Through an environmental science internship with EMH&T, a private consulting firm, I conducted various environmental consulting projects. The four main projects that I worked on included a Nationwide Permit application, Level II Isolated Wetland Permit application, Level II Ecological Survey Report, and a monitoring report. For each of these projects, I conducted the field work, entered and analyzed the data, as well as wrote and submitted the final document for the appropriate regulatory agency. All of these projects involved the same stream and wetland assessments; however, each one of them was regulated very differently. Therefore, although similar field methods were used for various projects, the rules and regulations and ultimately the final document behind a particular project can vary greatly. Every project had a different scenario with varied requirements and client needs. Regardless of the project, coordination and communication with clients, agencies, and within EMH&T were crucial.
FOUR DIFFERENT ENVIRONMENTAL CONSULTING PROJECTS IN OHIO:
THE SIMILARITY OF STREAM AND WETLAND ASSESSMENTS AND DIFFERENCES IN REGULATIONS

An Internship Report

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1.0 INTRODUCTION

An internship, practicum, or thesis is a requirement for the completion of the Masters of Environmental Sciences degree with the Institute for the Environment and Sustainability at Miami University, Ohio. To fulfill the professional experience requirement I chose to complete a six month internship. I chose an internship as my professional experience to provide me with valuable experience in the field of environmental consulting that would contribute to my career development for both the short and long term. I had the opportunity to experience environmental consulting firsthand, make professional connections, and work with clients, while working on my professional experience. In addition, an internship allowed me to apply the knowledge and experiences that I gained from my graduate work with IES to the professional field. I served as an Environmental Scientist Intern for six months with EMH&T, which is a private engineering and environmental consulting firm in Columbus, Ohio.

While at EMH&T, I worked on a variety of environmental consulting projects. There were four main projects that I focused on for the majority of my time. For each of these projects, I conducted the field work, entered and analyzed the data, as well as wrote and submitted the final document to the appropriate regulatory agency. All of these projects involved the same stream and wetland assessments; however, each one of them was regulated very differently. Therefore, although similar field methods were used for various projects, the rules and regulations can vary greatly among projects, which ultimately results in a substantially different final document.

2.0 ORGANIZATION

Evans, Emhart, Hambleton, & Tilton (EMH&T) is a consulting firm that has worked on a wide variety of projects since 1926. The company consists of about 300 employees that are distributed throughout four branches located in New Albany, Ohio; Cincinnati, Ohio; Charlotte, North Carolina; and Indianapolis, Indiana. The New Albany office, which was my location, is the largest office with 260 employees. The majority of the environmental division work stems from compliance with the National Environmental Policy Act (NEPA), which is a law that requires the completion of environmental assessments or environmental impact statements for any federal action that may impact the environment (CEQ, 2007). The overall purpose of the environmental division is to provide clients with the expertise to understand and follow regulations, conduct assessments, and complete impact statements and related documents.

The president of the company is an IES graduate, Sandy Doyle-Ahern. Within the company there are a total of 19 divisions (Figure 1).
Fig. 1. Organizational chart and structure of all the divisions at EMH&T.
The divisions include Environmental Services, Communications, Public Works, Infratechnologies, Cultural Resources, Public Business Development, Urban Design, Transportation, Traffic Engineering, Construction Services, Geospatial Solutions, Survey, Rail, Human Resources, Information Technology, Development, Accounting, Landscape Architecture, and Water Resources. All of the divisions are necessary in order for the company to effectively carry out their wide variety of services. Their services include site development, planning and landscape architecture, environmental sciences, archaeology and cultural resources, land surveying, construction services, railroad services, transportation and traffic engineering, wastewater collection systems, water distribution systems, stormwater and floodplain management, geospatial solutions, and infrastructure evaluation and management. Each of these services helps to meet various client needs.

As EMH&T carries out a wide variety of projects and objectives, they have acquired a very diverse client base. The clients of EMH&T include public and private organizations as well as government organizations, such as the Ohio Department of Transportation (ODOT). Client relationships are one of the most important goals in consulting; therefore, EMH&T works to maintain lasting, mutually beneficial relationships with clients.

Robert Milligan is the director of the Environmental Services Division at EMH&T and served as my main supervisor. The main purpose of this division is to conduct the environmental science services for the clients. Along with meeting the regulations of NEPA, many of the objectives for the Environmental Services Division are a result of the U.S. Clean Water Act (CWA) (13 USC 1344). This policy requires that actions must avoid stream and wetland impacts when possible, minimize impacts that cannot be avoided, and provide compensation for impacts that cannot be avoided through restoration, enhancement, or preservation projects (Hough and Robertson, 2009). Objectives of the division include completing stream and wetland assessments, ecological surveys, environmental site assessments, environmental impact statements, environmental assessments, categorical exclusions, other NEPA documentation, ecological restoration and monitoring, as well as effective client communication, interaction, and satisfaction. Within the Environmental Services Division I worked with their senior environmental scientists, including Michael Krokonko, Christy Pirkle, Bob Hedges, and Patrick Hoyng as well as other environmental scientists and technicians including Melissa Queen-Darby, Eric Nagy, Megan Wolf, Sarah Adams, Nicholas D’Eramo, Steven Bailey, and Kelly Davis. Figure 2 shows an organizational chart for the Environmental Services Division at EMH&T.
Fig. 2. Organizational chart of the Environmental Services Division at EMH&T.

### 3.0 ENVIRONMENTAL CONSULTING PROJECTS

While at EMH&T, I worked on four main environmental consulting projects. While working on these projects, I became aware that they all shared the same ecological assessments. As a result, the field work for each of the projects was very similar. I also realized that the projects all shared the same challenge of meeting strict deadlines. However, the projects also had many differences among them. The regulations behind each project were very different, which resulted in very different final documents. Also, while all of the projects required a lot of coordination within EMH&T as well as with other organizations and agencies, coordination varied greatly for each project.

All of my work for these projects involved the requirement for our clients to adhere to NEPA. NEPA requires the completion of environmental assessments and environmental impact
statements for any federal action that may impact the environment (CEQ, 2007). Each of these projects was the result of potential impacts to a stream or wetland; therefore, environmental assessments were required. Each project had a defined study area that involved stream and wetland assessments, data entry, as well as report writing and submittal. Part of our role as a consulting firm was to determine the type and quality of features located on a site as well as any potential impacts that may occur to those features.

In addition to NEPA, these projects were either regulated federally under Section 401 or Section 404 of the U.S. Clean Water Act (CWA) or through the state by the Ohio Environmental Protection Agency (Ohio EPA). The Ohio EPA issues Section 401 Water Quality Certifications under Section 401 of the CWA. These permits certify that the projects will comply with the regulations of the CWA with respect to water pollution and any discharges into navigable waters (Steiner et al., 1994). The United States Army Corps of Engineers (USACE) issues permits under Section 404 of the CWA (33 U.S.C. 1344). These permits are issued in regards to the discharge of dredged or fill material into navigable waters, including wetlands, of the United States (Steiner et al., 1994).

Streams and wetlands became regulated due to the recognition of their value and functions. They serve a variety of important services and functions including flood control, nutrient retention and removal, carbon storage, water quality maintenance, erosion and sediment control, open space, wildlife habitat (Mitsch and Gosselink, 2007), navigation, and recreation. Assessments are required to evaluate the various features of streams and wetlands in order to determine their potential complexity, functions, and habitat types. We conducted stream assessments using physical habitat variables, including the Qualitative Habitat Evaluation Index (QHEI) and the Headwater Habitat Evaluation Index (HHEI). The Ohio Rapid Assessment Method (ORAM) and wetland determination forms were used for wetland assessments, which combine both physical and biological variables.

While each of the four projects involved the assessment of streams and wetlands, each project fell under slightly different regulations. Therefore, they each required the submittal of a different permit or report to various agencies and organizations. The four different documents for the projects included a Nationwide Permit application, Level II Isolated Wetland Permit application, Level II Ecological Survey Report, and a monitoring report.

- In one case, a Nationwide Permit application was required for impacts to an intermittent stream.
- For a second project, a Level II Isolated Wetland Permit application was required for impacts to two isolated wetlands.
- A third project required a Level II Ecological Survey Report for impacts to five wetlands and two streams.
- The final project required a monitoring report for a restored stream and wetland associated with stream and wetland impacts.

The Nationwide Permit, Level II Isolated Wetland Permit, Level II Ecological Survey Report, and monitoring report required for each of these projects shared similar ecological assessments; however, they were all completed under various regulations.

4.0 **NATIONWIDE PERMIT**

The first project involved one intermittent (Stream 1) and one ephemeral (Stream 2) stream located on the southern end of the property, both of which were tributaries to the Olentangy River. The northern portion of the property consisted of a church, parking lot, and grassy areas. The client planned to demolish the church to develop a building for a car dealership. In addition, they planned to convert the grassy areas into parking lots along with two access roads. Only a small portion of the southern end of the property, where Stream 1 was located, was planned to be impacted for an additional access road. The company planned to put 136 linear feet of Stream 1 into a pipe to allow for the development of the access road. A conservation easement was placed on Stream 2 and a portion of Stream 1 for a total of 285 linear feet of preserved stream.

For this project, a Nationwide Permit application was required to impact 136 linear feet of Stream 1. The client planned to impact the stream for the development of a car dealership on land in Delaware, Ohio. A Nationwide Permit is the most basic permit required when an action will impact a stream. In order to qualify for a Nationwide Permit, the impacts must be under 300 linear feet of stream bed at a given stream crossing and there cannot be more than three crossings on a single stream (Nationwide Permits, 2012).

**Assessments***

During a site visit, we conducted a Headwater Habitat Evaluation Index (HHEI) on each of the streams. The Ohio EPA has developed manuals for stream and wetland assessments to ensure that methodologies are standardized among different organizations. Their manuals allow for the proper and accurate classification of streams and wetlands. We used the Field Evaluation Manual for Ohio’s Primary Headwater Habitat Streams to conduct this assessment (Ohio EPA, 2012). An HHEI is conducted on streams that have a drainage area of less than one square mile and predominant natural pools less than 40 cm in depth. The drainage area of a stream can be determined through the use of interactive maps at Ohio STREAMSTATS online (USGS, 2013).
These streams had drainage areas of 0.12 and less than 0.01 square miles as well as pools less than 40 cm in depth; therefore, HHEI assessments were appropriate. We had to ensure that the streams were near base flow for the period of year that we were conducting the survey and that they were not in severe drought conditions. In addition, we could not conduct the survey immediately during or after a rain event.

