	04/27/05
Client:	NAI Olympia Partners	County:	Hamilton
Investigator:	S. Shaw and S. O'Brien	State:	Indiana

WETLAND Station #	B-1		**UPLAND Station #**	B-2	
Normal Circumstance?	Yes/No	No	Normal Circumstance?	Yes/No	No
Significantly Disturbed?	Yes/No	Yes	Significantly Disturbed?	Yes/No	Yes
Potential Problem Area?	Yes/No	No	Potential Problem area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Cephalanthus occidentalis*	Shrub	OBL
2.	*Phalaris arundinacea*	Herb	FACW+
3.			
4.			
5.			
6.			
7.			
8.			
Percent Species OBL, FACW, FAC(excl. FAC-)			100%

Remarks: Wetland vegetation appears to have been burned.

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Zea mays*	Herb	UPL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
Percent Species OBL, FACW, FAC(excl. FAC-)			0%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water: 0"
Depth to Free Water: 12"
Depth to Saturated Soil: 10"

Primary Indicators		Secondary Indicators	
	Inundated	X	Oxidized Root Channels
X	Saturated <12"		Water-Stained Leaves
	Water Marks		Local Soil Survey Data
	Sediment Deposit	X	FAC-Neutral Test
	Drainage Patterns		Other (Explain in Remarks)

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water: None
Depth to Free Water: >16"
Depth to Saturated Soil: >16"

Primary Indicators		Secondary Indicators	
	Inundated		Oxidized Root Channels
	Saturated <12"		Water-Stained Leaves
	Water Marks		Local Soil Survey Data
	Sediment Deposit		FAC-Neutral Test
	Drainage Patterns		Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Westland silt clay loam (We)
Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 3/1		Silt clay loam

HYDRIC SOIL INDICATORS

	Histosol		Concretions
	Histic Epipedon		Organic Content/Sandy Soils
	Sulfidic Odor		Organic Streaking/Sandy Soils
	Aquic Moisture Reg.		Local Hydric Soils List
	Gleyed		National Hydric Soils List
X	Low Chroma		Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Westland silt clay loam (We)
Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 3/1		Silt clay loam

HYDRIC SOIL INDICATORS

	Histosol		Concretions
	Histic Epipedon		Organic Content/Sandy Soils
	Sulfidic Odor		Organic Streaking/Sandy Soils
	Aquic Moisture Reg.		Local Hydric Soils List
	Gleyed		National Hydric Soils List
X	Low Chroma		Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	X Yes	No
Wetland Hydrology Present?	X Yes	No
Hydric Soils Present?	X Yes	No
Sampling Point Within a wetland?	X Yes	No

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	Yes	X No
Wetland Hydrology Present?	Yes	X No
Hydric Soils Present?	X Yes	No
Sampling Point Within a wetland?	Yes	X No

Remarks:

Appendix 24: Wetland Delineation Report

Site:	Earlham College	Date:	04/27/05
Client:	NAI Olympia Partners	County:	Hamilton
Investigator:	S. Shaw and S. O'Brien	State:	Indiana

WETLAND Station # B-3

Normal Circumstance?	Yes/No	No
Significantly Disturbed?	Yes/No	Yes
Potential Problem Area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Phalaris arundinacea*	Herb	FACW+
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 100%

Remarks: Wetland vegetation appears to have been burned.

HYDROLOGY

Field Indicators

Depth of Surface Water:	None
Depth to Free Water:	>16"
Depth to Saturated Soil:	>16"

Primary Indicators		Secondary Indicators	
	Inundated	X	Oxidized Root Channels
	Saturated <12"		Water-Stained Leaves
	Water Marks		Local Soil Survey Data
	Sediment Deposit	X	FAC-Neutral Test
	Drainage Patterns		Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Westland silt clay loam (We)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 3/1		Silt clay loam

HYDRIC SOIL INDICATORS

	Histosol		Concretions
	Histic Epipedon		Organic Content/Sandy Soils
	Sulfidic Odor		Organic Streaking/Sandy Soils
	Aquic Moisture Reg.		Local Hydric Soils List
	Gleyed		National Hydric Soils List
X	Low Chroma		Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	X	Yes		No
Wetland Hydrology Present?	X	Yes		No
Hydric Soils Present?	X	Yes		No
Sampling Point Within a wetland?	X	Yes		No

Remarks:

UPLAND Station # B-4

Normal Circumstance?	Yes/No	No
Significantly Disturbed?	Yes/No	Yes
Potential Problem area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Rosa multiflora*	Herb	FACU
2.	*Phytolacca americana*	Herb	FAC-
3.	*Phalaris arundinacea*	Herb	FACW+
4.			
5.			
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 33%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water:	None
Depth to Free Water:	>16"
Depth to Saturated Soil:	>16"

Primary Indicators		Secondary Indicators	
	Inundated		Oxidized Root Channels
	Saturated <12"		Water-Stained Leaves
	Water Marks		Local Soil Survey Data
	Sediment Deposit		FAC-Neutral Test
	Drainage Patterns		Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Westland silt clay loam (We)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 3/1		Silt clay loam

HYDRIC SOIL INDICATORS

	Histosol		Concretions
	Histic Epipedon		Organic Content/Sandy Soils
	Sulfidic Odor		Organic Streaking/Sandy Soils
	Aquic Moisture Reg.		Local Hydric Soils List
	Gleyed		National Hydric Soils List
X	Low Chroma		Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?		Yes	X	No
Wetland Hydrology Present?		Yes	X	No
Hydric Soils Present?	X	Yes		No
Sampling Point Within a wetland?		Yes	X	No

Remarks:

Site:	Earlham College	Date:	04/27/05
Client:	NAI Olympia Partners	County:	Hamilton
Investigator:	S. Shaw and S. O'Brien	State:	Indiana

Data Point Station # DP-1

Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No
Potential Problem Area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Festuca arundinacea*	Herb	FACU+
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 0%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water: None
Depth to Free Water: >16"
Depth to Saturated Soil: 14"

Primary Indicators	Secondary Indicators
___ Inundated	___ Oxidized Root Channels
___ Saturated <12"	___ Water-Stained Leaves
___ Water Marks	___ Local Soil Survey Data
___ Sediment Deposit	___ FAC-Neutral Test
___ Drainage Patterns	___ Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Palms muck (Pa)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 2/1		Muck

HYDRIC SOIL INDICATORS

___ Histosol	___ Concretions
___ Histic Epipedon	___ Organic Content/Sandy Soils
___ Sulfidic Odor	___ Organic Streaking/Sandy Soils
___ Aquic Moisture Reg.	___ Local Hydric Soils List
___ Gleyed	___ National Hydric Soils List
X Low Chroma	___ Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	___ Yes	X No
Wetland Hydrology Present?	___ Yes	X No
Hydric Soils Present?	X Yes	___ No
Sampling Point Within a wetland?	___ Yes	X No

Remarks:

Data Point Station # DP-2

Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No
Potential Problem area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Zea mays*	Herb	UPL
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 0%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water: None
Depth to Free Water: >16"
Depth to Saturated Soil: >16"

Primary Indicators	Secondary Indicators
___ Inundated	___ Oxidized Root Channels
___ Saturated <12"	___ Water-Stained Leaves
___ Water Marks	___ Local Soil Survey Data
___ Sediment Deposit	___ FAC-Neutral Test
___ Drainage Patterns	___ Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Fox loam (FnB2)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 2/1		Loam

HYDRIC SOIL INDICATORS

___ Histosol	___ Concretions
___ Histic Epipedon	___ Organic Content/Sandy Soils
___ Sulfidic Odor	___ Organic Streaking/Sandy Soils
___ Aquic Moisture Reg.	___ Local Hydric Soils List
___ Gleyed	___ National Hydric Soils List
X Low Chroma	___ Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	___ Yes	X No
Wetland Hydrology Present?	___ Yes	X No
Hydric Soils Present?	X Yes	___ No
Sampling Point Within a wetland?	___ Yes	X No

Remarks:

Appendix 24: Wetland Delineation Report

Site:	Earlham College	Date:	04/27/05
Client:	NAI Olympia Partners	County:	Hamilton
Investigator:	S. Shaw and S. O'Brien	State:	Indiana

Data Point Station # DP-3

Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No
Potential Problem Area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Zea mays*	Herb	UPL
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 0%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water: None
Depth to Free Water: >16"
Depth to Saturated Soil: >16"

Primary Indicators	Secondary Indicators
___ Inundated	___ Oxidized Root Channels
___ Saturated <12"	___ Water-Stained Leaves
___ Water Marks	___ Local Soil Survey Data
___ Sediment Deposit	___ FAC-Neutral Test
___ Drainage Patterns	___ Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Westland silt clay loam (We)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 2/1		Silt clay loam

HYDRIC SOIL INDICATORS

___ Histosol	___ Concretions
___ Histic Epipedon	___ Organic Content/Sandy Soils
___ Sulfidic Odor	___ Organic Streaking/Sandy Soils
___ Aquic Moisture Reg.	___ Local Hydric Soils List
___ Gleyed	___ National Hydric Soils List
X Low Chroma	___ Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	___ Yes	X No
Wetland Hydrology Present?	___ Yes	X No
Hydric Soils Present?	X Yes	___ No
Sampling Point Within a wetland?	___ Yes	X No

Remarks:

Data Point Station # DP-4

Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No
Potential Problem area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Celtis occidentalis*	Tree	FAC-
2.	*Asarum canadense*	Herb	UPL
3.	*Articum lappa*	Herb	UPL
4.	*Galium aparine*	Herb	FACU
5.			
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 0%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water: None
Depth to Free Water: >16"
Depth to Saturated Soil: >16"

Primary Indicators	Secondary Indicators
___ Inundated	___ Oxidized Root Channels
___ Saturated <12"	___ Water-Stained Leaves
___ Water Marks	___ Local Soil Survey Data
___ Sediment Deposit	___ FAC-Neutral Test
___ Drainage Patterns	___ Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Hennepin loam (HeF)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 3/3		Loam

HYDRIC SOIL INDICATORS

___ Histosol	___ Concretions
___ Histic Epipedon	___ Organic Content/Sandy Soils
___ Sulfidic Odor	___ Organic Streaking/Sandy Soils
___ Aquic Moisture Reg.	___ Local Hydric Soils List
___ Gleyed	___ National Hydric Soils List
___ Low Chroma	___ Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	___ Yes	X No
Wetland Hydrology Present?	___ Yes	X No
Hydric Soils Present?	___ Yes	X No
Sampling Point Within a wetland?	___ Yes	X No

Remarks:

Site:	Earlham College	Date:	04/27/05
Client:	NAI Olympia Partners	County:	Hamilton
Investigator:	S. Shaw and S. O'Brien	State:	Indiana

Data Point Station # DP-5

Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No
Potential Problem Area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Bromus inermis*	Herb	UPL
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 0%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water:	None
Depth to Free Water:	>16"
Depth to Saturated Soil:	>16"

Primary Indicators	Secondary Indicators
___ Inundated	___ Oxidized Root Channels
___ Saturated <12"	___ Water-Stained Leaves
___ Water Marks	___ Local Soil Survey Data
___ Sediment Deposit	___ FAC-Neutral Test
___ Drainage Patterns	___ Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Fox clay loam (FxC3)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 3/2		Clay loam

HYDRIC SOIL INDICATORS

___ Histosol	___ Concretions
___ Histic Epipedon	___ Organic Content/Sandy Soils
___ Sulfidic Odor	___ Organic Streaking/Sandy Soils
___ Aquic Moisture Reg.	___ Local Hydric Soils List
___ Gleyed	___ National Hydric Soils List
___ Low Chroma	___ Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	___ Yes	X No
Wetland Hydrology Present?	___ Yes	X No
Hydric Soils Present?	___ Yes	X No
Sampling Point Within a wetland?	___ Yes	X No

Remarks:

Data Point Station # DP-6

Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No
Potential Problem area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Bromus inermis*	Herb	UPL
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 0%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water:	None
Depth to Free Water:	>16"
Depth to Saturated Soil:	>16"

Primary Indicators	Secondary Indicators
___ Inundated	___ Oxidized Root Channels
___ Saturated <12"	___ Water-Stained Leaves
___ Water Marks	___ Local Soil Survey Data
___ Sediment Deposit	___ FAC-Neutral Test
___ Drainage Patterns	___ Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Ockley silt loam (OcA)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 3/2		Silt loam

HYDRIC SOIL INDICATORS

___ Histosol	___ Concretions
___ Histic Epipedon	___ Organic Content/Sandy Soils
___ Sulfidic Odor	___ Organic Streaking/Sandy Soils
___ Aquic Moisture Reg.	___ Local Hydric Soils List
___ Gleyed	___ National Hydric Soils List
___ Low Chroma	___ Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	___ Yes	X No
Wetland Hydrology Present?	___ Yes	X No
Hydric Soils Present?	___ Yes	X No
Sampling Point Within a wetland?	___ Yes	X No

Remarks:

Appendix 24: Wetland Delineation Report

Site:	Earlham College	Date:	04/27/05
Client:	NAI Olympia Partners	County:	Hamilton
Investigator:	S. Shaw and S. O'Brien	State:	Indiana

Data Point Station # DP-7

Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No
Potential Problem Area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Phalaris arundinacea*	Herb	FACW+
2.	*Bromus inermis*	Herb	UPL
3.			
4.			
5.			
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 50%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water: None
Depth to Free Water: >16"
Depth to Saturated Soil: >16"

Primary Indicators	Secondary Indicators
___ Inundated	___ Oxidized Root Channels
___ Saturated <12"	___ Water-Stained Leaves
___ Water Marks	___ Local Soil Survey Data
___ Sediment Deposit	___ FAC-Neutral Test
___ Drainage Patterns	___ Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Ockley silt loam (OcB2)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 4/3		Silt loam

HYDRIC SOIL INDICATORS

___ Histosol	___ Concretions
___ Histic Epipedon	___ Organic Content/Sandy Soils
___ Sulfidic Odor	___ Organic Streaking/Sandy Soils
___ Aquic Moisture Reg.	___ Local Hydric Soils List
___ Gleyed	___ National Hydric Soils List
___ Low Chroma	___ Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	___ Yes	X No
Wetland Hydrology Present?	___ Yes	X No
Hydric Soils Present?	___ Yes	X No
Sampling Point Within a wetland?	___ Yes	X No

Remarks:

Data Point Station # DP-8

Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No
Potential Problem area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Gleditsia triacanthos*	Tree	FAC
2.	*Daucus carota*	Herb	UPL
3.	*Cirsium arvense*	Herb	FACU
4.	*Bromus inermis*	Herb	UPL
5.			
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 25%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water: None
Depth to Free Water: >16"
Depth to Saturated Soil: >16"

Primary Indicators	Secondary Indicators
___ Inundated	___ Oxidized Root Channels
___ Saturated <12"	___ Water-Stained Leaves
___ Water Marks	___ Local Soil Survey Data
___ Sediment Deposit	___ FAC-Neutral Test
___ Drainage Patterns	___ Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Fox clay loam (FxC3)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 4/3		Clay loam

HYDRIC SOIL INDICATORS

___ Histosol	___ Concretions
___ Histic Epipedon	___ Organic Content/Sandy Soils
___ Sulfidic Odor	___ Organic Streaking/Sandy Soils
___ Aquic Moisture Reg.	___ Local Hydric Soils List
___ Gleyed	___ National Hydric Soils List
___ Low Chroma	___ Other (Explain in Remarks)

Remarks: No soil pit excavated

Wetland Determination

Hydrophytic Vegetation present?	___ Yes	X No
Wetland Hydrology Present?	___ Yes	X No
Hydric Soils Present?	___ Yes	X No
Sampling Point Within a wetland?	___ Yes	X No

Remarks:

Site:	Earlham College	Date:	04/27/05
Client:	NAI Olympia Partners	County:	Hamilton
Investigator:	S. Shaw and S. O'Brien	State:	Indiana

Data Point Station # DP-9

Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No
Potential Problem Area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Celtis occidentalis*	Tree	FAC-
2.	*Festuca arundinacea*	Herb	FACU+
3.			
4.			
5.			
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 0%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water:	None
Depth to Free Water:	>16"
Depth to Saturated Soil:	>16"

Primary Indicators	Secondary Indicators
___ Inundated	___ Oxidized Root Channels
___ Saturated <12"	___ Water-Stained Leaves
___ Water Marks	___ Local Soil Survey Data
___ Sediment Deposit	___ FAC-Neutral Test
___ Drainage Patterns	___ Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Fox clay loam (FxC3)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 4/3		Clay loam

HYDRIC SOIL INDICATORS

___ Histosol	___ Concretions
___ Histic Epipedon	___ Organic Content/Sandy Soils
___ Sulfidic Odor	___ Organic Streaking/Sandy Soils
___ Aquic Moisture Reg.	___ Local Hydric Soils List
___ Gleyed	___ National Hydric Soils List
___ Low Chroma	___ Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	___ Yes	X No
Wetland Hydrology Present?	___ Yes	X No
Hydric Soils Present?	___ Yes	X No
Sampling Point Within a wetland?	___ Yes	X No

Remarks:

Data Point Station # DP-10

Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No
Potential Problem area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Juglans nigra*	Tree	FACU
2.	*Sonchus arvensis*	Herb	FAC-
3.	*Phalaris arundinacea*	Herb	FACW+
4.	*Allaria petiolata*	Herb	FAC
5.	*Lamium purpureum*	Herb	UPL
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 40%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water:	None
Depth to Free Water:	>16"
Depth to Saturated Soil:	>16"

Primary Indicators	Secondary Indicators
___ Inundated	___ Oxidized Root Channels
___ Saturated <12"	___ Water-Stained Leaves
___ Water Marks	___ Local Soil Survey Data
___ Sediment Deposit	___ FAC-Neutral Test
___ Drainage Patterns	___ Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Westland silty clay loam (We)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 3/2		Silty clay loam

HYDRIC SOIL INDICATORS

___ Histosol	___ Concretions
___ Histic Epipedon	___ Organic Content/Sandy Soils
___ Sulfidic Odor	___ Organic Streaking/Sandy Soils
___ Aquic Moisture Reg.	___ Local Hydric Soils List
___ Gleyed	___ National Hydric Soils List
___ Low Chroma	___ Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	___ Yes	X No
Wetland Hydrology Present?	___ Yes	X No
Hydric Soils Present?	___ Yes	X No
Sampling Point Within a wetland?	___ Yes	X No

Remarks:

Appendix 24: Wetland Delineation Report

Site:	Earlham College	Date:	04/27/05
Client:	NAI Olympia Partners	County:	Hamilton
Investigator:	S. Shaw and S. O'Brien	State:	Indiana

Data Point Station #	DP-11		**Data Point Station #**	DP-12	
Normal Circumstance?	Yes/No	Yes	Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No	Significantly Disturbed?	Yes/No	No
Potential Problem Area?	Yes/No	No	Potential Problem Area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Celtis occidentalis*	Tree	FAC-
2.	*Festuca arundinacea*	Herb	FACU+
3.	*Floerkea proserpinacoides*	Herb	FAC+
4.	*Menispermum canadense*	Herb	FAC
5.	*Galium asparine*	Herb	FACU
6.			
7.			
8.			
Percent Species OBL, FACW, FAC(excl. FAC-)			40%

Remarks:

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Juglans nigra*	Tree	FACU
2.	*Ostrya virginiana*	Tree	FACU-
3.	*Podophyllum peltatum*	Herb	FACU
4.	*Galium asparine*	Herb	FACU
5.	*Polygonatum biflorum*	Herb	FACU
6.			
7.			
8.			
Percent Species OBL, FACW, FAC(excl. FAC-)			0%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water:	None
Depth to Free Water:	>16"
Depth to Saturated Soil:	>16"

Primary Indicators	Secondary Indicators
___ Inundated	___ Oxidized Root Channels
___ Saturated <12"	___ Water-Stained Leaves
___ Water Marks	___ Local Soil Survey Data
___ Sediment Deposit	___ FAC-Neutral Test
___ Drainage Patterns	___ Other (Explain in Remarks)

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water:	None
Depth to Free Water:	>16"
Depth to Saturated Soil:	>16"

Primary Indicators	Secondary Indicators
___ Inundated	___ Oxidized Root Channels
___ Saturated <12"	___ Water-Stained Leaves
___ Water Marks	___ Local Soil Survey Data
___ Sediment Deposit	___ FAC-Neutral Test
___ Drainage Patterns	___ Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Ockley silt loam (OcA)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-12"	10YR 3/1		Silt loam
12-16"	10YR 4/3		Silt loam

HYDRIC SOIL INDICATORS

___ Histosol	___ Concretions
___ Histic Epipedon	___ Organic Content/Sandy Soils
___ Sulfidic Odor	___ Organic Streaking/Sandy Soils
___ Aquic Moisture Reg.	___ Local Hydric Soils List
___ Gleyed	___ National Hydric Soils List
X Low Chroma	___ Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Ockley silt loam (OcA)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-7"	10YR 3/2		Silt loam
7-16"	10YR 5/4		Silt loam

HYDRIC SOIL INDICATORS

___ Histosol	___ Concretions
___ Histic Epipedon	___ Organic Content/Sandy Soils
___ Sulfidic Odor	___ Organic Streaking/Sandy Soils
___ Aquic Moisture Reg.	___ Local Hydric Soils List
___ Gleyed	___ National Hydric Soils List
___ Low Chroma	___ Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	___ Yes	X No
Wetland Hydrology Present?	___ Yes	X No
Hydric Soils Present?	X Yes	___ No
Sampling Point Within a wetland?	___ Yes	X No

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	___ Yes	X No
Wetland Hydrology Present?	___ Yes	X No
Hydric Soils Present?	___ Yes	X No
Sampling Point Within a wetland?	___ Yes	X No

Remarks:

Site:	Earlham College	Date:	04/27/05
Client:	NAI Olympia Partners	County:	Hamilton
Investigator:	S. Shaw and S. O'Brien	State:	Indiana

Data Point Station # DP-13

Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No
Potential Problem Area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Zea mays*	Herb	UPL
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 0%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water:	None
Depth to Free Water:	>16"
Depth to Saturated Soil:	>16"

Primary Indicators	Secondary Indicators
___ Inundated	___ Oxidized Root Channels
___ Saturated <12"	___ Water-Stained Leaves
___ Water Marks	___ Local Soil Survey Data
___ Sediment Deposit	___ FAC-Neutral Test
___ Drainage Patterns	___ Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Westland silty clay loam (We)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 2/1		Silty clay loam

HYDRIC SOIL INDICATORS

___ Histosol	___ Concretions
___ Histic Epipedon	___ Organic Content/Sandy Soils
___ Sulfidic Odor	___ Organic Streaking/Sandy Soils
___ Aquic Moisture Reg.	___ Local Hydric Soils List
___ Gleyed	___ National Hydric Soils List
X Low Chroma	___ Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	___ Yes	X No
Wetland Hydrology Present?	___ Yes	X No
Hydric Soils Present?	X Yes	___ No
Sampling Point Within a wetland?	___ Yes	X No

Remarks:

Data Point Station # DP-14

Normal Circumstance?	Yes/No	Yes
Significantly Disturbed?	Yes/No	No
Potential Problem Area?	Yes/No	No

VEGETATION

	Dominant species	Stratum	Indicator
1.	*Cirsium arvense*	Herb	FACU
2.	*Taraxacum officinale*	Herb	FACU
3.	*Trifolium pratense*	Herb	FACU
4.	*Lamium purpureum*	Herb	UPL
5.	*Festuca pratensis*	Herb	FACU-
6.			
7.			
8.			

Percent Species OBL, FACW, FAC(excl. FAC-) 0%

Remarks:

HYDROLOGY

Field Indicators

Depth of Surface Water:	None
Depth to Free Water:	>16"
Depth to Saturated Soil:	>16"

Primary Indicators	Secondary Indicators
___ Inundated	___ Oxidized Root Channels
___ Saturated <12"	___ Water-Stained Leaves
___ Water Marks	___ Local Soil Survey Data
___ Sediment Deposit	___ FAC-Neutral Test
___ Drainage Patterns	___ Other (Explain in Remarks)

Remarks:

Soils

Map Unit Name: Ockley silt loam (OcB2)

Profile Description:

Depth	Matrix	Mottles	Texture, Structure, etc.
0-16"	10YR 3/2		Silt loam

HYDRIC SOIL INDICATORS

___ Histosol	___ Concretions
___ Histic Epipedon	___ Organic Content/Sandy Soils
___ Sulfidic Odor	___ Organic Streaking/Sandy Soils
___ Aquic Moisture Reg.	___ Local Hydric Soils List
___ Gleyed	___ National Hydric Soils List
___ Low Chroma	___ Other (Explain in Remarks)

Remarks:

Wetland Determination

Hydrophytic Vegetation present?	___ Yes	X No
Wetland Hydrology Present?	___ Yes	X No
Hydric Soils Present?	___ Yes	X No
Sampling Point Within a wetland?	___ Yes	X No

Remarks:

Appendix 24: Wetland Delineation Report

APPENDIX B

SITE PHOTOGRAPHS

NAI OLYMPIA PARTNERS

EARLHAM COLLEGE PROPERTY

SOUTHWEST OF RIVER ROAD AND EAST 146TH STREET

HAMILTON COUNTY, INDIANA

Photo Point 1: Cow Pasture
View: Looking West

Photo Point 2: Corn Field
View: Looking South

Appendix 24: Wetland Delineation Report

Photo Point 3: Wetland A
View: Looking East

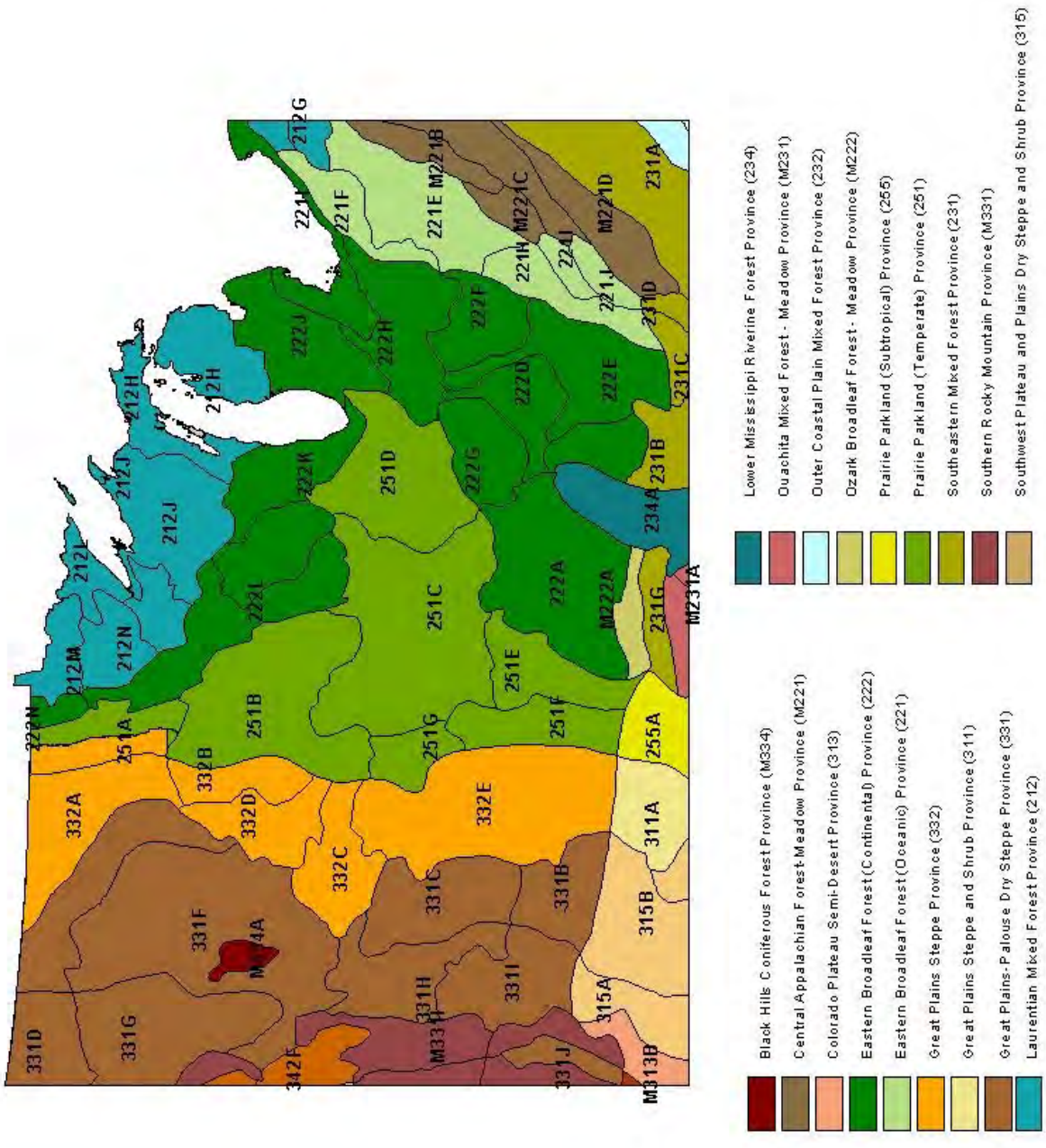
Photo Point 4: Wetland B
View: Looking East

Photo Point 5: Upland Forest
View: Looking East

Analysis & Research

Appendix 25: Plant Communities of the Midwest

Map of the ecological provinces and sections for the Midwestern part of the United.States (from Bailey et al. 1994).



https://www.natureserve.org/sites/default/files/plant-communities-midwest.pdf

Table 6. Ecological groups for the Midwest (Levels 1-3). (See also Tables 4 and 5.)

1. Wetlands - Non Tidal

1. Acid Peatlands
1. Northern (Laurentian) Acid Peatlands

2. Rich Peat Fens
1. Northern (Laurentian) Rich Fens
2. Midwestern Rich Fens
3. Interior Highlands Rich Fens
4. Great Plains Rich Fens
5. Rocky Mountains Rich Fens

3. Seeps
1. Northern (Laurentian) Seeps
2. Midwestern Seeps
3. Appalachian and Interior Highlands Seeps
4. Great Plains Seeps

4. Open and Emergent Marshes
1. Eastern Open and Emergent Marshes
2. Great Plains Open and Emergent Marshes
3. Rocky Mountains Open and Emergent Marshes

5. Wet Prairies and Wet Meadows
1. Northern (Laurentian) Wet Meadows
2. Great Lakes Shores Wet Meadows
3. Midwestern Wet Prairies and Wet Meadows
4. Appalachian and Interior Highlands Wet Prairies and Wet Meadows
5. Great Plains Wet Prairies and Wet Meadows
6. Rocky Mountains Wet Meadows

6. Wooded Swamps and Floodplains
1. Northern (Laurentian) Wooded Swamps and Floodplains
2. Midwestern Wooded Swamps, Floodplains and Wet Flatwoods
3. Appalachian and Interior Highlands Wooded Swamps, Ponds, Floodplains, and Wet Flatwoods
4. Southern Wooded Swamps, Depression Ponds and Floodplains
5. Great Plains Wooded Riparian Vegetation
6. Rocky Mountains Wooded Riparian Vegetation

2. Uplands

1. Shoreline Sand/Mud Strands, Beaches and Dunes
1. Great Lakes Shore Strands and Dunes
2. Midwestern Strands and Mudflats
3. Great Plains Strands and Mudflats

2. Rocky Shores
1. Northern (Laurentian) Lakes and Rivers Rocky Shores
2. Great Lakes Rocky Shores
3. Appalachian and Interior Highlands Riverine Rocky Shores

3. Rocky Uplands (Glades, Rock Barrens, Outcrops and Alvars)
1. Northern (Laurentian) Rock Outcrops and Rock Barrens
2. Great Lakes Alvars
3. Midwestern Rock Outcrops and Glades
4. Appalachian and Interior Highlands Glades (Rock Barrens)
5. Great Plains Rock Outcrops
6. Rocky Mountains Rock Outcrops

4. Cliffs, Talus, Buttes and Badlands
1. Northern (Laurentian) Cliffs and Talus
2. Great Lakes Shore Cliffs
3. Eastern Cliffs and Talus
4. Great Plains Cliffs, Talus, Buttes and Badlands
5. Rocky Mountains Cliffs, Buttes and Talus

5. Forests and Woodlands
1. Northern (Laurentian) Forests and Woodlands
2. Midwestern Forests and Woodlands
3. Appalachian and Interior Highlands Forests and Woodlands
4. Aspen Parkland Forests and Woodlands
5. Great Plains Forests and Woodlands
6. Rocky Mountains Forests and Woodlands

6. Shrublands/Dwarf-Shrublands
1. Northern (Laurentian) Shrublands
2. Midwestern Shrub Prairie and Barrens
3. Great Plains Shrublands

7. Shrub Grasslands
1. Great Plains Shrub Steppe

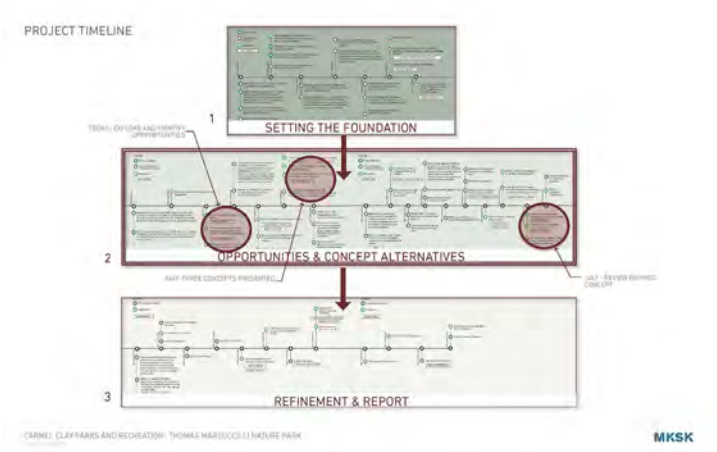
8. Savannas and Non-Rock Barrens
1. Northern (Laurentian) Pine Barrens
2. Midwestern Oak Savannas and Non-Rock Barrens
3. Interior Highlands Oak Savannas and Non-Rock Barrens
4. Great Plains Oak Savannas

9. Prairies/Grasslands
1. Midwestern Tallgrass Prairies
2. Southeastern Coastal Plain Prairies
3. Great Plains Prairies
4. Rocky Mountains Montane Grasslands

Ecological groups can also help clarify other dynamic processes that shape vegetation patterns of tallgrass prairie on the landscape. Prairies in the central Midwest are found in what is called the "prairie-forest border" region (Anderson 1983), with types ranging from open prairie to closed forest (Figure 6). The structural gradient from prairie to forest is often caused by the variability in fire frequency in the landscape, with prairies dependent on more frequent fire (Anderson 1983, Collins and Wallace 1990). Grazing (and more recently, haying) also affected this gradient. The prairie-forest structural/fire frequency continuum forms a second set of gradients that can be related to the topographic soil moisture/substrate continuum (Figure 7). Thus the tallgrass prairie ecological groups are dynamically related to tallgrass oak savannas and oak woodlands and forests. Using ecological groups, it is possible to show, in schematic fashion, these dynamic relationships, and thereby to gain a perspective on the ecological dynamics of the component associations.

Presentations

Appendix 26: Focus Group Presentation (04/14/2022)



GOAL NO. 3 - EDUCATION & STORYTELLING

REVEAL THE SUNDERED HISTORY OF SITE

REPOSITORY OF ARTIFACTS FROM FIVE VILLAGE SITE PLACES

NATIVE COMMUNITY

LOCAL FOLKLORE

UTILIZE HISTORICAL AND ARCHEOLOGICAL RESOURCES (SUCH AS ANTHROPOLOGY STATE LAB, CARMEL CLAY HISTORIC SOCIETY)

ALLOW MARGINALIZED COMMUNITIES TO TELL STORY FROM THEIR PERSPECTIVE

CARMEL CLAY PARKS AND RECREATION . THOMAS MARCUCCILLI NATURE PARK

MKSK

GOAL NO. 4 - CONNECTIVITY

PRAIRIE TRACE ELEMENTARY SCHOOL

HARVEST CHURCH

RESIDENTIAL CONTEXT

FUTURE DEVELOPMENT @ CONNER PRAIRIE

WILDLIFE PASSAGES

WHITE RIVER

CARMEL CLAY PARKS AND RECREATION . THOMAS MARCUCCILLI NATURE PARK

MKSK

GOAL NO. 5 - INNOVATIVE APPROACH

IN-LIEU FEE (ILF) BMP PROGRAM

TRIBAL ENGAGEMENT

RIVER HERITAGE FOREST MITIGATION WILL OCCUR IN SELECT AREAS OF SITE

SUSTAINABLE MAINTENANCE SOLUTIONS ENGAGED
- DESIGN
- COLLABORATION
- HABITAT CREATION
- RELATIONSHIPS
- LONG-TERM MONITORING

ELEVATED INTERPRETIVE SIGNAGE EXPERIENCE

CARMEL CLAY PARKS AND RECREATION . THOMAS MARCUCCILLI NATURE PARK

MKSK

INITIAL PROGRAMMING THOUGHTS

EDUCATIONAL INTERPRETIVE SIGNAGE
OUTDOOR CLASSROOM
RESTROOM
PARKING AND DROP OFF
SHADE ELEMENTS
SMALL GATHERING SPACES OFF TRAIL
SEATING OPPORTUNITIES
ECOLOGICAL LANDSCAPE RESTORATION
BRIDGE OR DECKING OVER WET AREAS

CARMEL CLAY PARKS AND RECREATION . THOMAS MARCUCCILLI NATURE PARK

MKSK

WELL NO. 25

CARMEL CLAY PARKS AND RECREATION . THOMAS MARCUCCILLI NATURE PARK VIEWING NORTHWEST

WELL NO. 25

CARMEL CLAY PARKS AND RECREATION . THOMAS MARCUCCILLI NATURE PARK VIEWING NORTHWEST AT NIGHT

Presentations

Appendix 26: Focus Group Presentation (04/14/2022)

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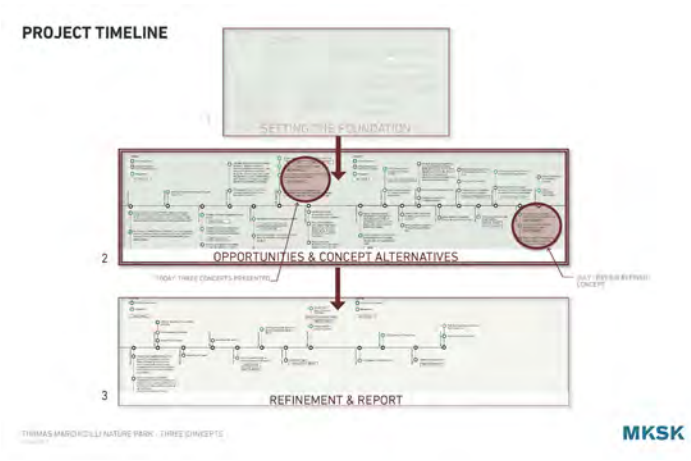
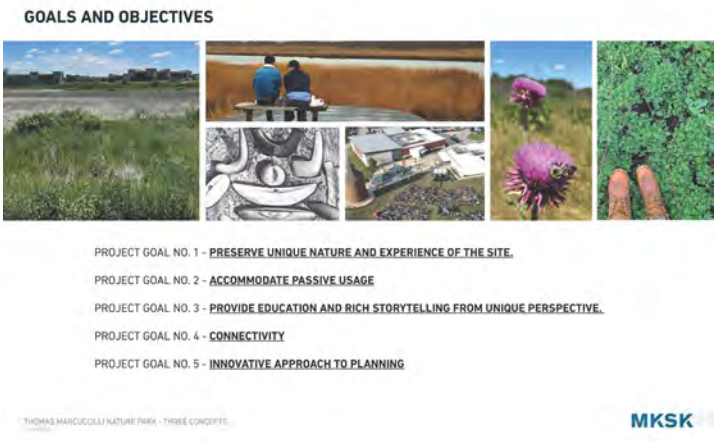
Presentations

Appendix 27: Community Concept Presentation (05/05/2022)





CONCEPT 01: TOUCHSTONE TO PAST STORIES

THOMAS MARCUCCILLI NATURE PARK - THREE CONCEPTS

MKSK

CONCEPT 01: TOUCHSTONE TO PAST STORIES

PROGRAM DIAGRAM

THOMAS MARCUCCILLI NATURE PARK - THREE CONCEPTS

MKSK

LANDSCAPE FOWARD

THOMAS MARCUCCILLI NATURE PARK - THREE CONCEPTS

MKSK

CONCEPT 02: LANDSCAPE FORWARD

THOMAS MARCUCCILLI NATURE PARK - THREE CONCEPTS

MKSK

CONCEPT 02: LANDSCAPE FORWARD

PROGRAM DIAGRAM

THOMAS MARCUCCILLI NATURE PARK - THREE CONCEPTS

MKSK

FRAMEWORK

L E A S T

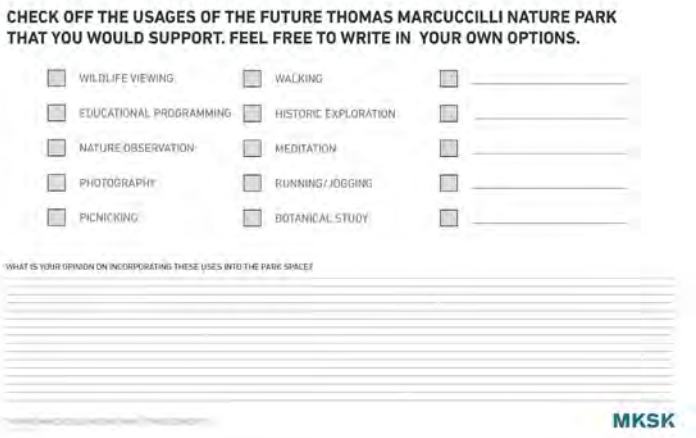
E D M M O N

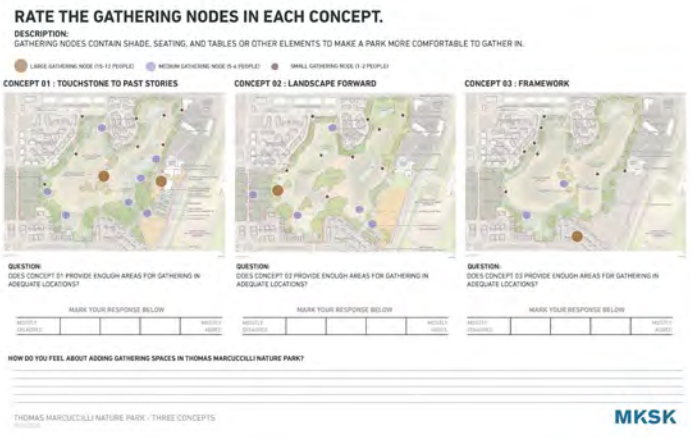
D E N O M I N A T O R

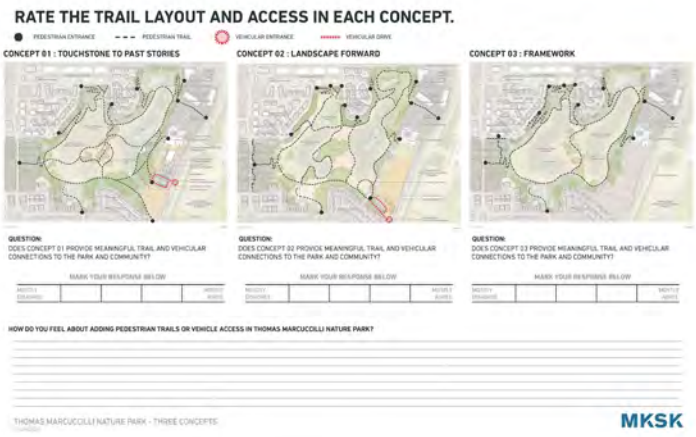
MKSK

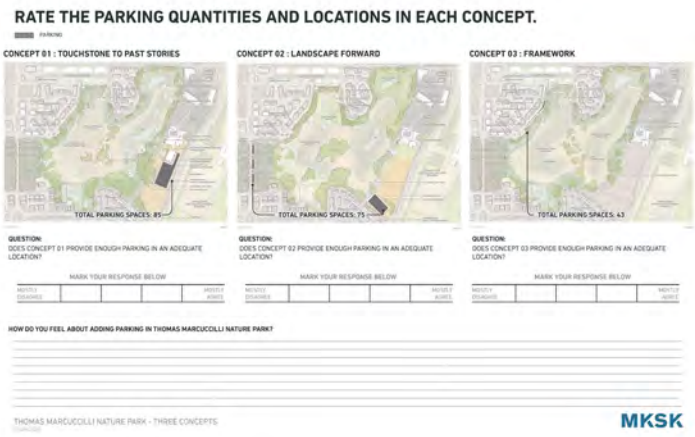
Presentations

Appendix 27: Community Concept Presentation (05/05/2022)









RATE THE RESTROOM LOCATIONS IN EACH CONCEPT.

RESTROOM FACILITY

CONCEPT 01 : TOUCHSTONE TO PAST STORIES

QUESTION:
DOES CONCEPT 01 PROVIDE AN ADEQUATE RESTROOM LOCATION?

