

Draft Environmental Assessment

Shiawassee National Wildlife Refuge, Ottawa National Wildlife Refuge Complex, and Detroit River International Wildlife Refuge Continued Aerial Herbicide Application

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Draft Environmental Assessment for Continued Aerial Herbicide Application on Shiawassee National Wildlife Refuge, Ottawa National Wildlife Refuge Complex, and Detroit River International Wildlife Refuge

This Environmental Assessment (EA) is being prepared to evaluate the effects associated with the proposed action and complies with the National Environmental Policy Act in accordance with Council on Environmental Quality regulations (40 CFR 1500-1509) and Department of the Interior (43 CFR 46; 516 DM 8) and U.S. Fish and Wildlife Service (550 FW 3) regulations and policies. The National Environmental Policy Act (NEPA) requires examination of the effects of proposed actions on the natural and human environment. Appendix A outlines all laws and executive orders evaluated through this Environmental Assessment.

Proposed Action

The U.S. Fish and Wildlife Service (Service) is proposing the continued use of herbicide for vegetation management through aerial herbicide application at three units of the National Wildlife Refuge (NWR) System: Detroit River International Wildlife Refuge (IWR), Shiawassee NWR in Michigan and Ottawa National Wildlife Refuge Complex (NWRC) in Ohio. The aerial application of herbicide aligns with the Habitat Management Plans (HMP) of Shiawassee NWR, Detroit River IWR, and Ottawa NWRC (see <https://ecos.fws.gov/ServCat/DownloadFile/161637> for Shiawassee, <https://ecos.fws.gov/ServCat/DownloadFile/100269> for Detroit River, and <https://ecos.fws.gov/ServCat/DownloadFile/100080> for Ottawa). Herbicide application will be used to control invasive plants and other undesirable vegetation, to set back succession in areas where prescribed fire or ground application of herbicides is not practical or cannot be conducted on a frequent basis and to maintain refuge facilities and infrastructure. In some areas of the refuges, invasive and/or undesirable plant populations are too large to control without aerial herbicide application, given constraints of staff size and time availability.

Shiawassee National Wildlife Refuge works with Saginaw County Mosquito Abatement Commission (SCMAC) to monitor for mosquitoes that pose a human health risk and to aerially treat approximately 1,500 acres of the refuge with the larvicide *Bacillus thuringiensis israelensis* (Bti), as needed based on monitoring. Monitoring and larvicide treatment is intended to reduce the public risk of mosquito-borne diseases such as West Nile virus, St. Louis Encephalitis, California group viruses and Eastern Equine Encephalitis. The target mosquito larvae (immature mosquitoes) to be treated will most likely be early spring mosquitoes, especially *Aedes* sp. and *Culex* sp., which occur in spring and summer flooded woodlands in the northern and

northeastern portion of the refuge. All treatments would be conducted in accordance with SCMAC's policies. The SCMAC would also conduct pre- and post-aerial larvicide treatment monitoring of adult and larval mosquito abundance and report these findings in an annual report to the refuge. This environmental assessment does not include this action as part of the proposed alternatives as it has previously been evaluated under NEPA but considers the action as part of the affected environment and planned actions that occur on the refuge from a cumulative impact perspective.

A proposed action may evolve during the NEPA process as the agency refines its proposal and gathers feedback from the public, federally recognized tribes and tribal entities, and other agencies or organizations. Therefore, the final proposed action may be different from the original. The agency action will be finalized at the conclusion of the public comment period after the incorporation of substantive comments received.

Background

National wildlife refuges are guided by the mission and goals of the National Wildlife Refuge System (NWRS), the purposes of an individual refuge, Service policy, and laws and international treaties. Relevant guidance includes the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997, Refuge Recreation Act of 1962, and selected portions of the Code of Federal Regulations and Fish and Wildlife Service Manual. The mission of the NWRS, as outlined by the National Wildlife Refuge System Administration Act (NWRSA), as amended by the National Wildlife Refuge System Improvement Act (16 U.S.C. 668dd et seq.), is

"... to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans"

Additionally, the NWRSA mandates the Secretary of the Interior in administering the NWRS (16 U.S.C. 668dd(a)(4)) to

- Provide for the conservation of fish, wildlife, and plants, and their habitats within the NWRS;
- Ensure that the biological integrity, diversity, and environmental health of the NWRS are maintained for the benefit of present and future generations of Americans;
- Ensure that the mission of the NWRS described at 16 U.S.C. 668dd(a)(2) and the purposes of each refuge are carried out;

- Ensure effective coordination, interaction, and cooperation with owners of land adjoining refuges and the fish and wildlife agency of the states in which the units of the NWRS are located;
- Assist in the maintenance of adequate water quantity and water quality to fulfill the mission of the NWRS and the purposes of each refuge;
- Recognize compatible wildlife-dependent recreational uses as the priority general public uses of the NWRS through which the American public can develop an appreciation for fish and wildlife;
- Ensure that opportunities are provided within the NWRS for compatible wildlife-dependent recreational uses; and monitor the status and trends of fish, wildlife, and plants in each refuge.

Shiawassee National Wildlife Refuge Purposes

Shiawassee NWR was established in 1953 under the authority of the Migratory Bird Conservation Act (16 USC § 715-715s) "...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." Additional purposes designated under the Refuge Recreation Act (16 USC § 460k-l) are "... (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, [and] (3) the conservation of endangered and threatened species."

The stated purposes for Shiawassee NWR include:

- for use as an inviolate sanctuary, or for any other management purpose, for migratory birds. 16 U.S.C. § 715d (Migratory Bird Conservation Act)
- "... suitable for— (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..." 16 U.S.C. § 460k-1
- "... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..." 16 U.S.C. § 460k-2 (Refuge Recreation Act (16 U.S.C. § 460k-460k-4), as amended).
- "... conservation, management, and ... restoration of the fish, wildlife, and plant resources and their habitats ... for the benefit of present and future generations of Americans..." 16 U.S.C. § 668dd(a)(2) (National Wildlife Refuge System Administration Act)

- "... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f(a)(4)
- "... for the benefit of the USFWS, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)
- "(1) to protect, enhance, restore, and manage an appropriate distribution and diversity of wetland ecosystems and other habitats for migratory birds and other fish and wildlife in North America; (2) to maintain current or improved distributions of migratory bird populations; and (3) to sustain an abundance of waterfowl and other migratory birds consistent with the goals of the North American Waterfowl Management Plan and the international obligations contained in the migratory bird treaties and conventions and other agreements with Canada, Mexico, and other countries." 16 U.S.C. § 4401 2(b) (North American Wetlands Conservation Act; USFWS 2012).

The refuge encompasses over 9,800 acres of marsh, bottomland hardwood forest, and grasslands within a larger landscape dominated by urban development and agricultural cultivation (Appendix B). The refuge's mission is to conserve an undeveloped expanse of floodplain forest, marshes, rivers; to encourage public stewardship and partnership; to provide educational outreach; and to support habitat enhancement on private lands in the area.

Shiawassee NWR provides resident and migratory habitats for nearly 300 species of birds as well as other taxa (Appendix C).

Detroit International Wildlife Refuge Purposes

Detroit River IWR was established by Public Law 107-91 on December 21, 2001. Located along the Detroit River and western Lake Erie in Wayne and Monroe Counties in southeast Michigan, Detroit River IWR is the first International Wildlife Refuge in the Refuge System. The authorized refuge boundary includes islands, coastal wetlands, marshes, shoals, and riverfront lands along 48 miles of the Lower Detroit River and Lake Erie in Michigan. Complementary to the refuge's authorized acquisition boundary on the Michigan side of the Detroit River, the Western Lake Erie Watersheds Priority Natural Area is the mechanism to grow the refuge in Ontario. Its location also makes it unique – it is one of only a few refuges situated in a major metropolitan area.

The refuge's establishing act redesignated islands that were once part of Wyandotte National Wildlife Refuge – Grassy Island, Mud Island, and Mamajuda Island – as part of the new international refuge. Section 4 of the Detroit River International Wildlife Refuge Establishment Act states the following purposes for the refuge: To protect the remaining high-quality fish and wildlife habitats of the Detroit River before they are lost to further development and to restore and enhance degraded wildlife habitats associated with the Detroit River; To assist in

international efforts to conserve, enhance, and restore the native aquatic and terrestrial community characteristics of the Detroit River (including associated fish, wildlife, and plant species) both in the United States and Canada; To facilitate partnerships among the United States Fish and Wildlife Service, Canadian national and provincial authorities, State and local governments, local communities in the United States and in Canada, conservation organizations, and other non-Federal entities to promote public awareness of the resources of the Detroit River.

Wyandotte National Wildlife Refuge was established by an Act of Congress known as Public Law 87-119, 75 Stat. 243, 87th Congress, H.R. 1182, dated August 3, 1961: ... “to be maintained as a refuge and breeding place for migratory birds and other wildlife...” Wyandotte National Wildlife Refuge is now part of the Detroit International Wildlife Refuge and is not considered a separate refuge.

Ottawa National Wildlife Refuge Complex Purposes

The Ottawa National Wildlife Refuge Complex is comprised of Ottawa National Wildlife Refuge, Cedar Point National Wildlife Refuge, and West Sister Island National Wildlife Refuge. West Sister Island National Wildlife Refuge was established by Executive Order 7937 on August 2, 1937 "... as a refuge and breeding ground for migratory birds and other wildlife..." and is designated wilderness. The aerial herbicide application action described in this Environmental Assessment is not planned to occur at West Sister Island NWR. Ottawa NWRC was established in 1961 and Cedar Point NWR was established in 1964, both under the authority of the Migratory Bird Conservation Act "...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d. The refuge was also established to preserve a remnant of the formerly vast Lake Erie coastal wetlands. Ottawa NWRC is located in Ottawa and Lucas Counties, Ohio, along the south shore of Lake Erie. The closest city is Toledo, located 20 miles west of the Ottawa NWRC.

Additional expansion and purposes for the Refuge Complex were established by Public Law 108-23, May 19, 2003, in the “Ottawa National Wildlife Refuge Complex Expansion and Detroit River International Wildlife Refuge Expansion Act.” The law formalized the three refuges as the Ottawa National Wildlife Refuge Complex. It also established a traditional inclusive acquisition boundary for the Refuge Complex, in addition to the limited 5,000-acre acquisition focal area. The law specifies that all lands within the Refuge Complex will be administered in accordance with the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd et seq.) and Public Law 108-23. Additional purposes are listed below verbatim from the Act:

(b) ADDITIONAL PURPOSES. —In addition to the purposes of the Refuge Complex under other laws, regulations, Executive orders, and comprehensive conservation plans, the Refuge Complex shall be managed—

(1) To strengthen and complement existing resource management, conservation, and education programs and activities at the Refuge Complex in a manner consistent with the primary purposes of the Refuge Complex—

(A) To provide major resting, feeding, and wintering habitats for migratory birds and other wildlife; and

(B) To enhance national resource conservation and management in the western basin.

(2) In partnership with nongovernmental and private organizations and private individuals dedicated to habitat enhancement, to conserve, enhance, and restore the native aquatic and terrestrial community characteristics of the western basin (including associated fish, wildlife, and plant species).

(3) To facilitate partnerships among the United States Fish and Wildlife Service, Canadian national and provincial authorities, State and local governments, local communities in the United States and Canada, conservation organizations, and other non-Federal entities to promote public awareness of the resources of the western basin; and

(4) To advance the collective goals and priorities that—

(A) Were established in the report entitled “Great Lakes Strategy 2002— A Plan for the New Millennium”, developed by the United States Policy Committee, comprised of Federal agencies (including the United States Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, the United States Geological Survey, the Forest Service, and the Great Lakes Fishery Commission) and State governments and tribal governments in the Great Lakes basin; and

(B) Include the goals of cooperating to protect and restore the chemical, physical, and biological integrity of the Great Lakes basin ecosystem.

The Ottawa NWRC’s Habitat Management Plan was completed in 2015 (USFWS, 2015) and established the following complex vision:

“The Ottawa National Wildlife Refuge Complex will be managed for the conservation, management, and restoration of fish and wildlife habitats. In its unique position on the shore of Lake Erie, the Complex will encourage and nurture diverse native plant communities to provide resting, feeding, and breeding sites for migrant and non-migrant birds, resident mammals, reptiles, amphibians, and fish. It will provide a place for people to enjoy wildlife dependent activities and learn about the complexities of the natural world through high quality education and interpretive programming. It will add to the richness of the

community by holding in trust a portion of the natural heritage of the Great Lakes ecosystem for the continuing benefit of the American people.”

Purpose and Need for the Action

The purpose of the proposed action is to control, prevent, and limit the spread of invasive species and other undesirable vegetation within all habitat management units and on or around refuge facilities at Shiawassee NWR and Ottawa NWRC and Detroit River IWR. The rapid growth of invasive species and other undesirable vegetation can displace native plants and significantly alter fish and wildlife habitats. This directly affects the refuges’ biological integrity, diversity, wildfire risk, and environmental health. Undesirable vegetation can impact refuge facilities and degrade roads, trails, dams, buildings, kiosks and other improvements. These actions will take place in multiple ecosystem types. The proposed action aligns with Chapter 4 of all three refuge Comprehensive Conservation Plans (CCP), which identify vegetation management and invasive species control as necessary refuge management activities that support the needs of wildlife (Shiawassee: <https://ecos.fws.gov/ServCat/DownloadFile/161637>, Detroit River: <https://ecos.fws.gov/ServCat/DownloadFile/44167>, Ottawa: <https://ecos.fws.gov/ServCat/DownloadFile/1506>). The refuge HMPs (Ottawa: <https://ecos.fws.gov/ServCat/DownloadFile/100080>, Detroit River: <https://ecos.fws.gov/ServCat/Reference/Profile/60208>, Shiawassee: <https://ecos.fws.gov/ServCat/DownloadFile/161637>) set more detailed goals for vegetation management. Table 1 below summarizes the vegetation management goals of each refuge by ecosystem.

Table 1. Vegetation management goals by habitat type for Detroit River IWR, Ottawa NWRC, and Shiawassee NWR, as described in their respective HMPs. A “not applicable” denotation has been used if a vegetation management goal does not exist for a specific habitat type for a station. Reference to the Habitat Management Goal number is included after the description of the goal.