For the HHEI we evaluated a 200 ft reach of the stream for substrate composition, average bankfull width, maximum pool depth, riparian zone, floodplain quality, flow regime, sinuosity, and gradient. The assessment only includes physical variables. We also assessed whether the stream channel had undergone any modifications, such as channelization. From these data we were able to calculate the score for each stream. Stream 1 received a score of 65, while Stream 2 received a score of 43. The scores were used along with a flow chart (Ohio EPA, 2012) to identify the two streams both as Modified Class II Primary Headwater Habitats (PHWH).

The streams were placed into one of three PHWH stream classes, including Class I PHWH, Class II PHWH, and Class III PHWH. Modified streams with an HHEI score between 30 and 69 are designated as Modified Class I PHWH, while modified streams with a score greater than 70 are designated as Modified Class II PHWH. If a channel is natural with a score less than 30, it is classified as a Class I PHWH. A natural channel with a score between 50 and 69 is a Class II PHWH. A stream is designated as a Class III PHWH if the channel is natural and the HHEI score is greater than 70. These classes are based upon the type of biological community that can be supported by the stream (Ohio EPA, 2012). Class I PHWH streams are classified by a lack of significant habitat for aquatic life, aquatic wildlife use, and the potential to achieve higher functions. Class II PHWH streams may have moderately diverse native aquatic life; however, temperatures prevent Class III function and life. Class III PHWH streams are perennial with moderately to highly diverse aquatic life throughout the year. Streams can also be classified as a Modified Class I or II if they have previously been channelized. Channelization can impair streams by altering stream hydrology, physical habitat, and sedimentation. Therefore, as both streams were Modified Class II PHWH, they both had modified channels with the potential for moderately diverse native aquatic life. The HHEI forms, scores, and stream classifications were incorporated into the permit application. Table 1 shows the extent, impacts, preservation, and classifications of the two on-site streams.
Table 1. Summary of the on-site streams including their extent, impacts, preservation, HHEI scores, and PHWH classifications.

<table>
<thead>
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<th>Resource ID</th>
<th>Onsite Extent (lin. feet)</th>
<th>Impacts (lin. feet)</th>
<th>Preserved (lin. feet)</th>
<th>HHEI Score</th>
<th>Classification</th>
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<td>136</td>
<td>194</td>
<td>65</td>
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<tr>
<td>Stream 2</td>
<td>138</td>
<td>0</td>
<td>138</td>
<td>43</td>
<td>Modified Class II PHWH</td>
</tr>
<tr>
<td>Site Total</td>
<td>468</td>
<td>136</td>
<td>332</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Regulations

The car dealership company is required to have a Nationwide Permit in order to alter the intermittent stream located on their property. This action is federally regulated under this permit. As there were less than 300 linear feet of proposed stream impacts for this project, it qualified for a Nationwide Permit. The U.S. Army Corps of Engineers (USACE) has been delegated to authorize this permit under Section 404 of the CWA (33 U.S.C. 1344). These permits are issued in regards to the discharge of dredged or fill material into navigable waters of the United States (Steiner et al. 1994). Navigable waters are defined as “waters of the United States, including the territorial seas” (Section 502(7) CWA). All navigable waters, including tributaries and adjacent wetlands, in which their degradation or destruction could affect interstate or foreign commerce are jurisdictional. Discharges can include “return water from dredged material disposed of on the upland and generally any fill material (e.g., rock, sand, dirt) used to construct fast land for site development, roadways, erosion potential, etc.” There are four USACE districts located in Ohio (Buffalo District, Louisville District, Huntington District, and Pittsburgh District), and each district oversees a different region of the state. Our permit application was sent to the USACE Huntington District.

This particular Nationwide Permit was Nationwide Permit #39 as it was for commercial and institutional development. Various permit numbers are assigned to different types of development. Nationwide Permit #39 is specifically for the discharge of dredged or fill material into non-tidal waters of the United States for the expansion or construction of commercial and institutional building foundations and building pads and associated features (Nationwide Permits, 2012). Associated features can include roads, parking lots, garages, yards, utility lines, storm water management facilities, and recreation facilities. Examples of commercial development include business parks, restaurants, retail stores, shopping areas, and industrial
facilities. Institutional development examples include libraries, hospitals, schools, churches, fire stations, government office buildings, judicial buildings, and public works buildings. Any impacts that are adjacent to tidal waters are not covered under this permit. Pre-construction notifications to the USACE district are required for activities that fall under Nationwide Permit #39, which can be in the form of a permit application or letter.

The permit application includes a project description, literature review, project purpose, types of materials discharged and amounts, surface area in acres of waters filled, stream delineation results, stream impact avoidance/minimization measures employed, compensatory mitigation plan summary, statement regarding presence of endangered species, and a statement regarding presence of historic or archaeological resources. Attached is the Nationwide Permit application that I completed (Appendix A). Due to confidentiality agreements, I cannot include any client information or actual site location information. I created a photographic log and photographic location map that were included in the application. In addition, I developed exhibits including a location map, topographic map, soil map, Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), and a National Wetland Inventory (NWI) map that were included. Engineering drawings were also part of the permit application.

Once we submitted our permit application to the USACE, I communicated with the USACE project manager assigned to our permit to determine whether additional work would be required. The USACE districts operate under a project manager system. Under this system, a single individual is responsible for handling a permit application from the point of receiving the permit until a final decision is made (USACE, 2010). The USACE can require additional work, such as a Phase I Cultural Resources study, if they review a permit application and determine that significant impacts to a resource could occur. We also conducted a site visit with the USACE to confirm the potential impacts. Our permit application did not require additional work; therefore, the USACE considered the application complete. The formal review process then began. The USACE project manager evaluated the impacts and negotiated any modifications to the project. They then came to a final permit decision and issued our permit. A permit is typically received from the USACE in approximately 60 to 120 days from the date of completion. The permit decision includes a discussion of the environmental impacts of the project and any special evaluation required by the project activities.

In addition to federal regulations under the Nationwide Permit, the stream was also protected at the state level under the Delaware Olentangy Stream Corridor Protection Zone (SCPZ). Due to the quality, history, and significance of the Olentangy River, the Ohio EPA provides additional protection to the Olentangy River and its tributaries. The Ohio EPA works with the City of Delaware to protect the Olentangy River and its tributaries through the SCPZ. The SPCZ requires
a 2:1 mitigation ratio for impacting an intermittent stream that is a tributary to the Olentangy River. In order to meet the mitigation requirements, a conservation easement was placed on the ephemeral stream and a portion of the intermittent stream for a total of 285 linear feet of preserved stream. As only 136 linear feet of an intermittent stream were proposed to be impacted, 285 linear feet exceeded the 2:1 mitigation ratio requirement. The SPCZ also required a Site Mitigation Plan to explain and display the mitigation that would occur. Before any impacts could occur to the stream, we had to meet with an Ohio EPA representative to have the Site Mitigation Plan approved.

I worked to develop the Site Mitigation Plan along with another environmental scientist and two of our engineers. The plan displayed the two streams located on the property, including which areas would be preserved and which areas would be impacted. In addition, it showed areas where honeysuckle would be removed and where seeding would occur. Details regarding seeding are included in a separate planting proposal that was developed later. Attached is a portion of our Site Mitigation Plan (Appendix B). The plan also included seven sections that we wrote on native tree protection during construction, herbicide cut-stump treatment of invasive shrubs and trees, invasive species removal warranty, riparian corridor preserved area monitoring and maintenance, preserved area debris removal, preserved area plantings and warranty, and seeding within the corridor. The Site Mitigation Plan also included a planting plan, which we developed for the site. We chose the trees and shrubs that should be planted in the riparian corridor as well as their spacing. To develop the plan we researched similar site plans that had been successful, worked with senior environmental scientists, and assessed the qualities and characteristics of each species. In addition, we chose to use live stakes of red osier dogwood and black, sandbar, shining, and peachleaf willow species to help stabilize the stream banks. The Site Mitigation Plan was included with the Nationwide Permit application.

**Coordination**

For the Nationwide Permit, coordination was required within EMH&T as well as with the Ohio Department of Natural Resources (ODNR), the U. S. Fish and Wildlife Service (USFWS), the Ohio EPA, and the USACE. I worked with one other environmental scientist to complete the permit application and Site Mitigation Plan. In addition, we collaborated with two of our engineers to develop the Site Mitigation Plan. As a cultural literature review was required for the site, I also collaborated with our archaeologists.

The permit application also required a letter to ODNR for a National Heritage Database Search regarding the potential presence of any state/federal listed species or features which may be present within or nearby the site. They provide records within a one mile radius of the site.
Regarding plants and animals, high quality plant communities, geologic features, breeding animal concentrations and unprotected significant natural areas. In addition, I was required to write a letter to USFWS regarding the presence of endangered and threatened species within or near the site. We received responses back from both ODNR and USFWS stating that there were no high quality plant communities, geologic features, breeding animal concentrations, unprotected significant natural areas or endangered and threatened species within or near the site. This allowed us to proceed with our permit application.

Coordination was required with the Ohio EPA under the SCPZ because the proposed stream to be impacted was a tributary to the Olentangy River. Therefore, the Ohio EPA had to approve the Site Mitigation Plan for the site. The final coordination occurred with the USACE as they authorized the Nationwide Permit. The coordination with ODNR, USFWS, and the Ohio EPA was all included in the permit application to the USACE.

Challenges

One challenge that was consistent among each of the projects was meeting the timelines of our clients. A lot of factors change throughout a project, making it very difficult to adhere to strict timelines. Prior to receiving the USFWS response, we learned that our client was not purchasing the property until April 1st. We were concerned that we may not receive summer approval for clearing trees on the site from April 1st to September 30th. It can be difficult to receive summer clearing approval due to migratory bird nesting and potential Indiana bat habitat. If potential Indiana bat habitat is found on a property, such as shagbark hickory trees or trees with peeling and exfoliating bark, a bat survey is typically required for requested tree clearing from April 1st to September 30th. Following the bat survey, tree clearing may or may not be permitted between April 1st and September 30th based upon the results. Our property did not contain any potential Indiana bat habitat; therefore, we were not concerned with this requirement. However, our property did contain potential migratory bird nesting habitat. Summer tree clearing is restricted from April 15th to July 15th for migratory bird nesting. The engineers worked with the client to see if they could clear the trees between April 1st and 15th in order to avoid the April 15th to July 15th restriction. Unfortunately, the client did not have their contract set up with the construction company yet and were unable to clear the trees in that window. We ended up receiving permission from USFWS for summer clearing a few days later. Therefore, our client was allowed to clear the trees on the property at any time and the restriction did not affect the project. However, many of our other projects were affected by this timeline restriction.
Another challenge arose for the Nationwide Permit application as a result of the cultural literature review from our archaeologists. The review revealed archaeological sites, historic structures, and one earthen mound near the site. In addition, the review indicated that none of the project area had previously been surveyed. Therefore, we were concerned that the USACE would require our client to have a Phase I Cultural Resources study conducted on the site. For a Phase I study, our archaeologists would have to dig various study plots across the property. If the archaeologists were to identify any historical items on the site, a Phase II Cultural Resources study would have to be completed. This process could have extended the project timeline 20 to 120 days and cost an additional $1,500 to $8,000. We had to inform the client of this potential timeline and cost increase. However, after several phone conferences with the USACE project manager, the USACE decided that a Phase I Cultural Resources study would not be required for the site. There were several reasons why they did not require a Phase I Cultural Resources study. One reason was that a church and parking lot were already located on the property; therefore, a significant amount of land had already been disturbed. In addition, they decided to limit the permit area to only the stream crossing impact area and not the entire property. Therefore, the permit area was very small. They were able to limit the permit area because the property was going to have multiple access points. The entire project could be built and accessed without impacting the stream; therefore, only the stream impact area was under the permit. However, if there had been only one access point to the project, which required impacting the stream, then the entire project area would be included in the permit. As a result of the limited permit area and minimal impacts, no additional work was required and we did not have to coordinate with the State Historic Preservation Office (SHPO).

5.0 LEVEL TWO ISOLATED WETLAND PERMIT

A second project involved three wetlands located in the northwest corner of the property, Wetland A, B, and C. A stream was also located on the property in the southeast corner. The eastern portion of the property consisted of occupied residential homes. The site also contained an active construction site, agricultural fields, and a woodlot.

A Level II Isolated Wetland Permit application was required for impacts to 2.29 acres of two Category 1, emergent isolated wetlands. The client planned to impact the wetlands for the expansion of a residential community in Licking County, Ohio. The housing company planned to impact all of Wetland A (2.10 acres) and a portion of Wetland B (0.19 acre). Wetland C (3.13 acres) was a Category 3, mature forested wetland that they planned to preserve. A portion of Wetland B (0.37 acre) would also be preserved. They planned to preserve all 1,340 linear feet of the stream on the property. The client also planned to preserve the woodlot, which contained Wetland C.
Prior to 2000, the property was an active agricultural field. In 2000 the land was sold to a housing development company and was no longer farmed. Due to the housing market crash, the company was unable to develop the land. They sold the property to the current land owner in 2008. When they bought the land it was an abandoned agricultural field. This housing company proceeded to develop portions of the property. However, they did not develop the back portion of the property. This area was historically a wetland before it was converted into an agricultural field. At some point between 2000 and 2008 the drainage tiles that were installed for agriculture broke and the land became saturated with water. Over time the land converted back into a natural wetland. In addition, an existing wetland expanded. Therefore, assessments of the two wetlands were required before the company could build the remaining section of their development.

Assessments

During the site visit we delineated the boundaries of the three wetlands and conducted an Ohio Rapid Assessment Method (ORAM) for each wetland. We flagged the boundaries of the wetlands, sampled the soil, assessed the vegetation and hydrology, and took pictures. Wetland determination data forms for both the wetlands and the upland areas were completed. These included information regarding hydrology, vegetation, and soil. The purpose of wetland delineations is to determine the area of a wetland (Mack, 2001). The delineated areas are subject to protection. They determine which areas are uplands and therefore are not subject to protection. For every wetland determination form that is completed, an associated upland form must also be completed. The upland areas at our site did not have wetland hydrology, hydric soils, or hydrophytic vegetation; therefore, we were able to confirm that these areas were not within a wetland. Wetlands A, B, and C all had wetland hydrology, hydric soils, and hydrophytic vegetation present. All three of these characteristics must be present in order for an area to be designated as a wetland.

The ORAM is used to assess the function and quality of a wetland in order to determine whether to permit the degradation, alteration, or destruction of a wetland (Mack, 2001). In addition they determine the required mitigation. The assessment combines both physical and biological variables. It was developed by the Ohio EPA and they continue to conduct research to validate the method. Their research uses indicator species, including vascular plants, macroinvertebrates, and amphibians. They developed the ORAM as a regulatory tool for wetland category determination. They specify that wetlands should not be assessed during a snowfall, flood events, and drought periods as these events can obscure plant communities and hydrology indicators. The ORAM consists of two separate parts, the narrative rating and the
quantitative rating. The quantitative rating is always used, and the narrative rating is used to further support the category results of the quantitative rating. The quantitative rating uses six different metrics to assess a wetland. These metrics include wetland size, upland buffers and surrounding land use, hydrology, habitat alteration and development, special wetland communities, vegetation, interspersions, and microtopography. A score is assigned to each of these metrics, which are then added up for a total score. This score determines the wetland category. There are three categories of wetlands under the ORAM, including 1, 2, and 3. Wetlands designated as category 1 (score between 0 and 29.9) have highly degraded systems with low functionality and minimal habitat. If a wetland scores in the gray zone between 30 and 34.9, it is always bumped up to the higher category 2 if no additional data are taken on the wetland. Wetlands can also score as modified category 2 with a score between 35 and 44.9. These wetlands may have previously been category 2 wetlands or are capable of becoming category 2 wetlands. Category 2 wetlands (score between 45 and 59.9) are in the broad middle category. They tend to support moderate wildlife habitat, or hydrological, or recreational functions. A score between 60 and 64.9 classifies a category 2 or 3 wetland. Again, if no additional data are taken for a wetland, it is designated as the higher category 3. Category 3 wetlands (score between 65 and 64.9) have high quality function and habitat.

From the ORAM scores we determined the newly formed wetland (Wetland A) and the expanded wetland (Wetland B) to be Category 1, emergent wetlands. Wetland A received a low score of 25 due to very narrow buffers, a recovering hydrologic regime, recovering substrate disturbance and habitat alteration, and low quality vegetation communities. Wetland B received a low score of 26 for the same reasons. A score of 68 was given to Wetland C due to medium buffers, a natural hydrologic regime, natural substrate and habitat, and a high quality mature forest vegetation community. Therefore, Wetland C was a mature forested, Category 3 wetland. The ORAM defines a mature forested wetland as characterized by woody vegetation that is at least twenty feet tall with an upper forest canopy dominated by trees with a diameter at breast height of greater than 17.7 in. A mature second growth forest is still considered a mature forest, even if the original forest was cut 60 to 100 years ago.

To complete an ORAM I had to identify the dominant plant species and visually determine the percent cover. The dominant plant species for Wetlands A and B included cottonwood, black willow, and reed canary grass, which is an invasive species. Wetland C had very different dominant vegetation as it was a mature forested wetland. Its dominant vegetation included buttonbush, spicebush, silver maple, American elm, American water horehound, and smallspike false nettle. Additional vegetation included aster species, polygonum species, sedge species, hybrid cattails, grass species, soft rushes, and softstem bulrushes. In addition, I had to be able to recognize high quality and unique wetlands, such as Wetland C. The ORAM forms, scores,
and wetland categorizations were incorporated into the permit application. Table 2 shows the extent, impacts, preservation, ORAM scores, and classifications of the three wetlands on the project site.

Table 2. Summary of the on-site wetlands including their areas, impacts, preservation, ORAM scores, and classifications.

<table>
<thead>
<tr>
<th>Resource ID</th>
<th>Total Area (acres)</th>
<th>Impacts (acres)</th>
<th>Preserved (acres)</th>
<th>ORAM Score</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolated Wetland A</td>
<td>2.1</td>
<td>2.1</td>
<td>0</td>
<td>25</td>
<td>Category 1/ Herbaceous &amp; Open water</td>
</tr>
<tr>
<td>Isolated Wetland B</td>
<td>0.56</td>
<td>0.19</td>
<td>0.37</td>
<td>26</td>
<td>Category 1/ Herbaceous &amp; Open water</td>
</tr>
<tr>
<td>Wetland C</td>
<td>3.13</td>
<td>0</td>
<td>3.13</td>
<td>68</td>
<td>Category 3/ Forested</td>
</tr>
<tr>
<td><strong>Site Total</strong></td>
<td><strong>5.79</strong></td>
<td><strong>2.29</strong></td>
<td><strong>3.5</strong></td>
<td><strong>-</strong></td>
<td><strong>-</strong></td>
</tr>
</tbody>
</table>

**Regulations**

Both Wetlands A and B were isolated, meaning they did not have a direct surface water connection to the downstream watershed. Isolated wetlands are regulated differently than non-isolated wetlands. Isolated wetlands are regulated by the state through the Ohio EPA. The United States Supreme Court issued a decision in January 2001 which stated that isolated wetlands are not “Waters of the United States.” In July 2001, Ohio House Bill 231 was enacted into law. This bill states that isolated wetlands are to be regulated by the Ohio EPA as State waters. Chapter 6111. of the Ohio Revised Code describes the rules for isolated wetland permits.

Non-isolated wetlands are jurisdictional, meaning they are regulated by the USACE. Proposed impacts to a jurisdictional wetland must receive a permit under Section 404 of the CWA from the USACE (33 U.S.C. 1344). Waters under this permit include all waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce. The USACE determines whether a wetland is a “Water of the United States”.

Impacts that are proposed to an isolated wetland must receive an Isolated Wetland Permit (Level I, II, or III) from the Ohio EPA. The size and quality of the isolated wetland determines
whether the permit is required to be a Level I, II, or III. Proposed impacts to a category 1 or 2 isolated wetland of one-half acre or less is regulated under a Level I Isolated Wetland Permit. A Level II Isolated Wetland Permit is required for the proposed filling of a category 1 isolated wetland of one-half acre or greater or a category 2 isolated wetland between one-half acre and three acres. If the proposed filling is for a category 2 wetland greater than three acres or a category 3 wetland of any size, a Level III permit is required.

A Level II Isolated Wetland Permit was required for this particular project as they were planning to impact 2.29 acres of Category I Isolated Wetlands. The isolated wetland permit level determines the level of review requirements. Level I permit applications are the most basic and have the least review requirements. They require an application, wetland delineation and categorization, project description, acreage of potentially impacted wetland, site photographs, and a mitigation proposal. Level II permit applications have the same requirements as a level I in addition to the analysis of practicable on-site alternatives and indication as to whether high quality waters will be avoided. Our permit included information on the study area; wetland delineations; wetland assessments; required authorization and agency coordination; proposed project description; analysis of on-site alternatives; avoidance of high quality waters; avoided wetland buffer zones; potentially scarce wetlands; potential impacts to rare, threatened, or endangered species; potential impacts to the aquatic ecosystem; stormwater plant and water quality improvements; and a proposed mitigation plan. Attached is the Level II Isolated Wetland Permit application that I completed (Appendix C). Due to confidentiality agreements, I cannot include any client information or actual site location information.

I also created a photographic log and photographic location map that were included in the application. In addition, I developed the same exhibits as the Nationwide Permit including a location map, topographic map, soil map, Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), and a National Wetland Inventory (NWI) map that were included. Engineering drawings were also part of the permit application. I completed and submitted this permit to the Ohio EPA.

The director at the Ohio EPA issues isolated wetland permits within ninety days of receiving an application. However, a permit may not be issued if the applicant did not demonstrate that there is a practicable on-site alternative; that there are reasonable buffers for wetlands that are not to be impacted; that the filled wetland is not regionally or locally scarce; that there would not be significant degradation to aquatic systems; there is mitigation for unavoidable impacts; stormwater and water quality controls would be installed; as well as other site-specific requirements. Permit applications can be denied if the wetland impacts are determined to cause negative short-term or long-term impacts on water quality. The Ohio EPA may determine that certain projects require monitoring prior to, during, or after a wetland is impacted.
Monitoring can include chemical water analyses, sediment quality tests, or bioassays. However, all Isolated Wetland Permits require a form of mitigation. Under the Level II Isolated Wetland Permit we were required to conduct mitigation at a 2:1 ratio either on-site, through a wetland mitigation bank, or off-site. We purchased 4.6 acres of wetland credits on behalf of the client from a wetland mitigation bank operated by the Wetlands Resource Center in order to fulfill the mitigation requirement. As 2.29 acres were proposed to be impacted, the 4.6 acres of wetland credits covered the 2:1 mitigation ratio.

**Coordination**

For the Level II Isolated Wetland Permit, coordination was required within EMH&I as well as with the Ohio Department of Natural Resources (ODNR), the Ohio EPA, and the USACE. I worked with another one of our environmental scientists to complete this permit application. We also collaborated with two of our engineers to develop the site plan. The site plan displayed the locations of the three wetlands with an overlay of the development plans. It also included the acreages of the wetlands as well as the wetland impacts. No collaboration took place with our archaeologists as a cultural literature review is not required for isolated wetland permits.

For the permit application I was again required to write and send a letter to ODNR for a National Heritage Database Search. This letter was very similar to the letter I wrote for the Nationwide Permit application. Unlike the Nationwide Permit application, no coordination was required with the USFWS for the Level II Isolated Wetland Permit application as no tree clearing was going to occur that could potentially impact the Indiana bat or any other endangered species. Coordination would have been required with USFWS if we had requested tree clearing for the site. We received a response back from ODNR stating that there were no records of rare or endangered species, unique ecological sites, geologic features, animal assemblages, scenic rivers, state wildlife areas, nature preserves, parks or forests, national wildlife refuges, or other protected natural areas within a one mile radius of the site. We were then able to incorporate this information into the permit application.

Coordination was required with the USACE; however, they did not authorize the permit as they did with the Nationwide Permit. The USACE provides jurisdictional determinations (JD) for wetlands and waters of the United States. A JD form is sent to the USACE for a particular water feature, such as a stream, wetland, ditch, etc. This form requires information regarding the project location and background; the presence of waters in the review area; any traditional navigable waters (TNW); wetlands adjacent to a TNW; tributaries to a TNW; determination whether tributaries or wetlands have an effect on the chemical, physical and biological integrity of a TNW; determination of jurisdictional findings; non-jurisdictional waters; and supporting
data that was reviewed. A JD received from the USACE states whether a features is jurisdictional or non-jurisdictional. Jurisdictional features are protected by law under the federal government through the USACE. Therefore, a permit must be obtained from the USACE in order to impact a jurisdictional feature. A non-jurisdictional feature is not protected by the federal government and does not require a permit from the USACE prior to impacts taking place. Isolated wetlands are considered non-jurisdictional as they do not connect to a TNW; therefore, they do not require a permit from the USACE. The Ohio EPA will not authorize an Isolated Wetland Permit until a JD has been received from the USACE. The USACE must agree with the applicant that the wetland is isolated and therefore non-jurisdictional. Many states do not regulate isolated wetlands at all, as they are only regulated at the state level. Therefore, in certain states, the designation of a wetland as isolated means that no permit is required to impact the feature. A JD prevents the biased classification of a non-isolated wetland as isolated. However, in Ohio isolated wetlands are still regulated through the Ohio EPA. In Ohio, the mitigation ratio is actually stricter for level I and II isolated wetlands (2:1) compared to jurisdictional wetlands (1.5:1). Our final coordination occurred with the Ohio EPA as they authorize Isolated Wetland Permits. The coordination with ODNR and USACE was included in the permit application to the Ohio EPA.

Challenges

The Level II Isolated Wetland Permit also faced the challenge of meeting the timeline of our clients. The client of the Level II Isolated Wetland Permit did not initially intend on needing a permit to expand their housing development. The two isolated wetlands were not present when the company originally designed section 3 of the development. These features developed over time due to broken drain tiles and a lack of maintenance. The site plans had already been designed and approved by Licking County prior to the development of the two isolated wetlands. In addition, the final engineering was completed. The company had been ready to construct the section with the isolated wetlands. Therefore, we began with a very strict timeline as the company wanted to begin development as soon as possible. The company was especially anxious to begin building section 3, as their constructed homes in sections 1 and 2 were all sold out.

Our biggest challenge for this project was keeping to the timeline. As I mentioned above, a permit application is not considered complete by the Ohio EPA until a JD is received from the USACE. We did not receive the JD quickly as we had intended. The USACE had recently received a large influx of permit applications and jurisdictional determinations. In addition, furloughs caused a delay in USACE responses as employees were working fewer hours per week.
Therefore, a delay in the JD resulted in a delay in the permit application. We were unable to submit our permit application until we received our JD.

6.0 LEVEL TWO ECOLOGICAL SURVEY REPORT

A Level II Ecological Survey Report (ESR) was required for impacts to 0.54 acres of five wetlands, 528 linear feet of two streams, two jurisdictional ditches, and five potential Indiana bat trees. Our client for this project was the Ohio Department of Transportation (ODOT). ODOT planned to impact these features for the replacement of a stoplight along a highway with a diamond shaped interchange in Fairfield County, Ohio. In addition, various smaller roads that connected to the highway were being converted into cul-de-sacs so that they no longer had access to the highway. The purpose of this project was to prevent congestion and stopped traffic in a small town along the highway. It was the only stoplight left on the highway. Initially, the study area for the project was 300.54 acres. However, after several revisions from ODOT, the final study area was only 84.19 acres.

The majority of the land use on the project site was developed high intensity (33.20 acres), such as the existing highway. This area was concentrated in the middle of the study area, where the town center was located with commercial buildings. A lot of the site was also developed open space (23.10 acres), such as along roadsides and large residential yards. Agricultural land (16.04 acres) was also found throughout the project area. Additional land use types throughout the site included developed medium intensity (1.60 acres) in residential areas, minimal scrub/shrub (0.68 acres), floodplain forest (1.81 acres) along streams, and strips of upland forest (7.22 acres) mainly along railroad tracks. A total of 0.54 acres of land on the site was wetlands including 0.13 acres of marsh wetland, 0.36 acres of shrub wetland, and 0.05 acres of forested wetland.

A total of 0.54 acres of modified category 2 and category 1 wetlands were planned to be impacted for this development. Two wetlands, Wetlands A and B, were located along the northern portion of the site along the highway. Wetland A (0.05 acre) was an isolated, Category 1, forested wetland. Wetland B (0.09 acre) was a jurisdictional, Category 1, scrub/shrub wetland. Along a stream in the middle of the project area was Wetland J, which was a jurisdictional, Category 1, scrub/shrub wetland. Wetland L (0.25 acres) was just off of the highway in the middle of the project area. This was a jurisdictional, Modified Category 2, scrub/shrub wetland. One wetland, Wetland M, was located in the middle of the study area along the highway. This was a jurisdictional, Modified Category 2, emergent wetland (0.49 acres). Only a portion of Wetland M (0.13 acres) was proposed to be impacted by the development. They were not planning to impact Wetlands C, D, E, F, G, H, I, K, N, O, P, Q, R, S, T, U, V, W, and X, which we had assessed and were all in the original study area.
Two streams were planned to be impacted as a result of this project for a total of 528 linear feet of stream impacts. These impacts included 428 linear feet of impacts along Stream 1. This stream had proposed impacts at four different locations for bridge construction and culvert extensions. Stream 1 was a tributary to Walnut Creek. In 2005, the Ohio EPA conducted a biological and water quality survey of Walnut Creek and its tributaries, including Stream 1. Stream 1 was designated Warmwater Habitat (WWH) by the Ohio EPA. This use designation was determined by the fish community at a single sampling location along the creek. The stream flowed north through the site to Walnut Creek, which then flowed south to its confluence with the Scioto River. The entire length of Stream 3 (46 linear feet) was proposed to be impacted for a bridge development. This was a small, Class I Primary Headwater Habitat, tributary that flowed east to Stream 1. We assessed six different streams that were in the original study area, although only two were ultimately proposed to be impacted.

Assessments

During multiple site visits we delineated the boundaries of 24 wetlands and conducted an Ohio Rapid Assessment Method (ORAM) for each wetland. The same wetland data are collected regardless of the permit or report type. Therefore, we conducted the same field methods and collected the same types of data as we did for the wetlands in the Level II Isolated Wetland Permit application. In addition to upland and wetland data forms, we completed an ORAM for each of the 24 wetlands. From the ORAM scores we determined Wetlands A, B, and J to be Category 1 wetlands. They received low scores of 24, 9, and 27 due to very narrow buffers, recovering hydrologic regimes, recovering substrate disturbance and habitat alteration, and low quality vegetation communities. These wetlands were characterized as highly degraded systems with low functionality and minimal habitat. Wetlands L and M were designated as Modified Category 2 wetlands, both with scores of 31. Wetland L had low surrounding land use, a recovered habitat with fair habitat development, and a diverse vegetation community. Wetland M had medium buffers, a recovering habitat with moderately good habitat development, and a diverse vegetation community. As modified category 2 wetlands, these wetlands were able to support moderate wildlife habitat, or hydrological, or recreational functions. None of the wetlands that we assessed for this project area was a high quality, category 3 wetland.

Dominant plant species and percent cover were again assessed for the wetland determinations and ORAMs. The dominant plant species for Wetlands A, B, and J included buttonbush, American elm, box elder, poison ivy, willow species, aster species, wingstem, yellow flag iris, winter creeper, moneywort, rough cocklebur, and foxtail grass. Wetlands L and M had different
dominant vegetation as they were Modified Category 2 wetlands. Their dominant vegetation included box elder, buttonbush, white mulberry, black walnut, bush honeysuckle, sedge species, grass species, grapevine species, and aster species. Table 3 shows the extent, impacts, preservation, ORAM scores, and classifications of the wetlands that were proposed to be impacted for the project.

Table 3. Summary of the proposed impacted streams and wetlands including their areas, impacts, preservation, ORAM scores, and classifications.

<table>
<thead>
<tr>
<th>Resource ID</th>
<th>Total Area (acres)</th>
<th>Impacts (acres)</th>
<th>Preserved (acres)</th>
<th>ORAM Score</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetland A</td>
<td>0.05</td>
<td>0.05</td>
<td>0</td>
<td>24</td>
<td>Category 1</td>
</tr>
<tr>
<td>Wetland B</td>
<td>0.09</td>
<td>0.09</td>
<td>0</td>
<td>9</td>
<td>Category 1</td>
</tr>
<tr>
<td>Wetland J</td>
<td>0.02</td>
<td>0.02</td>
<td>0</td>
<td>27</td>
<td>Category 1</td>
</tr>
<tr>
<td>Wetland L</td>
<td>0.25</td>
<td>0.25</td>
<td>0</td>
<td>31</td>
<td>Modified Category 2</td>
</tr>
<tr>
<td>Wetland M</td>
<td>0.49</td>
<td>0.13</td>
<td>0.36</td>
<td>31</td>
<td>Modified Category 2</td>
</tr>
<tr>
<td>Site Total</td>
<td>0.9</td>
<td>0.54</td>
<td>0.36</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

During the site visit we conducted a Headwater Habitat Evaluation Index (HHEI) on three of the streams, including the proposed impacted Stream 3. This stream was assessed using the same methods that we used for the Nationwide Permit application. This stream had a drainage area of less than 0.01 square miles; therefore, an HHEI assessment was appropriate. From the HHEI data we determined Stream 3 to be a Class I Primary Headwater Habitat (PHWH) with a low score of 23. Therefore, this stream was characterized by a lack of significant habitat for aquatic life, aquatic wildlife use, and the potential to achieve higher functions.

In addition to the HHEI, we conducted a Qualitative Habitat Evaluation Index (QHEI) on four of the streams located in the study area, including Stream 1, which was proposed to be impacted. The QHEI is another standardized methodology for stream assessments that was developed by the Ohio EPA (Ohio EPA, 2006). A QHEI is conducted on streams that have a drainage area of greater than one square mile or if the predominant natural pools are greater than 40 cm in depth. Stream 1 had a drainage area of 5.76 square miles; therefore, a QHEI assessment was
appropriate. Similar to the HHEI assessment, we had to ensure that the streams were near base flow for the period of year that we were conducting the survey and that they were not in severe drought conditions. In addition, we could not conduct the survey immediately after or during a rain event.

For the QHEI we evaluated a 200 ft reach of the streams’ substrate composition, instream cover, channel morphology, bank erosion and riparian zone, pool/glide and riffle/run quality, and gradient. More data are required from QHEI assessments compared to HHEI assessments, as QHEI streams are larger and tend to have higher functions and quality. From these data we were able to calculate the score for Stream 1. The score of 54.5 was used to identify Stream 1 as potential Warmwater Habitat (WWH). From the QHEI score, a stream can fall into one of four stream designation uses including Limited Resource Water, Modified Warmwater Habitat, Warmwater Habitat, and Exceptional Warmwater Habitat. A Limited Resource Water has a score of less than 30, while a Modified Warmwater Habitat has a score between 30 and 54. Warmwater Habitat has a score range of 55 to 69, while Exceptional Warmwater Habitat has a score greater than or equal to 70. However, only the Ohio EPA is able to officially assign a designation use to a stream. They use additional sampling, such as fish and macroinvertebrate surveys, to confirm a stream designation. When a group or individual performs a QHEI, the result is a potential designation use. Similar to the HHEI, these classes are based upon the type of biological community that can be supported by the stream (Ohio EPA, 2012). Limited Resource Water streams are characterized by a lack of significant habitat for aquatic life, aquatic wildlife use, and the potential to achieve higher functions. Modified Warmwater Habitat streams were typically channelized and are capable of becoming Warmwater Habitat through enhancement and preservation. Warmwater Habitat streams may have moderately diverse native aquatic life; however, temperatures prevent exceptional function and life. Exceptional Warmwater Habitat streams have highly diverse aquatic life throughout the year. All of the data collected for the ecological resources on the site were incorporated into the report. The extent, impacts, preservation, QHEI/HHEI scores, and classifications of the proposed impacted streams are shown in Table 4.
Table 4. Summary of the proposed impacted streams including their areas, impacts, preservation, assessment scores, and classifications.

<table>
<thead>
<tr>
<th>Resource ID</th>
<th>Total Length (lin. feet)</th>
<th>Impacts (lin. feet)</th>
<th>Preserved (lin. feet)</th>
<th>QHEI/HHEI Score</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream 1</td>
<td>8,635</td>
<td>482</td>
<td>8,153</td>
<td>54.5</td>
<td>Warmwater Habitat</td>
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<tr>
<td>Stream 3</td>
<td>46</td>
<td>46</td>
<td>0</td>
<td>23</td>
<td>Class I PHWH</td>
</tr>
<tr>
<td>Site Total</td>
<td>8,681</td>
<td>528</td>
<td>8,153</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Regulations

ODOT requires an Ecological Survey Report (ESR) for each of their projects. Therefore, although the stream and wetland assessments were the same as the Nationwide Permit application and the Level II Isolated Wetland Permit application, the required documentation was very different. Because ODOT conducts many large projects frequently, they have created their own set of rules and regulations for environmental assessments on their projects. Their regulations are actually stricter than the Ohio EPA and the USACE. ODOT always covers all potential issues very thoroughly upfront so that their projects do not get held up. They do not want to risk placing a million dollar project on hold because an additional water feature on their site was designated as jurisdictional by the Ohio EPA or USACE that was not originally assessed. Therefore, ESRs are much more detailed and complex than permit applications for other clients.

Within ODOT is the Division of Planning, which contains the Office of Environmental Services (OES). For every ODOT project an Ecological Assessment (EA) must be completed for an ESR. The OES reviews ESRs and coordinates with the Ohio EPA and USACE to receive a permit. Prior to OES submitting an ESR to either agency, they conduct several rounds of revisions with the consultants. We had four main drafts of our ESR with OES before it was finalized. One of our senior environmental scientists met with OES several times for clarifications on what they were requesting. Major changes occurred from each revision. For example, we went from having 24 wetlands in our first draft to only having six wetlands in our second draft due primarily to their changes in the extent of the planned impacts.

Depending on the project, a Level 1, 2, or 3 EA may be required. EAs are very complex and detailed. In addition to stream and wetland assessments they include vegetative, mammal,
bird, reptile, amphibian, macroinvertebrate, and fish assessments. Every single species located on the property must be recorded. This includes sightings, scat, tracks, road kill, and any other methods of species identification. All potential Indiana bat trees must also be noted along with GPS points and photographs taken. ODOT also has a flow chart to determine whether or not a ditch is considered jurisdictional. ORAM and wetland determinations must be conducted on every wetland as well as QHEI and HHEI assessments on streams. Water chemistry must also be taken on every stream including, total dissolved solids, conductivity, temperature, pH, and dissolved oxygen. Data on water chemistry is not required for Nationwide Permits or Isolated Wetland Permits. Although the assessments for wetlands are the same for EAs as other permits, ODOT is stricter in what they consider a wetland. Small areas along streams with wetland vegetation that would normally be considered part of the stream corridor are assessed as jurisdictional wetlands for EAs.

The ESR report required for ODOT was over 70 pages long and included very detailed information on the entire study area. Attached is the Level II Ecological Survey Report that I completed (Appendix D). Due to confidentiality agreements, I cannot include any client information or actual site location information. ESRs take into account all of the ecological resources located within the study area. The first portion of the report included data on every stream, wetland, ditch, pond, bat tree, plant, mammal, and bird that we found on the site. The second main portion of the report included the impacts that would occur to all of the ecological resources under both the preferred design and the alternative design. ESRs are required to have at least one alternative, while Nationwide Permits and Isolated Wetland Permits do not have to include alternatives. For the ESR, I worked very closely with one of our GIS experts to create seven different exhibits for the ESR. The first five exhibits were the same as the permit applications and included an area location map, USGS topographic map, soil survey map, floodplain insurance map, and a National Wetland Inventory map. We also created two exhibits that displayed the ecological resource impacts in the preferred design and the alternative design. In addition, we had two exhibits for the land use impacts in the preferred design and the alternative design. We also created a photographic location map to show the locations of all photos for the site. This map went along with the photograph log, which included photographs of each ecological resource and the overall study area.

Coordination

For the Level II Ecological Survey Report, coordination was required within EMH&T as well as with the Ohio Department of Natural Resources (ODNR) and ODOT. I worked with one of our senior environmental scientists to complete this report. In addition, I worked with three environmental scientists to conduct all of the field work. We also collaborated with some of our
engineers to overlay the stream and wetland features on the engineer design plans for the highway interchange. This allowed us to see exactly which features would be impacted or avoided. It also allowed us to determine areas where the development design could be slightly altered to avoid impacts to a stream or wetland. A cultural literature review was required for the site. However, ODOT requires separate documents for cultural resources and ecological resources due to the large amount of detail required. As a result, I did not directly collaborate with our archaeologists. However, our senior environmental scientist did collaborate with them. For the ESR I had a significant amount of coordination with one of our GIS experts. We met on a daily basis over the course of the project to go over edits and ODOT changes. We worked very closely with one another to develop the desired maps for ODOT. GIS coordination was not required for the Nationwide Permit or the Isolated Wetland Permit as they did not require intensive mapping.

For the ESR I was again required to write and send a letter to ODNR for a National Heritage Database Search. We received a response back from ODNR stating that there were no records of rare or endangered species, unique ecological sites, geologic features, animal assemblages, scenic rivers, state wildlife areas, nature preserves, parks or forests, national wildlife refuges, or other protected natural areas within a one mile radius of the site. We were then able to incorporate this information into the report. Unlike the Nationwide Permit application, we were not required to coordinate with USFWS. ODOT does all of the coordination with USFWS. Therefore, we never coordinate with USFWS for ODOT projects.

ODOT conducts all of the coordination with the Ohio EPA, USACE, as well as USFWS. They will be required to coordinate with all three of these agencies when they apply for their permit using the ESR. Throughout the entire ESR process we coordinated with OES at ODOT. We submitted our final document to ODOT after various rounds of revisions with them. The coordination with ODNR was included in the report to ODOT.

**Challenges**

Again, meeting the timeline of our clients was the greatest challenge. This ESR was for a fast track ODOT project. We received the project in early March and they wanted the first draft of the ESR by April 1st. This included all of the field work, data analysis, research, and report writing. The fast track timeline not only made the project difficult to finish on time, but we also did not have the final design plans for the highway interchange. Therefore, as I was working on the report, changes would occur to the engineering designs that would affect my work. Another related challenge was that we received many of our numbers for the report, such as
ecological resource acreages and linear feet, from GIS. We could not update our tables and report until GIS had updated their maps and numbers.

The turn-around time between receiving comments from OES at ODOT to submitting the next draft was also a challenge. We would receive comments from OES and they would request the next draft within a few days. This was very difficult at times because other ongoing projects had deadlines to be met and field work for other projects was already scheduled. In addition, we were often not clear on the comments from OES. Therefore, we would spend a few days e-mailing and talking with them in order to come to a consensus on what changes should be made to the report. There were a few instances in which we had to first wait for a consensus to be reached within ODOT, before we could proceed. Some of the comments that we received were challenging as they resulted in significant changes to the report. For example, the first draft of the report included 24 wetlands, six streams, and 16 potential Indiana bat trees. The second draft included only seven wetlands, six streams, and five potential Indiana bat trees. The majority of the changes were a result of changes in the study area. Initially the study area for the project was 300.54 acres, which included the total area of four different alternatives. However, OES decided to have the study area only include areas that would be impacted for the preferred alternative, which decreased the study area to only 84.19 acres and removed many of the wetlands and bat trees. Another major change that occurred was the number and type of alternatives. We initially had four alternatives and ended with only two. This drastically changed the report as there are separate sections for each alternative. Ultimately, all of these major changes were a result of OES debating how to best present the information to the Ohio EPA and USACE. They wanted their impacts to ecological resources to be very clear and include all potentially impacted features.

7.0 MONITORING REPORT

A monitoring Report was required for a restoration project that was designed to meet the performance criteria required by the issued permits. The restoration project included 2,700 linear feet of stream and 22.46 acres of forested and emergent wetlands located in Franklin County, Ohio. The wetland consisted of two mitigation cells, Cell 1A (14.96 acres) and Cell 1B (7.5 acres). The purpose of this project was to assess the health and sustainability of the stream and wetlands that were previously restored. The ultimate goal was to have the restoration activities result in significant benefits for the water quality and wildlife habitat within the watershed. The restored stream and wetlands were located on a former tree nursery site. The site was bordered by a creek to the north, a road and mature forest to the west, and additional former nursery land to the east and south. The initial planting and seeding of the wetlands and stream riparian corridor occurred in fall 2010. Therefore, the first year of monitoring began in
spring 2011 after the vegetation had become established. We conducted the third year of monitoring for this project.

**Assessments**

During a site visit we conducted stream and wetland assessments on the mitigation features. These were the same assessments that we conducted for the Level II Isolated Wetland Permit and the Level II Ecological Survey Report. The restored stream had a drainage basin of greater than one square mile; therefore, we conducted a QHEI on the stream. Due to the length of the stream, we had two separate QHEI sampling locations. The stream received scores of 58 and 59, designating it as potential Warmwater Habitat. Therefore, the stream may have moderately diverse native aquatic life with moderate function. Overall the stream was moderately stable and effectively restored. It was on the right trajectory to meeting the required conditions in five years.

We conducted an ORAM for each of the two wetland cells to assess the function and quality of the wetlands. From the ORAM scores we determined both Cells 1A and 1B to be Category 2 wetlands. They received moderate scores of 55 and 54 due to their large size, wide buffers, low surrounding land use, recovering hydrologic regimes, unaltered habitat, and the presence of amphibian breeding pools. As Category 2 wetlands, these wetlands have the potential to support moderate wildlife habitat, or hydrological, or recreational functions. Although wetland determination forms did not have to be completed for the wetlands this year, they will be required during the final year of the monitoring project. Table 5 shows the restored extent, assessment scores, and classifications for the restored stream and wetlands.

Table 5. Summary of the restored stream and wetlands including their extent, impacts, assessment scores, and classifications.

<table>
<thead>
<tr>
<th>Resource ID</th>
<th>Restored Extent</th>
<th>Score</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream 1</td>
<td>2,700 linear feet</td>
<td>QHEI: 58/59</td>
<td>Warmwater Habitat</td>
</tr>
<tr>
<td>Wetland Cell 1A</td>
<td>14.96 acres</td>
<td>ORAM: 55</td>
<td>Category 2</td>
</tr>
<tr>
<td>Wetland Cell 1B</td>
<td>7.5 acres</td>
<td>ORAM: 54</td>
<td>Category 2</td>
</tr>
</tbody>
</table>
Although the same QHEI and ORAM assessments were completed as other projects, we were also required to conduct additional stream and wetland assessments for the monitoring project. Various methods have been used to monitor restoration projects and determine their success or failure. More detailed data are required for monitoring projects to ensure that the features are functioning properly and meeting their performance criteria. Early monitoring only used physical habitat variables; however, these methods alone were criticized as inadequate. Studies have shown that physical habitat variables cannot always be used to induce biological function (Doyle and Shields, 2012). Therefore, methods using physical habitat variables, such as the QHEI and HHEI are typically combined with biological methods, such as vegetation assessments, the Index of Biotic Integrity (IBI), and the Invertebrate Community Index (ICI).

For the stream, we also assessed the woody plant survival along the riparian buffer. We measured out several 10 by 10 meter plots and identified and counted every woody plant species in the plot. Planted species were flagged to allow for differentiation between planted and recruited species. From the plots, we found that many of the woody plants had died or were missing from the corridor. The woody plants along the corridor included pin oak, red oak, swamp white oak, bur oak, black willow, sandbar willow, buttonbush, spicebush, black chokeberry, red maple, gray dogwood, rough leaf dogwood, and red osier dogwood. From our plots we were able to calculate the overall percent survival of woody plants. In addition, we determined the dominant plant species. In addition, IBI and ICI assessments will be conducted on the stream in August. These indexes confirm that the stream has high function and high quality life. The IBI is an assessment used to analyze fish assemblages based upon their taxonomic and trophic composition and their abundance and condition (Karr et al., 1987). The ICI is similar to the IBI, but measures the health and diversity of macroinvertebrates (Ohio EPA, 1989). The IBI and ICI are both important biological measuring tools used in combination with physical measurements, such as the HHEI and QHEI.

Additional assessments were also required for the mitigation wetland cells. A total of ten vegetation plots were assessed for the wetlands. The plots were 10 by 10 meters and were in fixed locations throughout the entire monitoring period. Again the woody plant survival was analyzed. The woody plants in the wetlands included black chokeberry, red maple, sugar maple, rough leaf dogwood, silky dogwood, gray dogwood, red osier dogwood, eastern cottonwood, white oak, swamp white oak, red oak, bur oak, pin oak, peachleaf willow, black willow, and southern arrow wood. At each of the vegetation plots we also analyzed soil samples and hydrology. In addition, we took water quality samples at the wetland outlet structures that we sent to a lab for an analysis of total dissolved solids, turbidity, conductivity, pH, metals, and biotic oxygen demand. A Vegetation Index of Biotic Integrity (VIBI) will be conducted on each of the wetland cells in August. The VIBI is a vegetation based wetland assessment tool, in which every plant in a plot is identified to the species level (Mack, 2004). The VIBI scores from 2011
were low at 34, 43, 29, and 10. These low scores were due to few sedge species, many tolerant species, and high annual to perennial ratios. Therefore, these plant characteristics will be monitored closely in following years. Overall, the wetland had many issues with vegetation, preventing it from meeting its required performance criteria. However, as the wetland is monitored for ten years, it still has seven years to develop. All of the data collected for the stream and wetlands will be incorporated into the yearly monitoring report.

**Regulations**

The monitoring report was a result of the requirement for clients to provide compensation for impacts that cannot be avoided through restoration, enhancement, or preservation projects under the CWA (Hough and Roberston, 2009). The monitoring helped to determine how effective the mitigation project had been and how future projects can be improved. Agencies, including the Ohio EPA and USACE, authorize 401/404 permits prior to the start of a project. Permits state the actions required by a client when they need to provide compensation for unavoidable impacts to a stream or wetland (Hough and Roberston, 2009). For the majority of our projects, the Ohio EPA issues Section 401 Water Quality Certifications under Section 401 of the CWA. These permits certify that the projects will comply with the regulations of the CWA with respect to water pollution and any discharges into navigable waters (Steiner et al., 1994). Most of our projects also receive permits under Section 404 of the CWA from the USACE (33 U.S.C. 1344).

The 401 and 404 permits dictate the requirements for each monitoring project. The client must restore, enhance, or preserve an area specified by an agency. The requirements include the number of years a site must be monitored, the assessments that must be conducted, and the performance standards that must be met. Performance standards are the goals set by the permits for the mitigated projects. These goals must be obtained in order for a site to no longer be monitored after three, five, or ten years. The permits also include information regarding the environmental impacts from a project, general conditions that must be followed, required mitigation and timing, and the requirements for monitoring reports. Therefore, consulting firms do not determine the monitoring methods or performance standards used for a particular project. The firms do assess the functionality and success of monitoring projects, whether additional mitigation is needed, problems associated with sites, and whether the performance standards have been met or not.

Once a permit is received from the Ohio EPA and USACE, we write a final mitigation plan. The final mitigation plan explains the proposed type and methods of mitigation, including enhancement, preservation, and restoration, for that project. Although for this project I did not write the final mitigation plan, as they are written prior to the start of mitigation, I wrote a final
mitigation plan for a new project that recently received 404 and 401 permits. Once the Ohio EPA and USACE approve the final mitigation plan, we develop a proposal that includes our mitigation plans and the cost. This proposal is sent to the client for approval. Once the client has signed and approved the mitigation plan, we can begin to restore and monitor the necessary features for a project. All of the monitoring occurs in the spring and summer. Following data collection, a monitoring report must be submitted for each project to the Ohio EPA and USACE every year by December 31 st. Streams and wetlands serve a variety of important services and functions including flood control, nutrient retention and removal, carbon storage, water quality maintenance, erosion and sediment control, open space, and wildlife habitat (Mitsch and Gosselink, 2007). The goal of monitoring projects is that restored stream and wetland features will achieve all or some of these functions before they are released from monitoring by the Ohio EPA and USACE.

For this project, our client had initially applied for a Section 404 Permit and a Section 401 Water Quality Certification Permit in order to impact 465 linear feet of two streams and 2.04 acres of nine wetlands for a development in Franklin County, Ohio. The Ohio EPA and USACE issued our client these permits, allowing them to conduct their project and impact the features. These permits required mitigation for their impacts to streams and wetlands. The permits stated that the stream had to be monitored annually for five years starting in 2011 and ending in 2015. The wetland was required to be monitored every other year for 10 years starting in 2011 and ending in 2020. In addition, the permit stated all of the required data for the stream and wetland monitoring. For the stream this included the QHEI, vegetation plots, IBI, and ICI assessments. The required data for the wetland included the ORAMs, wetland determinations, vegetation plots, soil samples, hydrology, water chemistry, and VIBI assessments.

Based on all of these assessments the Ohio EPA and USACE developed performance criteria that must be met by the stream and wetlands in order for them to be released from monitoring after five and ten years. The performance criteria for the stream included a QHEI score of at least 60 by the end of five years. It must meet the criteria for a Warmwater Habitat. In addition, the woody plantings along the riparian buffer of the stream are required to have at least 80% survival. There must also be at least 80% native Ohio woody plant cover along the buffer. The performance criteria for the wetlands required them to be classified as category 2 or 3 wetlands based upon their ORAM scores. They must also achieve a VIBI score of at least 51, which is equivalent to a category 2 wetland. The forested component of the wetlands must be on a trajectory towards forested wetlands. The wetlands must have less than 10% unvegetated open water. At least 80% of the total wetland area must be covered by native tree, shrub, and herbaceous species. Also, at least 75% of the total wetland area must be vegetated with native perennial hydrophytes. There cannot be more than 5% invasive species in the wetlands. Finally, a minimum of 50% of the perimeter can have slopes no greater than 6.67%. As this year was
only year three of monitoring, the stream still has two more years to develop and the wetland still has seven more years to become functional and meet the required criteria.

The purpose of the monitoring report was to discuss wetland and stream riparian buffer plant community development, maintenance and remedial activities, and whether the mitigation features were attaining the set performance standards. Attached are portions of a monitoring report that I completed (Appendix E). Due to confidentiality agreements, I cannot include any client information or actual site location information. I completed the attached monitoring report in January for a separate project. The report for the monitoring project that I described has not been written yet, as they are completed from September to January of each year. However, I conducted all of the preparation, field work, and data analysis for the project that I described. The report will provide the results of the year three monitoring activities. Each monitoring report has a similar layout with six main sections including, an introduction, project background, monitoring methodology, stream/wetland assessments, management activities, and conclusions. The introduction states the size and area that is being impacted and the size and area that is being restored. In addition, it includes permit information and monitoring requirements. The project background section includes all of the compensation information, including a description of the restoration site. The monitoring methodology includes the mitigation parameters that are required to be incorporated by the Ohio EPA and USACE, which includes performance standards and methodology. Methodology involves a description of the methods that will be used to monitor the site. These are the methods determined by the agencies. The stream and wetland assessment section includes the plant details, any remedial planting data, monitoring data, and development assessments. Management activities includes any action that took place before, during, or after monitoring, which could include remedial plantings, invasive species treatment, or putting up signage. The conclusion then summarizes the findings of the monitoring and determines whether the site should be released from further monitoring. Also included in the monitoring report were the stream and wetland data forms, plant species lists, exhibits, and site photographs. Exhibits included an area location map, topographic map, planting plan and monitoring location map, and a monitoring and remedial planting map. Although I did not fully complete this particular monitoring report, as additional data will be collected in August, I completed monitoring reports, field work, and data analysis for many other restoration projects.

Coordination

For the monitoring report, coordination was required within EMH&T as well as with the Ohio EPA. I collaborated with our Environmental Monitoring Coordinator to complete the report and conduct the field work. In addition, we worked with our water resource engineers, who developed the wetland basins. We discovered that there were historical agriculture drainage
tiles still functioning under a portion of the wetland. The tiles were draining this area and preventing this portion of the wetland from becoming healthy and functional. Therefore, the water resource engineers had to revisit their design plans and find the missing draining tiles that needed to be broken. We also collaborated with some of our engineers to overlay the sampling locations on the water resource design plans for the stream and wetland features. This allowed us to know the exact locations of our sampling points. No collaboration took place with our archaeologists as a cultural literature review is not required for monitoring reports. GIS coordination was not required for the monitoring report as it did not require intensive mapping.

The only agency coordination that was required for the monitoring report was with the Ohio EPA. Initial coordination was required with the Ohio EPA and USACE to obtain 404 and 401 permits for the project. However, only coordination with the Ohio EPA was required following monitoring. Some monitoring projects require coordination with the Ohio EPA and USACE following monitoring. No coordination with ODNR or USFWS was required for the report. The final document for this project will be submitted to the Ohio EPA by December 31st 2013. After receiving a monitoring report, the Ohio EPA conducts a site visit the following spring or summer. After the site visit they may require additional mitigation for a site. This mitigation could include additional plantings, invasive species control, and bank stabilization. At the end of a monitoring project, the Ohio EPA must agree that a site no longer needs to be monitored. Ultimately, the Ohio EPA releases a site from being monitored after we provide our recommendations.

**Challenges**

Just as with the other projects, adhering to the timeline of the project was one of the greatest challenges. We found various issues with the mitigation site, which could have ultimately resulted in the site not being released from monitoring on time. If the site were to fail to be released from monitoring after five or ten years, we would be required to conduct an additional year of monitoring until the performance criteria were met. This would cost the client additional time and money.

Wetland and stream restoration are both relatively new fields with mainly field trial data (Roberts et al., 2009). As a result, many of restoration projects encounter various issues throughout their monitoring period. One of the main issues at the site was the presence of an invasive species, reed canary grass, within the northern portion of the wetland. This species is very fast growing and is able to outcompete many of the native wetland species. Therefore, we recommended that herbicide treatment be applied to the areas with reed canary grass,
preventing it from spreading throughout the wetland. The wetland will not pass its performance criteria if there is more than 5% cover of invasive species. Another issue with the site was that many of the woody plantings along the riparian buffer of the stream had died or were missing. Some of our study plots had 60% woody plant survival, while others only had 30%. None of our plots met the required performance criteria of 80% woody plant survival. We believe that this was a result of deficient plantings by the planting company as well as deer browse and drought. As a result, we developed and recommended a new planting plan for the riparian buffer area. Although a VIBI will not be conducted on the wetland until August, we did an overview assessment of the wetland vegetation. The vegetation within the wetland also appeared low; therefore, we also recommended replanting for the wetland. As it was only year three of monitoring, both the stream and wetland were capable of still meeting their performance criteria with replanting and invasive species management. Invasive species and plant mortality were common issues found in some of the other mitigation sites. For other monitoring projects, some issues included the mowing of wetland buffers, wetland hydrology, low flow in streams, embedded streams, and the incision of stream banks.

8.0 ADDITIONAL PROJECTS

As the company was involved in diverse projects, I was exposed to a wide range of topics and challenges. Throughout my time at EMH&T I served a variety of roles to aid in the completion of public and private projects related to transportation and federally-funded work. An important aspect of environmental consulting was managing multiple priorities and deadlines for different ongoing projects. For a particular project I could write an environmental assessment or report, complete a permit application, aid with the understanding of NEPA regulations, or conduct field work. In addition to the Nationwide Permit, Level II Isolated Wetland Permit, Level II Ecological Survey Report, and monitoring reports, four of the main projects that I worked on while at EMH&T included an Acoustic Bat Survey Report, Phase I Environmental Site Assessments, pipeline field work, and tree surveys.

I completed an Acoustic Bat Survey Report for a study that was done in the summer of 2012 on the federally endangered Indiana bat. Acoustic detectors were placed at 111 locations throughout a 3,333.9 acre mitigation site in Hocking County, Ohio. Each detector ran for two nights and was able to record bat calls from all eleven bat species found in Ohio. These species include the big brown bat (Eptesicus fuscus), eastern red bat (Lasiurus borealis), eastern small-footed bat (M. leibii), evening bat (Nycticeius humeralis), hoary bat (Lasiurus cinereus), Indiana bat (Myotis sodalist), little brown bat (M. lucifugus), northern long-eared bat (M. septentrionalis), Rafinesque’s big-eared bat (Corynorhinus rafinesquii), silver-haired bat (Lasionycteris noctivagans), and the tri-colored bat (Perimyotis subflavus). From these data the
mitigation site was found to have the Indiana bat. The purpose of this survey was to document the presence or probable absence of the Indiana bat at the mitigation site. The survey determined that the mitigation site would provide forest habitat and serve as a conservation area for the Federal endangered Indiana bat to help offset impacts to potential bat habitat realized by a highway construction project. This was the first time that EMH&T had ever done an acoustic survey and they had never written an acoustic survey report. I wrote the majority of the report; however, another one of our environmental scientists, who had taken a course on how to conduct the acoustic survey and collected most of the data, wrote the results and discussion sections. This report included a project overview, site overview, survey overview, acoustic deployment and waterproofing methods, proper acoustic detector deployment, acoustic site selection, changes in acoustic site selections, verification of proper functioning, duration of survey, weather conditions, site descriptions, acoustic monitoring data, software programs, results, and discussion.

A variety of projects that I worked on were under the Comprehensive Environmental Response, Compensation, and Liability Act of 1908 (CERCLA). Under CERCLA, a buyer, lessor, or lender of a property is liable for the remediation of hazardous materials on their site (Marsh, Green, & Dong, 1996). Therefore, Phase I Environmental Site Assessments (ESA) are conducted to protect new land owners and lenders from liability. The purpose of a Phase I ESA is to determine the potential environmental risk and contamination of a commercial property and whether further investigation is needed. A Phase II ESA will be conducted if a site is considered to be contaminated or has a high potential to be contaminated. The most common substances of concern and that are tested during a Phase II ESA include petroleum hydrocarbons, heavy metals, asbestos, pesticides, solvents, and mold (Witkin, 2002).

I wrote various sections of more than six Phase I ESAs. I created exhibits for the ESA’s, including an area location map, USGS topographic map, soil map, floodplain map, and a National Wetland Inventory (NWI) map. I wrote and sent out letters to health and fire departments requesting information about specific sites. We were interested in whether the fire departments had any information regarding hazardous emergency responses, possible spills, unauthorized discharges, underground storage tanks, remediation or any environmental problems relating to toxic or hazardous substance releases on or near the property. We were interested in whether the health departments had any information regarding unauthorized discharges involving toxic or hazardous substances, illegal dumping, landfills, or any problems that would impact the environment negatively (including demolition waste, infectious waste and solid waste disposal, garbage complaints, refuse complaints, manure, radon and sewage violations). I also gathered auditor and parcel information on sites and discussed the ownership history. We received user questionnaires from each property owner and I used their answers in a section of the report as
well. In addition, I worked with historic aerial photographs to look as far back as 1850 for changes in land use both within the property and in adjacent properties. I also reviewed Sanborn maps, which are historical maps that were created by fire departments for assessing fire insurance liability. These maps contain very detailed parcel information, such as the presence of gasoline tanks, water lines, and details on manufacturing materials. I noted any changes that occurred within the property or adjacent properties for both the aerial photographs and the Sanborn maps for each year that they were available.

EMH&T recently had a lot of work as a result of the natural gas located in eastern Ohio. Environmental and survey teams were sent out to eastern Ohio for pipeline field work. The oil and gas companies were not allowed to begin pipeline construction until their proposed route had been surveyed for any streams or wetlands. Many of the proposed pipelines were rerouted due to the presence of high quality streams and wetlands that we assessed. The reroutes were then also surveyed. The oil and gas companies were all working on very tight schedules; therefore, they often called EMH&T and requested an assessment of a reroute within the next few days. Following field work, we entered and analyzed our data to determine whether or not an additional reroute would be necessary.

I was able to go out to eastern Ohio for a week to conduct pipeline field work with five other environmental scientists. Our role was to walk the proposed pipeline route and assess any streams or wetlands that we found. This involved working in teams of two and walking for miles on very hilly terrain searching for these features. Our study area included 150 meters on either side of the proposed pipeline route. The terrain included agricultural fields, pasture land, backyards, forest, streams, and wetlands. A lot of the land was already greatly impacted due to strip mining. My team found a total of six wetlands and 14 streams. I was in charge of taking pictures and GPS points. Two pictures were taken of every feature, which we later used in a photo log. For each wetland we delineated the boundaries and conducted an ORAM. We flagged the boundaries of the wetland, took GPS points at each flag, sampled the soil, and assessed the vegetation and hydrology. For each stream we either conducted an HHEI or QHEI assessment. I took GPS points along the length of each stream that was located in our study area. These points were later used by our GIS experts to map the features that we assessed.

Tree surveys are conducted almost every other week at EMH&T. Companies that wish to clear trees on a site for a particular project must have a tree survey completed. Each city has different regulations for the compensation of tree clearing. For example, the city of Dublin, Ohio, requires that each diameter at breast height (DBH) inch of tree that is cleared be replaced at a 1:1 ratio. Therefore, for every inch of tree that is cut down, an inch of tree must be planted. Other cities may have a 2:1 or even a 10:1 ratio for the replacement of cleared trees. The U.S.
Fish and Wildlife Service (USFWS) must grant permission for any tree clearing that occurs. Their main concerns are potential Indiana bat habitat and migratory bird nesting habitat. The tree surveys are important for assessing the presence of any potential Indiana bat habitat.

I conducted a tree survey with another environmental scientist on a 70-acre golf course located east of Columbus. For every tree located on the property we recorded the species name, condition, and DBH. The tree condition was recorded as good, fair, poor, or dead. We measured DBH by holding a tree diameter measuring stick up to the tree at breast height. Only trees with a DBH of greater than 6 inches were included in the survey. We also tied flagging tape around each tree with the tree number written on the tape. Our survey team then came out to the property and surveyed all of the trees that we had marked. After three full days of field work we surveyed 896 trees with diameters ranging from 6 to 89 DBH. A total of 51 different species were recorded on the property. The majority of the trees were white pine, scotch pine, Norway spruce, blue spruce, juniper, arborvitae, sugar maple, silver maple, red maple, red oak, cottonwood, black cherry, buckeye, black walnut, bitternut, white ash, hackberry, and crabapple. I learned how to identify each of these trees during the winter based upon their bark, buds, and overall shape. I also completed a tree survey by myself. This tree survey consisted of 330 trees and approximately 25 species. The minimum DBH for this tree survey was only 2 inches. For this survey, I marked the location of each tree on a map. Following data entry, I gave my work to the project manager for each tree survey.

9.0 IES REFLECTION

My environmental science internship at EMH&T fit in very well with both my background as well as my long and short term goals. My background in Zoology, Environmental Science, and Applied Ecology prepared me with the skills and knowledge that I needed to carry out my internship. These skills included understanding ecosystem functions, plant identification, knowledge of NEPA, writing environmental impact statements, conducting and analyzing ecological assessments, and effective problem solving. I was prepared to collect, analyze, and present data from my research background in Zoology and my work with the Butler County Stream Team. In addition, I had experience with actual client interaction as well as collaboration and communication from my professional service project with the Union County Parks and Recreation Board. I was able to apply the skills that I gained from these experiences to my internship.

Throughout my internship I was constantly faced with new challenges and problems on various projects. The problem solving skills that I acquired while at IES were crucial in completing the majority of my projects at EMH&T. IES was also very important for developing my team work
skills. Almost all of the projects that I worked on while at EMH&T required team work. This included team work in the field and in developing reports. My professional service project helped me to develop teamwork skills and effectively communicate and work with others on large projects. In addition, I utilized the skills from many of the courses that I completed while at IES. The plant taxonomy course that I took was crucial in developing my plant identification skills. I had to identify many tree species during tree surveys. In addition, I had to identify stream buffer and wetland plants for mitigation projects. I also had to identify upland and wetland plants for wetland determinations. The geographic information systems course that I completed was also very important. The course helped me understand and utilize GPS units in the field. In addition, I was able to effectively communicate with our GIS experts and understand the capabilities of ArcGIS. The environmental measurements and protocols course was also very useful. This course helped me to understand and conduct stream and wetland assessments including the QHEI, HHEI, and ORAM. These methods were very important for the majority of the projects that I worked on, both in completing the field work, analyzing the data, and writing the documents. In addition, we learned how to measure the DBH of trees, which I used to complete tree surveys. Another very important course was public policy analysis. This course helped to give me a background and understanding on the laws and regulations behind environmental consulting. Similarly, laws and regulations, such as NEPA and the CWA, which we discussed in environmental problem solving, were crucial to all my work. All of these skills helped me to effectively conduct my work as an environmental scientist intern.

10.0 CONCLUSION

Environmental consulting is a fast-paced, dynamic field that will continue to grow and change over time. Throughout my internship at EMH&T I gained a tremendous amount of experience and became exposed to many different aspects of environmental consulting. For each of my four main projects I conducted the field work, entered and analyzed the data, as well as wrote and submitted the final document to the appropriate regulatory agency. Through these projects I became aware that although similar field methods are used for various projects, the rules and regulations and ultimately the final document behind a particular project can vary greatly. Every project has a different scenario with varied requirements and client needs. I interacted with other environmental scientists daily and collaborated with GIS experts, water resource engineers, and archaeologists. In addition, I coordinated with USFWS, ODNR, USACE, Ohio EPA, and ODOT. Regardless of the project, coordination and communication with clients, agencies, and within EMH&T were crucial. Also, almost every project encountered unexpected challenges related to meeting deadlines that had to be worked through. Environmental consulting will continue to evolve as studies aim to improve and modify ecological assessments.
and changes in environmental regulations occur. Table 6 shows a summary of the four main projects that I completed.

Table 6. Summary of the four consulting projects including their documents, impacts, assessments, regulations, and time constraints.

<table>
<thead>
<tr>
<th>Project/Required Document</th>
<th>Impacts</th>
<th>Assessments</th>
<th>Regulations</th>
<th>Time Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nationwide Permit Application</td>
<td>136 lin. ft of stream</td>
<td>HHEI</td>
<td>Section 404 of the CWA by USACE</td>
<td>Summer tree clearing window</td>
</tr>
<tr>
<td>Level II Isolated Wetland Permit Application</td>
<td>2.29 ac. of isolated wetlands</td>
<td>ORAM</td>
<td>Ohio House Bill 231 by OEPA</td>
<td>Wetland development</td>
</tr>
<tr>
<td>Level II Ecological Survey Report</td>
<td>0.54 ac. of wetland &amp; 528 lin. ft of streams</td>
<td>QHEI, HHEI, ORAM</td>
<td>Ecological Assessment by ODOT</td>
<td>Changes in study area</td>
</tr>
<tr>
<td>Monitoring report</td>
<td>Stream &amp; wetland impacts requiring preservation of 2,700 lin. ft of stream &amp; 22.46 ac. of wetland</td>
<td>QHEI, ORAM</td>
<td>Section 401/404 permits by OEPA &amp; USACE</td>
<td>Site issues with invasive species</td>
</tr>
</tbody>
</table>
11.0 REFERENCES


Ohio Environmental Protection Agency. (1989). Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Ohio Environmental Protection Agency, Division of Water Quality Monitoring and Assessment, Columbus, OH.

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