MARK YOUR RESPONSE BELOW

MOSTLY DISAGREE					MOSTLY AGREE

CONCEPT 02 : LANDSCAPE FORWARD

QUESTION:
DOES CONCEPT 02 PROVIDE AN ADEQUATE RESTROOM LOCATION?

MARK YOUR RESPONSE BELOW

MOSTLY DISAGREE					MOSTLY AGREE

CONCEPT 03 : FRAMEWORK

QUESTION:
DOES CONCEPT 03 PROVIDE AN ADEQUATE RESTROOM LOCATION?

MARK YOUR RESPONSE BELOW

MOSTLY DISAGREE					MOSTLY AGREE

HOW DO YOU FEEL ABOUT ADDING RESTROOM FACILITIES IN THOMAS MARCUCCILLI NATURE PARK?

THOMAS MARCUCCILLI NATURE PARK - THREE CONCEPTS

MKSK

CONCEPT 01: TOUCHSTONE TO PAST STORIES

WHAT IS YOUR OPINION OF CONCEPT 01?

RATE THIS CONCEPT BASED ON YOUR PREFERENCE AND HOW IT MEETS THE PROJECT GOALS.

MARK YOUR RESPONSE BELOW

	MOSTLY DISAGREE				MOSTLY AGREE
• DOES CONCEPT 01 PRESERVE THE NATURAL CHARACTERISTICS OF THE SITE?					
• DOES CONCEPT 01 ACCOMMODATE PASSIVE ACTIVITIES?					
• DOES CONCEPT 01 PROVIDE AN OPPORTUNITY FOR EDUCATIONAL EXPERIENCES?					
• DOES CONCEPT 01 MAKE MEANINGFUL CONNECTION TO THE PARK AND COMMUNITY?					

MKSK

CONCEPT 02: LANDSCAPE FORWARD

WHAT IS YOUR OPINION OF CONCEPT 02?

RATE THIS CONCEPT BASED ON YOUR PREFERENCE AND HOW IT MEETS THE PROJECT GOALS.

MARK YOUR RESPONSE BELOW

	MOSTLY DISAGREE				MOSTLY AGREE
• DOES CONCEPT 02 PRESERVE THE NATURAL CHARACTERISTICS OF THE SITE?					
• DOES CONCEPT 02 ACCOMMODATE PASSIVE ACTIVITIES?					
• DOES CONCEPT 02 PROVIDE AN OPPORTUNITY FOR EDUCATIONAL EXPERIENCES?					
• DOES CONCEPT 02 MAKE MEANINGFUL CONNECTION TO THE PARK AND COMMUNITY?					

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CONCEPT 03: FRAMEWORK

WHAT IS YOUR OPINION OF CONCEPT 03?

RATE THIS CONCEPT BASED ON YOUR PREFERENCE AND HOW IT MEETS THE PROJECT GOALS.

MARK YOUR RESPONSE BELOW

	MOSTLY DISAGREE				MOSTLY AGREE
• DOES CONCEPT 03 PRESERVE THE NATURAL CHARACTERISTICS OF THE SITE?					
• DOES CONCEPT 03 ACCOMMODATE PASSIVE ACTIVITIES?					
• DOES CONCEPT 03 PROVIDE AN OPPORTUNITY FOR EDUCATIONAL EXPERIENCES?					
• DOES CONCEPT 03 MAKE MEANINGFUL CONNECTION TO THE PARK AND COMMUNITY?					

MKSK

DESIGN THE PARK ACTIVITY

INCLUDE THE FOLLOWING ELEMENTS IN YOUR DESIGN:

- TRAIL SYSTEM
- RESTROOM
- PARKING
- GATHERING NODES
- OVERLOOKS
- SHADE
- SEATING
- SIGNAGE
- WOODLAND
- RESTORED LANDSCAPES

WHAT OTHER ELEMENTS WOULD YOU LIKE TO SEE IN THOMAS MARCUCCILLI NATURE PARK?

MKSK

Presentations

Appendix 28: Tribal Engagement Presentation (06/08/2022)

GOAL NO. 3 - EDUCATION & STORYTELLING

PROJECT GOAL NO. 3 - **PROVIDE EDUCATION AND RICH STORYTELLING FROM UNIQUE PERSPECTIVE.**

HIGHLIGHT THE HISTORY OF THE SITE BY BUILDING STRONG PARTNERSHIPS WITH AND ALLOWING UNDERREPRESENTED COMMUNITIES TO TELL SITE'S STORY FROM THEIR PERSPECTIVE.

REVEAL THE SHELDED HISTORY OF SITE

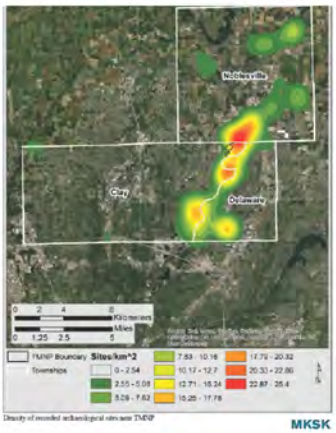
REPOSITORY OF ARTIFACTS FROM PREVIOUS TIME PERIODS

NATIVE COMMUNITY

LOCAL FOLKLORE

UTILIZE HISTORIC/ANTHROPOLOGICAL RESOURCES (APPLIED ANTHROPOLOGY INSTITUTE, CARMEL CLAY HISTORIC SOCIETY)

ALLOW MARGINALIZED COMMUNITIES TO TELL STORY FROM THEIR PERSPECTIVE



Density of recorded archaeological sites near TMNP

MKSK

GOAL NO. 4 - CONNECTIVITY

PROJECT GOAL NO. 4 - **CONNECTIVITY**

TO NEARBY PRAIRIE TRACE ELEMENTARY SCHOOL, HARVEST CHURCH, WHITE RIVER, RESIDENTIAL CONTEXT, WILDLIFE PASSAGES, AND THE FUTURE DEVELOPMENT OF CONNER PRAIRIE.

PRAIRIE TRACE ELEMENTARY SCHOOL

HARVEST CHURCH

RESIDENTIAL CONTEXT

FUTURE DEVELOPMENT @ CONNER PRAIRIE

WILDLIFE PASSAGES

WHITE RIVER

MKSK

GOAL NO. 5 - INNOVATIVE APPROACH

TRIBAL ENGAGEMENT

RIVER HERITAGE FOREST MITIGATION WILL OCCUR IN SELECT AREAS OF SITE

SUSTAINABLE MAINTENANCE SOLUTIONS ENGAGED
- DESIGN
- COLLABORATION
- HABITAT CREATION
- RELATIONSHIPS
- LONG-TERM MONITORING

ELEVATED INTERPRETIVE SIGNAGE EXPERIENCE

PROJECT GOAL NO. 5 - **INNOVATIVE APPROACH TO PLANNING**

INCLUDING TRIBAL ENGAGEMENT, FOREST MITIGATION, SUSTAINABLE MAINTENANCE SOLUTIONS, AND AN ELEVATED INTERPRETIVE SIGNAGE EXPERIENCE.

MKSK

INITIAL PROGRAMMING THOUGHTS

EDUCATIONAL INTERPRETIVE SIGNAGE
OUTDOOR CLASSROOM
RESTROOM
PARKING AND DROP OFF
SHADE ELEMENTS
SMALL GATHERING SPACES OFF TRAIL
SEATING OPPORTUNITIES
ECOLOGICAL LANDSCAPE RESTORATION
BRIDGE OR DECKING OVER WET AREAS

MKSK

TOUCHSTONE TO PAST STORIES

MKSK

CONCEPT 01: TOUCHSTONE TO PAST STORIES

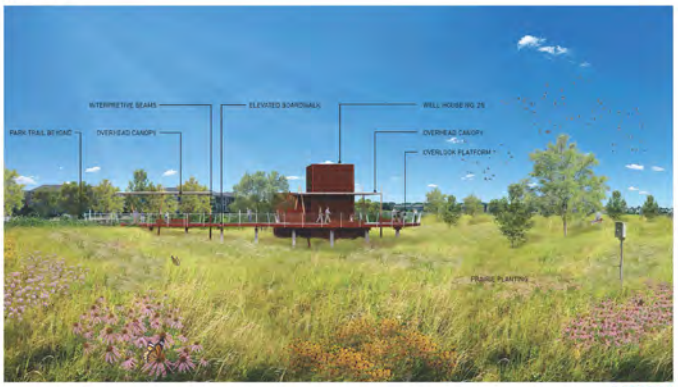
PROGRAM DIAGRAM

MKSK

Presentations

Appendix 28: Tribal Engagement Presentation (06/08/2022)

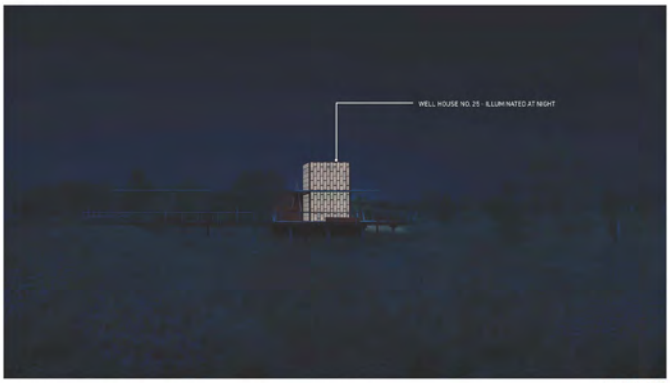
WELL NO. 26



CARMEL CLAY PARKS AND RECREATION : THOMAS MARCUCCILLI NATURE PARK VIEWING EAST

MKSK

WELL NO. 26



CARMEL CLAY PARKS AND RECREATION : THOMAS MARCUCCILLI NATURE PARK VIEWING EAST AT NIGHT

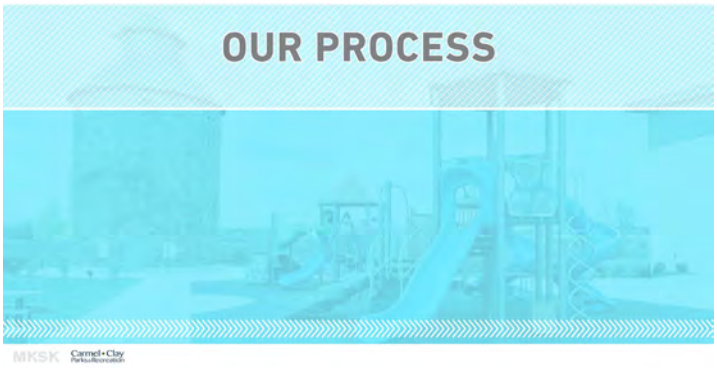
MKSK

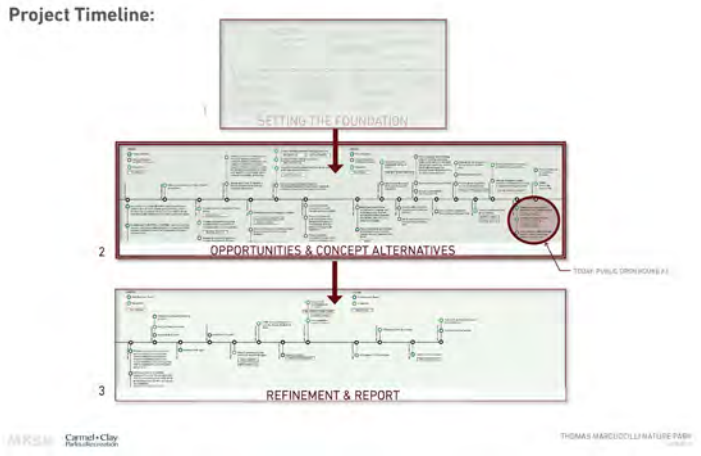
CARMEL CLAY PARKS AND RECREATION : THOMAS MARCUCCILLI NATURE PARK

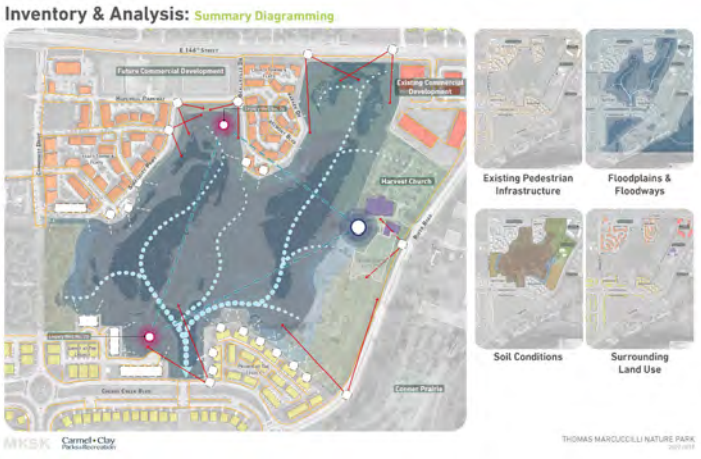
MKSK

Presentations

Appendix 29: Refined Concept Presentation (08/18/2022)







Inventory & Analysis: Plant Communities

THOMAS MARCUCCILLI NATURE PARK

Community Input & Feedback: Design Collaboration

THOMAS MARCUCCILLI NATURE PARK

MASTER PLAN

Proposed Master Plan

THOMAS MARCUCCILLI NATURE PARK

Proposed Master Plan: Upper Terrace

THOMAS MARCUCCILLI NATURE PARK

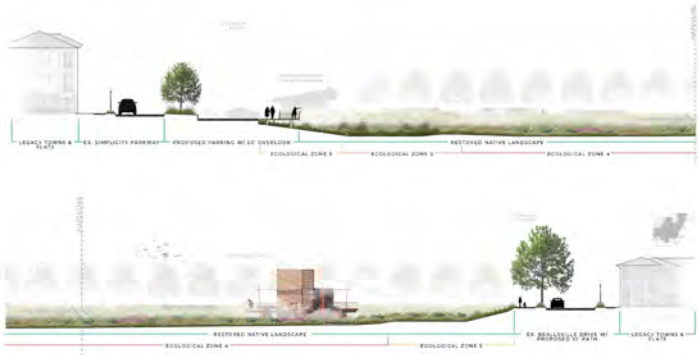
Upper Terrace Enlargements: Entry Experience at River Road

THOMAS MARCUCCILLI NATURE PARK

Presentations

Appendix 29: Refined Concept Presentation (08/18/2022)

Upper Terrace Sections: Legacy Well No. 26 - Facing North

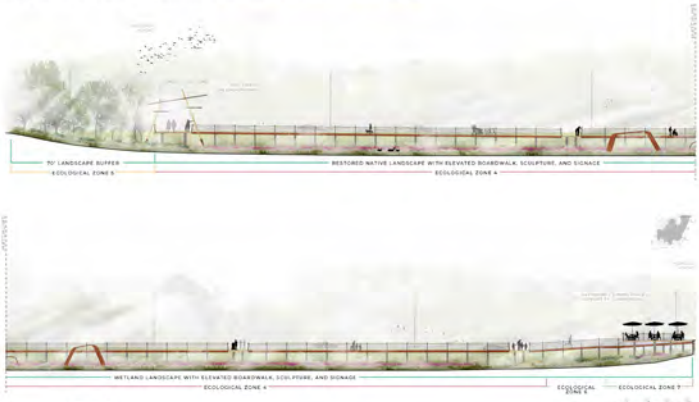


MKSK Carmel•Clay Parks&Recreation THOMAS MARCUCCILLI NATURE PARK

Upper Terrace Enlargements: Elevated Boardwalk

MKSK Carmel•Clay Parks&Recreation THOMAS MARCUCCILLI NATURE PARK

Upper Terrace Sections: Elevated Boardwalk - Facing North

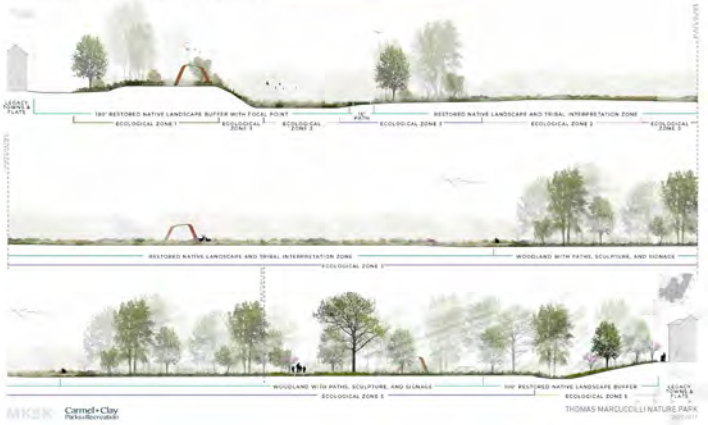


MKSK Carmel•Clay Parks&Recreation THOMAS MARCUCCILLI NATURE PARK

Proposed Master Plan: Transitional Terrace

MKSK Carmel•Clay Parks&Recreation THOMAS MARCUCCILLI NATURE PARK

Transitional Terrace Sections: Central Cross-Section - Facing West



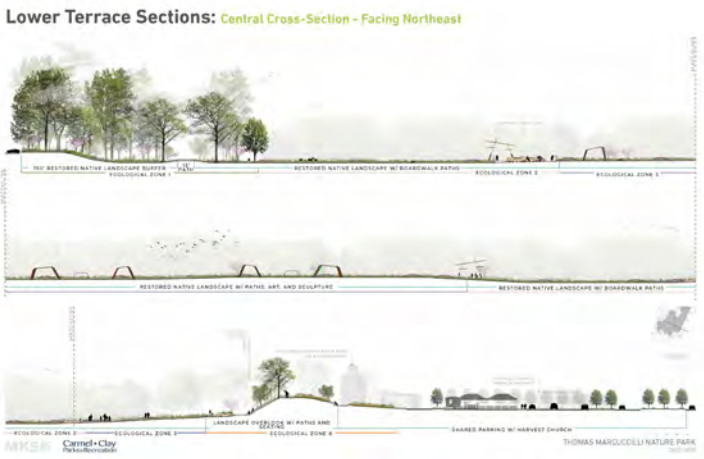
MKSK Carmel•Clay Parks&Recreation THOMAS MARCUCCILLI NATURE PARK

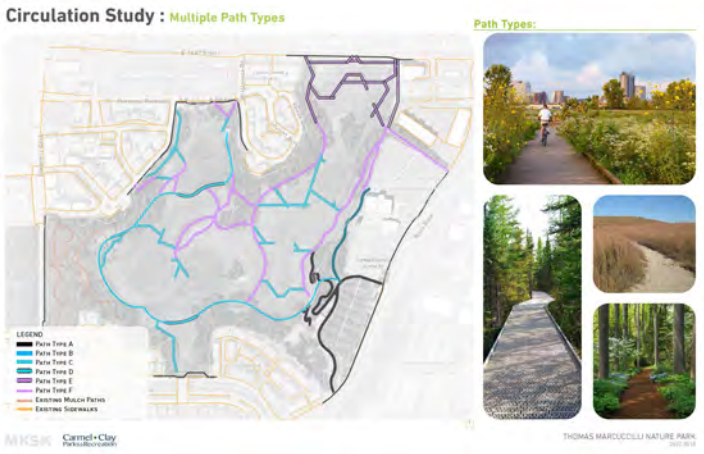
Proposed Master Plan: Lower Terrace

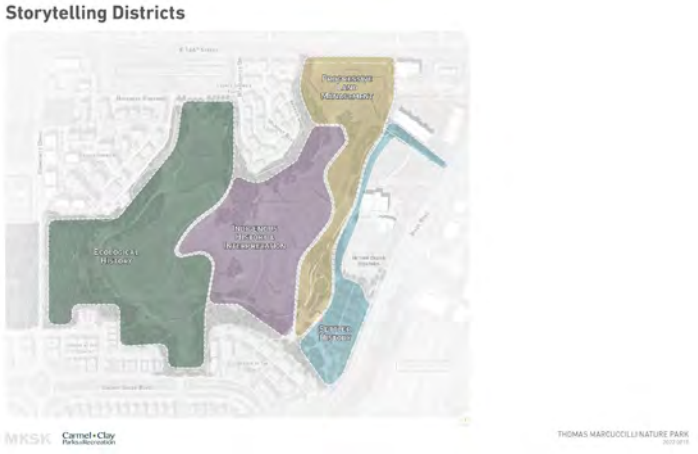
MKSK Carmel•Clay Parks&Recreation THOMAS MARCUCCILLI NATURE PARK

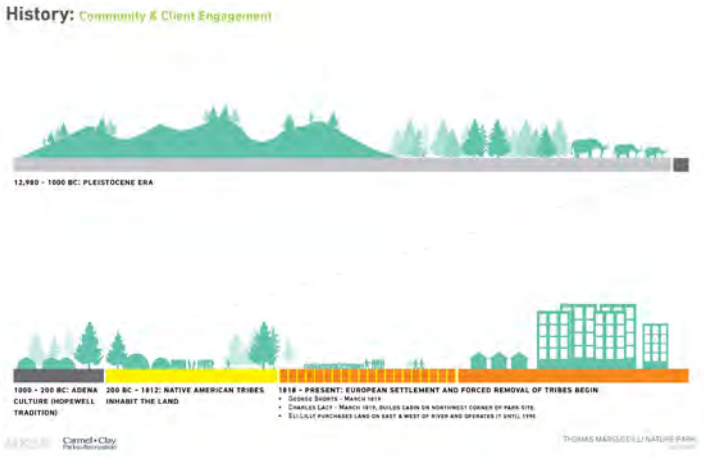
Presentations

Appendix 29: Refined Concept Presentation (08/18/2022)



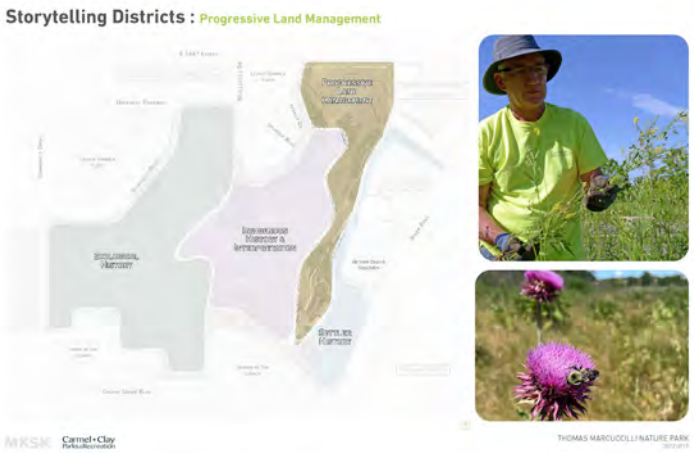






Storytelling Districts: Indigenous History & Interpretation

Storytelling Districts : Progressive Land Management

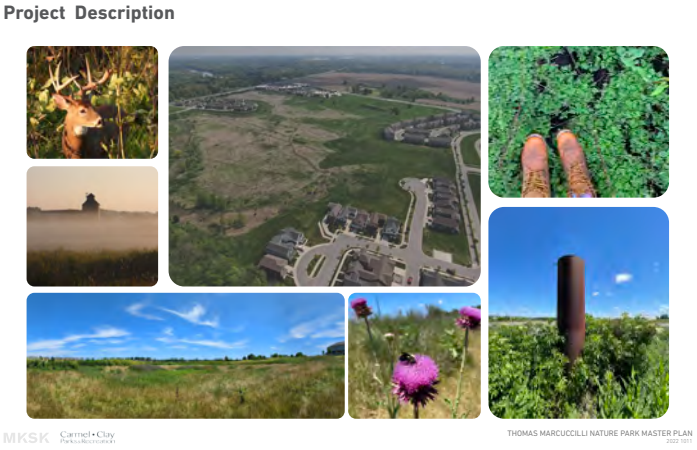


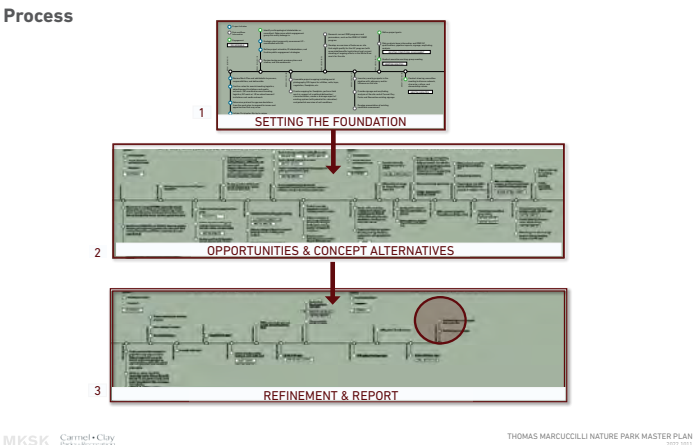
Storytelling Districts : History of Settlement

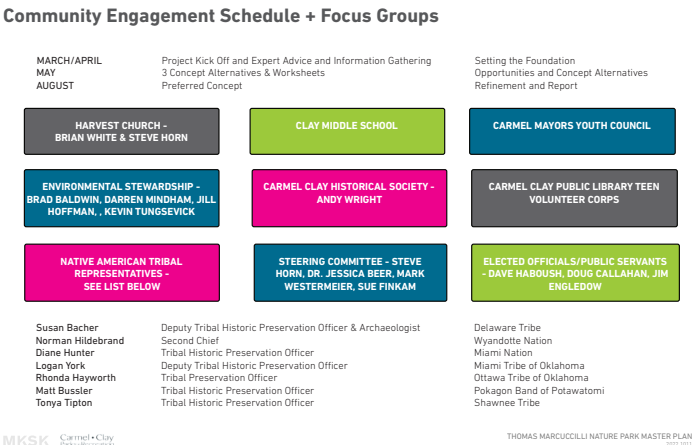
Proposed Master Plan

Presentations

Appendix 30: Park Board Presentation (10/11/2022)







Setting the Foundation - Site Analysis

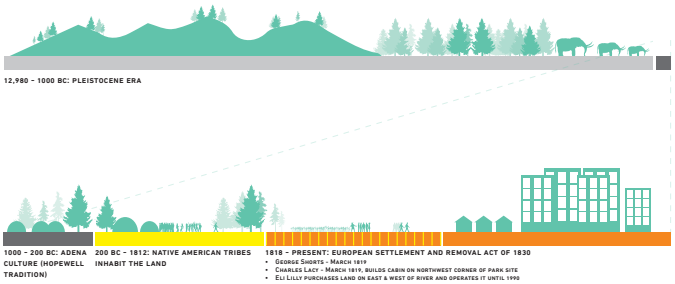
Existing Pedestrian Infrastructure

Floodplains & Floodways

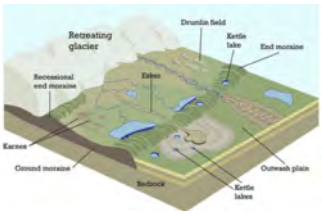
Soil Conditions

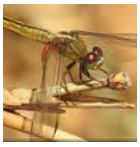
Surrounding Land Use

Setting the Foundation - History of the Land

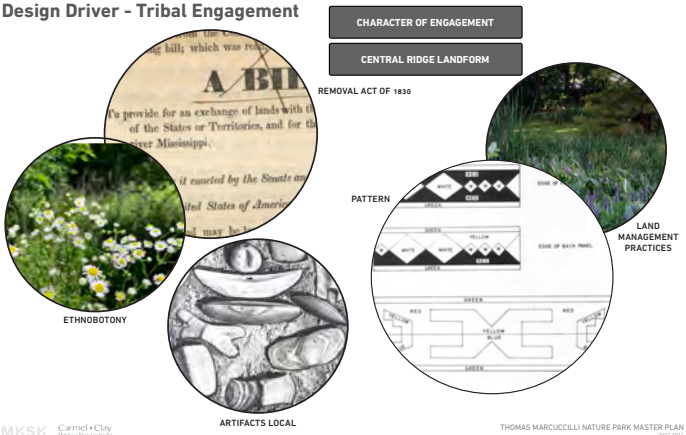


Design Driver - Ancient Ecology

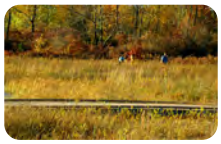




Design Driver - Tribal Engagement



Design Driver - Landscape Forward

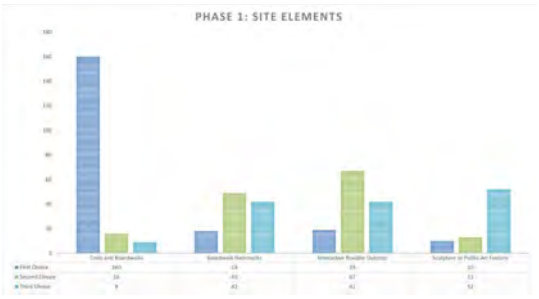


Opportunities & Concept Alternatives

Presentations

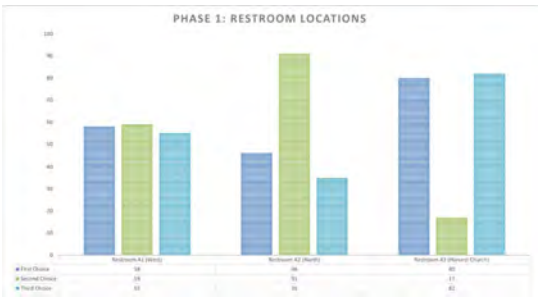
Appendix 30: Park Board Presentation (10/11/2022)

Community Engagement Data

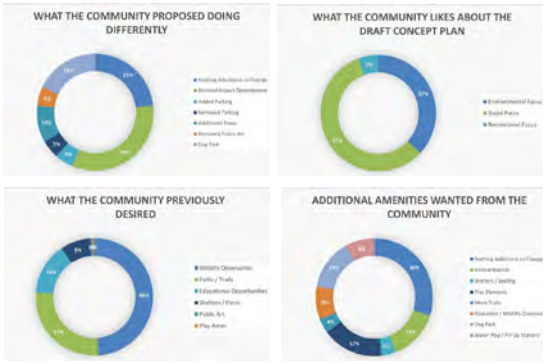


Community Engagement Data

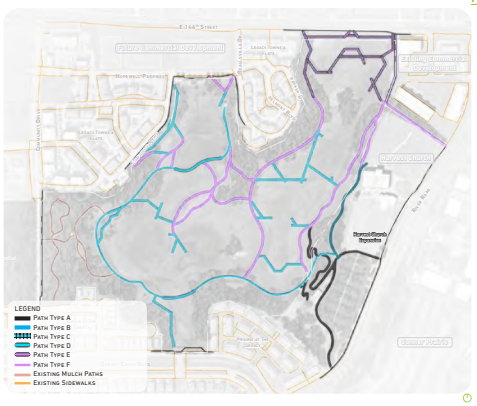
Community Engagement Data



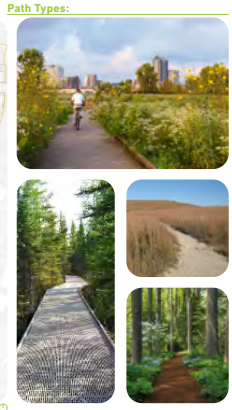
Community Engagement Data



Circulation Study : Multiple Path Types



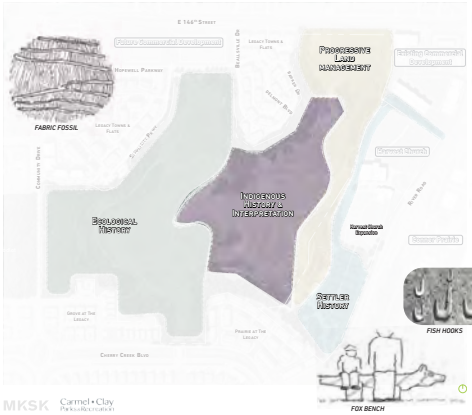
Path Types:

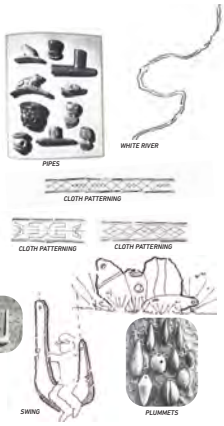


Storytelling Districts

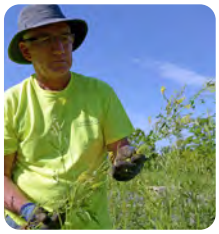
Storytelling Districts: Ecological History

Storytelling Districts: Indigenous History & Interpretation





Storytelling Districts : Progressive Land Management



Storytelling Districts : History of Settlement

Preferred Concept

Preferred Concept: Trailhead & Parking @ River Road

Presentations

Appendix 30: Park Board Presentation (10/11/2022)

Preferred Concept: Trailhead & Parking @ River Road

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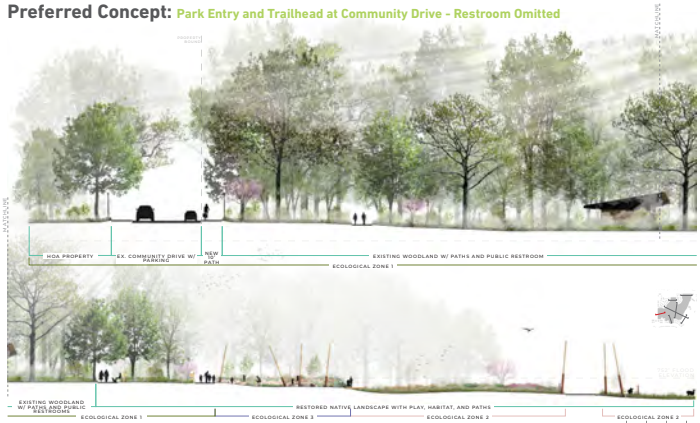
Preferred Concept: Park Entry and Trailhead at Community Drive - Restroom Omitted

MKSK Carmel • Clay Parks & Recreation

THOMAS MARCUCCILLI NATURE PARK MASTER PLAN
2022 1011

Preferred Concept: Park Entry and Trailhead at Community Drive - Restroom Omitted



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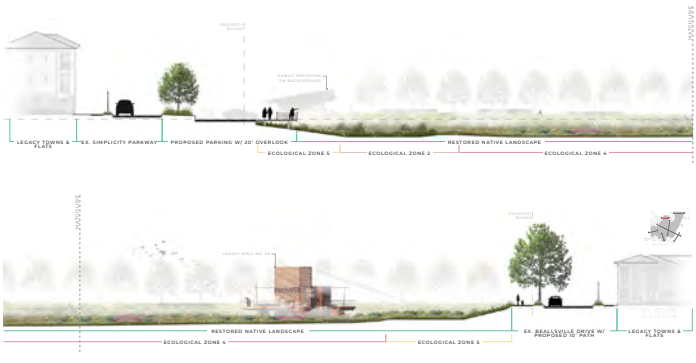
THOMAS MARCUCCILLI NATURE PARK MASTER PLAN
2022 1011

Preferred Concept: Park Entry at Hopewell Parkway

MKSK Carmel • Clay Parks & Recreation

THOMAS MARCUCCILLI NATURE PARK MASTER PLAN
2022 1011

Preferred Concept: Legacy Well No. 26 - Facing North

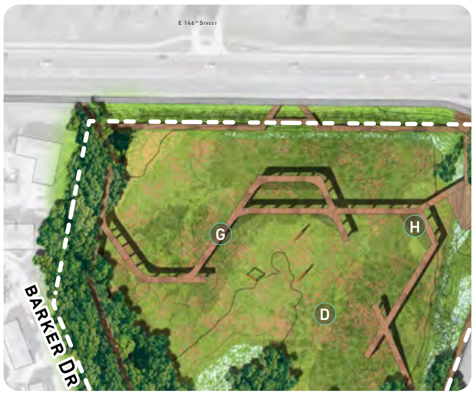


MKSK Carmel • Clay Parks & Recreation

THOMAS MARCUCCILLI NATURE PARK MASTER PLAN
2022 1011

MKSK Carmel • Clay Parks & Recreation

Preferred Concept: Elevated Boardwalk



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THOMAS MARCUCCILLI NATURE PARK MASTER PLAN
2022 1011

Preferred Concept: Elevated Boardwalk

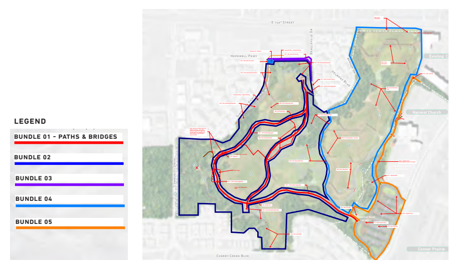
MKSK Carmel • Clay Parks & Recreation

Proposed Master Plan

MKSK Carmel • Clay Parks & Recreation

THOMAS MARCUCCILLI NATURE PARK MASTER PLAN
2022 1011

Phasing Plan



Thomas Marcuccilli General Site Work											
							BUNDLE 01	BUNDLE 02	BUNDLE 03	BUNDLE 04	BUNDLE 05
Item	Ext. Description	Qty.	Unit	@	Unit Cost	= Base Cost	Est. Budget	Est. Budget	Est. Budget	Est. Budget	Est. Budget
					Subtotal	$ 1,338,000.00					
COST SUMMARY											
Hard Cost											
					Total	$ 20,076,293.75	$3,504,713	$4,335,113	$4,205,396	$4,510,890	$3,520,183
Soft Cost											
					25% Construction Contingency	$ 5,019,073.44	$876,178	$1,083,778	$1,051,349	$1,127,723	$880,046
					10% Design Contingency	$ 2,007,629.38	$602,289	$401,526	$401,526	$301,144	$301,144
					5% General Requirments	$ 1,003,814.69	$175,236	$216,756	$210,270	$225,545	$176,009
					Total Probable Construction Cost	$ 28,106,811.25	$5,158,415	$6,037,172	$5,868,541	$6,165,301	$4,877,382

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THOMAS MARCUCCILLI NATURE PARK MASTER PLAN
2022 1011

Maintenance Standards

BEFORE DEVELOPMENT

Storm Event Management	• Create detour or closure around storm affected area for public safety • Remove obstructions from trails and open space • Inspect and clear out drains, outflows, ditches, and bioswales • Alert public of closure
Lawn Maintenance	• Inspect and remove trash, pet waste, and debris • Mow, blow, and trim • Fertilize • Edging • Pest control
Tree Maintenance	• Inspect, identify, and remove hazardous trees and limbs • Prune tree limbs or remove trees that impede user areas • Water new plantings • Install and maintain tree protectors for new plantings
Waste Removal	• Litter pick-up in wooded or natural areas • Empty pet waste stations, change liner • Restock pet waste bags in dispenser
Trail Maintenance	• Add surfacing material (mulch) • Clear branches • Repair washouts • Trim back vegetation corridor • Inspect for overhead hazards • Inspect for surface hazards • Use vegetation control in and along surfacing
Sign Maintenance	• Clean surfaces • Inspect for quality standards • Straighten • Vegetation control to maintain visibility
Wildlife/Nuisance Pest Control	• Remove roadkill from trails
Vandalism & Graffiti Removal	• Inspect/check for vandalism and graffiti • Call CPD to report vandalism/graffiti • Remove graffiti • Clean up after vandalism

Maintenance after development will include all the above standards and the below depending on what types of assets are developed.

AFTER DEVELOPMENT

Snow & Ice Event Management	• Salt and plow parking lots, driveways, and greenways according to snow and ice management plan • Salt, shovel, and snow blow sidewalks handicap parking areas and other pedestrian access areas
Landscape Maintenance	• Inspect and remove trash, pet waste, and debris • Inspect and report any dead or dying plants, pests, and weeds to landscape contractor • Spring clean up • Mulching and bed maintenance • Fall clean up • Pre-emergent • Edging • Pruning shrubs • Pruning trees • Perennial cutbacks • Perennial flower dead head • Leaf removal
Asphalt Surfaces & Parking Lots	• Inspect and clean drains • Sweep • Asphalt striping and painting • Repair/replace curb stops • Fill potholes with cold patch • Asphalt repairs • Crack fill as needed • Sealcoat • Replacement – milling and overlays • Debris removal • Vegetation trimming • Maintain gravel berm edge (if necessary) • Vegetation control in cracks and edges
Concrete Surfaces	• Inspect and identify uneven surfaces • Correct uneven surfaces by grinding or replacement • Remove debris • Remove graffiti • Vegetation control in cracks and edges • Epoxy fill or caulk cracks as needed
Fixture, Furniture, Equipment, & Outdoor Lighting	• Clean surfaces (environmental waste, food waste, trash, etc.) • Apply protection to wood surfaces • Inspect for proper function • Winterize and energize water fountains
Restroom Facilities	• Turn on heater, confirm operational, and check for system failures • Recaulk toilets and sinks • Paint interior walls and doors • Replace lightbulbs • Annual backflow testing • Flush water heater • Inspect locks, light, toilets, urinals, sinks, hand dryers, and soap dispensers for proper function • Roof replacement • Paint exterior structural posts, walls, etc. • Power wash floors and foundation • Clean out vents

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THOMAS MARCUCCILLI NATURE PARK MASTER PLAN
2022 1011

Preferred Concept: Combined Parking with Harvest Church - Facing West

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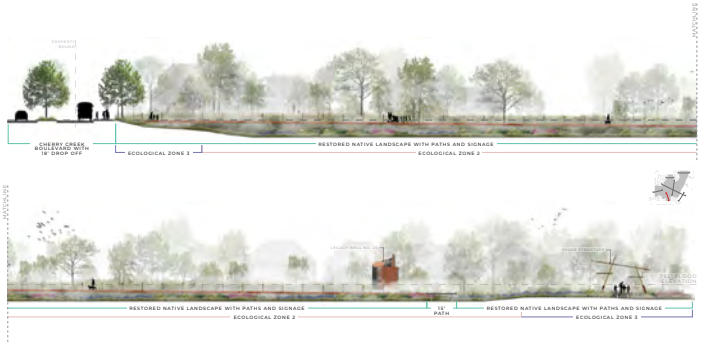
THOMAS MARCUCCILLI NATURE PARK MASTER PLAN
2022 1011

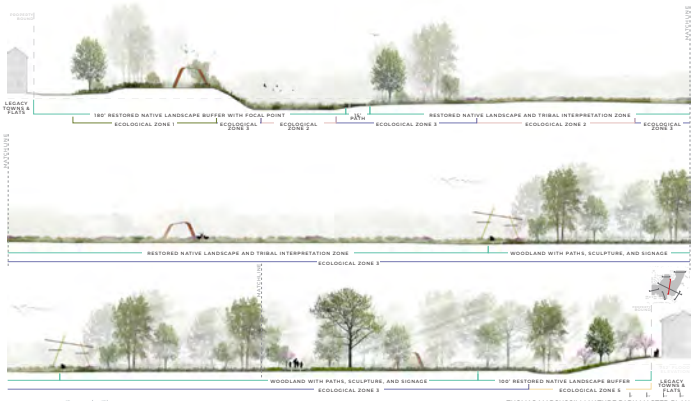
Presentations

Appendix 30: Park Board Presentation (10/11/2022)

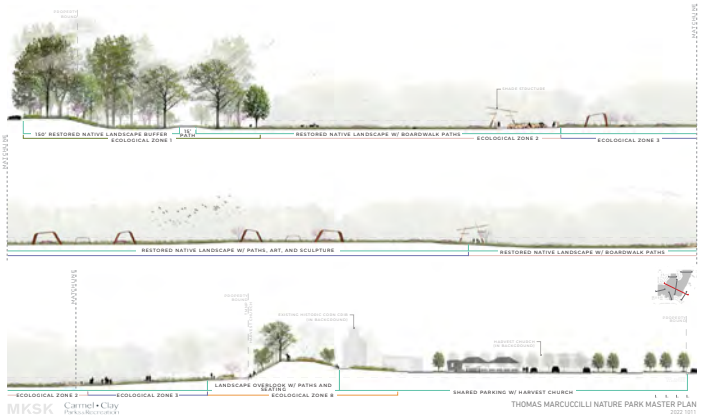
Preferred Concept: Legacy Well No. 25 - Facing South West



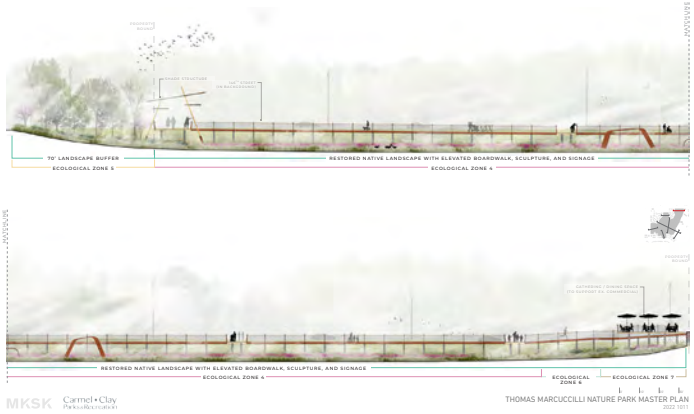
Preferred Concept: Central Cross-Section - Facing West



Preferred Concept: Central Cross-Section - Facing Northeast



Preferred Concept: Elevated Boardwalk - Facing North



Preferred Concept: Overlook and Trailhead at River Road - Drop Off Omitted

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