Refuge	Forest Management Goals	Marsh Management Goals	Moist Soil Management Goals	Wet Prairie Management Goals	Shrub Swamp Management Goals	Beach Management Goals
Detroit River	Prevent expansion of invasive species to new areas (4.3, Wet-Mesic Forest)	< 10% <i>Phragmites</i> cover and < 80% narrow-leaved and hybrid cattail cover (4.3, Emergent Wetlands)	< 25% total vegetative cover (4.3, Moist Soil/Mud)	< 50% non-native species cover (4.3, Wet Prairie)	Prevent expansion of invasive species to new areas (4.3, Wet-Mesic Forest)	Not applicable
Ottawa	Control and prevent spread of invasive species (4.2, Forest)	> 50-60% relative cover of native species (4.2, Lake Erie Coastal Wetland)	< 10% invasive species cover (4.2, Moist Soil and Mudflat)	< 40% shrub cover where eastern prairie fringed orchid present, < 20% shrub cover elsewhere (4.2, Wet Prairie and Sedge Meadow)	< 40% tree canopy cover (4.2, Shrubland)	Reduce percent cover of invasive species (4.2, Beach)
Shiawassee	< 20% invasive species cover (4.5.1)	< 5% <i>Phragmites</i> cover (Table 6, Emergent Marsh)	>25% bare soil in spring (4.4.1)	< 10% woody plant cover and < 25% reed canary grass cover (Table 6, Lakeplain Wet Prairie)	< 20% invasive species cover (Table 6, Inundated Shrub Swamp)	Not applicable

The need of the proposed action is to meet the Service’s priorities and mandates as outlined by the NWRSA to “provide for the conservation of fish, wildlife, and plants, and their habitats within the System” (16 U.S.C. 668dd(a)(4)). More specifically, the need is to reduce specific plant populations to manageable levels. At current levels, some species of plants are too densely populated to effectively manage with ground-based treatments. These species have direct negative impacts on individuals and populations of native wildlife and plants in addition to reducing the availability of habitat. Each habitat that the refuges manage for face threats from invasive species or other plant species that have excessively dense growth patterns as a result of human alterations to the landscape. In floodplain forests, buckthorn outcompetes native plants through aggressive growth and allelopathy; its laxative-laden berries dehydrate

birds and it emits toxins (emodin) that harm amphibians (Izhaki 2002, Brenes et. al 2022). Other invasive species, like honeysuckle (*Lonicera* spp.) and autumn olive (*Elaeagnus umbellata*), are similarly harmful to native plants while providing significantly less value to native wildlife than native plants (Maynard-Bean and Kaye 2019, Tallamy and Shriver 2021). In prairies, woody plants shade out native prairie plant species and are not historically part of the ecosystem. Reed canary grass (*Phalaris arundinacea*) similarly does not naturally occur as a dominant species in prairies and outcompetes native prairie plants. Anthropogenic alterations to the environment and limitations on fire allow woody plants and reed canary grass to spread through prairies, necessitating herbicide control. In marshes, invasive *Phragmites* can grow extremely densely, crowding out native plants and preventing native wildlife from navigating or nesting in the area. *Phragmites* is fire-adapted, and its dense growth reduces coverage from ground-based foliar spraying. Other invasive marsh plants include frog-bit (*Hydrocharis morsus-ranae*), non-native cattail (*Typha angustifolia*), and flowering rush (*Butomus umbellatus*). In moist soil units and marshes, purple loosestrife (*Lythrum salicaria*) and cocklebur (*Xanthium strumarium*) are highly invasive as well. These species all outcompete native plants that are beneficial to native fish and waterfowl, but grow in high densities in wet areas, rendering ground-based herbicide and prescribed fire ineffective. The threats posed by invasive species and other undesirable vegetation have increased because of range expansions and changing environmental conditions associated with climate change.

Alternatives

Alternative A – Continue Use of Aerial Herbicide Treatment (No Action and Preferred Alternative)

Under the no action and preferred alternative, aerial application of herbicide will continue to be used to reduce populations of invasive plants and other undesirable vegetation that are causing ecological harm in multiple habitat types. Multiple treatments of herbicide using aerial application may be required for denser populations. Under the no action and preferred alternative, aerial herbicide applications would continue to be integrated with ground herbicide applications and non-herbicide control methods including mowing, prescribed fire, hand-pulling and biological control when possible.

When possible, treatments will be scheduled to minimize impacts to native species. Herbicides need to contact growing parts of the plants to translocate within the plants to be effective. For example, in floodplain forests, treatments will take place after native overstory trees have entered dormancy. Some invasive plants retain their foliage later in the year than native trees, providing a window of opportunity to treat non-native species while minimizing damage to native tree species. This timing is also after the breeding season of forest birds; most species will have begun their southern migration at the time of application.

All aerial treatments will be conducted by licensed aerial herbicide applicators, likely contractors or other partners. Aerial applications may be carried out with fixed-wing aircraft, rotary-winged aircraft, and unmanned aerial vehicles (UAVs). Application methods and concentrations will follow all chemical product label standards. Accounting for criteria such as wind direction and velocity will ensure residential areas are not affected by the aerial application of herbicides. The use of best management practices (BMPs) to avoid herbicide drift to waterways will minimize impact to aquatic resources. Only herbicides approved for use in aquatic systems on the chemical product label will be used in floodplains or wetlands with open water. Treatment sites will be closed to the public during and 24 hours after the aerial applications or longer if required by the herbicide label's restricted entry interval, avoiding visitor contact with herbicide. Herbicide applications would continue to be integrated with non-herbicide control methods including mowing, prescribed fire, mechanical removal, hand-pulling and biological control when possible.

The Service's Integrated Pest Management (IPM) Policy (569 FW 1) requires a sustainable approach to managing pests that uses the following kinds of tools to minimize health, environmental, and economic risks: (1) Biological (e.g., predators, parasites, and pathogens), (2) Cultural (e.g., crop rotation, alterations in planting dates, and sanitation), (3) Physical (e.g., barriers, traps, hand-pulling, hoeing, mowing, and tilling), and (4) Chemical (e.g., pesticides, such as herbicides, insecticides, or fungicides). The IPM Policy also requires review and approval of a Pesticide Use Proposal (PUP) prior to all herbicide applications. All PUPs require a site-specific Endangered Species Act (Intra-Service Section 7) consultation. All herbicide applications on the Complex are required to follow product label restrictions (see below). Regionally approved BMPs have been designed to minimize environmental and safety risks. The BMPs are taken into consideration if a practice is not specifically addressed by the product label. They include:

- Slopes - Do not apply pesticides to slopes greater than 5% if significant rainfall is predicted within 24 hours.
- Wind speed - Do not apply pesticides when wind velocity exceeds 7 miles per hour or when inversion conditions exist.
- Buffers - Use a minimum 25-foot vegetated treatment buffer around all surface water resources.
- Air temperature - Do not spray pesticide containing 2,4-D when air temperatures exceed 85°F.
- Droplet size - Select nozzles and operate application equipment with boom pressures such that spray droplets produced medium (236 - 340 microns) or coarser (341 - 403 microns) sized droplets.
- Boom Height - Do not allow boom height to exceed 20 inches above target canopy.

- Dye -Where possible, use a dye for non-crop spot treatment to indicate treated areas.

The Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. §136 et seq. (1996)) requires all herbicide applications follow product label restrictions. These restrictions detail measures to minimize the potential for contamination and non-target effects. The Environmental Protection Agency (EPA) is the lead agency for approving herbicide product labels (40 CFR 156); this process includes NEPA analysis and Endangered Species Act (Intra-Service Section 7) consultations. Therefore, previous aerial herbicide applications on the refuges included in this Environmental Assessment received prior environmental analysis and review via the NEPA and Endangered Species Act consultation processes. Previous aerial treatments were also approved via the Service's PUP system. The same would be true for any future treatments under this alternative.

The following list of Best Management Practices (BMPs) are adapted from other NWRS refuges and are designed to protect the environment and wildlife while considering economic factors, availability, technical feasibility, ability to implement, and effectiveness. These BMPs are as follows:

1. All chemical applications will be planned and conducted with the coordination and under the supervision of a licensed applicator, certified in the appropriate State category that covers the application.
2. Boom spraying will only be conducted when wind speeds average 10 miles per hour (mph) or less, pausing during gusts and stopping if gusts are higher than 15 mph.
3. Inversion conditions will be avoided since these conditions can facilitate large-scale herbicide drift.
4. Boom spraying will not be conducted on days when there is an 80% or higher forecast for rain within the drying time of the herbicide.
5. Spot spraying operations will be conducted with fewer restrictions on wind speed due to the fact of less spray drift and spray being pointed directly at the pest.
6. A handheld wind meter will be used to determine wind speed at the application site, and wind direction will be used to evaluate relative to any sensitive sites. If the wind temporarily increases during boom spraying, lowering the nozzle pressure, thereby increasing droplet size, can reduce drift. If wind speeds stay above operating speeds, the operation will be shut down.
7. A nontoxic anti-drift agent will be used during aerial treatment when allowed by the label, especially adjacent to sensitive sites.
8. Equipment will be calibrated as necessary to ensure that herbicide applications rates are accurate, and that rough terrain features calculated. When boom spraying, it is desirable to maintain the same combination of gear and rpms used in calibrating the boom sprayer. A chart of speed and gear ratios will be available for staff to use to determine appropriate rate of speed/gear.

9. To aid staff involved in mixing, a conversion table is posted inside the pesticide storage building stating the amount of product needed for any given percentage of tank mix for each size of tank used on the refuge. Also, each tank will be clearly labeled “Pesticide Only.”
10. Daily herbicide applications information (i.e., wind/weather, chemical type, application method, operator(s), acres sprayed, and location) should be recorded before and/or after each herbicide application.

Alternative B – Discontinue Aerial Herbicide Treatment

Under this alternative, the refuges would not conduct aerial herbicide applications. The refuges would continue foliar spraying plants with herbicide from backpack sprayers or from a tank mounted on an all-terrain vehicle (ATV) or utility-terrain vehicle (UTV), along with mechanical control and prescribed fire. This alternative does not include aerial herbicide spraying of any kind. This alternative would require more treatments using other control methods. Cut-stump or basal bark treatment in fall and winter may be used in addition to the ground-based foliar spray. In areas with very dense woody plant populations, treatments will take place over at least 5 to 10 years and possibly indefinitely. Ground based herbicide treatments would also use herbicides approved by the U.S. EPA and follow label restrictions as well as BMPs. On the ground herbicide applications would continue to be integrated with non-herbicide control methods including mowing, prescribed fire, mechanical removal, grazing, hand-pulling and biological control when possible.

Alternative(s) Considered, But Dismissed from Further Consideration

Exclusively using mechanical removal of plants is unfeasible, as it would generate ecologically harmful levels of soil disturbance or would be ineffective long-term at managing invasive or undesirable plant communities for habitat health. Merely cutting undesirable trees and shrubs down to stumps would allow them to regrow from the roots quickly. However, digging up the entire root system of undesirable plants would result in extensive soil disturbance throughout the removal area. For most target species, using exclusively mechanical removal would require an impractical amount of staff time and resources given the level of continued management that would be needed to achieve any habitat goals. Therefore, neither form of mechanical removal is appropriate for a project of large scale.

Affected Environment and Environmental Consequences

This section is organized by affected resource categories and for each affected resource discusses both (1) the existing environmental and socioeconomic baseline in the action area for each resource and (2) the effects and impacts of the proposed action and any alternatives on

each resource. The effects and impacts of the proposed action considered here are changes to the human environment, whether adverse or beneficial, that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action or alternatives. This EA includes the written analyses of the environmental consequences on a resource only when the impacts on that resource could be more than negligible and therefore considered an “affected resource.” Any resources that will not be more than negligibly impacted by the action have been dismissed from further analyses.

Direct, indirect, and cumulative impacts are evaluated in this environmental assessment. Direct effects are those which are caused by the action and occur at the same time and place. Indirect effects are those which are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable. Cumulative impacts result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions.

Additional detailed information on the affected environment is included for each affected resource, but a general summary of the affected environment for each refuge is as follows. Shiawassee NWR consists of approximately 15 square miles in Saginaw County, Michigan and is primarily riparian habitat with marshes, managed moist soil units, floodplain forests, and wet prairies. Ottawa NWRC’s primary habitat types include coastal wetlands, managed wetland/moist soil impoundments, and a diverse patchwork of forests, shrubland, sedge meadows, and prairie. Detroit River IWR is located along 48 miles of shoreline along the Detroit River and Western Lake Erie in Wayne and Monroe counties. Habitat types within Detroit River IWR include open water and submergent wetland, managed and coastal emergent wetland, wet prairie, and wet-mesic forest. The proposed action may take place in any or all of these habitat types. (See maps of the refuges at Appendix B). For more information regarding the general characteristics of the refuges’ environments, please see Chapter 3 of the refuge Habitat Management Plans, which can be found here: (for Shiawassee NWR, see <https://ecos.fws.gov/ServCat/DownloadFile/161637> ; for Detroit River IWR, see <https://ecos.fws.gov/ServCat/DownloadFile/100269>; for Ottawa NWRC, see <https://ecos.fws.gov/ServCat/DownloadFile/100080>).

The following resources either (1) do not exist within the project area or (2) would either not be affected or only negligibly affected by the proposed action:

- Air Quality – Aerial herbicide application will produce negligible impacts on air quality. Aircraft produce emissions, but negligible amounts of air pollution will be produced within the amount of time that the aircraft are in operation and localized effects are not

substantial. BMPs will be employed to minimize drift. Aerial applications will not take place under weather conditions that result in herbicide volatilization.

- Floodplains – Aerial herbicide application does not affect water retention, discharge, current, or other factors related to flooding or floodplain landscapes. For these purposes, aerial herbicide application will have no impact. Floodplain impacts specific to wildlife, vegetation and habitat, and water quality are addressed in those respective sections below.
- Cultural Resources – There are culturally significant archeological sites located on the refuges. However, aerial herbicide application will not generate ground disturbance and will therefore have no effect on these sites.
- Land Use – Aerial herbicide application will not cause changes to refuge habitat management objectives or land acquisition policies. Land use-related effects specific to vegetation and habitat, water quality, and administration are addressed in those specific sections below.

Natural Resources

Habitat and Vegetation (including vegetation of special management concern)

Affected Environment

Description of Affected Environment for the Affected Resource

Shiawassee NWR

The refuge is located at the confluence of four rivers – the Cass, the Flint, the Shiawassee, and the Tittabawassee – that converge and form the Saginaw River. The rivers are surrounded by a diverse complex of wetland and floodplain ecosystems.

Low-elevation areas of floodplain forests on the refuge are frequently dominated by silver maple (*Acer saccharinum*), with ridges and higher elevations dominated by oak (*Quercus* spp.), hickory (*Carya* spp.), and walnut (*Juglans nigra*), among other species. Floodplain forests are home to a variety of wildlife, but these organisms are scarce or absent in areas that are heavily invaded by buckthorn. Shrub swamps are dominated either by buttonbush (*Cephalanthus occidentalis*) or willow (*Salix* spp.) and dogwood (*Cornus* spp.).

Submergent marshes contain coontail (*Ceratophyllum demersum*) and pondweed (*Potamogeton* spp.), while emergent marshes contain bulrush, cattail (*Typha latifolia*), and waterlily (*Nymphaea odorata*). Moist soil units are vegetated by foxtail (*Alopecurus aequalis*), panic grass, and beggar-ticks (*Bidens* spp.). These units are especially important foraging grounds for ducks and shorebirds. Water levels and vegetative cover in moist soil units are closely managed to meet the needs of migratory birds. Prairies are dominated by warm season

grasses like big bluestem (*Andropogon gerardii*), along with a mix of diverse wildflowers, including milkweed (*Asclepias* spp.).

Detroit River IWR

Wetland habitats within the refuge are dominated by submerged aquatic macrophytes including wild celery and emergent vegetation such as cattail, bulrushes, and phragmites. Wet prairie, which was historically abundant in the area, is now confined to a few small remnants and restoration areas, and typically contain blue-joint grass (*Calamagrostis canadensis*), a variety of sedges (*Carex* spp. and *Cyperus* spp.), sensitive fern (*Onoclea sensibilis*), marsh fern (*Thelypteris palustris*), swamp milkweed (*Asclepias incarnata*), boneset (*Eupatorium perfoliatum*), joe-pye weed (*Eupatorium maculatum*), goldenrods (*Solidago* spp.), and swamp rose mallow (*Hibiscus moscheutos*), among others. These areas are characterized by high seasonal water level fluctuation or frequent mowing – disturbances that promote grasses and limit tree growth.

The uplands and river islands include relatively young forests on wet to mesic portions of the refuge, which are frequently dominated by dogwood, cottonwood, willow, box elder, silver maple, ash, and/or Phragmites. Larger forests contain shagbark hickory, oaks, black cherry (*Prunus serotina*), basswood (*Tilia americana*), black walnut, and hackberry (*Celtis occidentalis*).

Ottawa NWRC

The complex contains over 10,600 acres and consists of four major units along the south shore of Lake Erie, along with a number of more recently acquired properties located mainly along riparian corridors of Turtle Creek, the Toussaint River, and the Portage River.

Interconnected coastal wetlands, the development of submerged, deep emergent, and shallow emergent areas is driven entirely by lake levels. The most significant connected coastal wetland within the complex is the Crane Creek estuary.

Moist soil occurs as the result of a deliberate management action within an impounded wetland. Through passive or active water removal, wetlands are drawn down to gradually provide shallow water and moist soil to benefit migratory birds. An additional goal of these management actions during spring and early summer drawdowns is the establishment of good growing conditions for annual and perennial plants.

Wet prairies and sedge meadows are dominated by sedges, bluejoint, and a variety of herbaceous plants. It is this natural community type where eastern prairie fringed orchid (*Platanthera leucophaea*) occurs. Planted areas include both tallgrass prairie dominated areas and more diverse sedge, grass, and forb dominated areas. These locations typically originated as restorations within agricultural fields within the last 20 years and are maintained using prescribed fire.

Shrublands occur as large habitat blocks, as habitat inclusions within other habitat types, and as linear features along dikes. Inclusions within other habitats occur interspersed with forests, and on higher elevation areas of wetlands. Shrub edges along dikes are particularly important to songbirds during migration, providing travel corridors and prime foraging locations for abundant insect resources from adjacent wetlands.

Forested habitats are highly fragmented and greatly reduced in extent from what occurred historically. Three basic forest types exist within the complex: swamp forest, hackberry, and cottonwood dune. The forest communities on the complex play a critical role in providing stopover habitat for migratory songbirds, particularly during spring migration.

Description of Environmental Trends and Planned Actions

The effects of invasive species and other undesirable vegetation are expected to be amplified in the future because of shifting precipitation patterns, altered disturbance regimes, and increased frequency of late-growing-season moisture stress, which are all associated with a changing climate (Angel et al. 2018 & Briscoe Runquist et al. 2019). For example, non-native (*Typha angustifolia*) or hybrid cattail (*Typha x. glauca*) can expand aggressively into open water and reduce the quality of wetlands. Their ability to grow in deeper water, robust rhizomatous root system, clonal reproduction, and high seed set (20,000-70,000 seeds annually/plant) allow them to outcompete native wetland plant species and create their own dense monocultures. Hybrid cattail is also able to store nitrogen and phosphorus in its roots, transferring them to the soil and altering soil chemistry to its benefit. Population growth and urbanization around the refuges will likely increase anthropogenic threats. This almost guarantees a continual source of new invasive species and other undesirable vegetation for the foreseeable future.

Shiawassee NWR

Floodplain forest habitat quality has decreased drastically where the understory has been invaded by buckthorn and other non-native woody species. Dense thickets of invasive shrubs outcompete native species through aggressive growth and, in the case of species like buckthorn, allelopathy results in a dearth of native understory and groundcover species. Many of the ash trees throughout refuge forests have been killed by the emerald ash borer (*Agrilus planipennis*), further reducing biodiversity.

The majority of floodplain forest habitat on all rivers entering the refuge has been lost to human development. The largest contiguous tract of forest on the Tittabawassee River is on refuge land. Part of this forest has already been aerially treated, as permitted by the Green Point Area Restoration Project (GPARP) Environmental Assessment (<https://ecos.fws.gov/ServCat/DownloadFile/223458>). A neighboring tract of land to the east of this site is a former industrial site now owned by the Michigan Department of Natural Resources (DNR); the DNR is implementing their own ecological restoration plan for Saginaw

River Headwaters Rec Area. Along the southwest boundary of the refuge, upriver on the Shiawassee River, the DNR operates the Shiawassee River State Game Area, a wetland complex managed for wildlife habitat.

Reforestation projects are ongoing at the refuge. The restoration of floodplain forest is being implemented along the Tittabawassee River as part of GPARP and where the Flint River's Spaulding Drain connects to the Ferguson Bayou. These projects will create hundreds of acres of new floodplain forest.

The refuge recently completed a project to hydrologically reconnect refuge marshes and floodplain forest with the Flint River, with plans to similarly reconnect refuge wetlands and the Cass River to take place in the near future. An ongoing restoration project is working to connect refuge marshes throughout the refuge, allowing for increased flexibility and reestablishment of natural hydrological conditions in the use of water control structures. These efforts increase quality and diversity of aquatic habitat on the refuge.

In some refuge prairies, woody plants like cottonwood (*Populus deltoides*) have begun colonizing the sites. Woody species were historically excluded from these ecosystems thanks to robust fire regimes. Although prescribed fire is used as a management tool on the refuge, complications arising from habitat fragmentation, urban-wildlands interfaces, and limited resources result in some prairies having a significant, growing woody plant component. Refuge prairies are generally located between agricultural lands and refuge floodplain forest.

Detroit River IWR

Invasive species, especially *Phragmites* and reed canary grass, have become common in refuge marshes and are outcompeting native species and reducing biodiversity. Buckthorn, honeysuckle, and multiflora rose (*Rosa multiflora*) have invaded wet-mesic flatwoods and are similarly impacting native biodiversity. The refuge's proximity to a heavily used waterway in the Detroit River and a major metropolitan city in Detroit mean that newly introduced invasive species are an ongoing threat as well, making early detection and rapid response a priority. Integrated pest management efforts by refuge staff are ongoing, with the goal of preventing or reducing the spread of invasive species in high quality habitat.

Detroit River IWR is working to restore coastal wetlands and marshes along Lake Erie and the Detroit River by restoring hydrologic conditions that have been disrupted by human development. This includes the installation or removal of dikes and water control structures, as well as ensuring the colonization of native plant species.

Ottawa NWRC

Today, the restoration of cropland back into productive habitat and restoring hydrological connectivity are primary objectives for Ottawa NWRC. This will help fulfill new complex

purposes added by Public Law 108-23, as well as contribute to regional goals of the Great Lakes Restoration Initiative and the U.S. Environmental Protection Agency (USEPA).

Restoration and habitat management goals include the removal of invasive species within the planning and action processes. Wet prairies, sedge meadows, moist soil units, coastal wetlands and impounded wetlands are frequently degraded through invasion of reed canary grass (*Phalaris arundinacea*), purple loosestrife (*Lythrum salicaria*), flowering rush (*Butomus umbellatus*) and phragmites (*Phragmites australis*). Planned activities to treat these invasive species, as well as other largely populated species that are degrading habitat, include a combination of aerial herbicide applications, ground applications of herbicides with truck, tractor, ATV/UTV, amphibious vehicle, or hand sprayers, and non-herbicide control methods including mowing, prescribed fire, hand-pulling, and biological control when possible.

Impacts on Affected Resource

Alternative A

Under the no action and preferred alternative, large populations of invasive species and other undesirable species could be treated in a short timeframe. This alternative would maximize the refuges' ability to control and prevent the expansion of invasive plants and other undesirable vegetation promoting not only suitable, but desirable habitat for wildlife species. This alternative would be expected to directly benefit refuge forests, shrub swamps, prairies, marshes, and moist soil.

There would be some risk of incidental treatment of non-target native species under any methodology for herbicide application. Potential negative effects of herbicide treatments would be indirect and include herbicide inadvertently being applied to non-target plants while treating invasive species and other undesirable vegetation. The greatest potential for non-target effects often occurs when herbicides are applied aerially. This is because the potential for drift can be much higher for aerial herbicide applications, depending on the aircraft used and environmental conditions. Aerial applications would be used in areas that would limit the potential for non-target drift.

The potential for non-target effects can be minimized using plant phenology. Many invasive species begin actively growing before native species in the spring and continue active growth after native species have gone dormant in the fall allowing minimal, if any, non-target treatment damage to native plants. For example, aerial applications of herbicide in forested units to treat invasive plants can be accomplished from late October through mid-November with reduced impact to native vegetation. Ground herbicide applications would be used in areas that are not logistically feasible for aerial application, such as with tractors along perimeter roads, and areas safe for access. Spot treatment of undesirable plants by foot using backpack sprayers and cut stump treatments would be used in areas that are safe for foot

entry. Additionally, non-target impacts to native woody plants in floodplain forests would be mitigated by conducting the treatment in late autumn, after native leaves have changed color but while invasive species' leaves are still green and actively sending chemicals to the plants' roots. Furthermore, aquatic invasive species (e.g., *Phragmites*) will be treated when the plant is translocating all the above ground nutrients to the rhizome for winter, resulting in herbicide translocation to the rhizome and increased treatment effectiveness. The reduced populations of invasive species and other undesirable species would benefit native plant species while increasing navigability for wildlife. Biodiversity would be expected to increase as a result.

The refuges have a history of herbicide use with non-target impacts limited in scale and duration. Shiawassee NWR conducted aerial herbicide applications in 2021 and 2022 in floodplain forest and wet prairie. Detroit River IWR has been using aerial herbicide applications in coastal marshes since 2010. Ottawa NWRC has been conducting aerial herbicide applications for over two decades in coastal marshes and lakeplain prairie. No major, lasting negative impacts to the surrounding ecosystems or environment have been observed.

As noted above, the potential for non-target effect has been analyzed under NEPA as part of the labeling process for all herbicides and measures to minimize those effects, including restrictions, are included in the product label. Because the label is the law, the potential for indirect negative effects on forests, shrub swamps, prairies, marshes, and moist soil are expected to be very minimal. This potential negative affect is further minimized by the refuges following regionally approved BMPs and all PUPs being reviewed and approved as detailed above. The indirect benefits of herbicide applications through improved habitat diversity and health are expected to benefit forests, shrub swamps, prairies, marshes, and moist soil.

This alternative would result in the direct effect of ground disturbance during ground herbicide applications and is expected to have short-term effects. Ground herbicide applications would result in direct disturbance to vegetation like trampling. These effects are expected to be short-term as vegetation is expected to quickly recover from this disturbance. The desired habitat diversity and structural conditions detailed above would maximize the benefits for forests, shrub swamps, prairies, marshes, and moist soil under this alternative because invasive species and other undesirable vegetation would not be allowed to alter those conditions.

Maintaining the refuges' ecosystem health and diversity maintains their resilience in the face of stressors like climate change, new invasive species introductions, and disease outbreaks. Continued herbicide use has the potential of contributing to herbicide resistance of target plants. This indirect effect can be minimized by using herbicides with different modes of action and/or using tank mixes of different herbicides.

Alternative B

Under this alternative, aerial herbicide applications would be discontinued, and invasive plants and other undesirable vegetation management would be limited to ground-based tools. Under this alternative, treatments of invasive species and other undesirable plants would occur much more slowly and as a result, encroachment of invasive plants and other undesirable vegetation would likely result in a reduction in forest, shrub swamp, prairie, marsh, and moist soil plant diversity. Large populations of undesirable species can occur in areas of the refuges that are unreachable by foot or ATV/UTV due to dense woody vegetation, deep muck and mud, or open water. Undesirable species located in the inaccessible portions of the refuges would remain largely untreated, if not completely untreated, and continue to propagate, act as a seed source, and expand to new areas within the refuges. The chance of non-target impacts would be significantly lower than the aerial herbicide treatment alternative, but there would still be some risk to non-target species. The risk of trampling native species with ATV/UTVs or foot traffic during treatments would be part of this alternative as well. Ground pressure from heavy equipment would increase soil compaction and could potentially create ruts in wet areas. In some cases, amphibious tracked vehicles may be used; however, these vehicles are costly to operate and soil compaction and rutting would also occur.

The total area treated annually using ground-based applications is limited due to the time and staff required to treat an area. Additionally, applying herbicides evenly on the landscape can be difficult using ground equipment due to uneven terrain, which reduces the operator's ability to maintain a constant speed and to avoid obstacles. There is also chance for overlap due to difficulties in navigating terrain and vegetation features leading to the application of more herbicide than initially planned.

Under the Alternative B, wildlife habitat will continue to degrade in some areas with the limited application of ground spraying. Large monotypic stands of undesirable plants would remain untreated and would continue to spread. Buckthorn would continue to dominate forest understories, reducing native groundcover and preventing tree regeneration. Hybrid cattail and *Phragmites* would further decrease the amount of open wetland habitat and the extent of desirable aquatic vegetation would continue to decline. In prairie habitats, undesirable woody vegetation would continue to outcompete native species, reducing the amount of habitat available to prairie-obligate species.

Terrestrial Wildlife and Aquatic Species

Affected Environment

Description of Affected Environment for the Affected Resource

Detroit River, Ottawa, and Shiawassee provide essential habitat for a variety of terrestrial and aquatic animals, though variations in habitat type, migration patterns, and land use result in

distinct assemblages of fauna at each refuge. A description of each refuge's environment, including animal species, can be found in Chapter 3 of each refuge CCP (Shiawassee CCP: <https://ecos.fws.gov/ServCat/DownloadFile/161637>, Detroit River CCP: <https://ecos.fws.gov/ServCat/DownloadFile/44167>, Ottawa CCP: <https://ecos.fws.gov/ServCat/DownloadFile/1506>). Appendix C lists Birds of Conservation Concern and state-listed species found on the refuges. Below is a brief description of each refuge's terrestrial wildlife and aquatic species.

Shiawassee NWR

Over 280 species of migratory birds have been observed on the refuge, with tens of thousands of waterfowl migrating through marshes and rivers in the spring and fall. Mallards (*Anas platyrhynchos*), wood ducks (*Aix sponsa*), blue-winged teal (*Spatula discors*), Canada geese (*Branta canadensis*), and other waterfowl species stay to breed on the refuge in the summer. Herons, pelicans (*Pelecanus erythrorhynchos*), and a variety of shorebirds utilize the same habitat. The abundance and diversity of waterbirds on the refuge is regularly tracked with Integrated Waterbird Monitoring and Management (IWMM) surveys.

There are 10 species of amphibians, 5 species of turtles, and 5 species of snakes that inhabit refuge wetlands as well. Frog and toad surveys conducted by partner organizations help provide information on which areas of the refuge are used by different species.

The refuge is home to 28 species of native, wild mammals. There are few terrestrial predators on the refuge, and white-tailed deer (*Odocoileus virginianus*), muskrats (*Ondatra zibethicus*), and raccoons (*Procyon lotor*) are overpopulated. Deer browse is a major limitation on plant regeneration throughout the refuge, especially in the Green Point area, where local law prohibits hunting. Anecdotal observations suggest that predation from raccoons may be inhibiting reproductive success of turtles. Beaver (*Castor canadensis*) and muskrat activity can interfere with the operation of dikes and water control structures.

Over 50 species of fish can be found in refuge waters. Sunfish (*Lepomis* spp.) are especially abundant in the warm, vegetated waters of refuge marshes. Pike (*Esox lucius*) and yellow perch (*Perca flavescens*) are popular sportfish for anglers in refuge rivers. Large populations of invasive carp are detrimental to the health of the refuge's aquatic ecosystems, as they significantly increase soil disturbance and uproot vegetation.

Detroit River IWR

Over 290 species of birds have been observed at the refuge. Hundreds of thousands of waterfowl utilize the Detroit River as a migratory stopover in the fall. Canvasbacks (*Aythya valisineria*), redheads (*Aythya americana*), common mergansers (*Mergus merganser*), and lesser scaup (*Aythya affinis*) are found in especially large numbers over the winter, in addition

to many other ducks, swans, and geese. The refuge provides important habitat for shorebirds as well as migratory songbirds and raptors.

At least 6 species of amphibians, 6 species of snakes, and 6 species of turtles utilize the refuge habitat. Salamanders have not been included in survey efforts, so the presence of these amphibian species on the refuge is unknown at this time.

There are over 14 species of mammals found at the refuge, with murid (mice, lemming, and vole) and bat populations not having been surveyed. White-tailed deer are overpopulated to the point that they are reducing native plant diversity. Beaver populations are increasing, recovering from centuries of overharvest.

More than 60 species of fish either reside or regularly migrate through the refuge. Lake sturgeon (*Acipenser fulvescens*) and lake whitefish (*Coregonus clupeaformis*) populations are increasing in response to improved water quality in the Detroit River. Anglers enjoy fishing for walleye (*Sander vitreus*) and white bass (*Morone chrysops*), which are native, in addition to introduced salmonid species. Mussels are also common, with 18 species found in refuge waters.

A survey of refuge insects found 43 species of dragonfly and 38 species of butterfly. The refuge hosts one of the largest populations of russet-tipped clubtails (*Stylurus plagiatus*) in the Great Lakes.

Ottawa NWRC

Over 330 species of migratory birds have been observed on the refuge. Tens of thousands of waterfowl and songbirds visit the refuge during spring and fall migration. Although the complex's most important role is in providing stopover habitat during migration, nesting species also occur in large numbers.

Approximately 10 species of amphibians, 6 species of turtles, and 7 species of snakes inhabit refuge wetlands. Amphibians are regularly surveyed by various research projects, and through annual surveys of Canada's Marsh Monitoring Program. Lizards are rare or absent, with the only known rare occurrence being the five-lined skink (*Plestiodon fasciatus*).

There are 27 different species of mammals that occur on the refuge. A few of the more charismatic species include white-tailed deer (*Odocoileus virginianus*), American beaver (*Castor canadensis*), and muskrats (*Ondatra zibethicus*).

Ottawa refuge complex has approximately 69 species of fish and 15 species of fresh-water mussels. Fish assemblages vary significantly between isolated impoundments and hydrologically connected wetlands. Existing and additional reconnections of impounded units will result in significant contributions to Lake Erie fish communities.

Invertebrates are abundant throughout the refuge. At least 38 species of butterflies have been documented on the refuge. To date surveys have had a limited coverage. Most other invertebrates, including dragonflies and damselflies, have not been formally surveyed and have little documentation.

Description of Environmental Trends and Planned Actions

Annual aerial surveys are conducted to measure the number of bald eagle nests at all three refuges. The Michigan Department of Natural Resources (DNR) conducts an annual winter aerial deer count to track deer populations at Shiawassee NWR and Detroit River IWR. Hunters take deer, small mammals, turkeys (*Meleagris gallopavo*), waterfowl, and pheasants (*Phasianus colchicus*) at the three refuges. All species hunted or trapped on the refuges have either healthy populations or are overpopulated.

Shiawassee NWR

Hunting is permitted on refuge lands outside of Saginaw city limits. Trapping is permitted for raccoons, muskrats, and beavers. All waterbird species and the majority of other bird species are regularly surveyed on Shiawassee NWR as part of IWMM protocols, allowing the refuge to monitor population changes over time. As part of hydrological restoration efforts to reconnect refuge wetlands and rivers, fish and other aquatic species are being monitored through frequent sampling by refuge staff, the U.S. Geological Survey (USGS), and the University of Michigan.

Ottawa NWRC

A monthly bird census is conducted by volunteers to record species presence and abundance. This census has been ongoing since 1969 and has helped with identifying species presence and species trends on refuge lands. The Ohio Department of Natural Resources conducts a variety of aerial wildlife surveys that provide the refuge with details on species populations.

Impacts on Affected Resource

Alternative A

This alternative would result in the direct effect of wildlife disturbance during aerial and ground pesticide applications. Disturbance to wildlife and short-term displacement would likely occur during aerial application. The duration of the disturbance would most likely be shorter for aerial herbicide applications than ground applications. Timing of aerial applications within the target plant's susceptibility window could also be modified to reduce disturbance issues. Wildlife disturbance would be temporary, lasting approximately the amount of time it would take to treat the desired site. Disturbances associated with ground treatments would be limited to the perimeter areas of the refuges that have been deemed safe for vehicular entry. Additionally, wildlife disturbance associated with ground herbicide application would include traveling to and from application sites. The aircraft noise may disturb wildlife for a couple hours while the treatment is ongoing. The refuges will seek to minimize overlap between the schedules of

application and the breeding season of birds of conservation concern that are present on the refuges. Some applications will occur in autumn; this will help mitigate impacts to migratory birds, which will have completed nesting for the year, as well as reptiles and amphibians, which will have started hibernation. The effects of continued herbicide use would indirectly benefit wildlife under this alternative, as the desired habitat diversity and structural conditions detailed above would be maximized because alterations caused by invasive species and other undesirable vegetation would be reduced. Wildlife benefits from improved plant diversity and from less cover dominated by harmful species.

Wildlife exposure to pesticides needs to be considered, regardless of application methods. Wildlife can be exposed to pesticides through direct spray and drift, direct exposure to contaminated water/vegetation, or ingestion of contaminated water, vegetation, or prey animals. Potential damage to aquatic species from applications that take place in habitats adjacent to rivers or other open water would be mitigated by using herbicide approved for aquatic use. Direct contact with herbicide can negatively impact animal health. Triclopyr (3,5,6-trichloro-2-pyridinyloxyacetic acid)-based herbicide can be irritating or corrosive if it enters the eyes (EPA 1998). Direct spray contact with larger wildlife species is less likely given the slower application rate while using ground equipment. However, the noise disturbance of certain aerial application equipment, such as fixed-wing aircraft or helicopters, may give wildlife advance warning to move out of the area. This potential non-target effect associated with aerial applications has been analyzed as part of the labeling process for all herbicides and measures to minimize those effects, including restrictions, are listed on the product label. Also, as noted above, each pesticide application is individually reviewed and approved prior to treatment as part of the PUP process. This includes regionally approved BMPs. Because all label restrictions and regionally approved BMPs must be followed and because each herbicide application is reviewed and approved, the potential for indirect negative effects to wildlife are expected to be very minimal. Indirectly, herbicide applications through improved habitat diversity and health are expected to benefit many wildlife groups. Over time, herbicide use should decrease as invasives species are reduced and controlled.

Alternative B

Under this alternative aerial herbicide applications would be discontinued. With this alternative, herbicide would be applied more selectively via backpacks and ATV/UTV-mounted sprayers, reducing the risk of accidental herbicide contact to wildlife. ATV/UTVs and foot traffic could disturb wildlife on a daily basis for an extended period of time in this alternative. Wildlife would benefit from the reduction of harmful plant populations, but treatment of entire populations would be much slower. As a result, these undesirable plant populations may still increase over time. Potential damage to aquatic species from applications that take place in

habitats adjacent to rivers or other open water would be mitigated by using herbicide approved for aquatic use.

Treatments would primarily be limited to the drier and more accessible portions of the refuges. Invasive species and undesirable vegetation located in rough terrain, islands, and other inaccessible portions of the refuges would remain largely untreated and their populations would continue to expand across their respective habitats throughout the refuges. *Phragmites* and non-native cattail expansion would continue to eliminate open water habitat, reduce native plant diversity, and negatively impact wetland dependent wildlife species. Buckthorn, autumn olive, and other undesirable woody vegetation, invasive grasses, and forbs would continue to expand in population, range, and density, outcompeting native prairie, forest, shrub swamp, moist soil and marsh communities and altering the habitat suitability for resources of concern. Ultimately, desirable habitat and habitat diversity would continue to be degraded, leading to a decline in wildlife use and abundance across the refuges.

Prairie habitat would eventually succeed to forest. This would affect grassland nesting birds like the eastern meadowlark (*Sturnella magna*) (Kahl et al. 1985) and bat species (Tibbels and Kurta 2003, Morris et al. 2010) that feed on insects in openings. In marshes and moist soil units, marsh birds like bitterns (*Botaurus* spp.) and rails (*Rallus* spp.) are significantly less likely to use habitat infested by invasive *Phragmites australis* (Tozer and Mackenzie 2019, Robichaud and Rooney 2017), which grows so densely that these areas become difficult to navigate. Invasive species and other undesirable vegetation degrade forest habitats by altering forest structure. This affects birds like the red-headed woodpecker (*Melanerpes erythrocephalus*) (King et al. 2007) that require an open understory. Degraded stands of even-aged invasive trees and vines decrease light to the forest floor, thus reducing herbaceous plant communities required by ground nesting birds, pollinators, and herbivores. Buckthorn can be particularly harmful to wildlife, as its berries dehydrate birds and it releases emodin, a chemical that is harmful to amphibians like green frogs (*Lithobates clamitans*) (Izhaki 2002, Brenes et. al 2022).

Threatened and Endangered Species, and Other Special Status Species

Affected Environment

Description of Affected Environment for the Affected Resource

There are several federally threatened, endangered, and special status species that live in or near Detroit River, Ottawa, and Shiawassee refuges. The table in this section describes federally listed species that occur in the same counties as the refuges. State-listed species and Birds of Conservation Concern found in or near the refuges are listed in Appendix C.

The federally listed species that have been detected on Ottawa NWRC include Eastern prairie fringed orchid, Northern long-eared bat, piping plover and rufa red knot. The piping plover and

rufa red knot can occur during migration seasons but have not been recorded nesting on refuge lands.

To date, none of the federally listed species (under the Endangered Species Act of 1973) that may occur within the boundaries of Shiawassee NWR and Detroit River IWR (Table 2) have been detected on either refuge. Bat surveys were conducted at SNWR in 2013 (Auteri and Kurta). Prior land use history, habitat types currently present within the refuge, data collection, and monitoring efforts suggest that it is unlikely that the Eastern massasauga, the Eastern prairie fringed orchid, the Northern long-eared bat, tri-colored bat, Indiana bat, or the rufa red knot occur within the proposed treatment areas. The candidate species monarch butterfly (*Danaus plexippus*) can be found in open areas throughout each refuge, including marshes, prairies, and other habitat that features its host plant, milkweed (*Asclepias* spp.).

The bald eagle (*Haliaeetus leucocephalus*) was removed from the endangered species list in 2007 (USFWS 2021). This species' recovery was largely the result of removal of the insecticide DDT from the environment and efforts to restore bald eagles to their former range. Illegal shooting of bald eagles led Congress to pass the Bald Eagle Protection Act in 1940, which prohibited killing, selling, or possessing the species. In 1962 the Act was amended to include the golden eagle, and the law became the Bald and Golden Eagle Protection Act. Although no longer included as a threatened or endangered species, the bald eagle maintains protection under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act and are a Species of Special Concern in Michigan. Bald eagles utilize the refuges year-round. There are breeding populations of bald eagles living on all three of the refuges. Golden Eagles (*Aquila chrysaetos*) are rarely observed on any of these three refuges and are also protected by the Bald and Golden Eagle Protection Act.

Table 2. Federally listed species that may occur within the counties that contain Shiawassee NWR, Ottawa NWRC, and Detroit River IWR.

Species	Status	Habitat Associations	Refuge
Indiana bat <i>Myotis sodalis</i>	Endangered	Small to medium rivers with well-developed riparian woods; woodlots within 1 to 3 miles of rivers and streams; upland forests. Caves and mines as hibernacula.	All
Northern long-eared bat <i>Myotis septentrionalis</i>	Endangered	Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. Roosts and forages in upland forests.	All

Species	Status	Habitat Associations	Refuge
Northern Riffleshell <i>Epioblasma rangiana</i>	Endangered	Riffles (shallow, rocky areas with high current) in rivers and large streams.	DRIWR
Karner Blue Butterfly <i>Lycaeides melissa samuelis</i>	Endangered	Oak savanna.	DRIWR
Piping Plover <i>Charadrius melodus</i>	Endangered	Open sandy beach with gravel cobble.	DRIWR ONWRC
Rufa red knot <i>Calidris canutus rufa</i>	Threatened	Large wetland complexes during the red knot migratory window of May 1 – Sept. 30.	All
Eastern massasauga <i>Sistrurus catenatus</i>	Threatened	Shallow wetlands or shrub swamps in spring. Crayfish towers or small animal burrows which are adjacent to drier upland open shrub forest sites. During summer, massasaugas move to drier upland areas.	SNWR DRIWR
Lakeside Daisy <i>Hymenoxys herbacea</i>	Threatened	Limestone alvar (bare rock with minimal organic soil).	ONWRC
Eastern prairie fringed orchid <i>Platanthera leucophaea</i>	Threatened	Mesic to wet prairies and meadows.	All
Tri-colored bat <i>Perimyotis subflavus</i>	Candidate	Forages in streams, ponds, forest edges while roosting in snags and buildings. Hibernates in caves and mines.	All
Monarch butterfly <i>Danaus plexippus</i>	Candidate	Savannas, prairies, and other open habitat containing milkweed (<i>Asclepias</i> spp.), the monarch's larval host plant.	All

SNWR, DRIWR, and ONWRC use the U.S. Fish and Wildlife Service Information for Planning and Consultation tool (IPaC) to identify threatened and endangered species, including for purposes of this environmental assessment. In order to ensure a thorough review, this document considers all threatened and endangered species identified by both the IPaC and ECOS databases. Note that these databases are updated regularly, approximately every 90 days, and it is thus possible that the specific threatened and endangered species identified as present on or near the refuges may change between the finalization of this environmental assessment and its publication and/or interested parties reading this document. Reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been

retained (or is authorized by law), and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. The full list of species generated by IPaC includes species ranges and not necessarily true presence of species. Staff present on the refuges and conducting the Intra-Service endangered species consultation generally have the best available information about the presence of fish and wildlife species in an area. Thus, where species are identified by either database, but the refuges have information that the species is not actually present within the action area is considered in the analysis. Eastern massasauga, Eastern prairie fringed orchid, Northern long-eared bat, tri-colored bat, Indiana bat, Northern riffleshell, Karner blue butterfly, and the rufa red knot have been documented to occur within borders of the counties containing SNWR and DRIWR but have not been specifically documented on the refuges within the specific action area. The lakeside daisy, tri-colored bat, and Indiana bat have been documented to occur within borders of the counties containing ONWRC but have not been specifically documented on the refuge within the specific action area. These species are not further described as there would be no expected impact to them do to not being present in the action area.

Northern long-eared bat

The Northern long-eared bat is an endangered species that has been recorded on ONWRC. Northern long-eared bats spend winter hibernating in caves and mines, called hibernacula. They use areas in various sized caves or mines with constant temperatures, high humidity, and no air currents. During the summer, northern long-eared bats roost singly or in colonies underneath bark, in cavities or in crevices of both live trees and snags (dead trees). Males and non-reproductive females may also roost in cooler places, like caves and mines. Northern long-eared bats seem to be flexible in selecting roosts, choosing roost trees based on suitability to retain bark or provide cavities or crevices (U.S. Fish and Wildlife Service 2015).

Monarch butterfly

The monarch butterfly is a candidate species found in all three refuges. On the refuges during the summer breeding season, they can be found in prairies and anywhere milkweed (*Asclepias* spp.), their obligate host plant, is found. Monarchs are known for their multi-generational long-distance migration. The eastern monarch population migrates to the Sierra Madre Mountains of Mexico, while the western monarchs overwinter in southern California. Winter roosting sites in Mexico are oyamel fir forests at least 2,400 meters above sea level (U.S. Fish and Wildlife Service 2020). The temperature and humidity of these forests allows them to survive without

expending their fat reserves. During the breeding season, monarchs lay their eggs on milkweed. After larvae emerge, they feed on the milkweed, which contains toxins that do not harm the monarchs while rendering them unpalatable to predators. Monarch populations have declined significantly over the past two decades, largely due to habitat loss and fragmentation (Brower et al. 2012b).

Piping plover

The piping plover is an endangered species that has been observed migrating through ONWRC, though it does not breed on the refuge and no critical habitat for the piping plover has been designated at ONWRC. The piping plover is a small, migratory shorebird, about the size of a robin, that is divided into three populations that breed in different geographies: the Atlantic Coast, the Great Lakes, and the Northern Great Plains. The Great Lakes population is endangered, while the other two are threatened. Piping plovers are found from April to August in the Great Lakes region, breeding in open sand and cobble beaches along Great Lakes coasts. They overwinter in coastal areas in the southeastern U.S.

Rufa red knot

The rufa red knot is a threatened species that has been observed migrating through ONWRC, though it does not breed on the refuge and no critical habitat for the species has been designated at ONWRC. The rufa red knot is notable for the great length of its migration between southernmost South America and the Arctic tundra, a round-trip journey that can be over 19,000 miles overall. These shorebirds use areas of exposed moist soils, such as those found in tidal areas, while migrating and overwintering, but their nesting sites are typically on open, elevated slopes in the tundra (U.S. Fish and Wildlife Service 2022).

Eastern prairie fringed orchid

The eastern prairie fringed orchid is a threatened species that is found at ONWRC. It is frequently located in wet prairie, in addition to a variety of other open wetland habitat types. Its population decline is largely due to habitat loss. The plant emerges in April and flowers in late June to early July. Eastern prairie fringed orchids are pollinated by hawkmoths (U.S. Fish and Wildlife Service 2022).

Description of Environmental Trends and Planned Actions

An extensive status assessment was completed by the Service in 2020, which determined that listing the monarch under the Endangered Species Act is warranted but was precluded at that time. Widespread habitat loss and fragmentation is believed to be one of the contributing factors of the species' decline. Monarchs rely on milkweed plant species as their obligate host plant to lay eggs on.

On the refuges, its host plant, milkweed (*Asclepias* spp.), is plentiful because the refuges maintain open landscapes that milkweed thrives in. Monarch butterflies are commonly seen in summer months on the refuges and no surveys are currently in place to measure population trends. However, habitat fragmentation in their wintering grounds and decreasing milkweed populations in other areas of the country are causing monarch populations to trend downward in North America (Brower et al. 2012b). The monarch is susceptible to loss of milkweed through indiscriminate herbicide use in agriculture and loss of habitat (Thogmartin et al. 2017).

Ottawa NWRC

Eastern prairie fringed orchid surveys are conducted annually to monitor current and potential populations. Areas where the orchid has been observed are mapped and monitored to avoid disturbance. The status of Northern long-eared bat on the complex is also unknown, although habitats used would be the same as other bat species. One detection of Northern long-eared bat was recorded by researchers in Spring 2013 at the Darby Unit of Ottawa NWRC. The decline and vulnerability of the northern long-eared bat and other listed bat species is largely related to disturbance and white-nose syndrome at their hibernation sites, which are not located on the refuges. Invasive non-native plants could cause declines in insect abundance which could affect local food availability for bats (Tallamy et al. 2020).

Impacts on Affected Resource

Alternative A

Under the no action and preferred alternative, invasive species and other undesirable vegetation would be treated with aerial herbicide applications and other ground-based methods where possible. The Intra-Service Section 7 endangered species consultation process informs all pesticide use on the refuges. The Section 7 consultation for herbicide use resulted in a preliminary no effect determination for all federally listed species. The effect on the monarch butterfly and tricolor bat, candidate species, was determined to be not likely to jeopardize candidate species. A section 7 consultation specific to aerial herbicide application will be completed along with the final draft of this Environmental Assessment.

The refuges have a history of ground and aerial pesticide application without any obvious or known impacts to listed species. Aerial spraying has been used on relatively small proportions of the refuges as initial treatment, follow up treatments, or to treat new invasions that arise due to environmental conditions. Much of this work has been in areas that do not have listed species present. In 2021 and 2022, over 200 acres of undesirable species, including buckthorn in floodplain forest and cottonwood in wet prairie, were aerially treated at SNWR. Over 400 acres of coastal marsh have been treated at DRIWR since 2010, focusing on controlling *Phragmites* and non-native cattail. ONWRC has been utilizing aerial herbicide treatments for over 20 years. Typically, treatments consist of approximately 50-100 acres of coastal marsh and

lakeplain prairie per year and are used to control plants like *Phragmites*, purple loosestrife, reed canary grass, and flowering rush. Aerial treatment of certain habitats at ONWRC had significant positive impact on improving areas for prairie fringed orchid that expanded that population. As noted above, the potential for non-target effect has been analyzed (NEPA) as part of the labeling process for all herbicides and measures to minimize those effects, including restrictions, are listed on the product label. Also as noted above, each pesticide application is individually reviewed and approved prior to treatment as part of the PUP process. This includes regionally approved BMPs. Because all label restrictions and regionally approved BMPs must be followed and because each herbicide application is reviewed and approved, the potential for indirect negative effects on the monarch are expected to be very minimal. Indirectly, herbicide applications through improved habitat diversity and health are expected to benefit threatened and endangered species that may be present on the refuges.

Monarch butterfly

Aerial herbicide application would primarily be prescribed in situations where large monocultures of a target invasive species exist. The highly degraded habitat being targeted is unlikely to harbor resident monarch butterfly individuals, but some monarch butterflies may move through these areas if more suitable habitat is nearby. It is therefore unlikely but possible that monarch butterflies would be directly impacted by aerial herbicide applications. The minimal impacts to monarch butterflies are likely to be mediated by increased plant diversity and overall habitat quality improvements. Aerial spraying would allow for more acres of undesirable and invasive species to be controlled across the refuges, leading to habitat more suitable for a greater suite of species. Therefore, it is not anticipated that monarch butterfly populations would be impacted by this action. Milkweed populations that act as hosts for monarch caterpillars may be temporarily harmed by herbicide drift if located near target species but would benefit from better access to sunlight in the long term.

The widespread use of pesticides is thought to have contributed to the decline of monarch butterflies in North America; however, this typically occurs when insecticides are used for agricultural practices. The loss of milkweed in agricultural fields through herbicide application has also reduced host plant availability (Thogmartin et al. 2017). There is not currently any agricultural land on the three refuges and no recent history of insecticide use on lands managed by the refuges, other than Bti for mosquito control at SNWR. Potential impacts on the monarch would most likely be indirect and include herbicide inadvertently being applied to milkweed plants and nectar plants while treating invasive species and other undesirable vegetation. Herbicide is used to remove non-native grasses and dense thickets of woody plants to restore pollinator habitat, including milkweeds, which directly benefit monarchs (Rhoades et al. 2002, Washburn et al. 2002).

Eastern prairie fringed orchid

Within the known population sites for the Eastern prairie fringed orchid on Ottawa NWR, control will be limited to spot spraying on a very limited basis from mid-April until the plants senesce to reduce and mitigate potential negative impacts to individual plants. These restrictions were put into place utilizing a consultation with the Service's Ohio Ecological Services Office and species experts.

Treatments would benefit species by enhancing habitat that is currently being closed by thickets of undesirable species. This alternative is expected to provide more suitable habitat in a shorter timeframe than the other alternative. Without aerial spraying, unchecked expansion of invasive species will likely occur, resulting in complete loss of desirable habitat in some areas of the refuges.

Northern long-eared bat and tricolor bat

No potential loss of habitat for Northern long-eared bats and tricolor bats will occur. These species' habitat are not subject to control treatment and aerial application will only occur in areas dominated by monotypic stands of invasive species.

Red knot and Piping plover

The complex is well outside the breeding range of the piping plover and Rufa red knot. During migration, refuge habitats would only be used as stopover habitats by either species, and because they are highly mobile and can easily evade any disturbance and use other undisturbed habitats, there is no conceivable action that would cause a threat to either species or individuals.

Bald Eagle

Following the National Bald Eagle Management Guidelines (USFWS 2007), aerial herbicide applications in the area surrounding bald eagle nests would only be made during the fall to not disrupt or otherwise disturb nesting eagles.

Alternative B

The Section 7 biological evaluations created to inform pesticide use on the refuges included the impacts of ground-based herbicide treatment with a determination of no effect for all federally listed species except for a candidate species, monarch butterfly, which had a determination of not likely to jeopardize. The use of prescribed fire and herbicides to control invasive species, and to promote native species, are likely to affect monarch butterflies of various life stages and temporarily reduce habitat suitability. Monarch-hosting milkweed could be negatively impacted by non-target spray or by trampling from staff or vehicles but would benefit from better access to sunlight in the long term. Ground based treatments can be more targeted to avoid native and desirable plants but would cover much less area, thereby not benefitting overall habitat

and associated species on these refuges. The minimal impacts to non-target species are likely to be mediated by increased plant diversity and overall habitat quality improvements where treatments occur.

Ground-based treatments would benefit all species by enhancing habitat that is currently being closed by thickets of invasive species or stands of other undesirable plants. The effects on threatened and endangered species of discontinuing aerial herbicide use would mostly be indirect. The habitat structural changes and conversions detailed above would be caused by uncontrolled succession, which would be an indirect effect of discontinuing aerial herbicide use in accessible areas. Conversion of habitats to monotypic stands of invasive species would greatly reduce the refuges' habitat diversity.

Geology and Soils

Affected Environment

Description of Affected Environment for the Affected Resource

Shiawassee NWR

Over 40 soil types occur on the refuge, but they are predominately poorly drained clay and silt-clay soil types, reflecting the geologic history of the area as a glacial lake plain (Heitmeyer et al. 2013). Soils within the Green Point Area are characterized as types that experience frequent flooding (Heitmeyer et al. 2013). Soils on the refuge range from poorly drained to very poorly drained (Heitmeyer et al. 2013, Newman 2011). Hazardous substances, including dioxins, were released into the Tittabawassee River and now occur in the river and its floodplain, which includes the majority of lands within the Green Point Area. For example, in the southeast corner of the 80-acre Learning Center Tract, an area with relatively high dioxin concentrations has been identified along the Tittabawassee River (USFWS 2015). The State of Michigan has issued advisories about moving soil within the 100-year floodplain of the Tittabawassee River in order to minimize or eliminate soil displacement and increased exposure of contaminated soils (MDEQ et al., undated).

Detroit River IWR

The predominant soil types within the refuge are silt loam and silty clay loam, which result in poorly drained conditions and support plant communities adapted to seasonal inundation including wet prairie, hardwood swamp, wet-mesic forest, and shrub-carr wetlands. Following the last glaciation, these soils were deposited over limestone bedrock in a layer ranging in depth from a few inches to 150 feet. Deposits of sandy material occur over the silt and clay in areas of temporary postglacial streambeds. Organic soils of varying thickness occur in parts of many coastal wetlands, particularly those that are protected from direct wave action and seiche events (Sherzer 1900, Albert 2003).

Ottawa NWRC

Soils tend to be rich, heavy clay, and relatively uniform as a result of their formation under the post-glacial lakes. The primary soil series on the refuge complex is Toledo which was formed in the clayey glacial lakebed sediments. They are characterized as deep, nearly level, very poorly drained soils on broad flats and concave areas on lake plains, are frequently flooded, and have high organic matter content. Toledo series and open water (unmapped soils) account for a majority of the site locations within the complex. The remaining unmapped acres are primarily open water areas of Lake Erie. Sandy soils are restricted to beach ridges along the shores of Lake Erie.

Description of Environmental Trends and Planned Actions

No major changes are expected in terms of soil and geology. Some invasive species add toxins to the soil through allelopathy. Areas with low biodiversity may be less resilient to disturbance like flooding, potentially reducing ecosystem services like erosion control.

Impacts on Affected Resource

Alternatives A and B

Both alternatives have the potential to impact soil quality. Spraying may affect soil fertility, temporarily increase erosion, and cause off-site transport of sediments into aquatic ecosystems consequently affecting soil quality. However, the presence and potential expansion of invasive species on the landscape can also affect soils by decreasing long-term erosion control capacity (Crooks 2002) and adding allelopathic chemicals to soil. Ground-based treatment has multiple impacts on soil. Driving ATV/UTVs through the landscape in order to conduct treatments could generate erosion, compaction, or displacement of soil, which would take place repeatedly over extended time periods. Herbicide may be added to the soil due to accidental overspray.

Healthy, organic soils help with absorption and breakdown of pesticides. Best management practices aimed at minimizing herbicide contact with soil are likely the best tool to mitigate any threats to soil health; these include minimizing soil compaction and disturbance, maximizing plant diversity, and maintaining permanent plant cover. Extra precaution is used when applying herbicides to sandy or well drained soils to minimize any herbicide to soil contact that may have detrimental effects to soil.

Alternative A

Under the no action and preferred alternative, aerial treatments may cause herbicide to directly contact the soil. The effects of pesticides on soil health have been poorly studied and those used for agriculture have received the most study (Gunstone et al. 2021). Invasive plants alter soil chemistry, microbial, and mycorrhizal fungal communities increasing the difficulty of restoration activities with native plant species (McNeish and McEwan 2016, Rai 2022). Invasive plants tend to have less robust root systems resulting in an increase in soil erosion in areas with

heavy infestations (Rai 2022). Therefore, a reduction in invasive species populations may improve soil health conditions as native plant communities are restored.

Alternative B

Under this alternative, aerial herbicide use would be discontinued, and management of invasive plants and other undesirable vegetation would be limited to ground-based tools. The continued proliferation of invasive species and reduction in biodiversity may indirectly affect soil by altering rates of erosion. Soil health conditions may improve more slowly or not at all if invasive species populations are not reduced.

Water Quality

Affected Environment

Description of Affected Environment for the Affected Resource

Shiawassee NWR

The 1987 amendment to the Great Lakes Water Quality Agreement between the United States and Canada created the framework for the identification of substantial areas of environmental degradation known as Areas of Concern (AOCs). The AOCs have been characterized in terms of Beneficial Use Impairments (BUIs). When originally designated as an AOC in 1987, the Saginaw River and Bay were characterized as having 12 of 14 BUIs. Three of the BUIs have been subsequently removed: Tainting of Fish and Wildlife Flavor, Drinking Water – Taste & Odor; Loss of Fish and Wildlife Habitat (PSC, Inc. 2012; USEPA 2014). The Saginaw River and Bay AOC extends from the Saginaw Bay to 22 miles upstream along the Saginaw River, bordering the refuge.

Impairments to water quality within the Saginaw Bay and River, and the larger watershed of the Saginaw River, parallel the history of development in the Shiawassee flats. The advent of commercial agriculture has contributed agricultural chemicals, nutrients, sediments, and wastes to area watersheds. The growth of urban centers has affected water quality by altering the characteristics of runoff and adding municipal wastes to area waters. Industrial development has added a suite of hazardous wastes to area rivers, among them legacy contaminants such as polychlorinated biphenyls (PCBs). All of the 11 remaining BUIs are associated in some way (e.g., bacteria, nutrients, hazardous chemicals) with impairment of water quality (USFWS 2010, MDEQ 2012).

Ottawa NWRC

Due to significant habitat alteration, industrial impacts, uncontrolled sewage overflows, and struggling wildlife in the greater Toledo and outlying areas, the Maumee AOC was designated as an Area of Concern. The waterways included in this AOC are located within the boundary of Ottawa NWR. There is a total of nine BUIs remaining within the Maumee AOC, four of which are applicable for the refuge to assist with for delisting purposes. The four BUIs that the refuge

addresses include: BUI 3a – Degradation of Fish Populations, BUI 6 – Degradation of Benthos, BUI 14a – Loss of Fish Habitat, BUI 14b – Loss of Wildlife Habitat.

A general concern for Lake Erie is the presence of Harmful Algal Blooms (HABs) that begin in the western basin and spread throughout the lake. Among all the Great Lakes, Lake Erie is the fourth largest, shallowest, smallest in water volume, and most southern. It is surrounded by a more urbanized environment and extensive agricultural land-use than any other lake regions. Due to the unique nature of the surrounding area and water depth, the western basin is subject to substantial impacts from excessive nutrient loadings (Tian D. & et al. 2017). PCBs and PAHs are relatively ubiquitous in the area due to historical industrial practices and atmospheric deposition; however, PCBs and PAHs are not a contaminant of concern at the refuge. A contaminants assessment process (CAP) was completed at the complex in 2012 to investigate potential contamination issues.

Detroit River IWR

The Detroit River has experienced over a century of contaminant discharges from point and nonpoint sources including stormwater runoff, air deposition, sewer overflows, and municipal and industrial discharges. The primary contaminants are cadmium, copper, lead, mercury, zinc, and PCBs, although other contaminants have been identified (UGLCCS 1988). Many of these contaminants bioaccumulate as they move through the food chain and have been identified at high levels in fish and wildlife inventoried on the refuge.

Although contamination levels in general have decreased substantially since the 1950s, contaminants are persistent in certain areas throughout the refuge. There are many contaminated sediment hotspots that represent the legacy of the industrial revolution. These are and will be remediated in the future through the Remedial Action Plans (RAPs) under the Great Lakes Water Quality Agreement. Grassy Island is part of the refuge and was constructed as a confined disposal facility (CDF) to deposit contaminated dredge spoils from the Rouge River. Because it was constructed without a liner or cap, wildlife may be exposed to contaminated surface soils, and contaminants may be leaching into the Detroit River.

Description of Environmental Trends and Planned Actions

Water quality monitoring and cleanup by agencies like the EPA, as well as the restoration of native plant communities that filter water and improve flood capacity, will likely contribute to improving water quality on all three refuges. Other factors related to water quality, including geology (e.g., karst features), depth to groundwater, locations of river, streams, ponds and

impoundments, soil characteristics (e.g., fragipans), and the influx of agricultural chemicals from offsite agricultural and industrial lands, are not expected to change in the future.

Impacts on Affected Resource

Alternative A

Under this alternative, accidental overspray from the aircraft may result in some herbicide entering a waterbody but will be mitigated using BMPs to reduce non-target drift. Additionally, all pesticide labels include restrictions for aerial applications. Direct herbicide contact with water is most likely if marshes are being sprayed. However, the herbicide used around waterbodies require use of those approved for aquatic use and thus have reduced risk for impacts on water quality and aquatic organisms. The potential for groundwater and surface water contamination has been analyzed as part of the labeling process for all herbicides and measures to minimize those effects, including restrictions, are included in the product label. Since pesticide labels are legally enforceable and must be followed, the potential for groundwater or surface water contamination is expected to be very minimal. Additionally, the refuges have organic soils to absorb and decompose herbicides. Extra precaution is taken, and alternative treatment methods are analyzed if a site has a shallow depth to groundwater.

The aerial application of herbicides will allow for the treatment of more habitat and help mitigate the degradation caused by undesirable plant species. The reduction and prevention of further establishment of these species will result in an increase of habitat available for priority resources. Furthermore, maintaining healthy, diverse groundcover indirectly benefits water quality by filtering water before it enters surface water or groundwater.

Possible negative effects of aerial herbicide treatments would include herbicide potentially dripping off target plants and leaching through the soil into groundwater or running off into nearby surface waters. Large-scale aerial application of herbicides could affect water quality, but this can be mitigated by applying only herbicides approved for specific uses. Impacts can be further mitigated with the timing of herbicide application. For example, most herbicide applications near temporary or seasonal wetlands would be made from late summer to early fall when the wetlands are dry. The refuges have previously used aerial and ground-based herbicide application, and no groundwater or surface water contamination has been observed. Herbicides such as glyphosate, triclopyr, and imazapyr typically have half-lives of less than one week in water (Tatum 2004).

Pesticide applications would be combined with non-pesticide methods like prescribed fire and could have cumulative effects. Prescribed fire often removes protective vegetation from the soil surface, thus resulting in a potential for increased siltation of water resources. The cumulative effect of using pesticides with prescribed fire could potentially increase both

siltation and chemical contamination of water resources. Timing the use of fire to minimize root damage to native vegetation would assure minimal siltation. Furthermore, following pesticide label instructions would ensure undesirable vegetation control can be achieved through minimal runoff into water resources.

Alternative B

Under the Alternative B, the chemical treatment of invasive species and undesirable woody plant species would be limited, and the refuges would rely on ground-based herbicide application and other non-herbicide methods. This limitation would allow undesirable plant populations to further expand and, in the instance of cattail and *Phragmites*, form large, dense mats. Large cattail and *Phragmites* invasions contain a significant amount of vegetative mass which alters the habitat and lowers the amount of water the wetlands can hold due to displacement. This reduces the capacity of the wetlands within the refuges, affecting not only the ability to capture water during spring snow melt and significant rain events, but also the amount of water available for aquatic plants and wildlife.

This alternative may result in some herbicide entering a waterbody as accidental overspray from backpacks, ATV/UTVs, or a marsh master. Direct herbicide contact with water is most likely if marshes are being sprayed. The herbicide used around waterbodies will be approved for aquatic use and thus have minimal impact on water quality and aquatic organisms. The potential for groundwater and surface water contamination has been analyzed as part of the labeling process for all herbicides and measures to minimize those effects, including restrictions, are included in the product label. Impacts can be further mitigated by timing of herbicide application; most herbicide applications near temporary or seasonal wetlands would be made from late summer to early fall when the wetlands are dry.

Wilderness or Other Special Designation

West Sister Island NWR, part of the Ottawa National Wildlife Refuge Complex, is designated wilderness, but will not be aerielly treated. No designated wilderness will be aerielly treated on these three refuges.

Affected Environment

Description of Affected Environment for the Affected Resource

Shiawassee NWR

Shiawassee National Wildlife Refuge has been designated an Important Bird Area (IBA) at the state level by the Audubon Society for its value as a migratory stop for waterfowl and as breeding grounds for king rail, sedge wrens, and prothonotary warblers. The bird habitat identified as important by the Audubon Society includes emergent marsh and floodplain forest.

Detroit River IWR

Detroit River International Wildlife Refuge has been designated an IBA at the global level for its concentrations of migrant and wintering waterbirds and waterfowl. DRIWR's bird habitat identified as important by the Audubon Society includes the Detroit River and its mouth at Lake Erie. Humbug Marsh is a Ramsar site, internationally recognized as a wetland of significant value under the Convention on Wetlands developed in 1971 (Ramsar List 2023).

Ottawa NWRC

Ottawa National Wildlife Refuge Complex is part of the global priority Lake Erie Western Basin IBA, which is valued as breeding grounds for herons and rails and as a migratory stop for waterfowl, bald eagles, double-crested cormorants, shorebirds, rails, and bitterns. The bird habitat identified as important by the Audubon Society includes coastal wetlands, open water, and beach.

Description of Environmental Trends and Planned Actions

Shiawassee NWR

The primary threat to these habitats, as identified by the Audubon Society, is invasive species. Secondary threats include pollution, succession, and browsing.

Detroit River IWR

According to the Audubon Society, pollution is the main threat to these habitats.

Ottawa NWRC

The primary threat to these habitats, as identified by the Audubon Society, is invasive species, with habitat fragmentation as another threat.

Impacts on Affected Resource

Alternative A

The aerial herbicide treatment would benefit bird habitat by reducing the threat of invasive species in floodplain forests and prairies as well as the threat of succession in prairies. The action to apply herbicide using any of the methods described in this alternative would not impact the special designation.

Alternative B

The ground-based treatment would slowly reduce or at least mitigate the threat of invasive species in floodplain forests and prairies as well as the threat of succession in prairies.

Visitor Use and Experience

Affected Environment

Description of Affected Environment for the Affected Resource

Shiawassee NWR

Over 88,000 visitors enjoy Shiawassee NWR on an annual basis (Carver and Caudill 2019). The wildlife drive auto tour, open from June through September, is the most popular visitor activity on the refuge. Other activities include hiking the three trail systems, hunting, and fishing. Hunting types include a managed white-tailed deer hunt, a random draw-based waterfowl hunt, a spring turkey hunt, furbearer trapping, and small game hunting. A non-ambulatory deer hunt takes place each fall to ensure equitable, accessible hunting opportunities for all. Waterfowl hunting is limited to a small number of hunters per day.

There are trails and a visitor center located in the floodplain forests of the treatment area. The Green Point Environmental Learning Center is currently closed. The Woodland Trail and Green Point trails are regularly used, but less frequented than the wildlife drive or its connected trail, the Ferguson Bayou trail. Hunting is allowed in refuge prairies and some areas of floodplain forests. Fishing is common on large rivers, but not allowed in marshes or smaller channels of the inner refuge.

Detroit River IWR

The DRIWR provides a wide variety of wildlife-dependent recreation opportunities, including hunting, fishing, wildlife observation, wildlife photography, and environmental education. Averaging over 120,000 visitors across all refuge units annually, the DRIWR serves as a vital resource for the urban communities nearby.

Visitor use on the refuge has been variable the past several years since the refuge's Visitor Center is new and about two years old. The Visitor Center opened in February 2020 before the COVID-19 lockdown and has opened and closed multiple times over the first two years. Visitation is expected to increase over the next several years as the large urban community within 20 miles begins accessing the refuge more.

Ottawa NWRC

Ottawa NWRC is open to wildlife observation, photography, hunting, fishing, and environmental education and interpretation. The refuge estimates public use, via the Refuge Annual Performance Plan, to be approximately 360,000 visits per year. Among the various public use opportunities, most visits are for wildlife observation and bird watching (National Wildlife Refuge Visitor Survey, 2018). There are approximately 10 miles of hiking trails through a variety of habitats. These trails are open to the public unless closed for refuge management, hunting, or nesting eagles. Hunting and fishing are permitted within certain boundaries during specific times of the year and abide by Ohio's state regulations and refuge specific regulations.

Ottawa NWRC participates in the Biggest Week in American Birding, which is a 10-day event during spring migration that greatly impacts visitation. It is estimated that around 90,000 people will visit the area between April and May to go birding, visit natural areas, attend seminars, take tours and a variety of other activities that take place during this event.

The refuge provides visitors with a variety of environmental education events throughout the year. Refuge staff and volunteers offer interpretive talks, hikes, and tours utilizing trams and buses. The wildlife drive is a popular attraction for many visitors that is open periodically for special events and designated weekends throughout the year.

Description of Environmental Trends and Planned Actions

Overall, visitation is expected to increase over time on these refuges due to more demand for outdoor recreation and increasing awareness of the refuges, especially Detroit River IWR. Some herbicide treatments may take place during hunting seasons, when hunters could otherwise be occupying lands where applications are taking place. Hiking trails are open year-round.

Impacts on Affected Resource

Alternative A

Aerial application and ground-based application of herbicide will result in a temporary closure of the treatment areas when that area would otherwise be open for public use. The length of closure is dependent on the herbicide being applied and is detailed as the “*Restricted Entry Interval*” on the product label. Because the restricted entry interval is detailed in the product label, it is a requirement. The restricted entry interval for most herbicides is “Until Dry,” but some are as restrictive as 48 hours. Areas would be closed where needed 24 hours prior to treatment and remain closed for 24 hours afterward or longer if required per the restricted entry interval. The preferred timing of aerial herbicide treatment typically falls outside of peak public use. All closures would be posted with signs indicating ongoing herbicide treatment. Because any given aerial treatment area would be treated over the course of a few hours, any trails within the treatment area would be closed for three or fewer days per year. In years where treatments are only taking place in remote, isolated locations, trails may not be closed at all.

Spraying herbicide may have a negative visual and noise impact. Reducing large monotypic stands of dense vegetation such as *Phragmites* or buckthorn will improve recreation areas for people and habitat for wildlife that people are interested in. Improved wildlife habitat will benefit wildlife viewing as well. Reduced woody shrub cover will improve sight lines and potentially access for hunters and wildlife viewers. However, screening structures for these groups to conceal themselves from wildlife may be reduced.

Alternative B

For ground-based spraying, signs will be placed along trails warning visitors not to enter areas that are being sprayed. The legal minimum length of closure is dependent on the herbicide being applied and is detailed as the “*Restricted Entry Interval*” on the product label. Because the restricted entry interval is detailed in the product label, it is a requirement. The restricted entry interval for most herbicides is “Until Dry,” but some are as restrictive as 48 hours. Refuges will close treatment areas to the public for 24 hours after spraying or longer if required by the label. At least some parts of treatment areas will be closed for 3 months or more with this alternative. However, the trails will not be directly sprayed and off-trail hiking is not open to the public at Shiawassee NWR, though it is at the other refuges. Also, the area of treatment would be smaller on a day-to-day basis, so popular public access points would only be closed for a fraction of the full treatment time, probably days or weeks instead of months. Staff spraying herbicide may have a negative visual and noise impact. Improved wildlife habitat will benefit wildlife viewing. Reduced woody shrub cover will improve sight lines for hunters. These visitor benefits may take more time to establish in Alternative B than in Alternative A.

Refuge Operations

Administration

Affected Environment

Description of Affected Environment for the Affected Resource

All three refuges have seven or more staff with administrative, biological, maintenance, and management duties. Staffing levels can vary with funding levels with some additional positions funded through grants and agreements. Seasonal staff varies from year to year with the use of volunteers, biological science technicians, and the Youth Conservation Corps crew. The administrative capacity to coordinate aerial spraying actions through contractors or other partners has been available for past efforts. Aerial spraying contracts will be funded with a variety of funds, including refuge appropriated funds and grant funds.

Description of Environmental Trends and Planned Actions

Primary refuge staff positions in management, maintenance, administration and biology tend to remain flat with other positions added as funding allows. There may be times when there are vacancies that limit refuge capacity. However, treatment of invasive species is generally a refuge habitat management priority and some duties associated with invasive species management can be handled by other staff during vacancies.

Impacts on Affected Resource

Alternative A

With the aerial treatment alternative, about three hours of field time would be required from biology staff and law enforcement or visitor services staff during the treatment. Staff time would also be required to procure a contractor or partner, provide public notice, and close trails. Aerial treatment is more cost effective per acre than ground treatments. Time spent on ground-based treatment would decrease or would be used on other, additional populations of undesirable plant species.

Alternative B

Under the ground-based treatment alternative, much more staff time would be required. To treat the same amount of area, treatments would take months of time from multiple employees on an annual basis. The majority of the work would be primarily performed by biology staff, with assistance from other divisions. Conducting ground-based treatments requires pesticide certification and equipment training that only qualified staff can perform. Staff may have to spend more time working on parts of the refuge where target species may have newly spread.

Socioeconomics

Local and Regional Economies

Affected Environment

Description of Affected Environment for the Affected Resource

Wildlife and recreation-based activities substantially contribute to both rural and urban economies. As reported in the 2011 National Survey of Fishing, Hunting and Wildlife Associated Recreation (USDOI 2013), 2011 hunting-related expenditures totaled \$2.3 billion, fishing-related expenditures totaled \$2.4 billion, and wildlife watching-related expenditures totaled \$1.2 billion. In 2017, the NWRS generated \$3.2 billion of economic output through recreational visits, resulting in 41,000 jobs and \$1.1 billion of employment income (Caudill and Carver 2019). Of this, the Midwest region generated \$456 million from recreational visits, with 5,849 jobs and \$152 million in employment income. Shiawassee NWR was estimated at having 88,270 recreational visits with a total economic output of \$984,500. Visitors spend money locally on food, lodging, transportation, and items such as equipment rental. Non-consumptive activities such as birding, hiking, photography, boating, and auto tours are cited as the most popular

activities at national wildlife refuges (Caudill and Carver 2019). All three of these refuges provide those opportunities as well as hunting and fishing.

Description of Environmental Trends and Planned Actions

Shiawassee NWR

Like many cities with industrial-based economies, the City of Saginaw has experienced substantial economic decline in the last several decades. Between 2000 and 2010, the population of Saginaw declined by nearly ten thousand people (TCF 2014). While the economy of the City of Saginaw continues to be anchored by manufacturing, economies of the adjacent townships of James and Spaulding are largely agricultural. In 2013, unemployment in Saginaw County was approximately 13.1% (TCF 2014).

The residents of census tracts encompassing the refuge treatment sites have an average median household income of \$49,235.39 (U.S. Census Bureau 2021). Approximately 10.1% have earned bachelor's degrees (U.S. Census Bureau 2020). Demographically, these census tracts are about 16.7% Black, 13.9% Hispanic or Latinx, and 68% white (U.S. Census Bureau 2020).

Detroit River IWR

The regional population is nearly 7 million, so the economic landscape is complex and varies geographically. The refuge visitor center is in Trenton, Michigan. Wayne County and the City of Gibraltar and Grosse Ile Township are immediately adjacent. The median household incomes in 2020 are as follows: Trenton (\$69,710); City of Gibraltar (\$74,919); Wyandotte (\$54,419); City of Monroe (\$53,068); and City of Ecorse (\$34,278). The City of Detroit is 25 miles from the site with an estimated 5-year median income of \$32,498. The median income for the United States is \$64,994. The residents of census tracts encompassing the refuge treatment sites have an average median household income of \$81,081.52 (U.S. Census Bureau 2021). Approximately 23.7% have earned bachelor's degrees (U.S. Census Bureau 2020). Demographically, these census tracts are about 3.2% Black, 4.5% Hispanic or Latinx, and 87.1% white (U.S. Census Bureau 2020). Based on these most recent census data, there are no minority or low-income populations in the immediate project vicinity, however, the Cities of Ecorse and River Rouge have 20.7% and 37.6% families in poverty. Those communities are about 10 miles north of the refuge. The residents of the City of Trenton are 94.6% non-Hispanic white, 1.6% African American, 0.0% Native American, 0.8% Asian, and 4.0% Hispanic or Latino. The United States contains 70.4 non-Hispanic white, 12.6% African American, 0.8% Native American, and 5.6% Asian.

Ottawa NWRC

The residents of census tracts encompassing the refuge include Ottawa and Lucas counties. The average median household incomes in 2021 are as follows: Ottawa (\$64,463); and Lucas (\$53,176). Within both counties, approximately 26.0%-27.5% have earned bachelor's degrees. Demographically, these census tracts are as follows: Ottawa County is approximately 91.8%

non-Hispanic White, 1.1% African American, 0.3% Native American, 0.4% Asian, and 5.4% Hispanic or Latino; Lucas County is approximately 67.4% non-Hispanic White, 20.5% African American, 0.4% Native American, 1.8% Asian, and 7.8% Hispanic or Latino (U.S. Census Bureau 2021). Based on these most recent census data, there are no minority or low-income populations in the immediate project vicinity, however, the Cities of Oregon and Toledo have 8.6% and 24.5% families in poverty (U.S. Census Bureau 2021). Those communities are about 20 miles west of the refuge.

Description of Environmental Trends and Planned Actions

Industry has been declining in the communities surrounding these refuges for years, and populations have decreased as a result. The areas around Detroit (DRIWR), Toledo (ONWRC), and mid-Michigan and Flint (SNWR) are all experiencing decreasing populations (U.S. Census Bureau 2020 and U.S. Census Bureau 2010).

Impacts on Affected Resource

Alternative A

Funds will be spent to hire a contractor and purchase supplies in the local area for aerial herbicide treatment. Aerial treatment is cost effective per acre of treatment but with higher one-time input costs. However, there are a limited number of certified aerial applicators, some of which are not local.

Alternative A and B

Improvement of habitats by reducing or eliminating invasive plants in portions of the refuges may improve visitor opportunities and experience thereby indirectly adding to the local economy through visitation. Other forms of habitat management to treat invasive species will also continue with supplies, fuel, equipment, and repairs purchased in the local communities. Various supplies, fuel, and equipment are purchased locally for ground-based application. The impacts from refuge herbicide application activities under both alternatives are negligible to local and regional economies given the minor amount of spending in local economies and a very small chance of increasing visitation to a point that would have substantial impact on local economies through lodging, gas or restaurant industries.

Environmental Justice

Affected Environment

Description of Affected Environment for the Affected Resource

Executive Order 12898, February 11, 1994 (59 FR 7629), requires each Federal agency to make environmental justice a part of its mission. Environmental justice means that, to the greatest extent practicable and permitted by law, all communities or populations are provided the opportunity to comment before decisions are rendered on proposed Federal actions.

Furthermore, the principles of environmental justice require that certain populations or communities are allowed to share in the benefits of, are not excluded from, and are not affected in a disproportionately high and adverse manner by government programs and activities affecting human health or the environment.

Shiawassee NWR

The City of Saginaw is an environmental justice “hot spot” in Michigan (Grier et al. 2019). The Michigan Department of Environment, Great Lakes, and Energy (EGLE) considers the community surrounding Shiawassee NWR to be disproportionately affected by environmental hazards. The east side of SNWR, which includes the wildlife drive and core of the refuge, scores in the 61st percentile in Michigan’s environmental justice index (MiEJScreen) tool, where higher scores indicate higher pollution burden and vulnerability. The area surrounding Green Point and Germania ranks in the 73rd percentile (MI EGLE 2021).

Communities neighboring the refuge have been subject to multiple instances of environmental injustice, including dioxin pollution of the Tittabawassee River by the Dow Chemical Company and polychlorinated biphenyl (PCB) pollution of the Saginaw River by General Motors, the City of Saginaw, and Bay City. Natural Resource Damage Assessment (NRDA) settlements have provided funding for the restoration of natural resources in the areas that were impacted by pollution, including multiple refuge projects such as GPARP (<https://ecos.fws.gov/ServCat/DownloadFile/223458>).

Detroit River IWR

Michigan EGLE has classified several areas surrounding Detroit River IWR as disproportionately affected by environmental hazards. The community near the Grassy Island unit is 75th percentile in MiEJScreen, the areas surrounding Humbug Marsh are 67th and 77th percentile in MiEJScreen, the area near Lagoon Beach is 68th percentile, the communities near the units connected to the River Raisin are between 67th and 89th percentile, and areas around the Erie Marsh unit are in the 58th percentile (MI EGLE 2021).

Ottawa NWRC

Ottawa National Wildlife Refuge lands and the areas that surround the refuge fall below the 50th percentile for a majority of the environmental justice indexes, according to the EPA’s Environmental Justice Screening and Mapping Tool (EPA EJSCREEN). There are a few exceptions with satellite parcels that are within the 60th-70th percentiles for certain environmental justice indexes. Areas with significantly higher environmental justice indexes are located 20 miles West in Toledo, Ohio.

Description of Environmental Trends and Planned Actions

NRDA funding is being used for several projects on Shiawassee NWR, including reforestation projects and improving connectivity between wetlands and rivers on the refuge. These projects

will benefit local communities not only through restorative, increased opportunities for outdoor recreation, but also through ecosystem services such as floodwater retention, water quality improvement, and erosion control. NRDA funding is also provided to other local organizations' ecological restoration efforts. The Michigan DNR's Saginaw River Headwaters Rec Area is undergoing restoration as well and will contribute to local environmental justice in similar ways.

Habitat restoration activities as well as land acquisition have been ongoing at Ottawa NWR, including coastal wetland, riparian and forested areas. Detroit River IWR has an ongoing and expanding urban wildlife conservation program to provide inclusive opportunities for outdoor experiences. Ottawa NWR also provides inclusive outdoor opportunities and environmental education to residents of Toledo and other local communities.

Impacts on Affected Resource

Alternative A and B

The Service has not identified any potential high and adverse environmental or human health impacts from this proposed action under either alternative. Mitigation measures required to be followed for application reduce impacts to the human environment. Minority or low-income communities will not be disproportionately affected by any impacts from this proposed action. Management actions will not vary based on the demographics of the surrounding communities. Following BMPs as listed in the Alternatives section above (pages 14-15) will ensure that air quality impacts are negligible and impacts to water quality and non-target sites are mitigated. In areas where minority or low-income populations are located near the treatment area, reducing undesirable vegetation could increase physical access to the refuge and increase nature-based benefits. Treatment of undesirable plants will benefit restoration efforts to establish native ecosystems, which will improve ecosystem services, help reduce the negative effects of pollution, and increase local access to high quality natural areas.

Alternative A

Aerial herbicide application will expedite the control of undesirable plant populations, hastening the benefits to the local community. For aerial herbicide treatments near residential areas, press releases will be used to inform the public in addition to signs on the refuges. In areas where there is sensitivity to chemical application, refuge staff can take additional measures for outreach including but not limited to education programming or flyers. Refuge and partner public education efforts about habitat restoration and invasive species can incorporate explanations for use of herbicides and the difference from environmental and human health impacts from industrial pollution. Past industrial contamination in areas near Shiawassee and Detroit River refuges resulted in potential exposure pathways to local communities and has resulted in remediation and restoration. Additions of herbicide to refuge lands near these communities will not add substantial exposure or meet a threshold of concern because it will be confined to refuge lands and applied with best management practices. In

addition, these are low toxicity, short half-life herbicide that will only be applied as needed during certain times of year. These herbicides are generally a different class of chemicals than industrial pollutants like dioxins. Labeled herbicides have had extensive testing and been approved by EPA for use in the human environment as opposed to non-labeled and non-permitted industrial waste. Aerial spray may add more total herbicide to the environment than Alternative B but overall will be a negligible addition within the surrounding agricultural landscape.

Alternative B

The process of ecological restoration will likely be slower and less efficient without aerial herbicide treatment, and the community will benefit more slowly as a result. Less control of invasive species will result in less benefit to adjacent communities in removal of undesirable plants and associated ecological and recreational benefits. Ground application of herbicides will result in less amount of herbicide being applied to the landscape but otherwise will have similar impacts to Environmental Justice as Alternative A.

Cumulative Impacts

Cumulative impacts are defined as the incremental, additional effects to the environment that result from implementing any of the alternatives under consideration. The cumulative impact analysis must consider this incremental impact of the proposed action, and any alternative actions, in addition to the impact of past, present, and reasonably foreseeable actions regardless of the jurisdiction of their origin.

Under the No Action and Preferred Alternative, aerial herbicide applications may be combined with ground-based treatments including non-herbicide methods like prescribed fire or mowing and could have cumulative effects. Following combined treatments, a reduction in plant abundance and diversity could occur. Such reductions would be localized but could result in a reduction in habitat quality. Such cumulative effects are expected to be temporary, lasting no more than one year as the habitat recovers from unaffected perennial root stock, seed bank resources, and immigration from surrounding untreated sites. The cumulative effect of fire and herbicide to control invasive plants has been shown to increase soil nitrogen and net nitrogen transformation rates, which improves native plant performance and diversity (Rhoades et al. 2002). Cumulative impacts can be negated through timing of management options, amount, and location of treatments to minimize or eliminate the compounding influence of multiple management programs.

Maintaining the health, diversity, and structure of plants, habitats, and soils on the refuges maintains their resilience in the face of stressors like climate change, invasive species introductions, and disease outbreaks. Improving habitat diversity on the refuges increases

insect diversity, including pollinators. Improved pollination directly benefits plants and increased insect diversity has cumulative benefits for multiple trophic levels.

This alternative would result in the desired habitat diversity and structural conditions detailed, which would improve conditions for wildlife and therefore wildlife-dependent recreation. The cumulative effects could both positively and negatively impact wildlife viewers and hunters. Treatments to monotypic *Phragmites* stands promote hemi-marsh conditions and provide an increase in hunting opportunities for wildlife viewers and duck hunters. However, a reduction of trees or shrubs in open habitats would reduce the amount of screening structure in the treatment areas. Wildlife viewers and hunters could potentially find fewer locations in which to conceal themselves to aid in those activities.

Cumulative impacts to water quality and soils from aerial or ground applications of herbicides on these refuges is negligible compared to local inputs on agricultural and industrial land and past contamination history. Herbicides are only applied to specific areas during certain times of the year and not applied every year. Once invasive species in any particular area are under control, herbicides do not need to be applied for several years or possibly ever again. Herbicides typically have half-lives that range from a couple days to several months (Tatum 2004). The effects of herbicide use in general, including its effects on the human environment, has already been evaluated under the NEPA process.

Under the Alternative B, wildlife habitat will continue to degrade in some areas with the limited application of ground spraying. Some stands of invasive plants would remain untreated or partially treated and would continue to spread. Encroachment of undesirable plants would likely result in a reduction in plant diversity. *Phragmites* would further decrease the amount of open wetland habitat and the extent of desirable aquatic vegetation would continue to decline. In prairie habitats, undesirable woody vegetation and invasive species in prairie habitats will continue to outcompete native plant species, thus reducing the amount of available habitat to prairie-obligate species. Discontinuing aerial herbicide application could result in conversion of habitats to monotypic stands of invasive species, and this could affect water quality through diminished water filtration. The loss of plant diversity would reduce the refuges' resilience in the face of stressors like climate change, new invasive species introductions, and disease outbreaks. This would directly affect the refuges' environmental health and would be a cumulative effect of discontinued aerial herbicide use.

Monitoring

Monitoring will take place as part of regular management actions. The USFWS, Midwest Region, requires all herbicide applications are recorded via the *R3 Management Actions Chemical Plant Map*. The *R3 Management Actions System* is also used to record non-herbicide treatments like

haying, grazing, and hand-pulling. The recorded information includes the treatment area and amount of applied herbicide. The refuge monitors vegetation response to herbicides with visual observations. Treated sites will be revisited once a month post-treatment the following year, excluding winter months. Monitoring will focus on the health and survival of both target and non-target plants. Observations of wildlife may also be used as indicators of effectiveness, especially with regard to species that are habitat specialists, as well as species that are mentioned in the Natural Resources section of this Environmental Assessment. No formal monitoring plans or biological monitoring protocols will be created for this project. Existing monitoring protocols may be used to help evaluate the effectiveness of herbicide treatments in areas where monitoring is already taking place. Each refuge has an Inventory and Monitoring Plan in place to determine whether habitat management objectives are being met (for Detroit River, see <https://ecos.fws.gov/ServCat/DownloadFile/111224>, for Ottawa, see <https://ecos.fws.gov/ServCat/DownloadFile/132580>, for Shiawassee see <https://ecos.fws.gov/ServCat/DownloadFile/170542>).

Summary of Analysis

Alternative A – Continue Aerial Herbicide Treatment

As described above, under the no action and preferred alternative the refuges would continue using aerial herbicide applications along with ground-based methods to control invasive plants and other undesirable vegetation. This would include applications in forests, prairies, marshes, shrub swamps, and moist soil. Herbicide application would improve habitat for plants and wildlife on the refuges, including migratory birds and state-listed species, through the reduction of impenetrably dense plant cover and harmful biological effects of invasive plants. An effective aerial herbicide application significantly decreases the amount of time spent by refuge staff on invasive species or undesirable plant control in the area of the action, allowing for more time spent on other ecological restoration and conservation activities. Aerial application allows for larger areas to be treated in a cost-effective manner, greatly improving habitat restoration area and timeframes. Swifter treatment would also be beneficial in that it reduces the window of time for the target species to reproduce and increase its density or spread to new areas.

Non-target plant species may be impacted during aerial herbicide treatments; impacts can be minimized by timing the treatments to avoid when habitats are being used by sensitive wildlife and aquatic species. Several measures are in place to mitigate potential negative impacts of herbicide use to control invasive plants and other undesirable vegetation. All herbicides are applied following product label restrictions, which have received environmental review (NEPA) and Endangered Species Act (Section 7) consultation. All herbicide applications are also reviewed and approved at the appropriate level using the Pesticide Use Proposal System. This includes site-specific Endangered Species Act (Section 7) consultation. All herbicide application

on the refuges must also follow standard USFWS BMPs. Herbicide may come into direct contact with open water, but the risk of contaminating surface or ground water would be mitigated with use of herbicides approved for aquatic application. The restricted entry interval for most herbicides is “Until Dry,” but some are as restrictive as 48 hours. Treatment areas are closed prior to treatment and remain closed for 24 hours afterward or longer if required per the restricted entry interval.

The preferred alternative would have a direct, major, long-term, beneficial impact on habitat and vegetation, as it would reduce populations of undesirable plants that outcompete native communities of plants. The quality of habitat would increase along with biodiversity. Threatened and endangered species, and wildlife species in general, would be subject to negligible short-term impacts related to disturbance and potential contact with herbicide, with indirect, major long-term benefits due to increased habitat quality. Soils would receive indirect, minor long-term benefits due to the restoration of native, biodiverse plant communities, which have robust root systems and are resilient to disturbance. Water quality may receive minor, short-term detriments if herbicide enters water sources or reduced plant populations result in increased runoff, but there would be indirect, minor, long-term effects due to the improved establishment of a biodiverse, native plant community that would increase water filtration and reduce runoff. Refuge administration would be subject to major, long-term impacts, as the amount of staff time spent on coordinating aerial treatment would be greatly outweighed by the time saved from treating large swaths of undesirable vegetation with exclusively ground-based methods. The local economy would receive minor or negligible long-term benefits from the possibility of hiring local contractors or increasing visitation as a result of improved ecological integrity. The effects on environmental justice would be positive long-term and minor or negligible, as aerial treatment would not necessarily be located near residential areas. In cases where aerial treatment does occur in proximity to local human residents, BMPs would be used to minimize the risk of human exposure to herbicide while reduced populations of undesirable vegetation could increase access to nature and recreational opportunities.

This alternative would meet the purpose of the action because it would reduce the invasion and encroachment of undesirable plants that are not historically present in native ecosystem types found on the refuges. The alternative would meet the need of the NWRS to conserve wildlife, plants, and their habitats by decreasing the negative impacts that invasive and undesirable vegetation have on these resources. This alternative would assist in meeting the purpose and need in a time-efficient manner, benefiting the refuge staff and budget while significantly reducing the chance for target species to spread.

Alternative B – Discontinue Aerial Herbicide Treatment

As described above, this alternative entails discontinuing all aerial treatment and treating undesirable plant species with exclusively ground-based treatments, including herbicide

applications with backpack sprayers, tanks mounted on ATVs/UTVs/tractors, mechanical removal, and prescribed fire. Ground-based treatments would gradually improve habitat for plants and wildlife on the refuge through the reduction of harmful biological effects caused by invasive species and undesirable plants. The risk of non-target herbicide impacts to native organisms would be reduced through more precise applications via backpack or ATV/UTV/tractor, or completely eliminated when using mechanical methods or fire.

The disadvantage of these methods would be the extensive amount of time and effort it would require of staff. Areas that could be aerially treated over the course of a few hours would take months or years to cover with a ground-based treatment such as mowing or ground-based spraying, taking staff time away from other refuge projects. Prescribed fire takes a combination of planning time, staff availability, and weather that make this technique unavailable for years at a time. Treatment options that do not include herbicide often only temporarily set back plant growth, rather than permanently killing undesirable plants. Additionally, the slow rates of treatment may allow the target species to propagate in untreated areas while treatment is occurring, prolonging treatment efforts even further. This is especially true of hand-pulling and fire. Disturbance caused by humans and equipment would occur over much longer time periods as well.

Although the spread of invasive species and undesirable plant encroachment would decrease with treatment, the slow rate of treatment means that less habitat would be improved over a longer period of time. This option would also reduce staff and financial resources available for other refuge projects. If the rate of target species spread outpaces treatment, habitat for wildlife and plants would continue to be reduced and degraded. In the long-term, biodiversity on the refuges would decrease. For example, birds, native plants, and amphibians in floodplain forests would be especially negatively impacted by invasive buckthorn, while *Phragmites* would prevent snakes, marsh birds, and waterfowl from moving through marshes. In moist soil units, cocklebur-dominated areas would not provide food sources for waterfowl. The proliferation of woody plants in prairies would decrease milkweed cover, thereby reducing habitat for the candidate species monarch butterfly.

Alternative B would have a direct, major, long-term, detrimental impact on habitat and vegetation, as it would slowly reduce or not affect populations of undesirable plants that outcompete native communities of plants. The quality of habitat would decrease as undesirable plant population continue to increase in range and density. Threatened and endangered species, and wildlife species in general, would be subject to negligible short-term impacts related to disturbance and potential contact with herbicide, with indirect, major long-term detriments due to decreased habitat quality. Soils would receive indirect, minor long-term detriments due to the proliferation of monotypic stands of undesirable plants, which can increase erosion (Crooks 2002) and are less resilient to disturbance. Water quality may receive

minor, short-term detriments if herbicide enters water sources or reduced plant populations result in increased runoff, and there would be indirect, minor, long-term effects due to the increasing loss of native plant communities that filter water and reduce runoff. Refuge administration would be subject to major, long-term impacts, as the amount of staff time spent on treating large swaths of undesirable vegetation with exclusively ground-based methods would greatly outweigh the time saved from coordinating aerial treatments. The local economy would not be affected. The effects on environmental justice would be long-term and minor or negligible, as BMPs would be used to minimize the risk of human exposure to herbicide.

In areas where travel by foot and ATV/UTV is blocked by dense vegetation, deep muck, or open water, treatment may not take place at all. These parts of the refuges would experience a much more rapid decline in habitat quality and ultimately biodiversity. It is therefore unlikely that this alternative would meet the purpose of the action to control, prevent, and limit the spread of invasive species and other undesirable vegetation. Neither would it meet the Service's need to "provide for the conservation of fish, wildlife, and plants, and their habitats within the System" (16 U.S.C. 668dd(a)(4)).

List of Sources, Agencies and Persons Consulted

Tribes, other federal agencies, state, county, and local agencies, non-governmental organizations, and other Service personnel have been invited to review the draft for this EA. Their comments will be included when provided.

List of Preparers

Sean Hollowell, Biological Science Technician, Shiawassee National Wildlife Refuge

Courtney Lopez, Wildlife Refuge Specialist, Ottawa National Wildlife Refuge Complex

Jessie Fletcher, Wildlife Biologist, Detroit River International Wildlife Refuge

State Coordination

A formal letter and this environmental assessment will be provided to State of Michigan and Ohio partners inviting them to provide comments on the proposed use of aerial application of herbicides when the public comment period commences. Any comments, concerns, suggestions, or other feedback will be included if substantive response is required.

Shiawassee NWR frequently coordinates with the neighboring Shiawassee River State Game Area (SGA), which is located adjacent to the refuge on its western boundary, by sharing

equipment and habitat management information. Shiawassee River SGA, managed by the Michigan DNR, also partners with the refuge on grant projects.

Detroit River IWR partners with the Detroit River-Western Lake Erie Collaborative Weed Management Area (CWMA) for control of invasive and undesirable species, including on herbicide treatments. The Michigan DNR and The Nature Conservancy are major partners in the CWMA.

Tribal Consultation

Tribes and tribal members are welcome to provide comment during the public comment period. A formal letter and this environmental assessment will be provided to refuge tribal partners inviting them to provide comments on the proposed continued use of aerial application of herbicides when the public comment period commences. Any comments, concerns, suggestions, or other feedback will be included if substantive response is required. Tribes and intertribal agencies contacted include:

Saginaw Chippewa Indian Tribe

Public Outreach

This draft Environmental Assessment will be available for public review and comment for 20 days from May 23 to June 12, 2023. Members of the public will be notified of the availability of the draft documents through a press release sent to state news media outlets and posted on the refuge website. The draft document will be made available at the refuge visitor centers or offices (SNWR: 6975 Mower Rd, Saginaw, MI 48601), via email (r3planning@fws.gov), and can be downloaded from the refuge websites (SNWR: <https://www.fws.gov/refuge/shiawassee>, ONWRC: <https://www.fws.gov/refuge/ottawa>, DRIWR: <https://www.fws.gov/refuge/detroit-river>). For access to the document in an alternative format contact the refuge. Comments may be submitted in writing via email to the email address listed above or by mail to the refuge address listed above. Any comments, concerns, suggestions, or other feedback will be included if substantive response is required.

References

- Albert, D.A. 1995. Regional landscape ecosystems of Michigan, Minnesota, and Wisconsin: A working map and classification. General Technical Report NC-178. USDA Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.
- Angel, J., C. Swanston, B.M. Boustead, K.C. Conlon, K.R. Hall, J.L. Jorns, K.E. Kunkel, M.C. Lemos, B. Lofgren, T.A. Ontl, J. Posey, K. Stone, G. Takle, and D. Todey. 2018. Midwest: In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 872–940.
- Auteri G and Kurta A. 2013. An Exploratory Netting and Acoustic Survey for Bats at the Shiawassee National Wildlife Refuge, Saginaw County, Michigan.
- Brenes, R., Nguyen, L. M., Miller, D. L., & Rohde, M. L. (2022). Hepatocellular toxicity of the metabolite emodin produced by the common buckthorn (*Rhamnus cathartica*) in green frog (*Lithobates clamitans*) tadpoles. *The Journal of Wildlife Diseases*, 58(2), 341-347.
- Briscoe Runquist, R.D., T. Lake, & D.A. Moeller. 2019. Species Distribution Model Projections for Incipient Invasive Species of Minnesota. Minnesota Invasive Terrestrial Plants and Pests Center, University of Minnesota. 65pp.
- Brower, L. P., Taylor, O. R., & Williams, E. H. (2012). Response to Davis: choosing relevant evidence to assess monarch population trends. *Insect Conservation and Diversity*, 5(4), 327-329.
- Carver, E. and J. Caudill. 2007. Banking on Nature 2006: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation. U.S. Fish and Wildlife Service, Division of Economic, Washington, D.C. 382 pp.
- Caudill, J. and E. Carver. 2019. Banking on Nature 2017: The Economic Contributions of National Wildlife Refuge Recreational Visitation to Local Communities. U.S. Fish and Wildlife Service, Falls Church, Virginia.
- Crooks, J. A. (2002). Characterizing ecosystem-level consequences of biological invasions: the role of ecosystem engineers. *Oikos*, 97(2), 153-166.

Environmental Protection Agency. EPA's Environmental Justice Screening and Mapping Tool (EPA EJScreen). Version 2.1. Retrieved March 13, 2023.
<https://ejscreen.epa.gov/mapper/>

Heitmeyer, M. E., C. M. Aloia, E. M. Dunton, B.J. Newman, and J.D. Eash. 2013. Hydrogeomorphic evaluation of ecosystem restoration and management options for Shiawassee National Wildlife Refuge. Prepared for U. S. Fish and Wildlife Service, Region 3. Greenbrier Wetland Services Report 13- 07, Blue Heron Conservation Design and Printing LLC, Bloomfield, MO.

Grier, L., Mayor, D., & Zeuner, B. (2019). Assessing the State of Environmental Justice in Michigan.

Gunstone T., T. Cornelisse, K. Klein, A. Dubey, and N. Donley. 2021. Pesticides and Soil Invertebrates: A Hazard Assessment. *Frontiers in Environmental Science*.
<https://doi.org/10.3389/fenvs.2021.643847>.

Izhaki, I. (2002). Emodin—a secondary metabolite with multiple ecological functions in higher plants. *New Phytologist*, 155(2), 205-217.

Kahl, R. B., T. S. Baskett, J. A. Ellis, and J. N. Burroughs. 1985. Characteristics of summer habitats of selected nongame birds in Missouri. *Research Bulletin 1056*. University of Missouri, Columbia, Missouri. 155 pages.

Kost, M.A., D.A. Albert, J.G. Cohen, B.S. Slaughter, R.K. Schillo, C.R. Weber and K.A. Chapman. 2007 (updated in 2010). Natural communities of Michigan: classification and description. Michigan Natural Features Inventory. Prepared for Michigan Department of Natural Resources Wildlife Division and Forest, Mineral, and Fire Management Division. Lansing, MI.

Maynard-Bean, E., & Kaye, M. (2019). Invasive shrub removal benefits native plants in an eastern deciduous forest of North America. *Invasive Plant Science and Management*, 12(1), 3-10.

McNeish, R.E. and R.W. McEwan. 2016. A review of the invasion ecology of Amur honeysuckle (*Lonicera maackii*, Caprifoliaceae) a case study of ecological impacts at multiple scales. *Journal of the Torrey Botanical Society* 143(4):367-385.

Michigan Department of Environment, Great Lakes, and Energy (EGLE). 2021. MiEJScreen. Retrieved December 21, 2022.

<<https://egle.maps.arcgis.com/apps/webappviewer/index.html?id=b100011f137945138a52a35ec6d8676f>>

Michigan Department of Environmental Quality (MDEQ). 2012. Stage 2 Remedial Action Plan for the Saginaw River/Bay Area of Concern. Michigan Department of Environmental Quality, Lansing, MI. 24 pp.

Michigan Department of Environmental Quality, Michigan Department of Community Health, and Michigan Department of Agriculture. Undated. Soil Movement Advisory for Private, Public, and Commercial Projects, Tittabawassee River Furan and Dioxin Flood Plain Soil and Sediment Contamination, Midland and Saginaw Counties. Available at http://www.michigan.gov/documents/deq/deq-whm-hwp-dow-TR-Advisory-dioxin-Color-Final_251808_7.pdf

Morris, A.D., D.A. Miller, and M.C. Kalcounis-Rueppell. 2010. Use of forest edges by bats in a managed pine forest landscape. *The Journal of Wildlife Management* 74:26-34. Natural Resources Conservation Service. 2022. Web Soil Survey Tool. Accessed July 22, 2022. <https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>.

Newman, B.J. 2011. Water Resource Inventory and Assessment Report – Shiawassee National Wildlife Refuge. Bloomington, MN: Region 3, United States Fish and Wildlife Service.

Public Sector Consultants, Inc. (PSC, Inc.). 2012. Saginaw Bay Watershed and AOC. Public Sector Consultants, Inc., Lansing, MI. 12 pp.

Rai, P.K. 2022. Environmental degradation by invasive alien plants in the Anthropocene: Challenges and Prospects for Sustainable Restoration. *Anthropocene Science* 1:5-28.

Robichaud, C. D., & Rooney, R. C. (2022). Invasive grass causes biotic homogenization in wetland birds in a Lake Erie coastal marsh. *Hydrobiologia*, 849(14), 3197-3212.

Rhoades, C., T. Barnes, and B. Washburn. 2002 Prescribed Fire and Herbicide Effects on Soil Processes During Barrens Restoration. *Restoration Ecology* 10:656-664.

Tallamy, D. W., & Shriver, W. G. (2021). Are declines in insects and insectivorous birds related? *The Condor*, 123(1), duaa059.

Tatum, V. L. (2004). Toxicity, transport, and fate of forest herbicides. *Wildlife Society Bulletin*, 32(4), 1042-1048.

- Tibbels, A.E. and A. Kurta. 2003. Bat activity is low in thinned and unthinned stands of red pine. *Canadian Journal of Forest Research* 33:2436-2442.
- The Conservation Fund. 2014. Gateway Community Livability Assessment & Recommendations Report. Shiawassee National Wildlife Refuge, Saginaw, Michigan & Surrounding Communities. The Conservation Fund in collaboration with the U.S. DOT Federal Highway Administration, Arlington, VA. 156 pp.
- Thogmartin, W. E., R. Wiederholt, K. Oberhauser, R. G. Drum, J. E. Diffendorfer, S. Altizer, O. R. Taylor, J. Pleasants, D. Semmens, B. Semmens, R. Erickson, K. Libby, and L. Lopez-Hoffman. 2017. Monarch butterfly population decline in North America: identifying the threatening processes. *Royal Society Open Science*. 4(9):170760.
- Tian D, Xie G, Tian J, Tseng K-H, Shum CK, Lee J, et al. 2017. Spatiotemporal variability and environmental factors of harmful algal blooms (HABs) over western Lake Erie. *PLoS ONE* 12(6): e0179622.
- Tozer, D. C., & Mackenzie, S. A. (2019). Control of invasive Phragmites increases marsh birds but not frogs. *Canadian Wildlife Biology and Management*, 8(2), 66-82.
- U.S. Census Bureau. 2010. *Populations and People, 2010 Decennial Census*.
- U.S. Census Bureau. 2020. *Race and Ethnicity, 2020 Decennial Census*.
- U.S. Census Bureau. 2020. *Populations and People, 2020 Decennial Census*.
- U.S. Census Bureau. 2021. *Income and Poverty, 2021 American Community Survey 5-year estimates*.
- U.S. Department of the Interior (USDOI), U.S. Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. 2013. 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. 94 pp.
- U.S. Environmental Protection Agency (USEPA). 2014. Correspondence to Roger Eberhardt, Michigan Department of Environmental Quality. Dated May 6, 2014.
- U.S. Environmental Protection Agency (USEPA). October 1998. Triclopyr (EPA-738-F-98-007). National Center for Environmental Publications and Information (EPA/NCEPI), Cincinnati, OH. 7 pp.

- U.S. Fish and Wildlife Service (USFWS). 2010. Contaminant Assessment Process Report
Shiawassee National Wildlife Refuge. U. S. Fish and Wildlife Service, Detroit River Sub-
Office of the East Lansing Field Office, Lansing, MI. 46 pp.
- U.S. Fish and Wildlife Service. 2020. Monarch (*Danaus plexippus*) Species Status Assessment
Report, version 2.1 September 2020.
[https://www.fws.gov/sites/default/files/documents/Monarch-Butterfly-SSA-
ReportSeptember-2020.pdf](https://www.fws.gov/sites/default/files/documents/Monarch-Butterfly-SSA-ReportSeptember-2020.pdf)
- U.S. