Responses to WDNR Request for Supplemental Information on Ecological Data and Impact Assessment

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This technical memorandum provides supplemental data on the biological communities and wetland ecological functions potentially impacted by the various project alternatives, whether via project-induced hydrologic changes and/or physical habitat impacts caused by the construction and operation of pipelines and various above-ground facilities for project alternatives. The responses are designed to address the Wisconsin Department of Natural Resources (WDNR) requests, reiterated in the following subsection in the groupings from the WDNR information request.

WDNR Information Request on Inland Waterways—Presence and Impacts to Biological Communities

1. Describe current flora and fauna (algae, macrophytes, invertebrates, herptiles, birds, and mammals) for the Fox River and anticipated effects on the resources from each water supply and return flow alternative.
2. Describe current flora and fauna (algae, macrophytes, invertebrates, herptiles, birds, and mammals) for Underwood Creek/Menomonee River and anticipated effects on the resources from each water supply and return flow alternative.
3. Describe current flora and fauna (algae, macrophytes, invertebrates, herptiles, birds, and mammals) for the Root River and anticipated effects on the resources from each water supply and return flow alternative.

WDNR Information Request on Natural Communities and Wetlands—Hydrologic and Pipeline Impacts

1. Provide a general discussion of the functional values of the wetlands affected by the proposed project. This should include a discussion of how the proposed project would impact wetlands in consideration of the functional values.

Response

Approach Used for Supplemental Biological Data Sources and Impact Assessment

To respond to the WDNR request for information on aquatic flora and fauna, numerous references were consulted to identify what taxa are present in the various aquatic ecosystems potentially affected by the proposed project and alternatives. The sources consulted include the following:

- Published ecological reports
- WDNR checklists of wildlife species
- Other online sources of biological data relevant for southeastern Wisconsin (Waukesha, Milwaukee, and Racine Counties)
- Known or potential historical occurrences of Rare (i.e., Special Concern), Threatened, or Endangered (RTE) species of fauna along the waterways, provided by WDNR (WDNR 2013a) and originally presented in Appendix 6-6B of the ER
- Supplemental RTE species occurrence data in other waterway/watershed-specific reports listed in the following references

- Communication with Southeastern Wisconsin Regional Planning Commission staff knowledgeable about reports available for these water bodies

In addition, a senior ecologist also consulted online data sources, such as the Wisconsin Herptile Atlas and Wisconsin All Bird Conservation Plan (WABCP), to identify amphibian, reptile, and bird species found in the three county study area that are likely to inhabit the waterways and adjacent habitats within the project area to augment the specific ecological reports reviewed. WABCP bird species lists for both Emergent Wetlands and Bottomland Hardwood swamps, including WABCP Priority Birds, were used to identify terrestrial birds, waterfowl, wading birds, piscivorous birds, and shorebirds most likely to inhabit or forage within aquatic, wetland, riparian, or terrestrial habitats associated with one or more of the waterways. Because the WABCP lists include both common and RTE bird species of wetland habitats, they complement project-specific lists of RTE bird species from WDNR, while offering insight to which common birds are most likely to be sensitive to hydrologic impacts associated with various project alternatives. The review of special status species and lists and reported occurrence was supplemented by the senior ecologist's knowledge of such species and their relationship to the habitats potentially affected. This allowed consideration of RTE species in the impact analysis. Based on this extensive and comprehensive review of available information, a list of common terrestrial and water-dependent mammals most likely to inhabit the riparian corridors along the waterways is summarized in Table 1 (attached).

All of the compiled data on known or potential occurrences of common and RTE species of fauna along one or more of the project-impacted waterways and associated habitats were organized into a summary matrix by organizing groups of species according to their habitat preferences and relative water dependence (Table 1). The listings in the matrix include reported sightings of individual species along each waterway and in Vernon Marsh, the status of RTE species in Wisconsin, WABCP Priority designations for birds, and brief habitat notes indicating relative water dependence of key species. This species occurrence matrix serves as a foundation for all other supplemental project impact assessments requested by the WDNR, including assessments of project impacts to natural communities comprised of common and RTE species, and to wetland ecological functions and values anticipated to result from the hydrologic alterations and from physical impacts of pipeline construction/operation.

Hydrologically-mediated project impacts to biological communities, habitats, and wetland functions resulting from waterway base flow increases/decreases, or groundwater drawdown from the groundwater supply options, were evaluated qualitatively on the basis of the hydrologic modeling results in the Environmental Report. Because site-specific data on the abundance and biodiversity of flora, fauna, and RTE species are not available for most waterways, qualitative assessments of impacts/risks to the biota were based on a comprehensive evaluation of the species potentially present and professional judgment of their sensitivity to hydrological changes. The hydrologically-mediated ecological impacts of altered base flows to natural communities along each of the waterways are summarized for each major biological group in Table 2 (attached). Because the hydrogeologic functions and seasonal discharge/recharge dynamics of the aquatic habitats, wetlands, and groundwater springs (e.g., Vernon Marsh) along each waterway are complex, quantitative evaluations are not feasible for biological and wetland functional impacts of reduced river/stream base flows and/or groundwater drawdown. Thus, there is uncertainty in the absolute magnitude of the impacts, but there is a high degree of certainty in the type of impacts that would occur and the relative intensity. For this assessment, it was assumed that changes in base flow within the waterways will influence key wetland ecological parameters, such as soil moisture, vegetation health, and water levels only within wetlands and open waters that abut the river/stream banks, whereas wetlands, open waters, and springs within floodplains or terraces that are disjunct or set back a considerable distance from the river or stream banks will not be significantly affected by waterway hydrologic changes.

The potential groundwater drawdown impacts to wetland functions and values of Vernon Marsh from the aquifer supply alternatives are summarized in Table 3 (attached). Given the model predicted changes in groundwater levels and base flow, this evaluation addresses a subset of the WDNR wetland functional values, documented in Version 2 of the Wetland Rapid Assessment Methodology (WRAM), which can be

reasonably assessed with the available data. Table 3 presents a detailed assessment of potential adverse functional impacts from groundwater drawdown on Vernon Marsh and surrounding wetlands bordering the Fox River and its tributaries, which provide habitat for diverse fauna and numerous RTE species.

Table 4 (attached) presents the requested assessment of the Proposed Project System Alternative impacts to wetland functions of palustrine emergent wetlands (PEM), palustrine scrub-shrub wetlands (PSS, shrub-carr), and palustrine forested wetlands (PFO), resulting from the construction and operation of water supply and return pipelines. This impact assessment focuses on the same subset of the WRAM functions and values presented for Vernon Marsh (Table 3), for which a preliminary, qualitative assessment can be based on professional judgment with the data that are available. Because the pipeline construction and operational impacts are mostly temporary and much less ecologically significant than hydrologic impacts to Vernon Marsh ecological functions and values, Table 4 includes a higher-level evaluation of pipeline impacts to the seven broader *categories* of ecological functions and values among wetland community types along the Proposed Project System Alternative supply and return flow routes.

For both the drawdown impacts to wetland functions of Vernon Marsh and the pipeline construction and operational impacts to three wetland community types, the following subset of WRAM functions and values was evaluated:

- Human Use Values—HU 1, 2, 3, 4, and 6
- Wildlife Habitat Values—WH 1, 3, 6, 7, 9, and 10
- Fish and Aquatic Life Habitat Values—FA 1 to 4
- Shoreline Protection Functions—SP 1 and 3
- Flood and Stormwater Storage Functions—ST 3 and 4
- Water Quality Protection Functions—WQ 4, 5, and 8
- Groundwater Processes—GW 1 and 3

Prior to construction of the proposed project, site-specific wetland mapping would be completed to identify specific approaches at each wetland crossing to avoid, minimize, and mitigate potential impacts and to protect the functional values provided by the wetlands. In addition, site-specific sampling and reconnaissance would be conducted as necessary at each wetland or waterway potentially affected in order to design and implement site-specific and appropriate mitigation measures. As part of the permitting of all activities potentially affecting water resources, a post restoration monitoring program would be put in place so that mitigation and wetland restoration following construction achieve success.

Supplemental Affected Environment Data on Biological Communities of Inland Waterways (Table 1)

The description of the affected biological communities of inland waterways was based on available data for communities in the area. Because, for many of the inland waterways potentially affected, there is no site-specific data, the assumption was made that any of the species that could occur in the types of habitats in the region were present and could potentially be affected by the proposed project. This approach is conservative in that it could over predict rather than under predict impacts.

For example, given the great importance of waterways and associated wetland habitats to all bird groups considered, Table 1 includes 86 species of common terrestrial (52) and water-dependent (34) birds listed in the WABCP as inhabiting Emergent Marshes and Bottomland Hardwoods, 56 of which are designated as WABCP Priority Species. Because emergent marshes and bottomland hardwood swamps are common throughout the project area and occur along all of the waterways evaluated, many of the 86 common bird species are likely to occur within one or more habitats potentially impacted by the various project alternatives. Also, given the limited available data on mammal occurrences for all waterways, common species of mammals found in southeastern Wisconsin that are likely to inhabit riparian corridors were also added to Table 1.

WDNR provided data on occurrences of RTE species of all biological groups, including insects, for habitats within a 2-mile-wide corridor following all of the waterways, as well as site-specific data for Vernon Marsh (see Table 1) (WDNR 2013a). Several other published reports on the waterways or watersheds also identified/corroborated occurrences of the same RTE species. All of these were included in the listing of species potentially present.

Based on known and potential occurrences of common and WDNR-verified, RTE species across all waterways evaluated for project alternatives, the potential biodiversity of the study area includes the following:

- 2 species of green algae (Chlorophyta) and unspecified species of diatoms, other Chrysophyta, and red algae (Rhodophyta), from Underwood Creek, Menomonee River or Root River
- 3 species of aquatic macrophytes, including 2 invasives
- 24 species of macroinvertebrates, including 6 RTE species and 2 invasive species
- 18 species of terrestrial and aquatic/wetland amphibians, including 6 RTE species
- 22 species of terrestrial and aquatic/wetland reptiles, including 11 RTE species
- 117 species of birds, including 21 RTE species and 67 WABC Priority Species
- 19 species of terrestrial and water-dependent mammals, including one RTE species

Assessment of Environmental Effects from Hydrologic Impacts to Biological Communities of Inland Waterways (Table 2)

Table 2 summarizes the likely or potential beneficial or adverse, surface water base flow and groundwater drawdown-mediated impacts to each aquatic, wetland and terrestrial biological community and species group, known or likely to occur along affected waterways (determined as described in the previous subsections) for each of the associated project alternatives. This assessment is based on the hydrologic impact model results for each of the supply and return alternatives, including the Proposed Project System Alternative of a Lake Michigan supply pipeline via Oak Creek Alignment 2 with the Root River Alignment 2 Return Flow to the lake. Potential beneficial or adverse ecological impacts from base flow changes, if any, are summarized here based on the detailed assessments for each of the three waterways (and associated habitats) presented in Table 2.

The water supply and return flow alternatives that impact each waterway are listed at the beginning of each discussion.

Root River, Underwood Creek and Menomonee River

These waterways would be affected by the following water supply and return flow alternatives, as described in Table 5.

TABLE 5
Water Supply and Return Flow Alternative Affecting Lake Michigan Basin Inland Waterways

Alternative	Root River	Underwood Creek and Menomonee River
Water Supply		
Deep and Shallow Aquifers	No Impact	No Impact
Shallow Aquifer and Fox River Alluvium	No Impact	No Impact
Lake Michigan (City of Milwaukee)	Evaluated in Return Flow Alternatives	Evaluated in Return Flow Alternatives
Lake Michigan (City of Oak Creek) Alignment 1	Evaluated in Return Flow Alternatives	Evaluated in Return Flow Alternatives

TABLE 5
Water Supply and Return Flow Alternative Affecting Lake Michigan Basin Inland Waterways

Alternative	Root River	Underwood Creek and Menomonee River
Lake Michigan (City of Oak Creek) Alignment 2	Evaluated in Return Flow Alternatives	Evaluated in Return Flow Alternatives
Lake Michigan (City of Racine)	Evaluated in Return Flow Alternatives	Evaluated in Return Flow Alternatives
Return Flow Alternatives for Lake Michigan Water Supplies		
Underwood Creek to Lake Michigan	No Impact	Impact Occur
Root River to Lake Michigan Alignment 1	Impacts Occur	No Impact
Root River to Lake Michigan Alignment 2	Impacts Occur	No Impact
Direct to Lake Michigan (or MMSD)	No Impact	No Impact

If selected as the Lake Michigan return flow alternative, each of the waterways is predicted to receive increased base flow, which will benefit flora and faunal communities of common and RTE species in aquatic, wetland, and riparian/terrestrial habitats abutting the creek/river banks, due to increased water availability, soil moisture, and health of drought-sensitive flora and fauna. The benefits will be greatest to aquatic and wetland species, especially during dry seasons/periods and within low-flow reaches that often lack water, such as Underwood Creek. Return flow will also be better in quality than the nutrient water quality standards for phosphorus that will, in turn, not support excessive nuisance algae and macrophyte growth, with commensurate water quality improvements via improved biological oxygen demand (BOD) and increased dissolved oxygen (DO) levels that would benefit aquatic biota. Water quality modeling results indicating the water quality improvements to Underwood Creek and the Menomonee River, as well as to the Root River, are included in Appendix H and Appendix M respectively in the Return Flow Plan, Volume 4 of the Application. Higher base flows during seasonal dry periods may prevent or mitigate drought-induced changes in the abundance, frequency, and biodiversity of benthic macroinvertebrate communities.

Aquatic and aquatic-dependent biological communities will benefit from the increased base flow provided by the return flow from Waukesha. The algae and macrophytes, benthic macroinvertebrates, and water-dependent and wetland-dependent fauna adjacent to the return flow stream will benefit most from increased base flows. However, the terrestrial flora and fauna, terrestrial amphibians, reptiles, birds, and mammals also should benefit indirectly from even marginal increases in the health, growth, and productivity of riparian vegetation and food chains that may be enhanced by the increased water availability. Terrestrial wildlife of riparian and floodplain habitats along the waterways may benefit from increased water availability, especially during chronic dry periods/seasons, because increased base flows likely will mitigate seasonal drought-induced changes in riparian/floodplain soil moisture, drought-sensitive vegetation, and the abundance or biodiversity of food and prey species consumed by all wildlife groups. Commensurate habitat quality and food chain benefits are equally likely for common and the 25 RTE species of water/wetland-dependent mussels, insects, amphibians, reptiles, and birds reported by WDNR or potentially found along one or more of the three waterways. The groups will also benefit from the relatively stable flow regime provided by the return flow.

Over time, increased biodiversity also may result within river/stream channels and adjacent habitats from return flow. Increased flows in runs/riffles, ponds, beaver impoundments, and bordering open water wetlands will benefit not only aquatic invertebrates, fish and amphibians, but also water-dependent species of greatest conservation need (SGCN) for Wisconsin's Wildlife Action Plan, WABCP Priority and RTE birds, and their aquatic food/prey, such as shorebirds, waterfowl, and wading birds, all of which are highly sensitive to water loss, especially during low flow periods and dry seasons.

Fox River

The Fox River would be affected by the following water supply and return flow alternatives, as described in Table 6.

TABLE 6
Water Supply and Return Flow Alternative Affecting the Fox River

Alternative	Fox River
Water Supply	
Deep and Shallow Aquifers	Impacts Occur
Shallow Aquifer and Fox River Alluvium	Impacts Occur
Lake Michigan (City of Milwaukee)	Evaluated in Return Flow Alternatives
Lake Michigan (City of Oak Creek) Alignment 1	Evaluated in Return Flow Alternatives
Lake Michigan (City of Oak Creek) Alignment 2	Evaluated in Return Flow Alternatives
Lake Michigan (City of Racine)	Evaluated in Return Flow Alternatives
Return Flow Alternatives for Lake Michigan Water Supplies	
Underwood Creek to Lake Michigan	Impacts Occur
Root River to Lake Michigan Alignment 1	Impacts Occur
Root River to Lake Michigan Alignment 2	Impacts Occur
Direct to Lake Michigan (or MMSD)	Impacts Occur

The reaches of the Fox River downstream of the wastewater treatment plant having base flow change either from return flow or from groundwater pumping will experience stream base flow reductions between 5 and 25 percent. Base flows will be reduced from 5 and 11 percent for the groundwater alternatives, but as much as 25 percent for the Lake Michigan water supply and return flow alternatives that would produce a surface water level drop of up to 2 inches in the Fox River. The groundwater drawdown from the groundwater supply alternatives will have a much greater impact on Vernon Marsh and surrounding wetlands than aquatic habitats in the Fox River. As discussed separately below, this assessment of hydrology-mediated impacts is based on the worst case scenario of a 25 percent base flow reduction. Even with the return flow removed from the Fox River, there would still be a continued base flow in the Fox River from the upstream City of Brookfield and Sussex wastewater treatment plants, along with natural drainage flows, including increased groundwater contributions because the existing City of Waukesha deep and shallow wells would no longer be in use. Although there would be a reduction of up to 25 percent base flow during annual low flows, analysis indicates that this would be a maximum of up to a 2-inch drop in water levels. The flow in the Fox River after removal of the Waukesha return flow discharge will still be compatible with the natural aquatic ecosystem in the river. Consequently, no significant adverse impact should occur to common and RTE species of terrestrial amphibians, reptiles, birds, and mammals of adjacent floodplain and riparian habitats from the decrease in base flows in the Fox River, even during seasonally dry periods, because riparian wildlife are pre-adapted to seasonal and weather-related fluctuations in water levels. A 2-inch drop in river channel water levels also should not significantly alter the soil moisture and any drought-sensitive vegetation within the riparian and floodplain habitats that do not directly abut the banks of affected river or stream channels. Although the maximum flow reduction (25 percent) and 2-inch lower water level in the Fox River could stress drought-sensitive riparian vegetation and prey species consumed by common, RTE, and WABCP Priority terrestrial bird species, such stress would be short-term and highly localized along the river banks, mostly during periodic or seasonal drought, rather than extending throughout riparian habitats along the river and its tributaries. Because riparian zone birds and mammals are highly mobile and pre-adapted to seasonal or weather-related fluctuations in water levels, they will be able to modify their foraging behavior

to compensate for any reductions in the abundance of plant foods or prey within riparian, floodplain, and wetland habitats bordering the river and stream banks.

Maximum flow reductions during seasonal dry periods may cause changes in the abundance, biodiversity, distribution, frequency, and species composition of algae, macrophytes, aquatic insects, and benthic macroinvertebrates compared to the conditions created by the discharge of Waukesha wastewater effluent to the river. The resulting conditions would be somewhat different from current conditions, but more reflective of an aquatic ecosystem not augmented by wastewater flows. A water level change of up to 2 inches in the Fox River would not be expected to cause a noticeable change in the native macroinvertebrate community or the fish and wildlife that prey on the aquatic biota. Impacts upon fish have been previously described in Environmental Report Section 6.4.2.5.

Common and RTE species of water-dependent birds found in aquatic and wetland habitats along the Fox River may experience minor, but highly-localized reductions in the abundance and diversity of aquatic and wetland plant foods and faunal prey, especially during seasonal dry periods. But such impacts are unlikely to extend very far from the river banks, so that ample breeding and feeding areas for water-dependent RTE bird species should persist throughout most of the open water and emergent wetland habitats of the Fox River floodplains. Because water-dependent birds, mammals, and some reptiles are highly mobile and pre-adapted to natural fluctuations in water levels, they will be able to modify their foraging behavior as needed to compensate for any temporary habitat changes and reductions in food/prey availability that may result from a change in water levels, localized within the reaches of aquatic and wetland habitats that directly abut the banks of the impacted river channels.

Although only five species of aquatic mammals were cited in available reports for the project study area, including beavers inhabiting Pebble Creek, the riparian and wetland habitats along the Fox River are likely to support other water-dependent mammals, such as herbivorous muskrats that eat cattails and other marsh plants. While a maximum flow reduction in the Fox River over the long-term could alter or reduce the food and prey resources for water-dependent mammals, such impacts are likely to be highly localized within the shallowest river channels rather than extending into adjacent, open water habitats of deeper wetlands within the river floodplain that also sustain these wildlife. However, because water-dependent mammals are highly mobile and pre-adapted to seasonal or weather-related fluctuations in water levels, they will be able to modify their foraging behavior as needed to compensate for any temporary, seasonal, or long-term permanent reductions in food/prey availability. Beavers, moreover, are especially resilient, because they create their own ponds, so that even a permanent water level change of up to 2 inches should not deter them from building and maintaining dams. Thus, as noted for other groups of water-dependent fauna, even the maximum decrease in base flow is unlikely to have a significant adverse ecological impact on water-dependent mammal populations and communities.

Long-term reductions in aquatic biodiversity are not expected in the Fox River and contiguous aquatic or deep marsh habitats from the small change (maximum of 2 inches) in water depth. Some changes to runs, riffles, and pools that support abundant and diverse communities of benthic and pelagic macroinvertebrates, fish, amphibians, and reptiles, but are not expected to have a significant adverse impact upon the species of those that depend upon them.

Fox River Tributaries (Pebble Creek, Pebble Brook, and Mill Brook)

The Fox River tributaries would be affected by the following water supply and return flow alternatives, as described in Table 7.

TABLE 7
Water Supply and Return Flow Alternative Affecting the Fox River Tributaries

Alternative	Fox River Tributaries (Pebble Creek, Pebble Brook, and Mill Brook)
Water Supply	
Deep and Shallow Aquifers	Impacts Occur
Shallow Aquifer and Fox River Alluvium	Impacts Occur
Lake Michigan (City of Milwaukee)	No Impacts
Lake Michigan (City of Oak Creek) Alignment 1	No Impacts
Lake Michigan (City of Oak Creek) Alignment 2	No Impacts
Lake Michigan (City of Racine)	No Impacts
Return Flow Alternatives for Lake Michigan Water Supplies	
Underwood Creek to Lake Michigan	No Impacts
Root River to Lake Michigan Alignment 1	No Impacts
Root River to Lake Michigan Alignment 2	No Impacts
Direct to Lake Michigan (or MMSD)	No Impacts

The reaches of the three Fox River tributaries falling within the groundwater drawdown cone of influence for the groundwater supply alternatives, where groundwater levels are predicted to drop from 1 to 5 feet, or greater below current levels, will experience stream base flow reductions of up to 34, 13, and 85 percent for Pebble Brook, Pebble Creek, and Mill Brook respectively for the groundwater supply alternatives (Environmental Report Section 6.4.2.2). The impact of base flow reduction on Fox River tributaries has significantly more impact upon habitat and species in these tributaries than the more modest base flow reduction on the Fox River from relocating the wastewater outfall to the Lake Michigan basin to meet the return flow requirement. As discussed separately in the following subsections, this assessment of hydrology-mediated impacts is based on the high base flow reduction range.

No significant adverse impact should occur to common and RTE species of terrestrial amphibians, reptiles, birds, and mammals of adjacent floodplain and riparian habitats from the base flow reduction on these tributaries, even during chronic dry periods/seasons, because riparian wildlife are pre-adapted to seasonal and weather-related fluctuations in water levels. Base flow reductions as high as those documented for Mill Brook would significantly alter the soil moisture and any drought-sensitive vegetation within the riparian and floodplain habitats that do not directly abut the banks of affected river or stream channels could be affected. This reduction could stress drought-sensitive riparian vegetation and prey species consumed by common, RTE, and WABCP Priority terrestrial bird species, such stress would be localized along the river banks, mostly during periodic or seasonal drought, rather than extending throughout riparian habitats along the river and its tributaries. Because riparian zone birds and mammals are highly mobile and pre-adapted to seasonal or weather-related fluctuations in water levels, they will be able to modify their foraging behavior to compensate for any reductions in the abundance of plant foods or prey within riparian, floodplain, and wetland habitats bordering the river and stream banks.

Maximum flow reductions during seasonal dry periods would be expected to cause changes in the abundance, biodiversity, distribution, frequency, and species composition of algae, macrophytes, aquatic insects, benthic macroinvertebrates, and water-dependent wildlife. The RTE mussels, insects, and amphibians documented in Table 1 are mostly associated with the Fox River, but some are also associated with the Fox River tributaries. The only RTE mammal reported for the Fox River/Vernon Marsh, Franklin's ground squirrel, is not at risk from reduced base flows because it is not water-dependent, preferring brushy

and partly wooded areas, dense grassy, and shrubby marshland, rather than open water habitats. A base flow change of 85 percent for Mill Brook would be expected to have a significant impact upon the native macroinvertebrate community or the fish and wildlife that prey on these aquatic biota.

Common and RTE species of water-dependent birds found in aquatic and wetland habitats along the Fox River tributaries would experience reductions in the abundance and diversity of aquatic and wetland plant foods and faunal prey as a result of the groundwater supply alternatives, especially during seasonal dry periods because the discharge of groundwater to these headwater tributaries would be reduced. These tributaries are more susceptible to impacts under low flow conditions and groundwater drawdown would reduce, sometimes significantly, the base flow contribution from groundwater that would in turn exacerbate the adverse biological impacts from low flow conditions. The impacts would be greatest to macroinvertebrates that inhabit smaller tributaries (such as caddisflies, mayflies, and stoneflies). Impacts to water-dependent RTE bird species are unlikely to extend very far from the river banks, so that ample breeding and feeding areas for them should persist, but might be reduced in area and duration for the species to the open water and emergent wetland habitats of the surrounding Fox River floodplains and nearby Vernon Marsh. Because water-dependent birds, mammals, and some reptiles are highly mobile and pre-adapted to natural fluctuations in water levels, they will be able to modify their foraging behavior to some degree over short-term low flow periods. This adaptation could partially offset the impacts of groundwater withdrawal.

Sustained, maximum flow reduction in the Fox River tributaries over the long-term would alter and reduce habitat, food, and prey resources for water-dependent mammals. In wet years, the reductions would be de minimus but, in dry years, and particularly in consecutive dry years, they could result in a reduction in the health and density of water-dependent species. Most significantly impacting those species dependent upon water (algae and macroinvertebrates) and species that heavily depend upon these species for prey, including mammal populations. During wet years, the impacts are likely to be highly localized within the shallowest river channels rather than extending into adjacent, open water habitats of deeper wetlands within the river floodplain that also sustain these wildlife. Beavers are especially resilient, because they create their own ponds, so that even a permanent base flow level change should not deter them from building and maintaining dams. Thus, in wet years, as noted for other groups of water-dependent fauna, even the maximum decrease in base flow is unlikely to have a significant adverse ecological impact on water-dependent mammal populations and communities. In dry years, the opposite would be true with reduced suitable habitat for macroinverebrates and amphibians, as well as the higher tropic level species that depend upon the lower level species for prey.

Decreased water levels resulting from the groundwater supply alternatives also may gradually and permanently alter the existing mosaic of habitats and slightly change the total acreage or relative proportion of wetlands situated between the Fox River tributaries and upland habitats. Significantly decreased base flow in the Fox River tributaries also may reduce the ability for fish movement from the river system, especially during dry periods.

Long-term reductions in aquatic biodiversity also may result within the Fox River tributaries under the groundwater supply alternatives, especially within shallower runs, riffles, and pools that support abundant and diverse communities of benthic and pelagic macroinvertebrates, fish, amphibians, and reptiles. Any long-term reductions in the abundance and diversity of the aquatic biota, in turn, may reduce the capacity of the river ecosystem to support wildlife consumers of the aquatic biota, including common, SGCN, WABCP Priority, RTE species of piscivores, shorebirds, waterfowl, and wading birds, all of which are highly sensitive to water loss, especially during low flow periods and dry seasons.

Assessment of Environmental Effects from Hydrologic Impacts to Vernon Marsh and Surrounding Wetland Functions (Table 3)

The wetlands in and near the Vernon Marsh have functional values impacted by the groundwater supply alternatives, as described in Table 8.

TABLE 8
Water Supply and Return Flow Alternative Affecting Groundwater Drawdown In and Near Vernon Marsh

Alternative	Vernon Marsh and Surrounding Wetlands
Water Supply	
Deep and Shallow Aquifers	Impacts Occur
Shallow Aquifer and Fox River Alluvium	Impacts Occur
Lake Michigan (City of Milwaukee)	No Impacts
Lake Michigan (City of Oak Creek) Alignment 1	No Impacts
Lake Michigan (City of Oak Creek) Alignment 2	No Impacts
Lake Michigan (City of Racine)	No Impacts
Return Flow Alternatives for Lake Michigan Water Supplies	
Underwood Creek to Lake Michigan	No Impacts
Root River to Lake Michigan Alignment 1	No Impacts
Root River to Lake Michigan Alignment 2	No Impacts
Direct to Lake Michigan (or MMSD)	No Impacts

Table 3 summarizes the likely impacts to the wetland functions and values of Vernon Marsh and surrounding wetlands caused by groundwater drawdown within the cones of influence for the groundwater supply alternatives. As described in Section 6.4.3.1 of the Environmental Report, under the Deep and Shallow Aquifers supply alternative, 1,000 acres of wetlands would experience a 5-foot or greater groundwater drawdown; a 1-foot or greater groundwater drawdown would occur for more than 3,000 wetland acres. The Shallow Aquifer and Fox River Alluvium alternative would have nearly 2,000 acres of wetlands experience a 5-foot or greater groundwater drawdown; a 1-foot or greater groundwater drawdown would occur for more than 4,000 wetland acres. Total acreage impacts by wetland type for the alternatives are summarized in Environmental Report Table 6-43. Groundwater drawdown would be a permanent condition and irreversible without an alternative water supply source, which is the greatest permanent impact to any natural environmental resource predicted for any of the supply alternatives. The impacts to wetlands could produce minor, moderate, or significant adverse impacts to the following categories of WRAM functions and values:

- Human Use values HU 1, 2 & 3—Recreation, Education, and Science (*Significant*)
- Human Use values HU 4—Biodiversity (*Significant*)
- Human Use values HU 6—Threatened and endangered species habitat (*Significant*)
- Wildlife Habitat Values WH 1—Wetland and contiguous habitat greater than 10 acres (*Minor*)
- Wildlife Habitat Values WH 3—Within wildlife habitat corridor (*Minor*)
- Wildlife Habitat Values WH 6—Interspersion of habitat types (*Significant*)
- Wildlife Habitat Values WH 7—Habitat for species of greatest conservation need or priority gird species in the WABCP (*Significant*)
- Wildlife Habitat Values WH 9 & 10—Ephemeral pond with water greater than 45 days and habitat for amphibians and aquatic invertebrates (*Significant*)
- Fish and Aquatic Life Habitat Values FA 1—Wetland contiguous with perennial stream (*Moderate to Significant*)

- Fish and Aquatic Life Habitat Values FA 2—Standing water for amphibians and aquatic invertebrates (*Significant*)
- Fish and Aquatic Life Habitat Values FA 3—Natural Heritage Inventory listed aquatic species in aquatic system (*Significant*)
- Fish and Aquatic Life Habitat Values FA 4—Vegetation is inundated in spring (*Moderate*)
- Shoreline Protection Functions SP 3—Densely rooted emergent or woody vegetation (*Significant*)
- Flood and Stormwater Storage Functions ST 3—Dense, persistent vegetation (*Minor*)
- Water Quality Protection Functions WQ 4—Vegetated wetland borders lake or stream (*Minor*)
- Water Quality Protection Functions WQ 5—Dense, persistent vegetation (*Minor*)
- Water Quality Protection Functions WQ 8—Discharge to surface water (*Significant*)
- Groundwater Processes GW 1—Springs, seeps, or groundwater are present (*Significant*)
- Groundwater Processes GW 3—Wetland remains saturated for an extended time period with no additional water inputs (*Significant*)

Detailed rationale for the risks of drawdown-mediated impacts to each of the wetland functions and values are provided in Table 3. The following discussion highlights key impact pathways likely to significantly alter multiple wetland functions due to permanent groundwater drawdowns of 1 to 5 feet or more within the cone of influence that includes Vernon Marsh and surrounding wetlands that border the Fox River and some segments of its tributaries, Pebble Creek, Pebble Brook, and Mill Brook.

Impacts are expected within emergent, scrub-shrub, or forested wetlands, as well as ephemeral ponds (vernal pools), along the Fox River, its tributaries, and adjacent wetland interiors within the cone of influence. The most pronounced groundwater drawdown impacts will occur in the shallower aquatic and bordering wetland habitats, whereas terrestrial habitats and species not dependent on an elevated water table and/or discharges from springs are much less likely to be adversely affected. Chronic drought stress from drawdown of the water table will decrease wetland soil moisture and adversely impact wetland vegetation, with obligate wetland (OBL) and facultative wet (FACW) plant species being displaced by more drought tolerant plants (facultative [FAC], facultative upland [FACU], and upland [UPL] plant species), causing significant floristic changes in species composition and dominance of existing wetland communities. This may increase the risk of colonization by invasive, non-native plant species of little or no value to ecologically and recreationally-important wildlife.

The area-wide drawdown impacts are likely to cause losses of immobile, common, and RTE species in ephemeral ponds and wetlands that cannot easily or quickly migrate into wetter habitats as drawdown impacts recue the surface water and saturated soils needed for survival, growth, and reproduction (e.g., flora, insects, amphibians, and reptiles). Biodiversity losses will be greatest among habitats and species that are highly sensitive to water loss, such as vernal pools used for amphibian breeding and wet meadows inhabited by RTE species (e.g., Liatris and Silphium borers). Drawdowns during seasonal low flow conditions will reduce the availability of an adequate food supply, reproductive success, and survival of amphibians and macroinvertebrates dependent on vernal pools. Near term impacts will be greatest during low flow periods and dry seasons when the drawn-down water table may not be adequately replenished by surface water inflows, which could eliminate minimum water depths needed for survival and reproduction. Short- and long-term reductions also would occur in the abundance and diversity of aquatic/wetland-dependent species of macroinvertebrates, insects, amphibians, reptiles, birds, mammals, and their food/prey supplies, especially in wetlands and vernal pools most sensitive to permanent water loss.

Changes to habitat interspersion may result from groundwater drawdown, losses of open waters and vernal pools, and reduced or eliminated discharges from springs/seeps, causing greater homogeneity of vegetative

communities with fewer ecotonal interfaces among aquatic, wetland, and upland habitats in and around Vernon Marsh and surrounding wetlands. Hydrology-driven transformations of shallow ponds, vernal pools and wet meadows into upland habitats/flora, coupled with reductions of open water and deeper marsh habitats, will reduce the existing habitat complexity and floristic diversity. Long-term impacts also could occur to SGCN, Priority, and RTE Birds residing, breeding, or feeding within impacted emergent, scrub-shrub, or forested wetlands, especially those dependent on immobile prey species of the ephemeral ponds and shallower wetlands that may be degraded or lost due to drawdown. Desiccation-driven losses of the bird breeding and feeding areas also poses a risk of permanent losses of the SGCN and WABCP Priority birds from the floristically and hydrologically transformed wetlands.

Significant adverse impacts to groundwater-dependent wetland seeps in and near Fox River tributaries, Vernon Marsh, and surrounding wetlands are anticipated due to significant groundwater drawdown. Less groundwater discharging to wetlands and via springs will reduce the supply of groundwater available for discharge into river and stream channels via seepage from banks and/or overland flow across the wetland from springs and/or surface water bodies into the channels. While lower base flows in channels across groundwater discharge wetlands can accommodate increased influx of surface and groundwater from the wetlands under normal, undisturbed conditions, wetland areas with predicted groundwater drawdown of 1 and 5 or more feet are highly unlikely to discharge groundwater into river or stream channels, unless the channels are incised to depths greater than 5 feet.

Assessment of Environmental Effects from the Proposed Project Pipeline Impacts to Natural Communities and Wetland Functions (Table 4)

This section describes impacts to wetland functional values for the proposed project only (Lake Michigan—City of Oak Creek Alignment 2 with Root River to Lake Michigan Alignment 2 Return Flow).

Table 4 summarizes potential impacts to wetland functions and values of three types of palustrine wetlands that abut roads followed by the proposed project water supply and return flow pipelines. The acres of each wetland type crossed by the proposed project were taken from Environmental Report Tables 5-31, 5-32, and 6-43, which were created by assuming a 75-foot-width pipeline construction corridor and then compared to Wisconsin Wetland Inventory wetland mapping using geographic information system (GIS). This same wetland impact assessment approach was conducted for all alternatives to consistently compare potential impacts of one alternative to another. Note that, in many cases during design of the pipelines, the wetland resources could be avoided altogether and, where wetlands would be crossed, the construction corridor would actually be much narrower than 75 feet to minimize, if not avoid, impacts. Temporary impacts are as those where impacts would only be expected during construction and, with proper restoration, the wetland functions would be expected to be restored. Post-construction monitoring would be conducted so that mitigation and wetland restoration following construction achieve success. Permanent impacts are those where ongoing operations and maintenance would cause a loss of wetland area and functions. To minimize natural resource impacts, the pipeline route follows street rights-of-way where land disturbance has already occurred. Environmental Report Table 6-53 documents that 94 percent of the proposed project pipeline alignment follows existing street and utility rights-of-ways.

Recent Google Earth imagery indicates several exceptions in the WDNR wetland mapping along the proposed project pipeline alignment, as documented in Table 4. The recent Google Earth imagery indicated that, in most locations, there is ample room to construct the pipelines outside of the wetland boundaries, thus, the reported acreage of wetland impact exceeds what would likely occur. Based on the relationship of the existing and proposed rights-of-way and the presence and location of wetlands, the aerial imagery also suggests that wetland impacts can be greatly minimized or entirely avoided by careful alignment and environmental construction best management practices, assuming no significant in-road/in-shoulder utility conflicts.

Where wetlands are unavoidable, temporary impacts will occur. Potential impacts resulting from the construction of the proposed project include vegetation clearing and soil disturbance for construction access

and pipeline construction. Trenches would be excavated to install the pipeline. Soil disturbance would be minimized by segregating the topsoil layer from the subsoil layer over the proposed trench line in unsaturated or non-inundated wetlands during excavation. All wetland soils excavated during construction would be segregated from other subsoils. The soil profile would be restored by replacing the layers in reverse order of the initial excavation when backfilling. Following construction, wetland areas would be restored to their pre-existing contours to allow for natural re-vegetation. Excess fill would be removed from the construction corridor, including from floodplain areas. However, many of the impacts can be minimized through the use of best management practices, as described in the following subsections, and many wetland functions would only be temporarily impacted until restoration is completed. In most cases, the construction would be completed in a matter of days, or weeks at the most, followed immediately by restoration, re-vegetation, and monitoring.

Although there are opportunities for careful pipe alignments that will avoid or greatly minimize impacts, the assessment assumes worst case impacts using the very conservative geographic information system estimates of wetland encroachment acreages that might occur *only if* the pipelines cannot be installed completely within the road bed or shoulders due to utility conflicts or other construction constraints. Maps showing potential wetland impacts from pipeline construction are included in Attachment 1 and have been previously provided to the WDNR.

It is highly unlikely that this degree of activity in wetlands would occur. The impact analysis in Table 4 also considers the minimization and mitigation of wetland function impacts that will be realized by the use of pipeline construction and water/wetland crossing methods that incorporate proactive environmental best management practices (BMPs) that are widely accepted by federal and state regulators, including the U.S. Army Corps of Engineers (USACE) and the Federal Energy Regulatory Commission (FERC). A subset of the most relevant, USACE- and FERC-approved construction methods and BMPs for water and wetland crossings were submitted to WDNR as Appendix 5-2 of the Environmental Report.

Emergent Marsh, Wet Meadow, and Unvegetated Mud Flats (National Wetland Inventory Code PEM)

Although a maximum of 0.07 to 0.08 acre of emergent wetlands may be temporarily disturbed during construction of the supply and return lines, the disturbances will be short-term, fully mitigated using environmental construction BMPs, and will not adversely impact the ecological functions or socioeconomic values of the wetlands.

Recent aerial imagery suggests that the temporary but non-invasive disturbance in temporary work areas from placement of swamp mats over herbaceous vegetation to allow equipment access, can be greatly minimized or entirely avoided by careful alignment and environmental construction BMPs, assuming no significant in-road/in-shoulder utility conflicts. If the pipeline must be placed inside the marsh or wet meadow, trench spoils will be managed and replaced to preserve the original soil profile and topsoil seed bank needed to facilitate rapid natural regeneration of the original emergent wetland from root stock and seed bank. Because emergent wetlands typically recover fully from the seed bank within a single growing season, the temporary disturbance of the plant community would be expected to be minor and ecologically insignificant to the wildlife habitat functions and values of PEM wetlands.

Wildlife will leave the marsh or wet meadow habitats adjacent to or within construction areas and will return after pipeline installation and site restoration (generally a maximum of a few weeks and less in most cases). Because the original hydrology, soils, and herbaceous wetland plant communities will be fully restored and operationally maintained, within both temporary work areas and the permanent right-of-way, the temporary disturbance of the plant community would be expected to have a de minimus impact on wildlife resources.

No adverse impacts will occur from either pipeline to Fish and Aquatic Life Habitat Values (FA 1 to 4), because none of the emergent wetlands that may be disturbed border aquatic habitats that provide these functions. Because the major water crossings along both pipeline routes occur at bridges or box culverts that

cannot be open cut, but are most likely to be crossed using boring or horizontal directional drilling (HDD) methods, emergent wetlands that border aquatic habitats at the few locations would not be adversely impacted. Although the WDNR wetland mapping indicates that the return pipeline will cross an aquatic bed/mud flat along the west bank of the Root River (Wetland 11209), the mapping is erroneous because this has been an agricultural field for at least 14 years, so no PEM or aquatic beds that might provide these aquatic life functions will be crossed by the supply or return pipelines.

No impacts would occur to Flood and Stormwater Storage Functions (ST 3 & 4) from either pipeline, because there will be no net fill of wetlands to reduce storage capacity. If a pipeline must be placed within a wetland, due to utility conflicts within the road bed or shoulder, a volume of trench spoil equal to the pipe volume(s) will be removed for upland disposal, thus resulting in no net filling of the wetland, as required under Section 404 of the Clean Water Act and state wetland regulations. No impacts to water quality functions of the wetland would occur because the pipelines are unlikely to be installed within an emergent wetland, so that there will be no disturbance of herbaceous vegetation root systems or soils that provide the pollution attenuation functions. Even if equipment must traverse wetland fringes during construction, all traffic will occur on swamp mats to protect emergent herbaceous vegetation. Because emergent wetlands typically recover fully from the seed bank within one growing season, temporary disturbance of the plant community will be negligible and ecologically insignificant to the water quality preservation and renovation functions and values of the PEM wetlands. Finally, there will be no significant adverse permanent or temporary impacts to groundwater processes because, by following BMPs such as using timber mats to minimize compaction or horizontal directional drilling techniques (see Environmental Report Appendix 5-2, Example Wetland and Waterbody Pipeline Construction and Mitigation Procedures), the project will not significantly alter the hydrology of the wetland either during or following construction.

Scrub Shrub (Shrub-Carr) and Forested Wetlands (National Wetland Inventory codes PSS & PFO)

No adverse permanent impacts from supply or return pipeline construction or operation are expected to occur to ecological functions and values of PSS or PFO wetlands, despite possible de minimis permanent conversions from PSS/PFO to herbaceous emergent (PEM) wetlands required to maintain within a permanent right-of-way free of woody vegetation to assure safe access and protect pipeline integrity from invasive woody root systems. While a maximum of 0.1 acre of PSS and 0.01 acre of PFO may require such conversion to PEM, only 0.1 acre of PSS and up to 0.36 acre of PFO will be temporarily disturbed during construction, but then fully restored and replanted or allowed to regenerate the original plant community via natural successional processes, including regrowth from the wetland soil seed bank and sprouts of flush cut woody stumps. Construction disturbances will be short-term, fully mitigated using environmental construction BMPs, and will not adversely impact the ecological functions or socioeconomic values of PSS or PFO wetlands.

Recent aerial imagery suggests that the temporary but non-invasive disturbance in temporary work areas from placement of swamp mats over herbaceous and flush-cut woody vegetation to allow equipment access, can be greatly minimized or entirely avoided by careful pipe alignment, assuming no significant in-road/in-shoulder utility conflicts. If the pipeline must be placed within PSS or PFO wetlands, flush-cut stumps can be removed only from the trench line and the required buffer on either side of the pipeline needed to prevent woody root damage to the lines. Trench spoils will be managed and replaced to preserve the original soil profile and topsoil seed bank needed to facilitate rapid natural regeneration of the original wetland from root stock and seed bank. Because PSS wetlands can recover fully from stump sprouts and the seed bank within a few growing seasons, the temporary disturbance of the scrub-shrub community will be negligible and ecologically insignificant to the wildlife habitat functions and values of PEM wetlands. Any permanent conversion of PSS and PFO to PEM needed within the right-of-way will also be negligible and ecologically insignificant because the minor shift in plant cover types will not adversely affect wetland functions or values to wildlife.

Wildlife will leave the PSS and PFO habitats adjacent to or within construction areas and, due to the short duration of construction, in most cases will return after pipeline installation and site restoration. Although shrubs and trees will be removed permanently within any right-of-way that encroaches into the fringe of PSS and PFO wetlands bordering the road shoulders, the original hydrology, soils, and herbaceous component of those PSS and PFO communities will be fully restored and operationally maintained as emergent wetlands, such that the temporary disturbance of the plant community will be negligible, short-term, and ecologically insignificant to the wildlife habitat functions and values of the original PSS and PFO wetlands.

No adverse impacts will occur from either pipeline to Fish and Aquatic Life Habitat Values (FA 1 to 4), because none of the PSS or PFO wetlands to be converted to PEM or temporarily disturbed provide these functions. Because the major water crossings along both pipeline routes occur at bridges or box culverts that cannot be open cut, but are most likely to be crossed using boring or HDD methods, any PSS or PFO wetlands bordering aquatic habitats at a few locations will not be adversely impacted. The only location where a sparsely vegetated river bank will be open cut is at the Root River return water outfall location, which was misclassified as a PFO (Wetland 11777) in the WDNR wetland mapping, but is actually not a PFO wetland but rather a sparsely vegetated river bank with scattered trees abutting cropland along the west bank of the Root River. Although the Root River provides these aquatic life functions, the brief outfall construction activity can be mitigated with environmental BMPs to prevent significant adverse impacts, whether temporary or permanent, to the aquatic habitats and the overhanging river bank vegetation that can benefit aquatic species.

No adverse impacts will occur to Flood and Stormwater Storage Functions (ST 3 & 4), because pipelines will be installed within PSS and PFO wetlands using BMPs to assure that there will be no net fill of wetlands that otherwise would reduce storage capacity. If a pipeline must be placed within a wetland due to utility conflicts within the road bed or shoulder, stumps from the trench line and a volume of trench spoil equal to the pipe volume(s) will be removed for upland disposal, thus resulting in no net filling of the wetland, as required under Section 404 of the Clean Water Act and state wetland regulations.

Under the worst case impact scenario of the right-of-way crossing PSS or PFO wetlands, such that shrubs and trees must be permanently removed to assure pipeline integrity/access, the permanent conversion to an emergent wetland (PEM) will not adversely affect the water quality functions of the wetland because the PEM will provide equivalent or superior water quality enhancement functions. Beyond the pipeline trench, there will be little or no disturbance of shrub or tree roots that stabilize soils and promote soil microbial and fungal communities that help to attenuate pollution, so that there will be no adverse permanent or temporary impacts to water quality functions of disturbed PSS and PFO wetlands. In some cases, moreover, a dense herbaceous wetland community can be more effective at renovating surface water quality than a more sparsely vegetated PSS or PFO wetland with little or no ground cover of herbaceous vegetation. If trenching occurs across a grubbed area of scrub-shrub or forested wetland to place a pipeline within the wetland, trench spoils will be managed and replaced to preserve the original soil profile and segregated, then topsoil with intact seed bank will be replaced to facilitate rapid natural regeneration of the original wetland vegetation from root sprouts and the seed bank. Because many species of flush-cut wetland shrubs (alders, dogwoods) and trees (e.g., red maple) can recover from stump sprouts within a few growing seasons, disturbances of the woody plant community within temporary work areas will be negligible and insignificant to the water quality preservation and renovation functions and values of these PSS and PFO wetlands.

Finally, there will be no adverse permanent or temporary impacts to groundwater processes because the project will not significantly alter the hydrology of the existing PSS or PFO wetlands, either during or following construction. Even in any scrub-shrub or forested wetlands where trees and shrubs must be removed during construction and a permanent right-of-way within the wetland must be maintained as a PEM free of trees or shrubs, for access and pipeline integrity reasons, the surface and subsurface hydrology of the original PSS or PFO wetland will not be altered.

Conclusions

The proposed project would have beneficial impacts to the Root River flora and fauna from base flow increases while only having minor impacts to Fox River flora and fauna from a decrease in base flow. Species most benefitting in the Root River would include benthic macroinvertebrates and aquatic amphibians along with higher trophic species depending upon benthic macroinvertebrate and amphibian species for prey.

Long-term reductions in aquatic biodiversity are not expected in the Fox River and contiguous aquatic or deep marsh habitats from the small change (maximum of 2 inches) in water depth. Some changes to runs, riffles, and pools that support benthic and pelagic macroinvertebrates, fish, amphibians, and reptile assemblages established by the flow augmentation provided by the Waukesha wastewater discharge may occur, but are not expected to have a significant adverse impact upon the species of those that depend upon them.

While the proposed project pipeline corridor was selected within street and utility rights-of-way to minimize impacts, some impacts to wetlands could occur with a maximum of 1 acre of wetlands affected. Recent aerial imagery suggests that wetland impacts can be greatly minimized or entirely avoided by careful alignment and environmental construction BMPs. If the pipeline must be placed inside a wetland, a wetlands permitting process, including BMPs will be required to minimize wetland impacts. Restoration will occur immediately after construction and successful reestablishment, a post restoration monitoring program would be put in place so that mitigation and wetland restoration following construction achieve success. Impacts to wetland functional values are consequently expected to be temporary during construction with wetland functions quickly recovering from restoration.

The degree of wetlands affected and impacts upon wetland functional values by pipeline construction for alternatives to the proposed project are similar for the Lake Michigan water supply and return flow alternatives.

This is not the case for the two groundwater alternatives. The Deep and Shallow Aquifers supply alternative, has 1,000 acres of wetlands that would experience a 5-foot or greater groundwater drawdown; a 1-foot or greater groundwater drawdown would occur for more than 3,000 wetland acres. The Shallow Aquifer and Fox River Alluvium alternative would have nearly 2,000 acres of wetlands experience a 5-foot or greater groundwater drawdown; a 1-foot or greater groundwater drawdown would occur for more than 4,000 wetland acres. Significant permanent and irreversible impacts would occur to wetland functional values.

In addition, the groundwater alternatives reduce the base flow in Fox River tributaries (Pebble Brook Pebble Creek, Mill Brook) up to 34, 13, and 85 percent respectively. Long-term reductions in aquatic biodiversity may result, especially within shallower runs, riffles, and pools that support abundant and diverse communities of benthic and pelagic macroinvertebrates, fish, amphibians, and reptiles. If long-term reductions in the abundance and diversity of the aquatic biota occur, it may in turn reduce the capacity of the river ecosystem to support wildlife highly sensitive to water loss, especially during low flow periods and dry seasons.

Groundwater drawdown to supply continued drinking water to the City of Waukesha would be a permanent condition and irreversible without an alternative water supply source, which is the greatest permanent impact to the natural environmental resources predicted for any of the supply alternatives.

References and Data Sources

American Society of Mammalogists. 2015. Mammals of Wisconsin. Accessed on January 5, 2015. http://www.mammalsociety.org/mammals-wisconsin

Barbiero, R. P.; H. J. Carrick; J. B. Volerman; and M. L. Tuchman. 2000. “Factors affecting temporal and spatial distribution of diatoms in Lake Michigan.” *Verhandlungen Internationale Vereinigung für Limnologie*. Volume 27: 1788–94. December.

Casper G. S. 2007. *Wisconsin Herpetological Atlas*. Accessed on December 29, 2014. http://www4.uwm.edu/fieldstation/herpetology/AtlasFr1.html.

CH2M HILL. 2013. City of Waukesha Environmental Report for Water Supply Alternatives, Prepared by CH2M HILL for the City of Waukesha. October.

Kreitinger, K.; Y. Steele; and A. Paulios. 2013. *Species List (Priority Species)*. http://www.wisconsinbirds.org/plan/species/list.htm. Accessed on December 29, 2014.

Mueller, W. P. 2013. *Emergent Marsh*. Wisconsin All Bird Conservation Plan Species Listings. Accessed on December 29, 2014. http://www.wisconsinbirds.org/plan/habitats/EmergentMarsh.htm.

Nalepa, T. F.; D. J. Hartson; D. L. Fanslow; G. A. Lang; and S. J. Lozano. 1998. "Declines in benthic macroinvertebrate populations in southern Lake Michigan, 1980–1993." *Can. J. Fish. Aquat. Sci*. Volume 55:2402–13.

Natural Resources Conservation Service (NRCS). 2001. *Wetland Mammals*. Fish and Wildlife Habitat Management Leaflet Number 21. March 2001. US Department of Agriculture.

Southeastern Wisconsin Regional Planning Commission (SEWRPC). 2014. Root River Restoration Plan. A Restoration Plan for the Root River Watershed. Part One of Two. Chapters 1-7. Community Assistance Planning Report No. 316. July.

SEWRPC. 2010. Stream Habitat Conditions and Biological Assessment of the Kinnickinnic and Menomonee River Watersheds: 2000-2009. Memorandum Report No. 194. January.

SEWRPC. 2014. Personal Communication with Tom Slawski. December 9, 2014.

Steele, Y. 2011. *Bottomland Hardwood*. Wisconsin All Bird Conservation Plan Species Listings. Posted June 2011. Accessed on December 29, 2014. http://www.wisconsinbirds.org/plan/habitats/BottomlandHardwood.htm.

Thomas, J.C., M.A. Lutz, et al. 2007. *Water-quality characteristics for selected sites within the Milwaukee Metropolitan Sewerage District planning area, Wisconsin, February 2004–September 2005.* U.S. Geological Survey Scientific Investigations Report 2007–5084, 187 p.

Uncle Dave's Enterprise. 2014. Undated website posting. *Mammals*. Profiles of Wisconsin mammals excerpted from an unidentified source. Accessed on December 29, 2014. http://www.uncledavesenterprise.com/file/wisconsin/mammals/Mammals%20of%20Wisconsin.pdf

Waukesha County Department of Parks and Land Use and Southeastern Wisconsin Regional Planning Commission (Waukesha County and SEWRPC). 2008. Community Assistance Planning Report No. 284, Pebble Creek Watershed Protection Plan. Waukesha County, Wisconsin. Part One. June.

Wisconsin Butterflies. 2015. Undated online postings of rare, threatened or endangered species of butterflies. Accessed on January 5, 2015. https://wisconsinbutterflies.org/

Wisconsin Department of Natural Resources (WDNR). 2014a. Online postings of biological and ecological profiles for RTE species of fauna. Accessed on various dates in December 2014 and January 2015. http://dnr.wi.gov/topic/endangeredresources/animals.asp

WDNR. 2014b. Wisconsin's Amphibians and Reptiles—Checklist. PUB ER-110. 2014.

WDNR. 2014c. Wisconsin Natural Heritage Working List. June 2014. http://dnr.wi.gov/topic/NHI/documents/NHIWorkingList.pdf

WDNR. 2014d. Wetland Rapid Assessment Methodology – User Guidance Document, Version 2.0, March, 2014.

WDNR. 2013a. Natural Heritage Inventory query results of known or potential RTE species within all project alternative study areas, provided by Shari Kozlowsky in January 2011 and supplemented in January 2013. In: *Confidential Appendix 6-6B, NHI Species, Environmental Report for Water Supply Alternatives, City of Waukesha Water Utility—Lake Michigan Water Supply*. Prepared by CH2M HILL for City of Waukesha, WI. October 2013.

WDNR. 2013b. Current Scientific and Standard Common Names of Wisconsin Amphibians and Reptiles. Bureau of Science Services, Miscellaneous Publication PUB-SS-1121. April.

WDNR. 2013c. Blanchard's Cricket Frog (*Acris blanchardi*) Species Guidance. 8 PUB-ER-666. Last updated November 1.

WDNR. 2011. Current Scientific and Standard Common Names of Wisconsin Mammals. Bureau of Science Services, Miscellaneous Publication PUB-SS-1089. September.

WDNR. 2002. *The State of the Southeast Fox River Basin.* Wisconsin Department of Natural Resources et. al. PUBL WT-701-2002. February.

Wisconsin Public Service Commission (WPSC). 2003. Final Environmental Impact Statement, Elm Road Generating Station—Vol. 1. July.

Tables

Table 1. Summary of Known or Potential Species Occurrences within Aquatic, Wetland and Terrestrial Habitats of Project Hydrologic Impact Areas

Overall Project Area Species Occurrences by Group (Waukesha, Milwaukee & Racine Counties)		Local/Regional Species Reported within Impacted Watercourses, Springs and/or Wetlands					
		Project Impact Area:	**Underwood Creek & Menomonee River**	**Root River**	**Fox River**	**Pebble Brook, Pebble Creek, and Mill Brook**	**Vernon Marsh incl. Nearby Wetlands and Springs**
Group, Common Name and Habitat Notes	**Scientific Name**	***Base Flow Changes:***	***Higher Base Flow***	***Higher Base Flow***	***Lower Base Flow***	***Lower Base Flow from Groundwater Drawdown***	***Groundwater Drawdown 1 to 5+ feet***
Algae (Diatoms and Green Algae are nearly ubiquitous in aquatic habitats, including open water areas of marshes/wetlands).							
Benthic algae (No Location-specific Data)	Multiple taxa						N/A
Blue green algae (No Location-specific Data)	Cyanophyta						Open Waters
Diatoms (Ubiquitous)	Chrysophyta		X				Open Waters
Green Algae (No Location-specific Data)	Chlorophyta						Open Waters
Green Algae (Lake Michigan)	*Cladophora glomerata*						N/A
Green Algae	*Stigeoclonium lubricum*		X				N/A
Periphyton (No Location-specific Data)	Diatoms et al. taxa on macrophytes						Open Waters
Red Algae	Rhodophyta			X			N/A
Macrophytes							
Curly-Leaf Pondweed (INVASIVE)	*Potamogeton crispus*					X	Open Waters
Elodea (Ubiquitous)	*Elodea* spp.					X	Open Waters
Eurasian Watermilfoil (INVASIVE)	*Myriophyllum spicatum*		X				Open Waters
Benthic Macroinvertebrates: Common - All species are likely or possible in suitable aquatic habitats of all impact areas.							
Three-Ridge Mussel	*Amblema plicata*			X			N/A
Zebra Mussel (INVASIVE)	*Dreissena polymorpha*		X	X			N/A
Spike Mussel	*Elliptio dilatata*			X			N/A
Wabash Pigtoe Mussel	*Fusconaia flava*			X			N/A
Fat Mucket Mussel	*Lampsilis siliquoidea*			X			N/A
White Heelsplitter Mussel	*Lasmigona complanata*			X			N/A
Fluted-Shell Mussel	*Lasmigona costata*			X			N/A
Fragile Papershell Mussel	*Leptodea fragilis*			X			N/A
Giant Waterbug	*Lethocerus grisea*			X			Open Waters
Giant Floater Mussel	*Pyganodon [= Anodonta] grandis*			X			Open Waters
Creeper Mussel	*Strophitus undulatus*			X			Open Waters
Lilliput Mussel	*Toxolasma parvus*			X			Open Waters
Rusty Crayfish (INVASIVE)	*Orconectes rusticus*		X	X			Open Waters
Caddisfly Larvae	Various Taxa			X			Open Waters
Damselfly Larvae	Various Taxa			X			Open Waters
Isopods	Various Taxa			X			Open Waters
Mayfly Larvae	Various Taxa			X			Open Waters
Midge Larvae	Various Taxa			X			Open Waters
Benthic Macroinvertebrates: [1] RTE Species include federal and state-listed Endangered (E), Threatened (T) and Wisconsin Special Concern (SC) species.							
Elktoe (SC; mussel)	*Alasmidonta marginata*				X	X	X
Slippershell (T: mussel)	*Alasmidonta viridis*				X	X	X
Round Pigtoe (SC; mussel)	*Pleurobema sintoxia*				X		X
Ellipse (E; mussel)	*Venustaconcha ellipsiformis*			X	X		X
Rainbow Shell (E; mussel)	*Villosa iris*				X	X	X
Prairie Crayfish (SC; crustacean) (creeks, ponds, wetlands)	*Procambarus gracilis*		X	X	X	X	X
Insects: [1] RTE Species include federal and state-listed Endangered (E), Threatened (T) and Wisconsin Special Concern (SC) species.							
Mottled Darner (SC) (reed bordered lakes)	*Aeshna clepsydra*			X		X	
Great Spreadwing (SC) (slow, small streams, ponds, wetlands)	*Archilestes grandis*						
Swamp Metalmark (E) (alkaline wetlands - fens)	*Calephelis muticum*				X		X
Double-striped Bluet (SC) (slow or spring fed rivers/streams)	*Engallagnma basidens*				X		X
Swamp Darner (SC) (shady ponds, ditches, or sloughs)	*Epiaeschna heros*			X			
Two-spotted Skipper (SC) (sedge marshes/meadows)	*Euphyes bimacula*				X		X

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Group, Common Name and Habitat Notes	**Scientific Name**	***Base Flow Changes:***	***Higher Base Flow***	***Higher Base Flow***	***Lower Base Flow***	***Lower Base Flow from Groundwater Drawdown***	***Groundwater Drawdown 1 to 5+ feet***
Dion Skipper (SC) (marshes and sedge meadows)	*Euphyes dion*				X		
Pronghorned Clubtail (SC) (slow streams, ponds or lakes)	*Gomphus graslinellus*			X			
Lilypad Forktail (SC) (aquatic - lily pads)	*Ischnura kellicotti*				X		
Fragile Forktail (SC) (slow waters, marshes, ponds, swamps)	*Ischnura posita*				X		X
Slaty Skimmer (SC) (marshy ponds near floodplain forests)	*Libellula incesta*			X			
Great Blue Skimmer (SC) (swamp pools/ponds, slow streams)	*Libellula vibrans*			X			
Painted Skimmer (SC) (marshy forest ponds)	*Libellula semifasciata*			X			
Gray Copper (SC) (wet open grasslands, stream edges)	*Lycaena dione*					X	
Elfin Skimmer (SC) (shallow water wetlands)	*Nannothemis bella*				X		X
Liatris Borer Moth (SC) (mesic tall grass prairie or wetter)	*Papaipema beeriana*				X		X
Silphium Borer Moth (E; wet to dry-mesic prairie)	*Papaipema silphii*				X		X
Mulberry Wing (SC) (marshes and sedge meadows)	*Poanes massasoit*				X	X	X
Broad-winged Skipper (SC) (Obligate wetland species)	*Poanes viator*				X		X
Little Glassy Wing (SC) (grassy areas near wetlands)	*Pompeius verna*		X	X			
Smokey Eyed Brown (butterfly) (SC) (*outside project counties*)	*Satyrodes eurydice fumosa*				X		
Lemon-Faced Emerald (SC) (small streams lined by woods)	*Somatochlora ensigera*						
Regal Fritillary (SC) (grasslands with tallgrass prairie)	*Speyeria idalia*			X			
Douglas Stenelmis Riffle Beetle (SC) (spring-fed rivers/streams)	*Stenelmis douglasensis*			X			
Amphibians: Common Terrestrial/Vernal Pool (County occurrences from Wisconsin Herptile Atlas) - All species are likely or possible in suitable habitats of all impact areas.							
Blue-spotted Salamander	*Ambystoma laterale*				X		
Spotted Salamander	*Ambystoma maculatum*						
Eastern Tiger Salamander	*Ambystoma tigrinum*						
American Toad [Eastern]	*Anaxyrus (Bufo) americanus*			X	X	POSSIBLE[2]	
Cope's Gray Treefrog (savannahs/meadows)	*Hyla chrysoscelis*				POSSIBLE[2]	POSSIBLE[2]	
(Eastern) Gray Tree Frog (closed canopy forest)	*Hyla versicolor*				X	POSSIBLE[2]	
Central Newt	*Notophthalmus viridescens louisianensis*			X	X		
(Eastern) Redbacked Salamander	*Plethodon cinereus*				X		
Amphibians: Common Aquatic/Wetland (County occurrences from Wisconsin Herptile Atlas) - All species are likely or possible in suitable habitats of all impact areas.							
(Northern) Green Frog	*Lithobates (Rana) clamitans*			X	X	X	
Wood Frog	*Lithobates (Rana) sylvatica*				X		
Northern Spring Peeper	*Pseudacris crucifer*				X	POSSIBLE[2]	
Western Chorus Frog	*Pseudacris triseriata*				X		
Amphibians [Mostly aquatic]: [1] RTE Species include federal/state Endangered (E), Threatened (T) and Wisconsin Special Concern (SC) species (from WDNR & Wisconsin Herptile Atlas).							
*Blanchard's (formerly Northern) Cricket Frog (End.)	*Acris blanchardi* (formerly *A . crepitans*)		X	X	X	X	
Four-Toed Salamander [Terrestrial]	*Hemidactylium scutatum*			X			
(American) Bullfrog	*Lithobates (Rana) catesbeianus*		X	X	X	POSSIBLE[2]	
Pickerel Frog	*Lithobates (Rana) palustris*				POSSIBLE[2]	POSSIBLE[2]	
(Northern) Leopard Frog	*Lithobates (Rana) pipiens*				X	POSSIBLE[2]	
Common Mudpuppy	*Necturus maculosus*						
Reptiles: Common Terrestrial - All species are likely or possible in suitable habitats of all impact areas (from WDNR & Wisconsin Herptile Atlas).							
Smooth Greensnake	*Opheodrys vernalis*						
Western Foxsnake (Pine)	*Pantherophis vulpinus*			X	X		
DeKay's Brownsnake	*Storeria dekayi wrightorum*						
(Northern) Red-Bellied Snake	*Storeria occipitomaculata*				X		
Common Gartersnake	*Thamnophis sirtalis*			X	X	POSSIBLE[2]	

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Group, Common Name and Habitat Notes	**Scientific Name**	***Base Flow Changes:***	***Higher Base Flow***	***Higher Base Flow***	***Lower Base Flow***	***Lower Base Flow from Groundwater Drawdown***	***Groundwater Drawdown 1 to 5+ feet***
(Eastern) Milksnake	*Lampropeltis triangulum*						
.Reptiles: Common Aquatic - All species are likely or possible in all aquatic/wetland impact areas (from WDNR & Wisconsin Herptile Atlas).							
Spiny Softshell Turtle	*Apalone spinifera*						
(Eastern) Snapping Turtle	*Chelydra serpentina*			X	X	POSSIBLE[2]	
Painted Turtle	*Chrysemys picta*				X	POSSIBLE[2]	
Northern Watersnake	*Nerodia sipedon*				X	POSSIBLE[2]	
(Eastern) Musk Turtle	*Sternotherus odoratus*			X			
Reptiles: [1] RTE Species include federal and state-listed Endangered (E), Threatened (T) and Wisconsin Special Concern (SC) species (from WDNR & Wisconsin Herptile Atlas).							
North American (Blue) Racer (SC) (Dry prairie/Oak savanna)	*Coluber constrictor*						
Northern Ringneck Snake (SC/Terrestrial)	*Diadophis punctatus edwardsii*				X		
Blanding's Turtle (SC/aquatic)	*Emydoidea blandingii*		X	X	X	X	X
Eastern Hog-nosed Snake (SC) (Sandy upland soils)	*Heterodon platirhinos*				X		
Common Five-Lined Skink (SC) (Hardwood forest edges)	*Plestiodon fasciatus*						
Queensnake (Endangered/aquatic)	*Regina septemvittata*			X			
Eastern Massasauga (Rattlesnake)(state Endangered)	*Sistrurus catenatus*				X		
Butler's Gartersnake (SC) (Wetlands)	*Thamnophis butleri*		X	X	X	X	X
Western Ribbonsnake (Endangered) (rivers and marshes)	*Thamnophis proximus*			X	X		
Plains Garter Snake (SC) (Wetlands)	*Thamnophis radix*						
Northern (Eastern) Ribbon Snake (Endangered) (Bogs)	*Thamnophis sauritus septentrionalis*			X			
[2] Birds: Common Terrestrial, Riparian & Wetland - All species are likely or possible in suitable habitats of all impact areas.							
Red-winged Blackbird (marsh bird)	*Agelaius phoeniceu*				X	X	
Whip-poor-will (WABCP PRIORITY)	*Antrostomus vociferus*						
Tufted Titmouse (bottomland hardwoods)	*Baeolophus bicolor*						
Ruffed Grouse (forest & streams) (WABCP PRIORITY)	*Bonasa umbellus*						
Red-tail Hawk (open upland/wetland habitats)	*Buteo jamaicensis*				X	X	
Cardinal (shrubby forest edges/woodlands)	*Carduelis cardinalis*					X	
Veery (WABCP PRIORITY)	*Catharus fuscescens*						
Brown Creeper (bottomland hardwoods)	*Certhia americana*						
Chimney Swift (WABCP PRIORITY)	*Chaetura pelagica*						
Marsh Wren (WABCP PRIORITY)	*Cistothorus palustris*						
Yellow-billed Cuckoo (WABCP PRIORITY)	*Coccyzus americanus*						
Black-billed Cuckoo (WABCP PRIORITY)	*Coccyzus erythropthalmus*						
Northern Flicker (WABCP PRIORITY)	*Colaptes auratus*						
Eastern Wood-Pewee (bottomland hardwoods)	*Contopus virens*						
American Crow (diverse upland/wetland habitats)	*Corvus brachyrhynchos*					X	
Blue Jay (bottomland hardwoods)	*Cyanocitta cristata*					X	
Chestnut-sided Warbler (WABCP PRIORITY)	*Dendroica pensylvanica*						
Bobolink (grassland/prairie)	*Dolichonyx oryzivorus*				X		
Least Flycatcher (WABCP PRIORITY)	*Empidonax minimus*						
Willow Flycatcher (WABCP PRIORITY)	*Empidonax traillii*						
Rusty Blackbird (WABCP PRIORITY)	*Euphagus carolinus*						
Kentucky Warbler (WABCP PRIORITY)	*Geothlypis formosa*						
Common Yellowthroat (WABCP PRIORITY)	*Geothlypis trichas*						
Barn Swallow (WABCP PRIORITY)	*Hirundo rustica*				X		
Wood Thrush (WABCP PRIORITY)	*Hylocichla mustelina*						
Baltimore Oriole (bottomland hardwoods)	*Icterus galbula*						

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		Project Impact Area:	**Underwood Creek & Menomonee River**	**Root River**	**Fox River**	**Pebble Brook, Pebble Creek, and Mill Brook**	**Vernon Marsh incl. Nearby Wetlands and Springs**
Group, Common Name and Habitat Notes	**Scientific Name**	***Base Flow Changes:***	***Higher Base Flow***	***Higher Base Flow***	***Lower Base Flow***	***Lower Base Flow from Groundwater Drawdown***	***Groundwater Drawdown 1 to 5+ feet***
Red-headed Woodpecker (WABCP PRIORITY)	*Melanerpes erythrocephalus*						
Turkey (grassland/forest/woodland)	*Meleagris gallopavo*					X	
Swamp Sparrow (WABCP PRIORITY)	*Melospiza georgiana*						
Song Sparrow (bottomland hardwoods)	*Melospiza melodia*						
Great Crested Flycatcher (bottomland hardwoods)	*Myiarchus crinitus*						
Mourning Warbler (WABCP PRIORITY)	*Oporornis philadelphia*						
Louisiana Waterthrush (WABCP PRIORITY)	*Parkesia motacilla*						
Savannah Sparrow (grassland/prairie)	*Passerculus sandwichensis*				X		
Cliff Swallow (cliffs near bottomland hardwoods)	*Petrochelidon pyrrhonota*						
Rose-breasted Grosbeak (WABCP PRIORITY)	*Pheucticus ludovicianus*						
Downy Woodpecker (bottomland hardwoods)	*Picoides pubescens*						
Chickadee (upland/wetland forests/marshes)	*Poecile atricapillus*					X	
Blue-gray Gnatcatcher (bottomland hardwoods)	*Polioptila caerulea*						
American Golden Plover (WABCP PRIORITY)	*Pluvialis dominica*						
Prothonotary Warbler (WABCP PRIORITY)	*Protonotaria citrea*						
Common Grackle (diverse upland/wetland habitats)	*Quiscalus quiscula*						
Bank Swallow (WABCP PRIORITY)	*Riparia riparia*						
American Woodcock (shrub wetlands) (WABCP PRIORITY)	*Scolopax minor*				X		
Yellow-throated Warbler (WABCP PRIORITY)	*Setophaga dominica*						
American Redstart (bottomland hardwoods)	*Setophaga ruticilla*						
Yellow-bellied Sapsucker (WABCP PRIORITY)	*Sphyrapicus varius*						
American Goldfinch (prairie/wet meadows)	*Spinus tristis*				X		
Field Sparrow (tall grass and brush)	*Spizella pusilla*				X		
Northern Rough-winged Swallow (WABCP PRIORITY)	*Stelgidopteryx serripennis*						
Barred Owl (forests/swamps)	*Strix varia*						
Eastern Meadowlark (prairie/wet meadows)	*Sturnella magna*				X		
European Starling (diverse upland/wetland habitats)	*Sturnus vulgaris*						
Brown Thrasher (WABCP PRIORITY)	*Toxostoma rufum*						
House Wren (bottomland hardwoods)	*Troglodytes aedon*						
American Robin (bottomland hardwoods)	*Turdus migratorius*					X	
Eastern Kingbird (open habitats along water)	*Tyrannus tyrannus*				X		
Golden-winged Warbler (WABCP PRIORITY)	*Vermivora chrysoptera*						
Blue-winged Warbler (WABCP PRIORITY)	*Vermivora cyanoptera*						
Warbling Vireo (WABCP PRIORITY)	*Vireo gilvus*						
Yellow-throated Vireo (WABCP PRIORITY)	*Vireo flavifrons*						
Mourning Dove (open upland/wetland habitats)	*Zenaida macroura*					X	
Others: Sparrows, Warblers & Woodpeckers	SWRPC (2008) did not list scientific names					X	
[2] Birds: Common Piscivores, Shorebirds, Waders and Waterfowl - All species are likely or possible in in suitable aquatic/wetland habitats of all impact areas.							
Wood Duck (bottomland hardwoods/marshes)	*Aix sponsa*						
Blue-winged Teal (WABCP PRIORITY)	*Anas discors*						
Mallard (WABCP PRIORITY)	*Anas platyrhynchos*						
American Black Duck (WABCP PRIORITY)	*Anas rubripes*						
Great Blue Heron (emergent marshes)	*Ardea herodias*				POSSIBLE[2]	POSSIBLE[2]	
Great Egret (WABCP PRIORITY)	*Ardea alba*				POSSIBLE[2]	POSSIBLE[2]	
Lesser Scaup (WABCP PRIORITY)	*Aythya affinis*						
Ring-necked Duck (emergent marshes)	*Aythya collaris*						
Canvasback (WABCP PRIORITY)	*Aythya valisineria*						

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Group, Common Name and Habitat Notes	**Scientific Name**	***Base Flow Changes:***	***Higher Base Flow***	***Higher Base Flow***	***Lower Base Flow***	***Lower Base Flow from Groundwater Drawdown***	***Groundwater Drawdown 1 to 5+ feet***
American Bittern (WABCP PRIORITY)	*Botaurus lentiginosus*						
Canada Goose (marshes/wet meadows)	*Branta canadensis*						
Dunlin (WABCP PRIORITY)	*Calidris alpina*						
Pectoral Sandpiper (emergent marshes)	*Calidris melanotos*						
Buff-breasted Sandpiper (WABCP PRIORITY)	*Calidris subruficollis*						
Belted Kingfisher (mostly aquatic diet) (WABCP PRIORITY)	*Ceryle alcyon*						
Trumpeter Swan (WABCP PRIORITY)	*Cygnus buccinator*						
Tundra Swan (WABCP PRIORITY)	*Cygnus columbianus*						
Snowy Egret (WABCP PRIORITY)	*Egretta thula*						
American Coot (emergent marshes)	*Fulica americana*						
Short-billed Dowitcher (WABCP PRIORITY)	*Limnodromus griseus*						
Marbled Godwit (WABCP PRIORITY)	*Limosa fedoa*						
Hudsonian Godwit (WABCP PRIORITY)	*Limosa haemastica*						
Hooded Merganser (WABCP PRIORITY)	*Lophodytes cucullatus*						
Whimbrel (WABCP PRIORITY)	*Numenius phaeopus*						
Yellow-crowned Night-Heron (WABCP PRIORITY)	*Nyctanassa violacea*						
Ruddy Duck (emergent marshes)	*Oxyura jamaicensis*						
Wilson's Phalarope (WABCP PRIORITY)	*Phalaropus tricolor*						
Red-necked Grebe (WABCP PRIORITY)	*Podiceps grisegena*						
Sora (emergent marshes)	*Porzana carolina*						
King Rail (WABCP PRIORITY)	*Rallus elegans*						
Virginia Rail (emergent marshes)	*Rallus limicola*						
Common Tern (WABCP PRIORITY)	*Sterna hirundo*						
Greater Yellowlegs (WABCP PRIORITY)	*Tringa melanoleuca*						
Solitary Sandpiper (WABCP PRIORITY)	*Tringa solitaria*						
Unspecified species of "Ducks"	SWRPC (2008) did not list scientific names					X	
Birds: [1] RTE Species (includes federal and state-listed Endangered (E), Threatened (T) and Wisconsin Special Concern (SC) species.							
Henslow's Sparrow (T) (tall, weedy grassland/mesic prairie)	*Ammodramus henslowii*				X	X	
Grasshopper Sparrow (SC) (tall, weedy grassland/mesic prairie)	*Ammodramus savannarum*				X		
Northern Pintail (SC) (WABCP PRIORITY) (shallow wetlands)	*Anas acuta*				X		X
Redhead (SC) (WABCP PRIORITY) (emergent marshes, open water)	*Aythya americana*			X	X		
Upland Sandpiper (SC) (native prairie/grassland)	*Bartramia longicauda*				X		
Red-shouldered Hawk (T) (WABCP PRIORITY) (riparian swamps)	*Buteo lineatus*						
Black Tern (SC) (WABCP PRIORITY) (shallow marshes, water)	*Chlidonias niger*			X	X	X	X
Northern Harrier (SC) (WABCP PRIORITY) (crops, sedge meadows)	*Circus cyaneus*				X		
Acadian Flycatcher (T) (WABCP PRIORITY) (lowland forests)	*Empidonax virescens*				X		
Common Moorhen (SC) (emergent marshes)	*Gallinula chloropu*				X		X
(Mississippi) Sandhill Crane (E; WABCP PRIORITY) (wetlands)	*Grus canadensis pulla*					X	
Bald Eagle - fish eaters (SC) (WABCP PRIORITY) (Waukesha Co.)	*Haliaeetus leucocephalus*						
Least Bittern (SC) (emergent marshes)	*Ixobrychus exilis*			X	X		X
Black-Crowned Night Heron (SC) (emergent marshes)	*Nycticorax nycticorax*		X		X	X	
Osprey - fish eaters (SC) (bottomland hardwoods)	*Pandion haliaetus*						
Cerulean Warbler (T) (WABCP PRIORITY) (floodplain forest)	*Setophaga cerulea*				X		
Hooded Warbler (T) (hardwood forest with understory)	*Setophaga citrina*				X		
Dickcissel (SC) (grasslands/prairie)	*Spiza Americana*						
Forster's Tern (E; WABCP PRIORITY) (marshes, lake islands)	*Sterna forsteri*			X	X		
Barn Owl (E; open crop fields, grassland or marshes)	*Tyto alba*				X		

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Yellow-headed Blackbird (SC) (WABCP PRIORITY) (marshes/water)	*Xanthocephalus xanthocephalus*			X			
Mammals: Common Terrestrial - Likely to inhabit upland field/meadows, prairie, woodlands and forests along multiple rivers/streams.							
Coyote	*Canis latrans*				POSSIBLE[2]	POSSIBLE[2]	
Opossum	*Didelphis virginiana*					X	
Woodchuck	*Marmota monax*						
Striped Skunk	*Mephitis mephitis*						
Meadow Vole (lowlands, grasslands, riparian habitats)	*Microtus pennsylvanicus*						
Whitetail Deer	*Odocoileus virginianus*					X	
White-footed deer mouse (Dry forest/shrubby woodland)	*Peromyscus leucopus*						
Deer Mouse (Dry forest/shrubby woodland)	*Peromyscus maniculatus*						
Raccoons	*Procyon lotor*				POSSIBLE[2]	X	
Gray & Fox Squirrels	*Sciurus carolinensis & S. niger*					X	
Eastern Cottontail Rabbit	*Sylvilagus floridanus*					X	
Chipmunk	*Tamias striatus*					X	
Red Squirrel	*Tamiasciurus striatus*					X	
Red Fox	*Vulpes vulpes*						
Mammals - Common Aquatic and Wetland Likely to Inhabit One or More Habitats along Multiple Rivers/Streams.							
Northern Short-tailed Shrew (grassland, marshes, forests)	*Blarina brevicauda*						
Beaver (streams/rivers, riparian forests, wetlands)	*Castor canadensis*					X	
North American River Otter (rivers/streams, riparian forest)	*Lontra canadensis*						
Mink (rivers/streams, forests, wetlands)	*Neovison vison*						
Muskrat (shorelines, marshes, wetlands)	*Ondatra zibethicus*						
Mammals: [1] RTE Species (includes federal and state-listed Endangered (E), Threatened (T) and Wisconsin Special Concern (SC) species.							
Franklin's Ground Squirrel (SC) (grasslands, shrub wetlands)	*Spermophilus frankilinii*				X		X

NOTES:

1 - All RTE species listed are those identified by WDNR as found in the overall study area and included in area-specific tables of Appendix 6-6 of prior report, without indicating river/stream-specific occurrences, except for historical presence within groundwater drawdown areas including the Fox River and Vernon Marsh, as well as several water supply or return routes, such as Root River Return Alternative 2. Thus, aquatic and wetland species entries were made, respectively, in columns for Vernon Marsh and Fox River based on historical occurrence data from WDNR for the groundwater drawdown areas. Other column-specific occurrences of RTE species in specific rivers/streams, watersheds and/or wetlands are based on supplemental data from reports on specific rivers/watersheds.

2 - Entries of "POSSIBLE" occurrences of herptile or other wildlife species are based on: (1) reported presence of Blanchard Cricket Frog in and (2) WDNR (2013) Fact Sheet for this species that lists associated predators of these frogs and other amphibian species that share the same wetland breeding habitats of Blanchard Cricket Frogs.

3 - (WABCP PRIORITY) indicates a Priority Bird Species of Emergent Marshes and Bottomland Hardwoods listed in the Wisconsin All Bird Conservation Plan

X - Those species marked with an X had documented presence within sited literature and other agency sources. However, all species noted as common are likely to be present in all habitats listed.

N/A - Indicates that the species is unlikely to occur in the specified habitat.

Open Waters - Those species indicated with Open Waters indicate that they would only be likely to occur within open areas of the Vernon Marsh, not shallower emergent marsh areas.

TABLE 2

Summary of Project Hydrologic Impacts to Aquatic and Associated Riparian/Wetland Biological Communities and Species Groups

Impacted Watercourses:	Underwood Creek and Menomonee River	Root River	Fox River	Fox River Tributaries (Pebble Brook Pebble Creek, Mill Brook)
Applicable Alternatives:	**Applicable Return Flow Alternative:** **1. Underwood Creek to Lake Michigan**	**Applicable Return Flow Alternatives:** **1. Proposed Project (Root River to Lake Michigan Alignment 2)** **2. Root River to Lake Michigan Alignment 1**	**Applicable Water Supply or Return Flow Alternatives:** **1. Proposed Project (Root River to Lake Michigan Alignment 2) Return Flow** **2. Underwood Creek to Lake Michigan Return Flow (Same impacts as the proposed project)** **3. Direct to Lake Michigan Return Flow (Same impacts as the proposed project)** **5. MMSD Return Flow Alternatives (Same impacts as the proposed project)** **6. Deep and Shallow Aquifers Water Supply** **7. Shallow Aquifer and Fox River Alluvium Water Supply**	**Applicable Water Supply Alternatives:** **1. Deep and Shallow Aquifers** **2. Shallow Aquifer and Fox River Alluvium**
Hydrologic Impact Scenarios:	**Higher Base flow - 100% of Base flow During Drought Conditions on Underwood Creek**	**Higher Base flow - 80 to 90% of Base flow During Drought Conditions on the Root River**	**5% to 25% Lower Base Flow from relocating the Waukesha Wastewater Discharge for the return flow requirement** **Increased natural flow from discontinuing groundwater withdrawal for Waukesha water supply (Maximum Reduction of 25% and 2 inches for Proposed Project and All Lake Michigan Return Alternatives; 5% - 11% for Groundwater Alternatives)**	**Maximum Reduction of 34, 13, and 85% respectively**
Algae and Macrophytes	Beneficial impacts to species that require steady water levels, especially during dry periods of seasonal low water levels, such what occurs in Underwood Creek. Increased flow meets or is better than nutrient standards, thus reducing eutrophication and seasonal blooms of nuisance algae and macrophytes. Return flow low biological oxygen demand and high dissolved oxygen levels provides beneficial conditions.	Beneficial Impact, especially during dry periods of seasonal low water levels and in reaches of the river with shallow water. Increased flows also may dilute nutrient levels, thus reducing eutrophication and seasonal blooms of nuisance algae and macrophytes. Return flow low biological oxygen demand and high dissolved oxygen levels provides beneficial conditions.	Minor adverse impact from base flow reduction during dry seasons in shallow water reaches of the river where area available for algae and macrophytes will have minor reductions. The impact would be a slight reduction in habitat area and not quality. Analysis has shown a maximum water level change from redirecting return flow is 2 inches. Consequently, only minor changes are expected.	Significant Adverse Impact from base flow reduction during dry seasons in shallow water reaches of the headwater tributaries where area available for algae and macrophytes will have significant reductions.
Benthic Macroinvertebrates - Common and RTE Species	Macroinvertebrate data indicates very poor to fair index scores for Underwood Creek and the Menomonee River. Beneficial impacts to macroinvertebrates would be expected from higher base flows resulting from return flow creating more habitat, especially during chronic dry periods/seasons. Benefits would include preventing or mitigating drought-induced stress in the abundance, frequency and species composition of benthic macroinvertebrate communities. Any resultant increases in the abundance and biodiversity of macroinvertebrates also will benefit the fish and wildlife that prey on these aquatic biota.	Macroinvertebrate data indicates poor to fair index scores in much of the Root River. Beneficial Impacts of increased base flows resulting from return flow creating more habitat, especially during chronic dry periods/seasons. Benefits would include preventing or mitigating drought-induced stress in the abundance, frequency, and species composition of benthic macroinvertebrate communities that will benefit from increased base flows. Any resultant increases in the abundance and biodiversity of benthic macroinvertebrates also will benefit the fish and wildlife that prey on these aquatic biota.	Base flow changes during seasonal dry periods may have a minor adverse change in the habitat along the land/water interface. This may result in a change in the abundance, frequency, spatial patterns and species composition of benthic macroinvertebrate communities. However, analysis has shown a maximum water level change from redirecting return flow is 2 inches. Reductions in the abundance or biodiversity of benthic macroinvertebrates caused by seasonally reduced base flows would only have a de minimus adverse effect on the diet of fish and wildlife that prey on these aquatic biota and this would only occur in dry years.	Base flow changes during seasonal dry periods would have significant adverse change in the habitat along the land/water interface. This may result in a change in the abundance, frequency, spatial patterns and species composition of benthic macroinvertebrate communities. In dry years affected reaches of the tributaries could completely dry up for extended periods. Any reductions in the abundance or biodiversity of benthic macroinvertebrates caused by chronically reduced base flows also could adversely affect the diet of fish and wildlife that prey on these aquatic biota.

TABLE 2

Summary of Project Hydrologic Impacts to Aquatic and Associated Riparian/Wetland Biological Communities and Species Groups

Impacted Watercourses:	Underwood Creek and Menomonee River	Root River	Fox River	Fox River Tributaries (Pebble Brook Pebble Creek, Mill Brook)
RTE Insects	No rare, threatened or endangered insect species were reported from the Menomonee River or Underwood Creek in query results from WDNR nor in other available studies of these waterbodies and associated habitats. However, since many of the 21 species of RTE insects reported from habitats along the Fox River and Root River are aquatic or wetland species, the benefits to the aquatic and wetland communities that would result from increased base flows also should benefit RTE insects of these areas.	Nine (9) rare, threatened or endangered insect species were reported from habitats associated with the Root River, either by WDNR or in other available studies of this river and associated habitats, including 3 species of skimmer (*Libellula* spp.), a genus of dragonflies, and several other RTE insects that are aquatic or wetland-dependent species. Given their dependence on wetland communities for food and habitat, the increased base flows in the river will benefit these insects and the aquatic and wetland communities they rely on for food and habitat.	Threatened or endangered aquatic insect species were reported from habitats associated with the Fox River, either by WDNR or in other available studies of this river and associated habitats, including 2 species of skipper (*Euphyes* spp. - a genus of butterflies), 2 species of the damselfly genus *Ischnura*, and several other RTE insects that are aquatic or wetland-dependent species. Since these species depend on aquatic resources, reduced flows to aquatic and wetland habitats along the Fox River could have a minor adverse effect on these insects, especially during a drought. However, analysis has shown a maximum water level change from redirecting return flow is 2 inches, so significant adverse impacts are not expected and if any occur they would be to reduce the quantity and not the quality of suitable habitat.	Twelve (12) rare, threatened or endangered insect species were reported from habitats associated with the Fox River, either by WDNR or in other available studies of this river and associated habitats, including 2 species of skipper (*Euphyes* spp. - a genus of butterflies), 2 species of the damselfly genus *Ischnura*, and several other RTE insects that are aquatic or wetland-dependent species. *Euphyes* larvae and adults feed on emergent wetland plants, including sedges, woolgrass, pickerelweed, sneezeweed, and buttonbush. Since these and several other RTE insects found along the Fox River and tributaries are aquatic or wetland species, reduced flows to aquatic and wetland habitats could have a significant adverse effect locally in these tributaries on these RTE insects, especially during a drought. Thus there could be significant reduction in habitat area for these species
Amphibians - Common Terrestrial Species	No data were available on the occurrences of amphibians along the Menomonee River or Underwood Creek, but data available for the other rivers/streams evaluated for various project alternatives indicate that at least six (6) common species of terrestrial amphibians might be expected to inhabit these riparian corridors. Beneficial Impacts to terrestrial amphibians of floodplain and riparian habitats that will benefit from increased water availability, especially during chronic dry periods/seasons, by potentially mitigating drought-induced changes in soil moisture, drought-sensitive vegetation and abundance or biodiversity of amphibian food and prey resources.	Available data from the Wisconsin Herptile Atlas and other studies of the Root River indicate that at least six (6) common species of terrestrial amphibians might be expected to inhabit these riparian corridors, including two (2) actually reported for the Root River. Terrestrial amphibians of floodplain and riparian habitats will benefit from increased base flows and water availability, especially during chronic dry periods/seasons, which will mitigate drought-induced changes in soil moisture, drought-sensitive vegetation, and the abundance of amphibian food and prey resources.	Available data from the Wisconsin Herptile Atlas and other studies of the Fox River indicate that at least six (6) common species of terrestrial amphibians inhabit these riparian corridors. Little or no adverse impact should result to terrestrial amphibians of floodplain and riparian habitats from slightly decreased water availability, even during seasonal dry periods, because a two-inch drop in river channel water levels should not cause significant adverse effects on the soil moisture, drought-sensitive vegetation, nor the abundance of amphibian food and prey resources in riparian and upland forests and other habitats. Since riparian zone amphibians are pre-adapted to seasonal and weather-related fluctuations in water levels, they should not be adversely impacted by any slight soil moisture reductions within riparian and floodplain habitats that do not directly abut the river banks.	Available data from the Wisconsin Herptile Atlas and other studies of the Fox River system indicate that at least six (6) common species of terrestrial amphibians inhabit these riparian corridors. Adverse impact could result to terrestrial amphibians of floodplain and riparian habitats from significantly decreased water availability when the tributaries contribute to significant life stage needs of these terrestrial amphibians. Since riparian zone amphibians are pre-adapted to seasonal and weather-related fluctuations in water levels, adults should not be adversely impacted by moisture reductions within riparian and floodplain habitats that do not directly abut the river banks.
Amphibians - Common Aquatic and Wetland Species	No data were available on the occurrences of amphibians along the Menomonee River or Underwood Creek, but data available for the other rivers/streams evaluated for project alternatives indicate that at least 4 common, native species of aquatic amphibians might be expected to inhabit aquatic and wetland habitats along these riparian corridors. Amphibians of aquatic and wetland habitats will benefit from increased water availability, especially during chronic dry periods/seasons, since increased base flows likely will mitigate seasonal drought-induced changes in wetland/floodplain soil moisture, drought-sensitive vegetation and abundance/biodiversity of amphibian food and prey.	Available data from the Wisconsin Herptile Atlas and other studies of the Root River indicate that at least four (4) common species of aquatic and wetland amphibians might be expected to inhabit these riparian corridors, including the Northern Green Frog reported for the Root River. Amphibians of aquatic and wetland habitats will benefit from increased water availability, especially during chronic dry periods/seasons, since higher base flows likely will mitigate drought-induced changes in water levels, wetland soil moisture, drought-sensitive vegetation, and the abundance/biodiversity of amphibian food and prey resources.	While no inventories or lists of common amphibian species were available for the Fox River, at least four (4) common frog species are reported for the three project counties in the Wisconsin Herptile Atlas and other reports for the overall project area. Maximum flow reductions during seasonal dry periods may reduce the quantity of habitat for aquatic and wetland amphibian populations during dry years but the habitat would return during normal rainfall years. However, because the maximum water level change is expected to be two-inches, any habitat changes should not cause significant adverse effects to amphibian habitat.	At least four (4) common frog species are reported for the three project counties in the Wisconsin Herptile Atlas and other reports for the overall project area. Maximum flow reductions during seasonal dry periods could produce changes in the spatial patterns and species composition of aquatic and wetland amphibian populations, as well as water-dependent insects or macroinvertebrate prey upon which they feed during low rainfall periods. Any reductions in the abundance or biodiversity of amphibians caused by chronically reduced base flows also could adversely affect the diet of fish and wildlife that prey on these amphibians.
Amphibians - RTE Species	WDNR has reported two (2) RTE, aquatic frog species that do inhabit reaches of the Menomonee River and/or Underwood Creek that will benefit from increased water availability, especially during chronic dry periods/seasons, by potentially mitigating drought-induced changes in water levels, wetland soil moisture, drought-sensitive aquatic/wetland vegetation, and the relative abundance/biodiversity of amphibian food and prey resources.	WDNR has reported three (3) RTE species of amphibians that do or may inhabit reaches of the Root River impacted by this project, including the terrestrial four-toed salamander and two aquatic frog species. RTE amphibians of aquatic, wetland and floodplain/riparian habitats will benefit from increased water availability, especially during chronic dry periods/seasons, since higher water levels will mitigate drought-induced changes in soil moisture, drought-sensitive vegetation and abundance/biodiversity of amphibian food and prey resources.	WDNR has reported four (4) RTE species of aquatic amphibians that do or may inhabit reaches of the Fox River impacted by this project. Maximum flow reductions during seasonal dry periods may reduce the quantity but not the quality of suitable habitat during dry years. However, because the maximum water level change is expected to be two-inches, any habitat changes should not cause significant adverse effects to amphibian habitat.	WDNR has reported four (4) RTE species of aquatic amphibians that do or may inhabit reaches of the Fox River system impacted by this project. Maximum flow reductions during seasonal dry periods could cause permanent changes in the spatial patterns and species composition of RTE amphibian populations, as well as water-dependent insect or macroinvertebrate prey upon which they feed. Any reductions in the abundance or biodiversity of RTE amphibians caused by chronically reduced base flows also could adversely affect the diet of fish and wildlife that prey on these amphibians.

TABLE 2

Summary of Project Hydrologic Impacts to Aquatic and Associated Riparian/Wetland Biological Communities and Species Groups

Impacted Watercourses:	Underwood Creek and Menomonee River	Root River	Fox River	Fox River Tributaries (Pebble Brook Pebble Creek, Mill Brook)
Reptiles - Common Terrestrial Species	Data were not available on the occurrences of common, terrestrial reptile species of riparian or upland habitats along the Menomonee River or Underwood Creek, but data for the Fox River and Root River indicate that at least three (3) common, native species of terrestrial reptiles also may occur in suitable habitats along these riparian corridors. Three (3) other terrestrial reptiles found in the three-county project area, reported in the Wisconsin Herptile Atlas, also are likely to occur in upland or habitats along these riparian corridors. Terrestrial reptiles of riparian and floodplain habitats along these waterways may benefit from increased water availability, especially during chronic dry periods/seasons, since increased base flows likely will mitigate seasonal drought-induced changes in riparian/floodplain soil moisture, drought-sensitive vegetation, and the abundance or biodiversity of food and prey species consumed by reptiles.	Very few data were available on the occurrences of common, terrestrial reptile species of riparian or upland habitats along the Root River, for which only two (2) common snake species were reported among the six (6) terrestrial reptiles found in the three-county project area according to the Wisconsin Herptile Atlas. Terrestrial reptiles of the Root River riparian and floodplain habitats may benefit from increased base flows, especially during chronic dry periods/seasons, since greater water availability is likely to mitigate seasonal drought-induced changes in riparian/floodplain soil moisture, drought-sensitive vegetation, and abundance/biodiversity of food and prey consumed by reptiles.	Available data from the Wisconsin Herptile Atlas and other studies of the Fox River indicate that at least three (3) common species of terrestrial reptile inhabit Fox River riparian corridors, although it is likely that three (3) other terrestrial snakes reported from the three-county study area by the Wisconsin Herptile Atlas also occur along the Fox River. No adverse impact should result to terrestrial reptiles of floodplain and riparian habitats from even maximum reductions in base flow, even during seasonal dry periods, because a two-inch drop in river channel water levels should not cause significant adverse effects on the soil moisture, drought-sensitive vegetation, nor the abundance of reptile food and prey. Since riparian zone reptiles are pre-adapted to seasonal and weather-related fluctuations in water levels, they should not be adversely impacted by any slight soil moisture reductions within riparian and floodplain habitats that do not directly abut the river banks.	Available data from the Wisconsin Herptile Atlas and other studies of the Fox River system indicate that at least three (3) common species of terrestrial reptile inhabit Fox River riparian corridors, although it is likely that three (3) other terrestrial snakes reported from the three-county study area by the Wisconsin Herptile Atlas also occur along the Fox River. No adverse impact should result to terrestrial reptiles of floodplain and riparian habitats from even maximum reductions in base flow, even during seasonal dry periods, because riparian zone reptiles are pre-adapted to seasonal and weather-related fluctuations in water levels, they should not be adversely impacted by soil moisture reductions within riparian and floodplain habitats that do not directly abut the river banks.
Reptiles - Common Aquatic Species	No data were available on the occurrences of aquatic reptiles along the Menomonee River or Underwood Creek, but data available for the Fox River and Root River indicate that at least 4 common, native species of aquatic reptiles might be expected to inhabit aquatic and wetland habitats along these riparian corridors, as well as the Spiny Softshell Turtle, which was reported from the three-county study area in the Wisconsin Herptile Atlas. Reptiles of aquatic and wetland habitats will benefit from increased water availability, especially during chronic dry periods/seasons, since increased base flows likely will mitigate seasonal drought-induced changes in wetland and floodplain soil moisture and drought-sensitive vegetation. Increased base flow also may mitigate drought-induced reductions in the abundance and species composition of aquatic and wetland communities of macroinvertebrates, insects, amphibians, fish or other faunal prey upon which these reptile populations depend for survival. Any increased abundance or biodiversity of prey species for reptiles caused by greater base flows, in turn, could beneficially affect the diet of predatory wildlife that feed on these reptiles.	Available data from the Wisconsin Herptile Atlas and other studies of the Root River indicate that at least five (5) common species of aquatic reptiles may inhabit the Root River channel and adjacent ponds/wetlands, including two turtle species reported for the Root River. Aquatic reptiles of the Root River channel and associated wetlands will benefit from increased water availability, especially during chronic dry periods/seasons, since higher base flows likely will mitigate drought-induced changes in water levels, wetland soil moisture, drought-sensitive vegetation, and the abundance/biodiversity of their food and prey resources. Increased base flow also may mitigate drought-induced reductions in the abundance and species composition of aquatic and wetland communities of macroinvertebrates, insects, amphibians, fish or other faunal prey upon which these reptile populations depend for survival. Any increased abundance or biodiversity of prey species for reptiles caused by greater base flows, in turn, could beneficially affect the diet of predatory wildlife that feed on these reptiles.	Available data from the Wisconsin Herptile Atlas and other studies of the Fox River indicate that at least three (3) common species of aquatic reptiles may inhabit the Fox River channel and adjacent ponds/wetlands, including two (2) turtle species reported for the Fox River. The Fox River channel and associated ponds/wetlands also are likely to support two (2) other common turtles reported for the three project counties in the Wisconsin Herptile Atlas. Maximum base flow reductions during seasonal dry periods could cause changes in the quantity but not the quality of suitable habitat for these species. However, because the maximum water level change is expected to be two-inches, any habitat changes should not cause significant adverse effects to aquatic habitat. A minor reduction in the abundance of prey species for reptiles caused by seasonally reduced base flows, in turn, could affect the diet of predatory wildlife that feed on these reptiles during periods of low flow but any impacts would be of short duration.	Available data from the Wisconsin Herptile Atlas and other studies of the Fox River system indicate that at least three (3) common species of aquatic reptiles may inhabit the Fox River channel and adjacent ponds/wetlands, including two (2) turtle species reported for the Fox River. The Fox River channel and associated ponds/wetlands also are likely to support two (2) other common turtles reported for the three project counties in the Wisconsin Herptile Atlas. The Fox River tributaries likely contain these species also. Maximum flow reductions during seasonal dry periods would likely cause permanent changes in the abundance and species composition of aquatic and wetland communities of macroinvertebrates, insects, amphibians, fish or other faunal prey upon which these reptile populations depend for survival. Any reductions in the abundance or biodiversity of prey species for reptiles caused by chronically reduced base flows, in turn, could adversely affect the diet of predatory wildlife that feed on these reptiles.

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Impacted Watercourses:	Underwood Creek and Menomonee River	Root River	Fox River	Fox River Tributaries (Pebble Brook Pebble Creek, Mill Brook)
Reptiles - RTE Species	The Wisconsin Herptile Atlas reports eleven (11) RTE species of reptiles from the three-county project study area, including several reported in watersheds affected by the project. WDNR reported two (2) RTE reptiles, Blanding's Turtle and Butler's Gartersnake, from unspecified habitats along the Menomonee River or Underwood Creek, although WDNR and other reports indicate than six (6) other RTE species of reptiles occur within the overall project study area, so that some of them also may inhabit these riparian corridors. The beneficial impacts of increased base flows, as described above for common species of terrestrial, wetland and aquatic reptiles, also can be expected for these RTE species.	The Wisconsin Herptile Atlas reports eleven (11) RTE species of reptiles from the three-county project study area, including several reported in watersheds affected by the project. Blanding's Turtle and four (4) RTE species of snakes were reported from habitats along the Root River, by WDNR or in other reports, although these same sources indicate that three (3) other RTE snake species occur within the overall project study area, so that some of them also may inhabit the Root River riparian corridor. It also is conceivable that several of the other three (3) RTE reptiles reported from the three-county area also occur along the Root River. The beneficial impacts of increased Root River base flows, as described above for common species of terrestrial, wetland and aquatic reptiles, also can be expected for these RTE species.	The Wisconsin Herptile Atlas reports eleven (11) RTE species of reptiles from the three-county project study area, including several reported in watersheds affected by the project. WDNR has reported Blanding's Turtle and five (5) RTE species of snakes that inhabit reaches of the Fox River impacted by this project but it is conceivable that several of the other five (5) RTE reptiles reported from the three-county area also occur along the Fox River. Maximum flow reductions during seasonal dry periods may cause changes in the quantity but not the quality of suitable habitat for these species However, because the maximum water level change is expected to be two-inches, any habitat changes should not cause significant adverse effects to aquatic habitat. Any reductions in the abundance or biodiversity of RTE reptiles caused by reduced base flows also could affect the diet of predatory wildlife that prey on these snakes and turtles during periods of low flow but any impacts would be of short duration.	The Wisconsin Herptile Atlas reports eleven (11) RTE species of reptiles from the three-county project study area, including several reported in watersheds affected by the project. WDNR has reported Blanding's Turtle and five (5) RTE species of snakes that inhabit reaches of the Fox River system impacted by this project but it is conceivable that several of the other five (5) RTE reptiles reported from the three-county area also occur along the Fox River system. Maximum flow reductions during seasonal dry periods could cause permanent changes in the spatial patterns and species composition of RTE reptile populations, and would likely adversely affect the water-dependent macroinvertebrate, insect, amphibian or fish prey upon which they feed. Any reductions in the abundance or biodiversity of RTE reptiles caused by chronically reduced base flows also could adversely affect the diet of predatory wildlife that prey on these snakes and turtles.
Birds - Common Terrestrial Species	Data were not found on the common, terrestrial bird species of riparian or upland habitats along the Menomonee River or Underwood Creek but available data on terrestrial birds along the Fox River and its tributaries, Pebble Creek, Pebble Brook and Mill Brook, confirm at least ten (10) common, species of terrestrial birds along those riparian corridors. Other terrestrial birds likely to occur within the study area include 52 species listed in the Wisconsin All Bird Conservation Plan as commonly inhabiting or using Emergent Marshes and Bottomland Hardwoods, which occur along these riparian corridors, 31 of which are designated as WABCP Priority Species. Terrestrial birds of riparian and floodplain habitats along these waterways may benefit from increased water availability, especially during chronic dry periods/seasons, since increased base flows likely will mitigate seasonal drought-induced changes in riparian/floodplain soil moisture, drought-sensitive vegetation, and the abundance of plant foods and prey species consumed by terrestrial birds.	Data were not found on the common, terrestrial bird species of riparian or upland habitats along the Root River but available data on terrestrial birds along the Fox River and its tributaries, Pebble Creek, Pebble Brook and Mill Brook, confirm at least ten (10) common, species of terrestrial birds along those riparian corridors. Other terrestrial birds likely to occur along the Root River riparian corridor are 52 common species listed in the Wisconsin All Bird Conservation Plan as inhabiting or using Emergent Marshes and Bottomland Hardwoods, which occur along the Root River, including 31 that are designated as WABCP Priority Species. Terrestrial birds of riparian and floodplain habitats along these waterways may benefit from increased water availability, especially during chronic dry periods/seasons, since increased base flows likely will mitigate seasonal drought-induced changes in riparian/floodplain soil moisture, drought-sensitive vegetation, and the abundance of plant foods and prey species consumed by terrestrial birds.	Available data on terrestrial birds along the Fox River and its tributaries, Pebble Creek, Pebble Brook and Mill Brook, confirm at least ten (10) common, species of terrestrial bird inhabiting this riparian corridor. Other terrestrial birds likely to occur along the Fox River and tributary riparian corridors are 52 common species, listed in the Wisconsin All Bird Conservation Plan as inhabiting or using Emergent Marshes and Bottomland Hardwoods, 31 of which are designated as WABCP Priority Species. It is possible but unlikely that the maximum flow reduction (25%) and water level 2 inches lower could result in minor stress to drought-sensitive riparian vegetation and prey species consumed by terrestrial birds, such stress would be short-term and highly localized along the river banks, rather than extending throughout riparian habitats along the river, occurring under periodic or seasonal drought conditions. Since riparian zone terrestrial bird populations are highly mobile and pre-adapted to seasonal or weather-related fluctuations in water levels, they will be able to modify their foraging behavior as needed to compensate for any temporary reductions in food/prey availability that may result from localized but temporary reductions in water levels, soil moisture, and the abundance of food/prey within riparian and floodplain habitats that directly abut the river banks.	Available data on terrestrial birds along the Fox River and its tributaries, Pebble Creek, Pebble Brook and Mill Brook, confirm at least ten (10) common, species of terrestrial bird inhabiting this riparian corridor. Other terrestrial birds likely to occur along the Fox River and tributary riparian corridors are 52 common species, listed in the Wisconsin All Bird Conservation Plan as inhabiting or using Emergent Marshes and Bottomland Hardwoods, 31 of which are designated as WABCP Priority Species. Although likely that the maximum base flow reduction would stress drought-sensitive riparian vegetation and prey species consumed by terrestrial birds, such stress would be highly localized along the tributary banks, rather than extending throughout riparian habitats along the river. Since riparian zone terrestrial bird populations are highly mobile and pre-adapted to seasonal or weather-related fluctuations in water levels, they will be able to modify their foraging behavior as needed to compensate for any temporary reductions in food/prey availability that may result from localized but temporary reductions in water levels, soil moisture, and the abundance of food/prey within riparian and floodplain habitats that directly abut the river banks.

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Impacted Watercourses:	Underwood Creek and Menomonee River	Root River	Fox River	Fox River Tributaries (Pebble Brook Pebble Creek, Mill Brook)
Birds - Common Waterfowl/Waders	Data were not found on the common piscivores, shorebirds, waterfowl and wading birds inhabiting or using aquatic and wetland habitats along the Menomonee River or Underwood Creek but water-dependent birds likely to occur within the study area include 34 species listed in the Wisconsin All Bird Conservation Plan as commonly inhabiting or using Emergent Marshes and Bottomland Hardwoods, which occur along these riparian corridors, 25 of which are designated as WABCP Priority Species. Water-dependent birds of aquatic and wetland habitats along these waterways may benefit from increased water availability, especially during chronic dry periods/seasons, since increased base flows are likely to mitigate seasonal drought-induced changes in water depth/quality, emergent wetland soil moisture, drought-sensitive aquatic or wetland vegetation, and the abundance or biodiversity of aquatic prey species consumed by piscivores, shorebirds, waterfowl and wading birds.	Data were not found on the common piscivores, shorebirds, waterfowl and wading birds inhabiting or using aquatic and wetland habitats along the Root River but water-dependent birds likely to occur within the study area include 34 species listed in the Wisconsin All Bird Conservation Plan as commonly inhabiting or using Emergent Marshes and Bottomland Hardwoods, which occur along these riparian corridors, 25 of which are designated as WABCP Priority Species. Water-dependent birds of aquatic and wetland habitats along these waterways may benefit from increased water availability, especially during chronic dry periods/seasons, since increased base flows likely will mitigate seasonal drought-induced changes in water depth/quality, emergent wetland soil moisture, drought-sensitive aquatic or wetland vegetation, and the abundance or biodiversity of aquatic plants and prey species consumed by piscivores, shorebirds, waterfowl and wading birds.	Data were not found on the common piscivores, shorebirds, waterfowl and wading birds inhabiting or using aquatic and wetland habitats along the Fox River but water-dependent birds likely to occur within the study area include 34 species listed in the Wisconsin All Bird Conservation Plan as commonly inhabiting or using Emergent Marshes and Bottomland Hardwoods, which occur along these riparian corridors, 25 of which are designated as WABCP Priority Species. Water-dependent birds of aquatic and wetland habitats along the Fox River may experience minor, highly-localized reductions in quantity of aquatic and wetland plant foods and faunal prey under scenarios of maximum (25%) base flow reduction with a two-inch drop in water levels, especially during seasonal dry periods. But such impacts are unlikely to extend very far from the river banks, so that ample breeding and feeding areas for water-dependent birds should persist throughout most of the open water and emergent wetland habitats of the Fox River floodplains. Since water-dependent birds also are highly mobile and pre-adapted to natural fluctuations in water levels, they will be able to modify their foraging behavior for the short periods of any reduced food availability as needed to compensate for any temporary habitat changes and reductions in food/prey availability that may result from temporary reductions in water levels, localized within the reaches of aquatic and wetland habitats that directly abut the banks of the impacted river channels.	Data were not found on the common piscivores, shorebirds, waterfowl and wading birds inhabiting or using aquatic and wetland habitats along the Fox River tributaries but water-dependent birds likely to occur within the study area include 34 species listed in the Wisconsin All Bird Conservation Plan as commonly inhabiting or using Emergent Marshes and Bottomland Hardwoods, which occur along these riparian corridors, 25 of which are designated as WABCP Priority Species. Water-dependent birds of aquatic and wetland habitats along the Fox River tributaries may experience reductions in the abundance and diversity of aquatic and wetland plant foods and faunal prey under expected base flow reductions, during seasonal dry periods. Such impacts are unlikely to extend very far from the river banks, but critical habitat in the upstream reaches of the tributaries could be adversely affected in dry years.
Birds - RTE Species	Limited data were available from WDNR and various published data sources on RTE bird species inhabiting or using aquatic, wetland and terrestrial habitats along the Menomonee River or Underwood Creek. However, the Wisconsin All Bird Conservation Plan has identified 21 RTE bird species (including 11 WABCP Priority Birds) that inhabit emergent marshes and bottomland hardwood swamps that are similar to those found along all streams and rivers throughout the project study area. While 17 of these RTE birds have been reported locally among the stream, river, wetland and riparian impact areas evaluated for the various project alternatives, only the Black-Crowned Night Heron was reported from the Menomonee River or Underwood Creek. However, it is likely that some of the RTE bird species found in the other study areas also reside or periodically forage within suitable habitats along this riparian corridor. RTE birds of diverse habitats along the Menomonee River or Underwood Creek are expected to enjoy the same ecological benefits from increased base flows as described above for common bird species, especially during chronic dry periods/seasons, since increased water availability can directly enhance the health of all plant communities, as well as the abundance or biodiversity of prey species consumed by RTE species of terrestrial, wetland and water-dependent birds.	Limited data were available from WDNR and various published data sources on RTE bird species inhabiting or using aquatic, wetland and terrestrial habitats along the Root River. However, the Wisconsin All Bird Conservation Plan has identified 21 RTE bird species (including 11 WABCP Priority Birds) that inhabit emergent marshes and bottomland hardwood swamps that are similar to those found along all streams and rivers throughout the project study area. While 17 of these RTE birds have been reported locally among the stream, river, wetland and riparian impact areas evaluated for the various project alternatives, only five (5) RTE birds were reported from the Root River. However, it is likely that some other RTE bird species found elsewhere within the project study areas also reside or periodically forage within suitable habitats along this riparian corridor. RTE birds of diverse habitats along the Root River are expected to enjoy the same ecological benefits from increased base flows as described above for common bird species, especially during chronic dry periods/seasons, since increased water availability can directly enhance the health of all plant communities, as well as the abundance or biodiversity of prey species consumed by RTE species of terrestrial, wetland and water-dependent birds.	Fifteen (15) RTE birds were reported from the Fox River by WDNR, including 7 WABCP Priority Birds. RTE species of terrestrial birds that are not sensitive to minor changes in water levels will not be adversely impacted even by the maximum base flow reduction. RTE species of water-dependent birds found in aquatic and wetland habitats along the Fox River may experience minor and highly-localized reductions in the abundance but not the quality of aquatic and wetland plant foods and faunal prey under the maximum (25%) base flow reduction scenario with a two-inch drop in water levels, especially during seasonal dry periods. But such impacts are unlikely to extend very far from the river banks, so that ample breeding and feeding areas for water-dependent RTE bird species should persist throughout most of the open water and emergent wetland habitats of the Fox River floodplains. Since these water-dependent birds also are highly mobile and pre-adapted to natural fluctuations in water levels, they will be able to modify their foraging behavior during any brief periods of reduced food availability as needed to compensate for any temporary habitat changes and reductions in food/prey availability that may result from water level changes, localized within the reaches of aquatic and wetland habitats that directly abut the banks of the impacted river channels.	Fifteen (15) of the total of 17 RTE birds found locally across all impact areas evaluated for various project alternatives were reported from the Fox River system by WDNR, including 7 WABCP Priority Birds. RTE species of terrestrial birds that are not sensitive to changes in water levels will not be adversely impacted even by the maximum base flow reduction. In contrast, there could be some effects on RTE species of water-dependent birds found in aquatic and wetland habitats along the Fox River tributaries such as: henslow's sparrow, black-crowned night heron, and yellow-headed blackbird. These species would likely experience minor, reductions in the abundance and diversity of aquatic and wetland plant foods and faunal prey under the maximum base flow reduction scenario, especially during seasonal dry periods. Such impacts are unlikely to extend very far from the river banks, but for the species highly dependent on aquatic resources, at least in dry years breeding and feeding areas could be reduced or diminished in availability and quality

TABLE 2

Summary of Project Hydrologic Impacts to Aquatic and Associated Riparian/Wetland Biological Communities and Species Groups

Impacted Watercourses:	Underwood Creek and Menomonee River	Root River	Fox River	Fox River Tributaries (Pebble Brook Pebble Creek, Mill Brook)
Mammals - Common Terrestrial Species	Since no published data were found on mammal species or communities along Menomonee River or Underwood Creek, published information on the mammals of Wisconsin was reviewed to identify common mammals most likely to occur within the diverse terrestrial, wetland or aquatic habitats throughout the entire project study area. Based on the habitats known to occur throughout the study area, 14 species of terrestrial mammals are likely to occur within the three-county project study area. Limited published data for Pebble Brook, Pebble Creek, and Mill Brook also verified the presence of 7 of these terrestrial mammals. As noted for other groups of terrestrial fauna, increased base flows within the Menomonee River and Underwood Creek can be expected to benefit terrestrial mammals by enhancing water availability, riparian zone soil moisture, the overall health and vigor of riparian vegetation, and the abundance and diversity of aquatic, wetland and terrestrial food plants and/or faunal prey consumed by these mammals.	Since no published data were found on mammal species or communities along the Root River, published information on the mammals of Wisconsin was reviewed to identify common mammals most likely to occur within the diverse terrestrial, wetland or aquatic habitats throughout the entire project study area. Based on the habitats known to occur throughout the study area, 14 species of terrestrial mammals are likely to occur within the three-county project study area. Limited published data for Pebble Brook, Pebble Creek, and Mill Brook also verified the presence of 7 of these terrestrial mammals. As noted for other groups of terrestrial fauna, increased base flows within the Root River are expected to benefit terrestrial mammals by enhancing water availability, riparian zone soil moisture, the overall health and vigor of riparian vegetation, and the abundance and diversity of aquatic, wetland and terrestrial food plants and/or faunal prey consumed by these mammals.	Since no published data were found on mammal species or communities along the Fox River system, published information on the mammals of Wisconsin was reviewed to identify common mammals most likely to occur within the diverse terrestrial, wetland or aquatic habitats throughout the entire project study area. Based on the habitats known to occur throughout the study area, 14 species of terrestrial mammals are likely to occur within the three-county project study area. Although the maximum base flow reduction could stress drought-sensitive riparian vegetation and prey species consumed by terrestrial mammals these only represent a minor food source for terrestrial mammals. Also, such stress would be highly localized along the tributary banks, rather than extending throughout riparian habitats. Since terrestrial mammal populations are highly mobile and pre-adapted to seasonal or weather-related fluctuations in water levels, they will be able to modify their foraging behavior as needed to compensate for any temporary or permanent reductions in food/prey availability that would likely result from localized reductions in water levels, soil moisture, and the abundance of food/prey within riparian and floodplain habitats that directly abut the river banks. Thus, as noted for other groups of terrestrial fauna, decreased base flows are unlikely to have a significant adverse ecological impact on terrestrial mammal populations and communities.	Published information on the mammals of Wisconsin was reviewed to identify common mammals most likely to occur within the diverse terrestrial, wetland or aquatic habitats throughout the entire project study area. Based on the habitats known to occur throughout the study area, 14 species of terrestrial mammals are likely to occur within the three-county project study area. Limited published data for Pebble Brook, Pebble Creek, and Mill Brook also verified the presence of 7 of these terrestrial mammals. Since terrestrial mammal populations are highly mobile and pre-adapted to seasonal or weather-related fluctuations in water levels, they will be able to modify their foraging behavior for short duration low flow periods as needed to compensate for any temporary reductions in food/prey availability that may result from any localized reductions in water levels, soil moisture, and the abundance of food/prey within riparian and floodplain habitats that directly abut the river banks. Thus, as noted for other groups of terrestrial fauna, decreased base flows are unlikely to have a significant adverse ecological impact on terrestrial mammal populations and communities.

TABLE 2

Summary of Project Hydrologic Impacts to Aquatic and Associated Riparian/Wetland Biological Communities and Species Groups

Impacted Watercourses:	Underwood Creek and Menomonee River	Root River	Fox River	Fox River Tributaries (Pebble Brook Pebble Creek, Mill Brook)
Mammals - Common Aquatic Species	Since no published data were found on mammal species or communities along Menomonee River or Underwood Creek, published information on the mammals of Wisconsin was reviewed to identify common mammals most likely to occur within the diverse terrestrial, wetland or aquatic habitats throughout the entire project study area. Based on the habitats known to occur throughout the study area, five (5) species of aquatic mammals are likely to occur within the three-county project study area. Limited published data for Pebble Brook, Pebble Creek, and Mill Brook also verified the presence of a single aquatic mammal, the beaver, reported from Pebble Creek above its confluence with the Fox River. However, the emergent wetland habitats of this riparian corridor also are likely to support species such as muskrat, which preferentially feed on cattails and other emergent plants. As noted for other groups of water-dependent fauna, increased base flows within the Menomonee River and Underwood Creek can be expected to benefit aquatic mammals by enhancing water depth/quality, riparian zone soil moisture, the overall health and vigor of riparian vegetation, and the abundance and diversity of aquatic and wetland food plants and/or faunal prey consumed by these water-dependent mammals.	Since no published data were found on mammal species or communities along the Root River, published information on the mammals of Wisconsin was reviewed to identify common mammals most likely to occur within the diverse terrestrial, wetland or aquatic habitats throughout the entire project study area. Based on the habitats known to occur throughout the study area, five (5) species of aquatic mammals are likely to occur within the three-county project study area. Limited published data for Pebble Brook, Pebble Creek, and Mill Brook also verified the presence of a single aquatic mammal, the beaver, reported from Pebble Creek above its confluence with the Fox River. However, the emergent wetland habitats of this riparian corridor also are likely to support other mammals like muskrat, which preferentially feed on cattails and other emergent plants. As noted for other groups of water-dependent fauna, increased base flows within the Root River are expected to benefit aquatic mammals by enhancing water depth/quality, riparian zone soil moisture, the overall health and vigor of riparian vegetation, and the abundance and diversity of aquatic and wetland food plants and/or faunal prey consumed by these water-dependent mammals.	Published information on the mammals of Wisconsin was reviewed to identify common mammals most likely to occur within the diverse terrestrial, wetland or aquatic habitats throughout the entire project study area. Based on the habitats known to occur throughout the study area, five (5) species of aquatic mammals are likely to occur within the three-county project study area While possible it is unlikely that the maximum flow reduction (25%) and water level 2 inches lower could stress drought-sensitive, aquatic/wetland vegetation and faunal prey consumed by water-dependent mammals, such stress likely would be short-term, during periodic or seasonal drought conditions, and be highly localized within the river channels rather than extending into open water habitats of deeper wetlands within the river floodplain. Since water-dependent mammal populations are highly mobile and pre-adapted to seasonal or weather-related fluctuations in water levels, they will be able to modify their foraging behavior for the short durations of any changes in food availability as needed to compensate for temporary reductions in food/prey availability that may result from any temporary reductions in water levels and the abundance of food/prey within river channels and adjacent open water wetlands directly abutting the river banks. Beavers, for example, are especially resilient since they create their own ponds and even a permanent, up to two-inch drop in water level should not deter them from building and maintaining dams. Thus, as noted for other groups of water-dependent fauna, even the maximum decrease in base flow is unlikely to have a significant adverse ecological impact on water-dependent mammal populations and communities.	Published information on the mammals of Wisconsin was reviewed to identify common mammals most likely to occur within the diverse terrestrial, wetland or aquatic habitats throughout the entire project study area. Based on the habitats known to occur throughout the study area, five (5) species of aquatic mammals are likely to occur within the three-county project study area. Limited published data for Pebble Brook, Pebble Creek, and Mill Brook also verified the presence of a single aquatic mammal, the beaver, reported from Pebble Creek above its confluence with the Fox River. However, the emergent wetland habitats of this riparian corridor also are likely to support other mammals like muskrat, which preferentially feed on cattails and other emergent plants. The maximum flow reduction would stress any drought-sensitive, aquatic/wetland vegetation and faunal prey consumed by water-dependent mammals. This could result in both a decrease in quality and quantity of habitat for these species, particularly in dry years.
Mammals - RTE Species	No RTE mammal species were reported from habitats found along Menomonee River or Underwood Creek.	No RTE mammal species were reported from habitats found along the Root River.	Franklin's Ground Squirrel (*Spermophilus frankilinii*), a species of Special Concern in Wisconsin, is the only RTE mammal species reported by WDNR from the Fox River. WDNR reports that this semi-colonial species prefers brushy and partly wooded areas, dense grassy, shrubby marshland, as well as, prairie edges, rather than open prairie. Although conceivable that the maximum flow reduction (25%) and water level 2 inches lower could stress drought-sensitive, riparian or wetland vegetation found in close proximity to the river bank, no impact is anticipated on the preferred habitat of the squirrel. Thus, even during a prolonged drought, the 25% base flow reduction and up to two-inch drop in water level of the Fox River would be unlikely to extend throughout the grassy and scrub-shrub wetlands of the Fox River floodplain that would be preferred habitat for this ground squirrel.	Franklin's Ground Squirrel (*Spermophilus frankilinii*), a species of Special Concern in Wisconsin, is the only RTE mammal species reported by WDNR from the Fox River and Vernon Marsh system. WDNR reports that this semi-colonial species prefers brushy and partly wooded areas, dense grassy, shrubby marshland, as well as, prairie edges, rather than open prairie. Although likely that the maximum flow reduction would stress drought-sensitive, riparian or wetland vegetation found in close proximity to the tributary banks, such stress likely would highly localized within the tributary channels. Thus, even during a prolonged drought, the base flow reduction would be unlikely to extend throughout the grassy and scrub-shrub wetlands of the floodplain that would be preferred habitat for this ground squirrel.

TABLE 3

Summary of Project Hydrologic Impacts to Wetland Functions and Values of Vernon Marsh and Nearby Wetlands from Groundwater Supply Alternatives

Select Wetland Functional Values Recognized by WDNR (WRAM v.2)	Groundwater Drawdown Impacts to Wetland Functions and Values of Vernon Marsh and Nearby Wetlands
	Groundwater Drawdown 1 to 5 or more feet
Human Use Values	
HU 1, 2 & 3: Recreation, Education & Science	Impacts are expected to ephemeral ponds/vernal pools as well as to wildlife, from hydrology-related losses of wetland habitat value and potential drought stress to wetland vegetation, especially during low flow periods and seasons. Drawdown impacts to springs in Vernon Marsh and other wetland drawdown impact areas, both along the Fox River and its tributary streams and adjacent wetland interiors, will further exacerbate the area-wide drawdown impacts mediated by soil desiccation and direct drought stress to wetland flora and fauna, especially water-dependent insects, macroinvertebrates, amphibians, reptiles and birds. Chronic drought stress from drawdown will cause permanent soil and floristic changes in the patterns and species composition of existing wetland communities, increasing the risk of colonization by invasive, non-native plant species of little or no value to ecologically and recreationally-important wildlife, as well as increased risk of summertime brush fires due to desiccation of riparian and wetland soils and vegetation. Significant adverse impacts are predicted. These impacts will significantly reduce the value of the wetlands and Vernon Marsh for human recreation, education, and potential for advancement and teaching of science.
HU 4: Biodiversity	Impacts are expected within emergent, scrub-shrub or forested wetlands, especially losses of immobile species in ephemeral ponds and wetlands that cannot easily/quickly migrate into wetter habitats as drawdown impacts eliminate the surface water and saturated soils needed for survival, growth and reproduction (e.g., flora, insects, amphibians, and reptiles). Biodiversity losses will be greatest among habitats and species that are highly sensitive to water loss, such as vernal pools used for amphibian breeding and wet meadows inhabited by RTE species (e.g., Liatris and Silphium borers), especially during low flow periods and seasons when the water table drawdown may not be adequately replenished by surface water inflows, thus eliminating minimum water levels required for survival and reproduction. Decreased wetland soil moisture and increased depth to water table caused by drawdown will adversely impact the diversity of wetland vegetation, with OBL and FACW species being displaced by more drought tolerant plants (FAC, FACU & UPL). Similar reductions will occur in the diversity of aquatic/wetland species of insects, macroinvertebrates, amphibians, reptiles, water/wetland-dependent birds, and their food/prey supplies in wetlands/vernal pools, which are highly sensitive to water loss. Significant adverse impacts could occur. Because there are many species which only occur in these habitats the reduction of biodiversity will be not only for the wetlands but also for the region.
HU 6: T & E Species Habitat	Impacts are expected to RTE species dependent on ephemeral or shallow ponds and wetlands living, breeding and/or feeding within emergent, scrub-shrub or forested wetlands and emergent (e.g., insects: swamp metalmark, double-striped bluet, two-spotted skipper, and fragile forktail; amphibians: pickerel frog, leopard frog and common mudpuppy; and birds: common moorehen, least bittern, and black-crowned night heron). Drawdown poses the greatest risks to species of habitats that are highly sensitive to water loss, such as vernal pools used for amphibian breeding and wet meadows inhabited by RTE species (e.g., Liatris and Silphium borers), especially during low flow periods and seasons when the water table drawdown may not be adequately replenished by surface water inflows to maintain minimum water levels required for survival and reproduction. Drawdown-driven decreases of wetland soil moisture and increased water table depths will adversely impact wetland vegetation and RTE species of insects, macroinvertebrates (e.g., crustaceans), amphibians, fish, water-dependent reptiles and birds, and their wetland/vernal pool food/prey supplies, all of which are highly sensitive to water loss. Chronic drought stress from drawdown also will cause permanent floristic changes in the

TABLE 3

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Select Wetland Functional Values Recognized by WDNR (WRAM v.2)	Groundwater Drawdown Impacts to Wetland Functions and Values of Vernon Marsh and Nearby Wetlands
	Groundwater Drawdown 1 to 5 or more feet
	patterns and species composition of existing wetland communities, increasing the risk of colonization by invasive, non-native species of little or no value to ecologically and recreationally-important wildlife, which is especially stressful for many RTE species. Significant adverse impacts could occur.
Wildlife Habitat Values	
WH 1 - Wetland and contiguous habitat >10 acres	Impacts would likely occur from drawdown-driven contraction, desiccation and transformation of existing Vernon Marsh and other wetlands and/or spring-fed habitats, into drier habitats lacking wetland flora and fauna, especially in peripheral, higher elevation wetland reaches. As described in Section 6.4.3.1 of the Environmental Report, under the Deep and Shallow Aquifers supply alternative, 1,000 acres of wetlands would experience a 5-foot or greater groundwater drawdown; a 1-foot or greater groundwater drawdown would occur for more than 3,000 wetland acres. The Shallow Aquifer and Fox River Alluvium alternative would have nearly 2,000 acres of wetlands experience a 5-foot or greater groundwater drawdown; a 1-foot or greater groundwater drawdown would occur for more than 4,000 wetland acres. While groundwater drawdown will not directly reduce the combined acreage of contiguous wetland and upland wildlife habitat, it would likely result in more upland habitat becoming available and thus at risk for land use change, causing long-term cumulative reductions in total contiguous habitat available to wildlife. Significant adverse impacts to wildlife habitat types could occur.
WH 3 - Within wildlife habitat corridor	Impacts would likely occur to the types of habitats dominant in the primary environmental corridor in and around the Vernon Marsh. Communities affected include emergent marsh, scrub/shrub, forested, and open water wetland habitats. Impacts from drawdown-driven contraction, desiccation and transformation of existing Vernon Marsh and other wetlands and/or spring-fed habitats, into drier habitats lacking wetland flora and fauna, will directly change the characteristics and habitat value of the wildlife corridor, by resulting in less wetland habitat and more upland habitat available, thus changing the types and quality of contiguous habitat available to wildlife. If these floristic changes result in more available upland habitat, the existing wildlife habitat corridor could be at risk for cumulative impacts from future land use change of unprotected uplands, ultimately causing long-term reductions in total contiguous habitat available to wildlife. Significant adverse impacts to wildlife habitat types could occur.
WH 6 - Interspersion of Habitat Types	Changes to Habitat Interspersion may result from groundwater drawdown, losses of surface waters/vernal pools, and chronic desiccation of wetland soils and some springs/seeps, causing greater homogeneity of vegetative communities with fewer ecotonal interfaces among aquatic, wetland and upland habitats in and around Vernon Marsh and surrounding wetland drawdown areas. Hydrology-driven transformations of shallow ponds, vernal pools and wet meadows into upland habitats/flora, coupled with reductions of open water and deeper marsh habitats, will reduce the existing habitat complexity and floristic diversity. Drought-stressed wetlands will become more vulnerable to monocultural invasions of non-

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Summary of Project Hydrologic Impacts to Wetland Functions and Values of Vernon Marsh and Nearby Wetlands from Groundwater Supply Alternatives

Select Wetland Functional Values Recognized by WDNR (WRAM v.2)	Groundwater Drawdown Impacts to Wetland Functions and Values of Vernon Marsh and Nearby Wetlands
	Groundwater Drawdown 1 to 5 or more feet
	native plant species, which in turn will further reduce habitat interspersion and degrade overall wildlife habitat quality. Significant adverse impact could occur.
WH 7 - Habitat for Species of Greatest Conservation Need (SGCN)or priority bird species in WI All-Bird Cons. Plan	Impacts would occur to SGCN, Priority & RTE Birds residing, breeding or feeding within impacted emergent, scrub-shrub or forested wetlands, especially those that depend heavily on immobile prey species of the ephemeral ponds and shallower wetlands that may be degraded or lost due to chronic drawdown. Drawdown of Vernon Marsh and surrounding wetlands also may enable colonization of invasive vegetation, while eliminating surface water and saturated soils needed for survival, growth and reproduction of these wildlife foods and prey (e.g., flora, insects, amphibians, and reptiles). Desiccation-driven losses of these key bird breeding and feeding areas also can reduce local populations of SGCN and WABCP Priority birds, at least seasonally and/or during low flow periods when the depleted water table is not adequately replenished by surface water inflows, thus eliminating the minimum water levels required for adequate feeding, survival and reproduction. Drawdown-induced habitat changes, eventually, also risk permanent losses of these birds from the floristically and hydrologically transformed wetlands. Decreased wetland soil moisture and increased depth to water table caused by drawdown also will reduce the abundance and diversity of the aquatic/wetland/vernal pool species of macroinvertebrates, insects, amphibians, and reptiles preyed upon by these avian SGCN, WABCP Priority and other water/wetland-dependent birds. Significant adverse impact could occur.
WH 9 & 10 - Ephemeral pond with water > 45 days and Habitat for amphibians and aquatic invertebrates	Impacts are expected to amphibians and aquatic invertebrates inhabiting wetlands, vernal pools and springs from groundwater drawdown, causing chronically lower water levels in vernal pools and the shallower open water wetlands, all of which are highly sensitive to water loss, especially during low flow periods and seasons. Drawdown of open waters that are fed by ground water upwelling into channel bottoms and spring discharges into bordering wetlands also will reduce the amount of surface water flow that otherwise might periodically overtop river/stream banks and creating vernal and other isolated pools which constitute rare and sensitive habitat. Lower open water levels would also diminish replenishment soil moisture and surface water levels in the drawdown-impacted wetlands of Vernon Marsh and other areas fed by springs or surface water inflows. During low flow the drawdowns also will reduce the chances of adequate food supply, reproductive success and even survival of amphibians and macroinvertebrates dependent on vernal pools. Similarly, chronic drawdown during the summer dry periods also could exacerbate any eutrophic conditions and accelerate long-term eutrophication of shallow water areas by increasing flushing time, gradually reducing the total wetland acreage and water quality of flooded habitats available for amphibians and aquatic invertebrates. Significant adverse impacts could occur.
Fish and Aquatic Life Habitat Values	

TABLE 3

Summary of Project Hydrologic Impacts to Wetland Functions and Values of Vernon Marsh and Nearby Wetlands from Groundwater Supply Alternatives

Select Wetland Functional Values Recognized by WDNR (WRAM v.2)	Groundwater Drawdown Impacts to Wetland Functions and Values of Vernon Marsh and Nearby Wetlands
	Groundwater Drawdown 1 to 5 or more feet
FA 1 - Wetland contiguous with perennial stream	Impacts to wetland/stream connections are likely to occur from groundwater drawdown and surface water losses, which will reduce the frequency of existing hydrologic connections of Vernon Marsh and other bordering wetlands, via shallow wetland contractions and the transformation of peripheral, wet meadow habitats into upland plant communities. Moderate to significant adverse impacts could occur.
FA 2 - Standing water for amphibians & aquatic invertebrates	Impacts to amphibians and aquatic invertebrates from groundwater drawdown and surface water losses from deeper water marsh habitats likely to degrade or destroy the ephemeral ponds/vernal pools and other wetland habitats needed by amphibians and aquatic invertebrates to survive, proliferate and reproduce. The chronically reduced surface and ground water levels in the vernal pools and open water wetlands, coupled with the potential for desiccation of higher elevation wetland soils and/or the cessation of spring/seep discharges, all pose high risks of severe impact and permanent losses of all or most water-dependent species, especially during drought conditions. Significant adverse impacts could occur.
FA 3 - Natural Heritage Inventory (NHI) listed aquatic species in aquatic system	Impacts to NHI-listed aquatic biota, found in the vernal pools, deep water marshes and open water habitats of Vernon Marsh and other wetlands, will result from the significant drawdown of groundwater. Losses of vernal pool and other open water wetlands, coupled with reductions in wetland soil moisture and transformation of some wetlands into upland plant communities, will result from groundwater drawdown of wetlands. The water losses will adversely impact NHI-listed species of macroinvertebrates, insects, fish, amphibians and reptiles, as well as water-dependent RTE species of birds and mammals. Adverse impacts from reduced water levels also can degrade water quality in open water wetland habitats, which in turn may further reduce the summertime abundance and biodiversity of aquatic food/prey supply for NHI-listed wildlife species. Significant adverse impacts could occur.
FA 4 - Vegetation is inundated in spring	Impact on springtime flooding of wetland vegetation from groundwater drawdown in Vernon Marsh and other wetlands could occur, including reduced flows from seeps and springs, with greatest impacts within drier reaches of wetland, such as wet meadows. The drawdown impact is not likely to be mitigated by overbank flooding of surface water into the wetlands because flood waters will infiltrate and recharge ground water much faster than baseline/normal conditions, due to the much drier soils and greater depths to ground water within drawdown areas. However, the impacts of groundwater drawdown will be most severe during periods of drought and less during periods of significant runoff. Minor to moderate adverse impacts could occur.
Shoreline Protection Functions	
SP 3 - Densely rooted emergent or woody vegetation	Significant impacts to densely rooted vegetation along river/stream banks in Vernon Marsh and other wetlands will result from drawdown of groundwater and resultant reductions in seep and spring discharges, wetland soil moisture and areas of standing water. Floristic transformations from wetland to terrestrial plant communities will be most rapid and pronounced during low flow periods and the drier, summer season, causing a decline in plant health/vigor, stem/foliage density, and total cover of densely rooted, shoreline vegetation. Significant adverse impacts could occur.
Flood and Stormwater Storage Functions	

TABLE 3

Summary of Project Hydrologic Impacts to Wetland Functions and Values of Vernon Marsh and Nearby Wetlands from Groundwater Supply Alternatives

Select Wetland Functional Values Recognized by WDNR (WRAM v.2)	Groundwater Drawdown Impacts to Wetland Functions and Values of Vernon Marsh and Nearby Wetlands
	Groundwater Drawdown 1 to 5 or more feet
ST 3 - Dense, persistent vegetation	Minor to moderate adverse impacts to dense, persistent vegetation will result from drawdown of groundwater and resultant reductions in seep/spring discharges, wetland soil moisture and areas of standing water. Floristic transformations from wetland to terrestrial plant communities will be most rapid and pronounced during low flow periods and the summer season, causing a decline in plant health/vigor, stem/foliage density, and total cover of dense, perennial vegetation. Reduced base flows also could change some channel segments from perennial to intermittent or seasonal flows, thus depriving riparian vegetation, Vernon Marsh and other wetlands of overbank flooding and surface water replenishment. However, storage volume for flood and stormwater storage is not expected to change. Minor adverse impacts could occur.
ST 4 - Evidence of flashy hydrology	Impact of stream flow flashiness of seasonal and weather related stream flows due to groundwater drawdown is not expected to significantly change. Other flashiness evaluation of streams showed no significant change in streamflow with discharge changes and the impacts from groundwater drawdown are expected to be similar. No significant adverse impact is expected.
Water Quality Protection Functions	
WQ 4 - Vegetated wetland borders lake or stream	Impacts to bordering vegetated wetlands' ability to detain and renovate surface and ground water quality via normal soil and microbially-mediated pollutant attenuation and removal processes could change due to lower groundwater levels. Localized groundwater drawdown, including possible loss of seep or spring discharges, will gradually transform the biogeochemical processes of the wetland soils, microbes and vegetation. These adverse hydrologic changes also will increase the potential for colonization by upland and/or invasive plant species, further reducing the pollution attenuation functional capacity of Vernon Marsh and other bordering vegetated wetlands. Also a 1 to 5 foot or more drop in groundwater levels will significantly reduce the areal extent of bordering vegetation which typically exist in areas with surface expression of the groundwater table. However, wetlands that are immediately bordering the Fox River could derive hydrology inputs from river level fluctuations allowing vegetated wetland borders to the Fox River to remain. Minor adverse impact could occur.
WQ 5 - Dense, persistent vegetation	Same as Wetland Function ST-3 above: Minor adverse impact could occur.
WQ 8 - Discharge to surface water	Impacts to groundwater discharges to surface waters will occur in Vernon Marsh and other wetlands, despite the presence of seeps or springs, due to significant groundwater drawdown coupled with reduced base flows in adjacent channels. Less groundwater discharging to wetlands and springs will result in less water discharging from wetlands to surface waters. Chronic drawdown of groundwater within the wetlands will reduce the supply of ground water available for discharge into river and stream channels via seepage from banks and/or overland flow across the wetland from springs and/or surface water bodies into the channels. While lower base flows in channels across groundwater discharge wetlands can accommodate increased influx of surface and ground water from the wetlands under normal, undisturbed conditions, wetland areas with predicted groundwater drawdown of 1 and 5 or more feet are highly unlikely to discharge groundwater into river or stream channels, unless they are deeply incised and greater than 5 feet deep. Significant adverse impacts could occur.

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Select Wetland Functional Values Recognized by WDNR (WRAM v.2)	Groundwater Drawdown Impacts to Wetland Functions and Values of Vernon Marsh and Nearby Wetlands
	Groundwater Drawdown 1 to 5 or more feet
Groundwater Processes	
GW 1 - Springs, seeps or groundwater are present	The flow of groundwater discharges from springs or seeps of Vernon Marsh and other wetlands are likely to become less frequent, especially during drought or summer conditions. Reduced discharges from the spring-containing wetlands will result from lower amounts of water stored in wetlands and lower groundwater levels in the shallow aquifer, due to the chronic drawdown of wetland groundwater levels and shallow aquifer pressure available for discharge from springs and river/stream banks especially during drought conditions and low flow periods/seasons. Figures in Appendix 6-3 of the Environmental Report document springs within the groundwater drawdown which along with seeps provide important flow for sensitive habitat. Seep and spring flows would likely be affected by groundwater drawdown. Significant adverse impacts could occur.
GW 3 - Wetland remains saturated for an extended time period with no additional water inputs	Impacts to wetland saturation will result from the chronic drawdown of groundwater within Vernon Marsh and other wetlands, permanent losses of the shallowest surface waters and vernal pools, and chronic soil desiccation in the driest wetland reaches, such as scrub-shrub/forested wetlands and wet meadows. Because discharges from springs or seeps of Vernon Marsh and other wetlands will also be adversely impacted, they are unlikely to mitigate these drawdown losses in the surrounding wetlands. Under this drawdown scenario, additional water inputs would be needed to maintain the existing, normal wetland functions. Significant adverse impacts could occur.

TABLE 4

Summary of Proposed Project Pipeline Impacts to Wetland Functions and Values

WRAM Version 2 - Relevant Wetland Functions and Values	Proposed Project Pipeline Impacts to Wetland Functions and Values **0.11 acres of Emergent Marsh, Wet Meadow and Un-vegetated Mud Flats (NWI code PEM)** **0.10 acres of Scrub-Shrub Wetlands (NWI code PSS)** **0.57 acres of Palustrine Forested Wetlands (NWI code PFO)**
Human Use Values (HU 1 to 4 and 6)	No adverse permanent impacts to human use functional values of wetlands will occur as a result of the alternative pipeline routes. Temporary restrictions on access to wetlands during construction will be limited to the actual construction window, which is anticipated to be very brief and a return to existing conditions will occur shortly after construction is complete.
Wildlife Habitat Values (WH 1,3,6,7,9 & 10)	Wildlife will leave the palustrine scrub-shrub wetlands (PSS) and palustrine forested wetlands (PFO) habitats adjacent to or within construction areas and, due to the short duration of construction, in most cases will return after pipeline installation and site restoration. For most species they can still occupy/forage in the construction area during periods (e.g. at night) when there would be no human activity. Trench spoils from within wetlands will be segregated and replaced in the original soil profile to preserve the topsoil seed bank and to facilitate rapid natural regeneration of the original wetland vegetation from root sprouts and the seed bank. Since palustrine emergent (PEM) wetlands typically recover fully from the seed bank within a single growing season, the temporary disturbance of the plant community would be expected to be minor and ecologically insignificant to the wildlife habitat functions and values of PEM wetlands. Many species of flush-cut wetland shrubs (e.g., alders, dogwoods) and trees (e.g., red maple) can recover from stump sprouts within a few growing seasons and, consequently, disturbances of the woody plant community within PSS wetlands will be temporary and insignificant. Similarly, trees cut within PFO wetlands will recover from existing stumps left in place; however, the timeline for full regrowth will be more significant than for PSS wetland resources. Ultimately, no loss of functional value are anticipated within PFO wetlands within temporary construction workspaces. Where the permanent maintained right-of-way encroaches on wetland resources, those wetland areas will be operationally maintained as PEM conditions resulting in type class changes. However, the areas are very minor and the original hydrology, soils, and herbaceous component of those PSS and PFO communities will be fully restored such that the temporary disturbance of the non-plant community will be negligible, short-term, and ecologically insignificant to the wildlife habitat functions and values of the original PSS and PFO wetlands.
Fish and Aquatic Life Habitat Values (FA 1 to 4)	No adverse impacts will occur from either pipeline to fish and aquatic life habitat values (FA 1 to 4), since none of the wetlands to be disturbed directly provide these functions. The major waterbody crossings along the proposed and alternative pipeline routes occur at bridges or box culverts that cannot be open cut and, therefore, are most likely to be crossed using boring or horizontal directional drilling (HDD) methods. Consequently, any wetlands bordering aquatic habitats at a few locations will not be adversely impacted.
Shoreline Protection Functions (SP 1 & 3)	The major waterbody crossings along both pipeline routes occur at bridges or box culverts that cannot be open cut, but are most likely to be crossed using boring, HDD, or other trenchless construction methods; consequently, shoreline protection functions afforded by wetlands bordering aquatic habitats will not be adversely impacted. PEM resources adjacent to waterbodies that are disturbed during construction will be restored such that the existing seed bank can quickly reseed and stabilize the area. If necessary, additional BMPs including erosion control netting and temporary over seeding with an annual rye can be utilized to provide additional short-term shoreline protection. As a result of the implementation of these practices, any impacts to shoreline protection functions will be temporary and insignificant. PSS and PFO resources adjacent to waterbody crossings that are temporarily disturbed during construction will be restored with the environmental BMPs discussed previously for PEM resources. In addition, shrubs and trees outside of the actual trench line will be flush-cut at the ground surface and the stumps left in place to continue to provide stabilization.
Flood and Stormwater Storage Functions (ST 3 & 4)	No adverse impacts will occur to flood and stormwater storage functions (ST 3 & 4), since pipelines will be installed within wetlands using BMPs so that there will be no net fill of wetlands that otherwise would reduce storage capacity. If a pipeline must be placed within a wetland due to utility conflicts within the road bed or shoulder, stumps from the trench line and a volume of trench spoil equal to the pipe volume(s) will be removed for upland disposal, thus resulting in no net filling of the wetland, as required under Section 404 of the Clean Water Act and Wisconsin wetland regulations.
Water Quality Protection Functions (WQ 4, 5 & 8)	Impacts to water quality functions will temporarily occur within PEM wetlands while construction is occurring due to vegetation removal. However, aside from the pipeline trench itself, construction equipment will operate on swamp mats to protect the roots of emergent herbaceous vegetation. Since emergent wetlands typically recover fully from the existing root systems and seed bank within one growing season, temporary disturbance of the plant community will be negligible and ecologically insignificant to the water quality preservation and renovation functions and values of the PEM wetlands. For PSS and PFO wetlands, the permanent conversion to PEM conditions will not adversely affect the water quality functions of the wetland because the PEM will provide equivalent or superior water quality enhancement functions. Beyond the pipeline trench, there will be little or no disturbance of shrub or tree roots or soils that stabilize and promote soil microbial and fungal communities that help to attenuate pollution, so that there will be no adverse permanent or temporary impacts to water quality functions of disturbed PSS and PFO wetlands Even if equipment must traverse wetlands during construction any such traffic could occur on swamp mats to protect the flush-cut root systems of shrubs, many of which then should re-sprout and recover fully within a few growing seasons. In some cases, moreover, a dense herbaceous wetland community can be more effective at renovating surface water quality than a more sparsely vegetated PSS or PFO wetland with little or no ground cover of herbaceous vegetation.
Groundwater Processes (GW 1 & 3)	Finally, there will be no adverse permanent or temporary impacts to groundwater processes, since the project will not significantly alter the hydrology of the existing wetlands, either during or following construction. Even if there are any PSS and PFO wetlands where trees and shrubs must be removed during construction and a permanent right-of-way within the wetland must be maintained as a PEM free of trees or shrubs, for access and pipeline integrity reasons, the surface and subsurface hydrology of the original PSS or PFO wetland will not be altered.

Attachment 1
Proposed Project Wetland Crossing Map

Proposed Project Wetland Crossings Index Map

0 0.5 1 2 3 4 Miles

N

Legend

- Lake Michigan Supply - Oak Creek Alignment 2
- Root River Return Flow Alignnment 2
- Municipalities
- Major Roads

Pewaukee
Waukesha
BROOKFIELD
Brookfield
West Allis
West Milwaukee
Milwaukee
New Berlin
WAUKESHA
Hales Corners
Greenfield
Greendale
Muskego
Franklin
Oak Creek
Big Bend

US HWY 18
DAVIDSON RD
I 94
STATE HWY 59
W GREENFIELD AVE
W MITCHELL ST
W BECHER ST
STATE HWY 32
MADISON ST
E MAIN ST
S SPRINGDALE RD
S EAST AVE
N EAST AVE
E RACINE AVE
W LINCOLN AVE
S 84TH ST
S 70TH ST
S 43RD ST
S 35TH ST
W CLEVELAND AVE
W NATIONAL AVE
S 92ND ST
W BELOIT RD
STATE HWY 24
W OKLAHOMA AVE
US HWY 41
W HOLT AVE
W SUNSET DR
E SUNSET DR
S PRAIRIE AVE
CENTER RD
RACINE AVE
W COFFEE RD
S MOORLAND RD
W MORGAN AVE
S 60TH ST
W HOWARD AVE
S 124TH ST
STATE HWY 100
I 894
W COLDSPRING RD
S 20TH ST
S 6TH ST
STATE HWY 38
W LAYTON AVE
S 13TH ST
W EDGERTON AVE
STATE HWY 164
S CALHOUN RD
S MARTIN RD
S RACINE AVE
W SMALL RD
S SUNNYSLOPE RD
W GRANGE AVE
MKE
W RAMSEY AVE
STATE HWY 36
S 51ST ST
6TH ST
W COLLEGE AVE
I 43
COUNTY HWY ES
COLLEGE AVE
MARTIN DR
JANESVILLE RD
W WOODS RD
W RAWSON AVE
W DREXEL AVE
S 92ND ST
S 76TH ST
S 68TH ST
US HWY 45
S 116TH ST
LANNON DR
W PUETZ RD
W RYAN RD
STATE HWY 100
W OAKWOOD RD
I 94
RAMP

1
2
3
4
5
6
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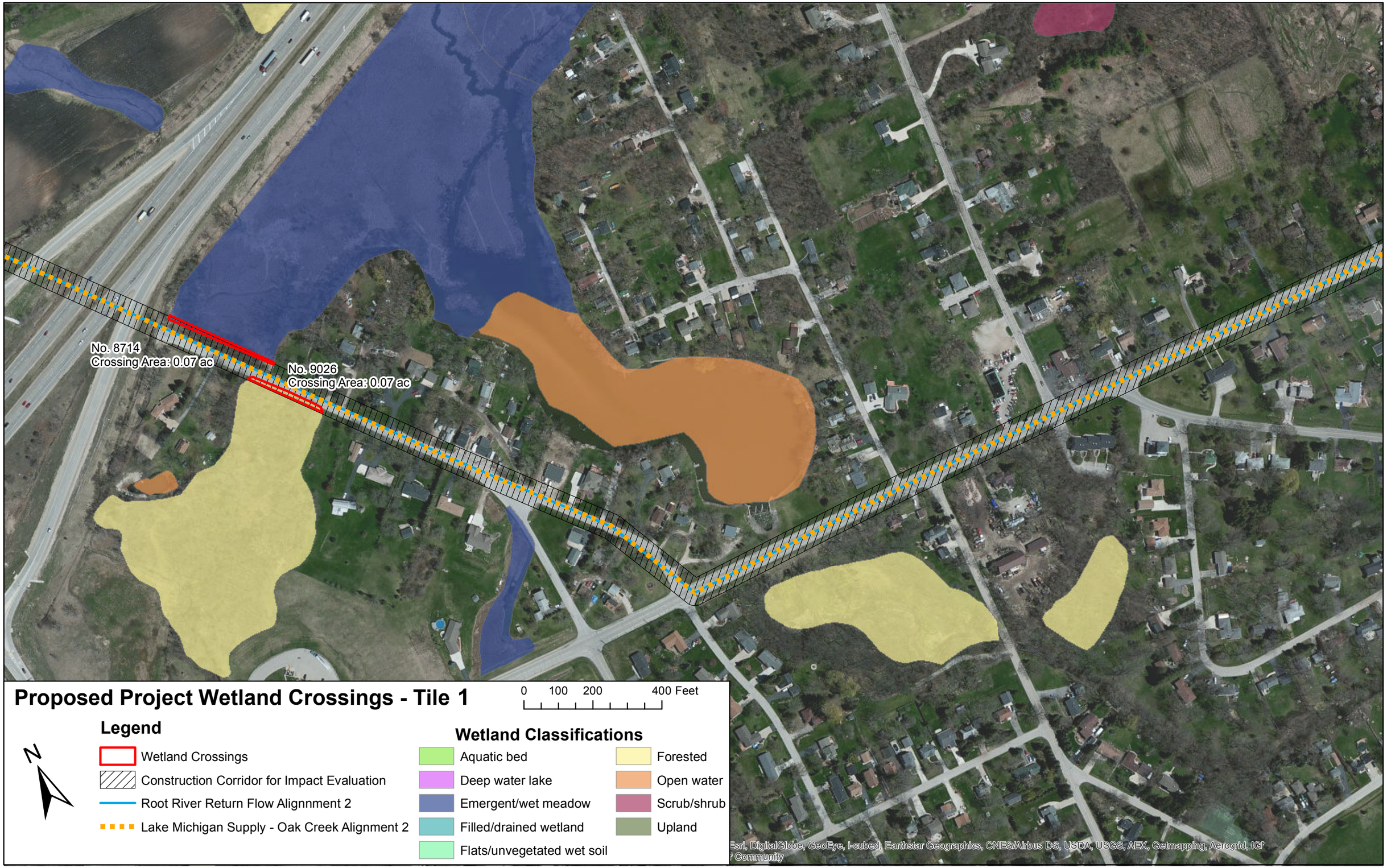
8
9
10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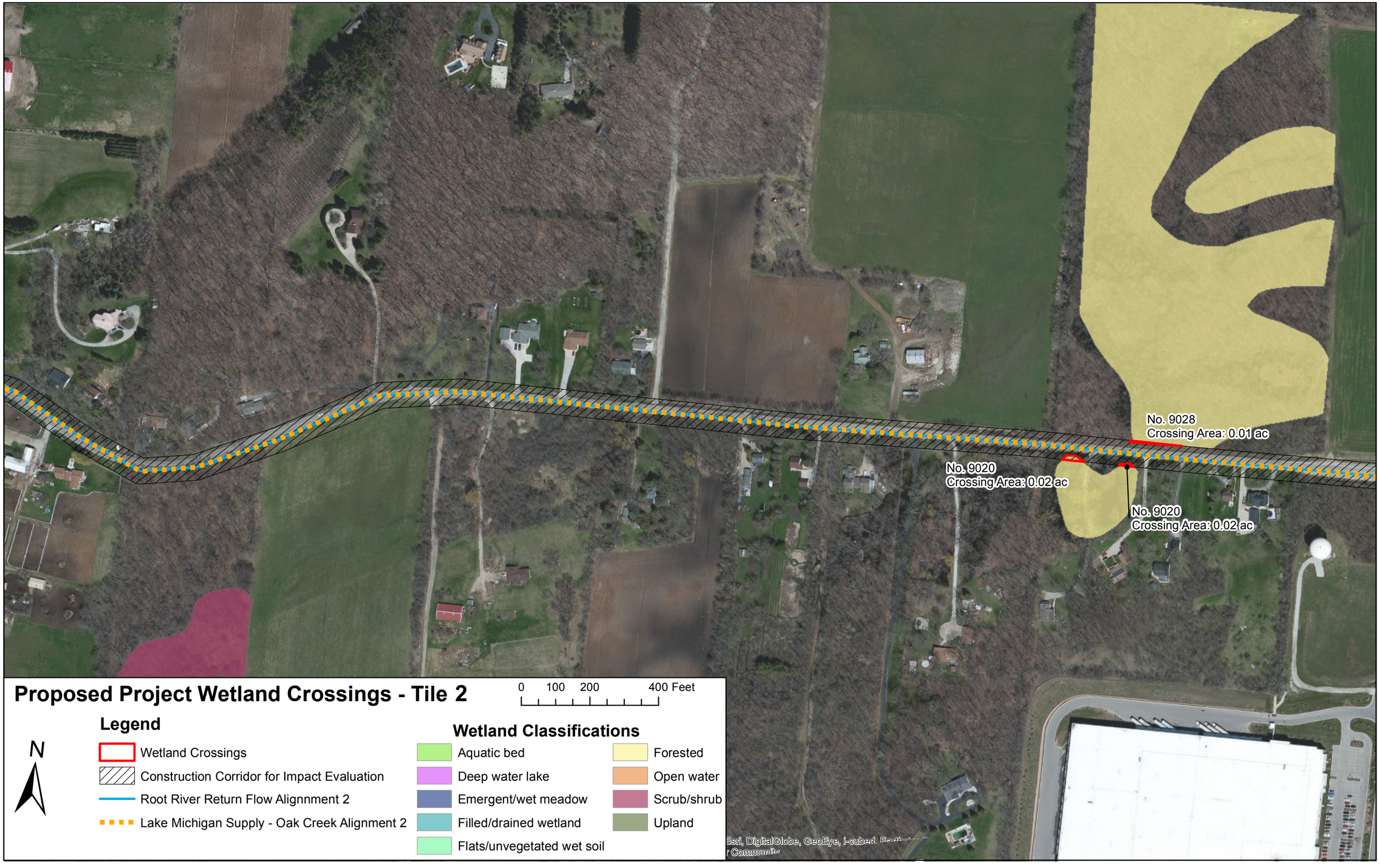
Legend
Wetland Crossings
Construction Corridor for Impact Evaluation
Root River Return Flow Alignnment 2
Lake Michigan Supply - Oak Creek Alignment 2
Wetland Classifications
Aquatic bed
Deep water lake
Emergent/wet meadow
Filled/drained wetland
Flats/unvegetated wet soil
Forested
Open water
Scrub/shrub
Upland
N
Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN
Community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Legend
Wetland Crossings
Construction Corridor for Impact Evaluation
Root River Return Flow Alignnment 2
Lake Michigan Supply - Oak Creek Alignment 2
Wetland Classifications
Aquatic bed
Deep water lake
Emergent/wet meadow
Filled/drained wetland
Flats/unvegetated wet soil
Forested
Open water
Scrub/shrub
Upland
Esri, DigitalGlobe, GeoEye, i-cubed,
Community

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No. 11290
Crossing Area: 0.02 ac

No. 10573
Crossing Area: 0 ac

Proposed Project Wetland Crossings - Tile 3

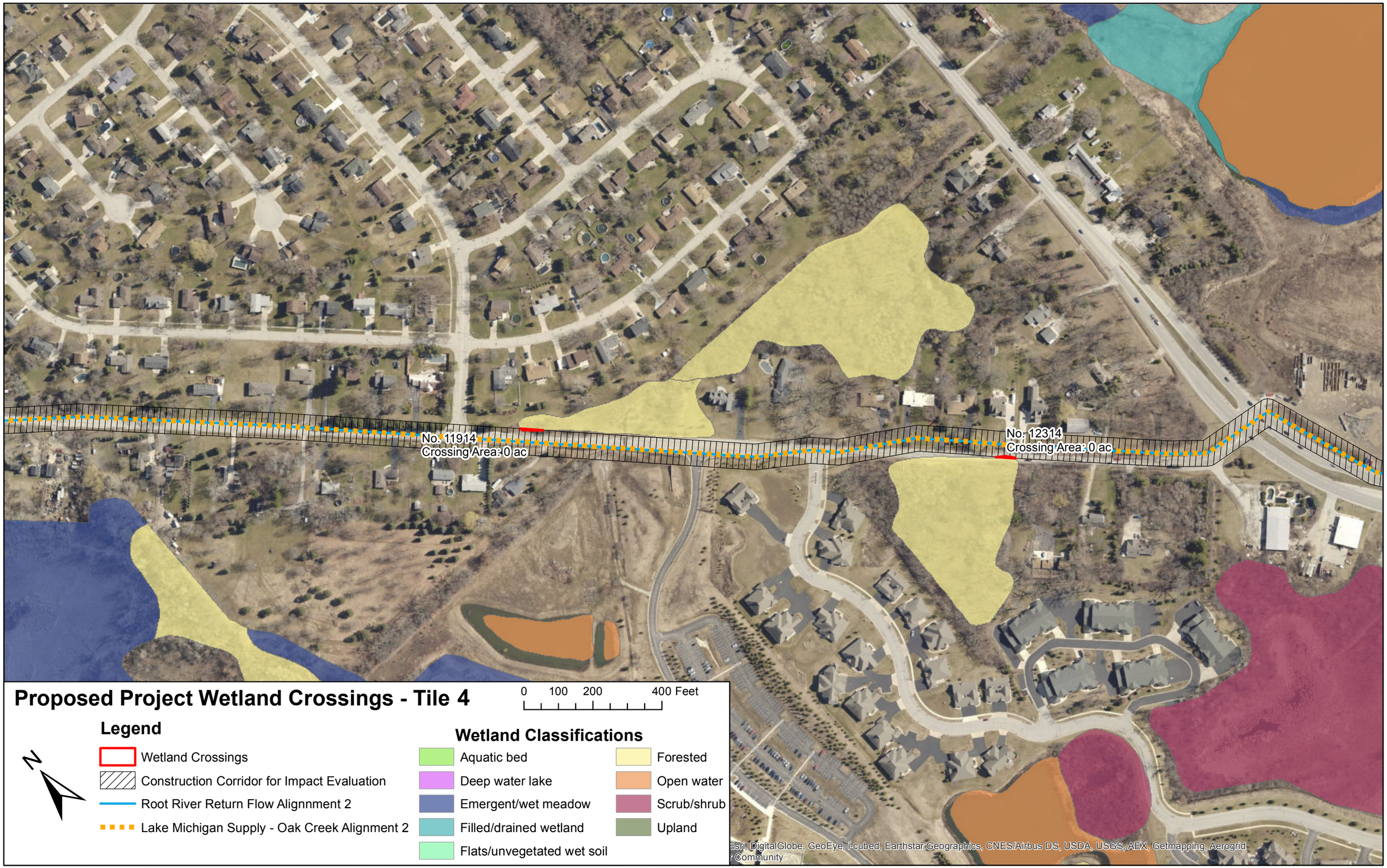
0 100 200 400 Feet

Legend

- Wetland Crossings
- Construction Corridor for Impact Evaluation
- Root River Return Flow Alignnment 2
- Lake Michigan Supply - Oak Creek Alignment 2

Wetland Classifications

- Aquatic bed
- Deep water lake
- Emergent/wet meadow
- Filled/drained wetland
- Flats/unvegetated wet soil
- Forested
- Open water
- Scrub/shrub
- Upland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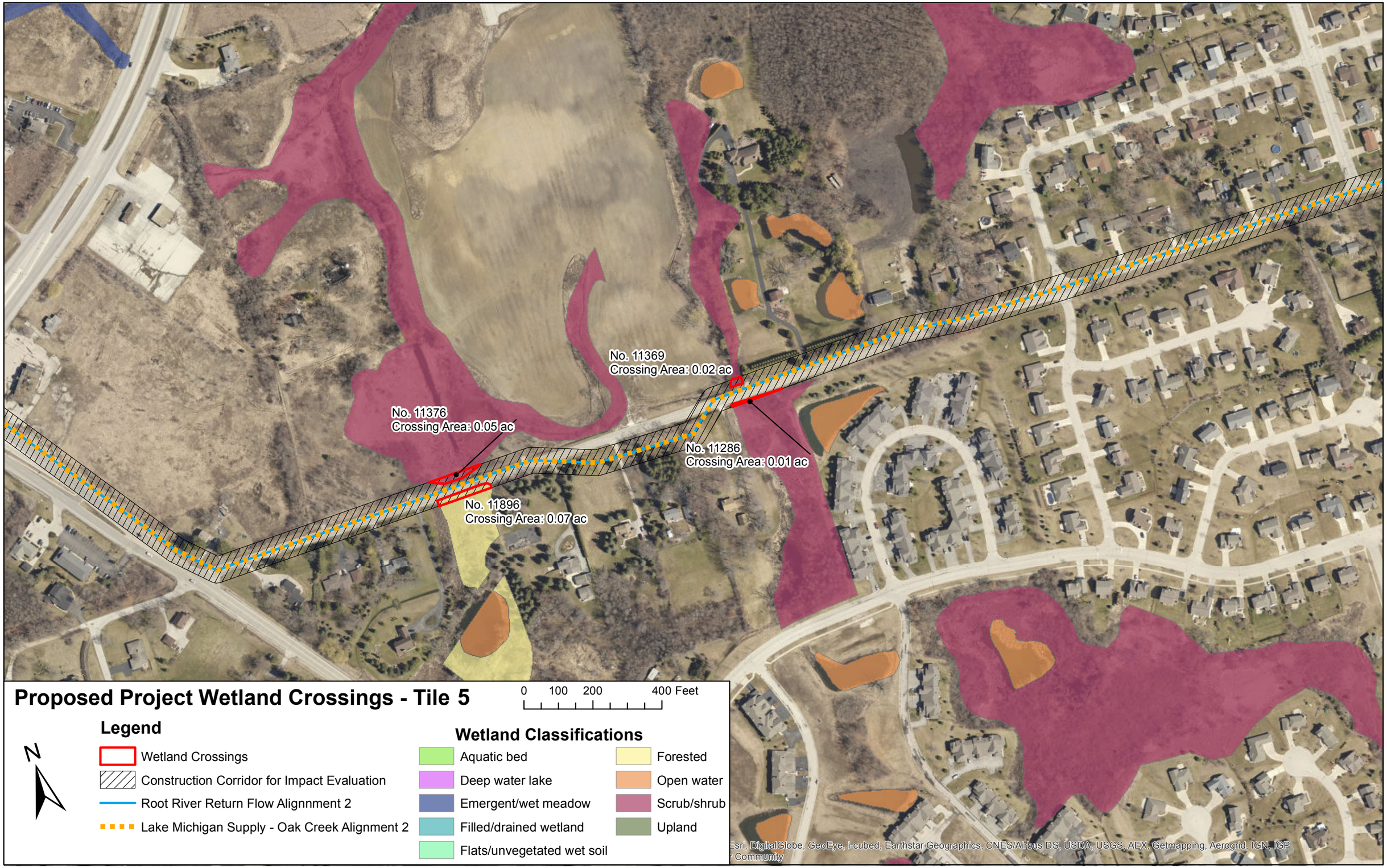
Wetland Crossings
Construction Corridor for Impact Evaluation
Root River Return Flow Alignnment 2
Lake Michigan Supply - Oak Creek Alignment 2
Wetland Classifications
Aquatic bed
Deep water lake
Emergent/wet meadow
Filled/drained wetland
Flats/unvegetated wet soil
Forested
Open water
Scrub/shrub
Upland
Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid
Community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Legend
Wetland Crossings
Construction Corridor for Impact Evaluation
Root River Return Flow Alignnment 2
Lake Michigan Supply - Oak Creek Alignment 2
Wetland Classifications
Aquatic bed
Deep water lake
Emergent/wet meadow
Filled/drained wetland
Flats/unvegetated wet soil
Forested
Open water
Scrub/shrub
Upland
N
Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP
Community

Proposed Project Wetland Crossings - Tile 6

0 100 200 400 Feet

Legend

- Wetland Crossings
- Construction Corridor for Impact Evaluation
- Root River Return Flow Alignnment 2
- Lake Michigan Supply - Oak Creek Alignment 2

Wetland Classifications

- Aquatic bed
- Deep water lake
- Emergent/wet meadow
- Filled/drained wetland
- Flats/unvegetated wet soil
- Forested
- Open water
- Scrub/shrub
- Upland

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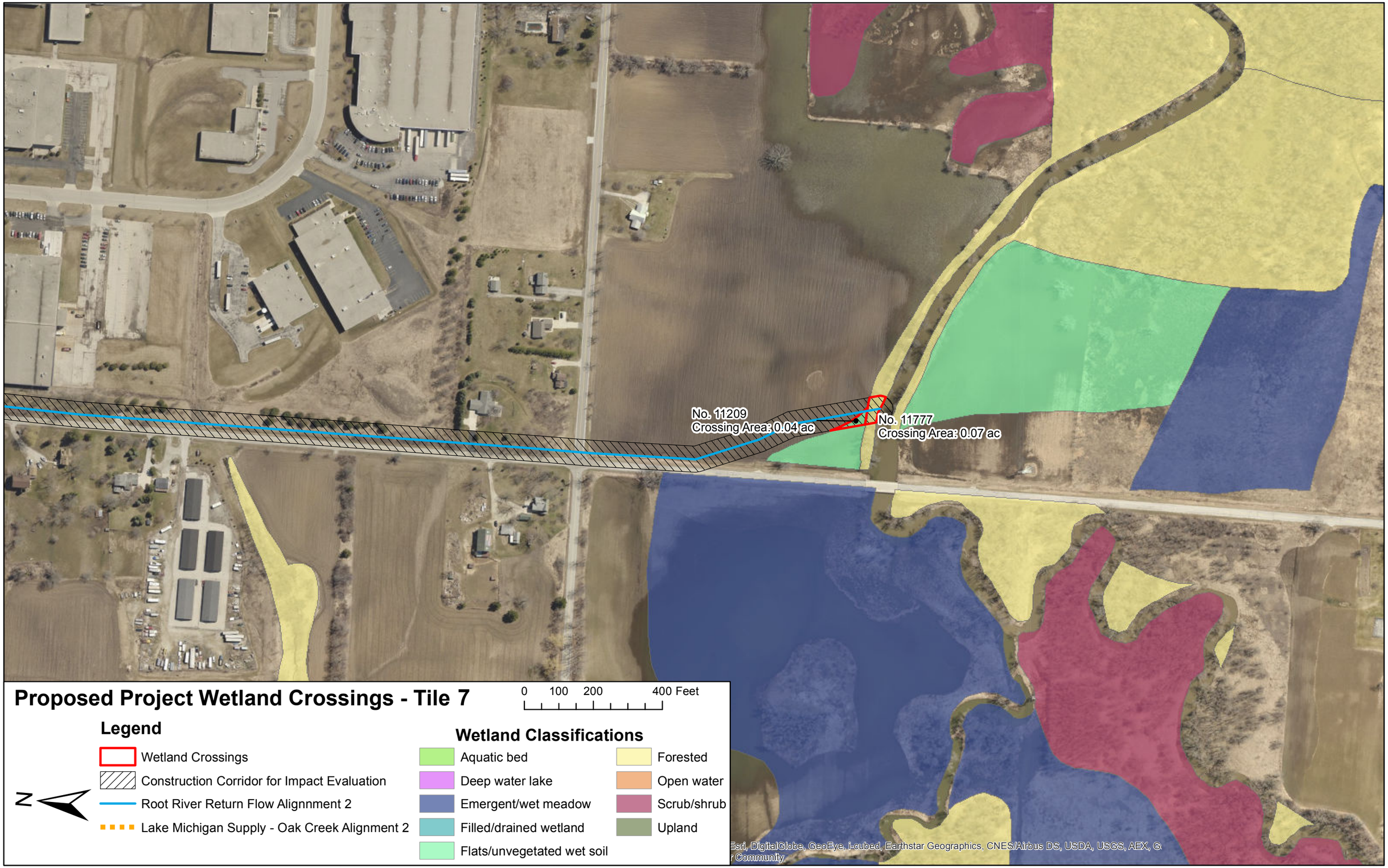
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Wetland Crossings
Construction Corridor for Impact Evaluation
Root River Return Flow Alignnment 2
Lake Michigan Supply - Oak Creek Alignment 2
N
Wetland Classifications
Aquatic bed
Deep water lake
Emergent/wet meadow
Filled/drained wetland
Flats/unvegetated wet soil
Forested
Open water
Scrub/shrub
Upland
Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, G
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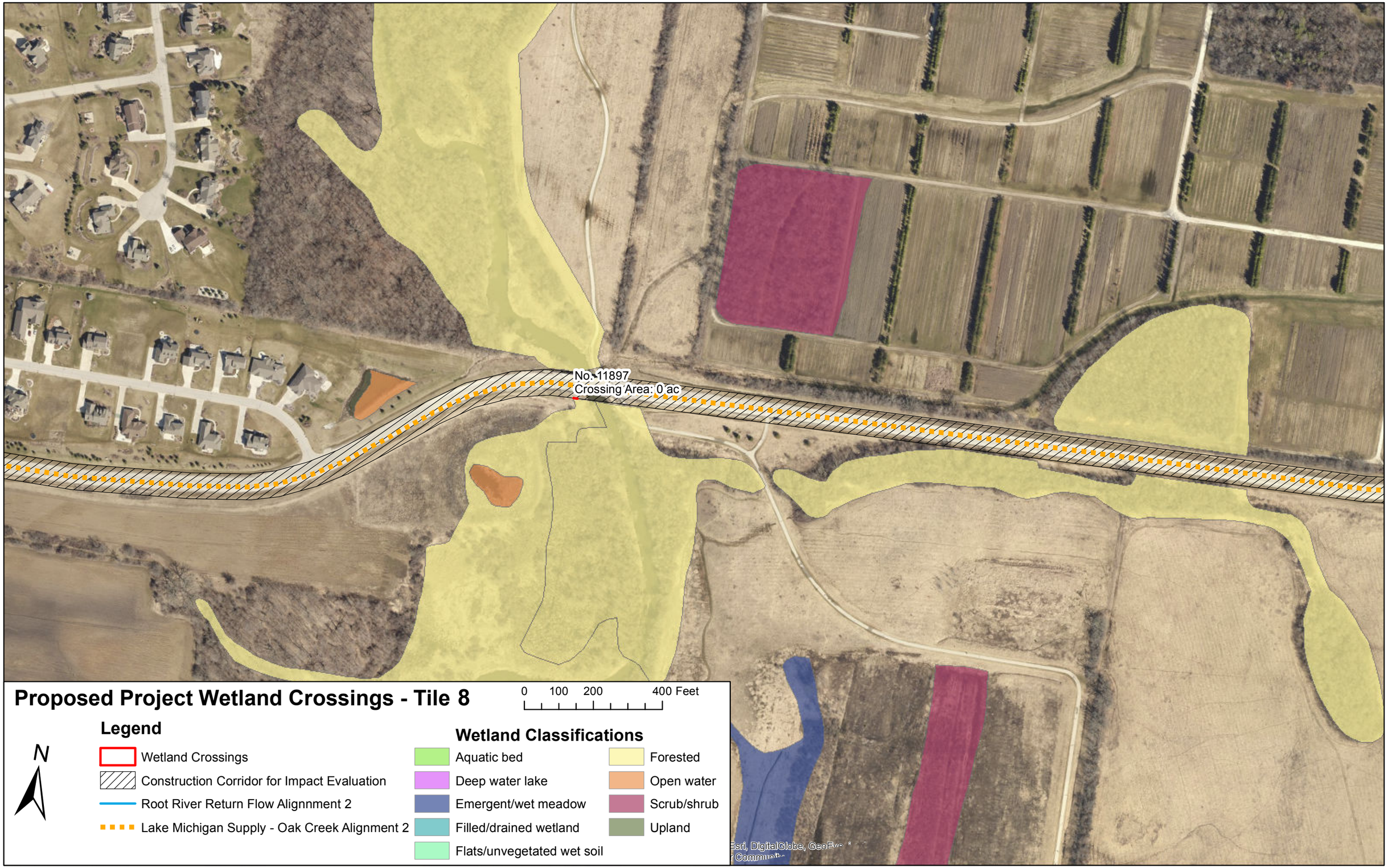
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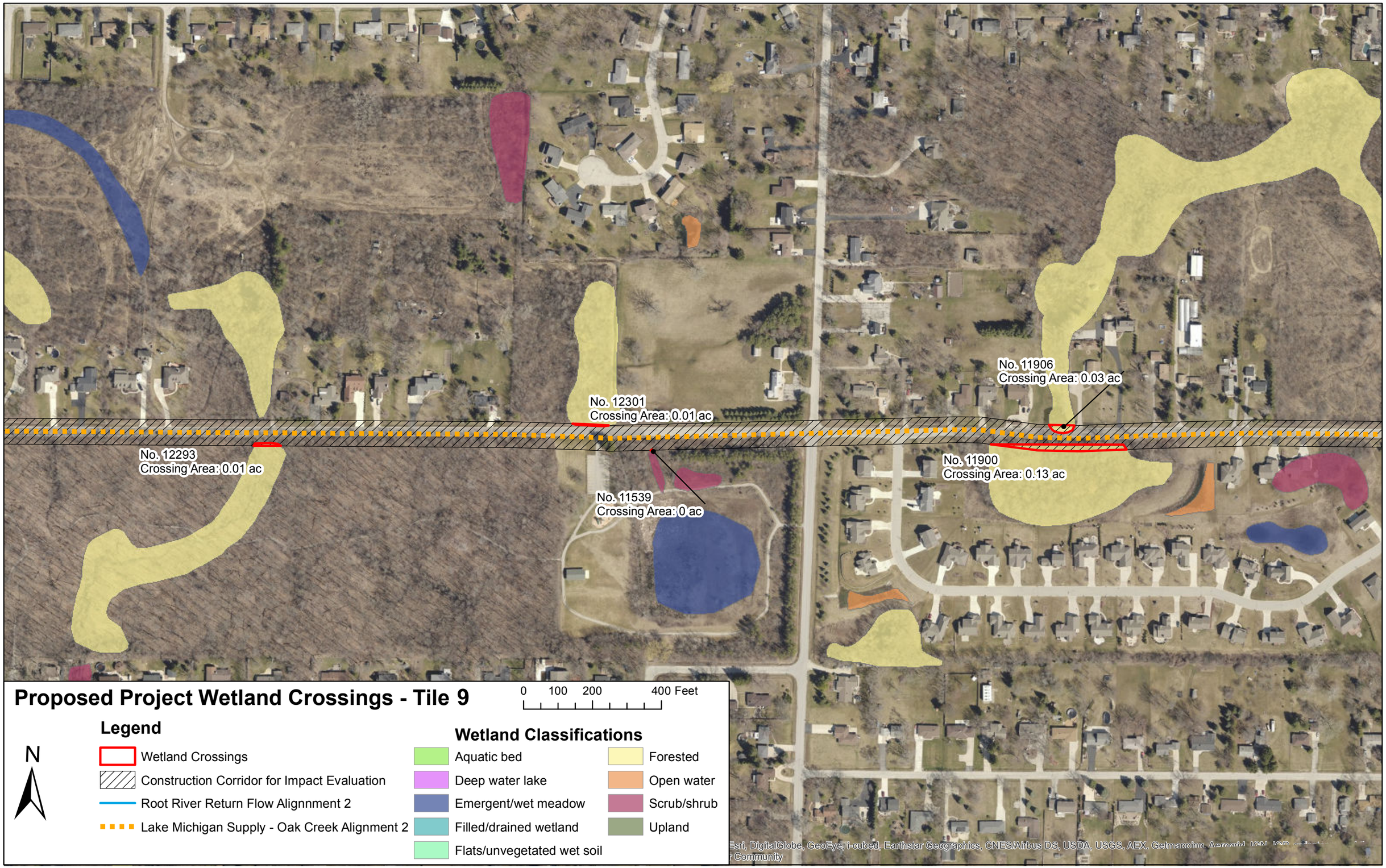
Wetland Crossings
Construction Corridor for Impact Evaluation
Root River Return Flow Alignnment 2
Lake Michigan Supply - Oak Creek Alignment 2
N
Wetland Classifications
Aquatic bed
Deep water lake
Emergent/wet meadow
Filled/drained wetland
Flats/unvegetated wet soil
Forested
Open water
Scrub/shrub
Upland
Esri, DigitalGlobe, GeoEye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Legend
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Wetland Crossings
Construction Corridor for Impact Evaluation
Root River Return Flow Alignnment 2
Lake Michigan Supply - Oak Creek Alignment 2
Wetland Classifications
Aquatic bed
Deep water lake
Emergent/wet meadow
Filled/drained wetland
Flats/unvegetated wet soil
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Upland
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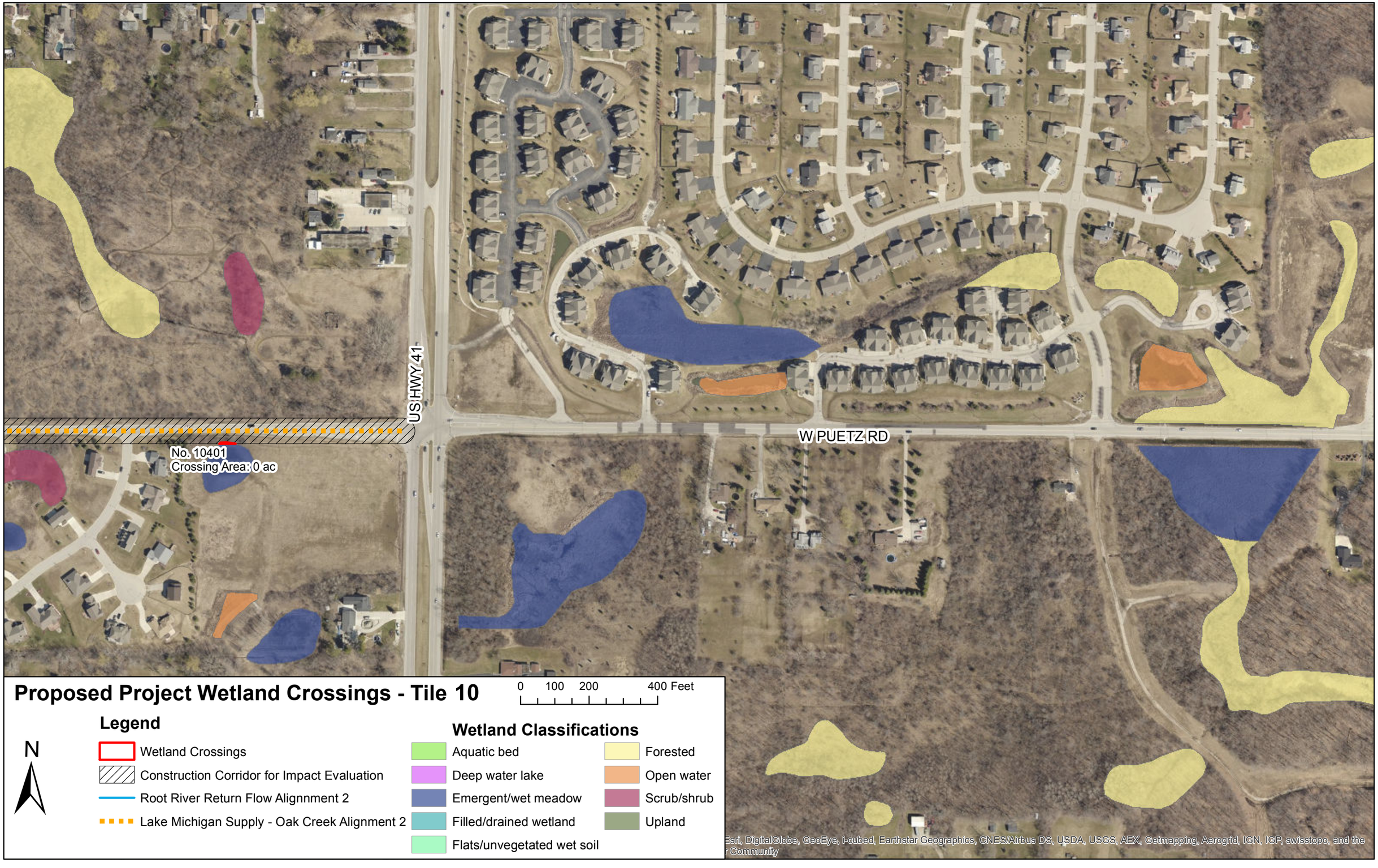
r Community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Legend
Wetland Crossings
Construction Corridor for Impact Evaluation
Root River Return Flow Alignnment 2
Lake Michigan Supply - Oak Creek Alignment 2
N
Wetland Classifications
Aquatic bed
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Upland
Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the
r Community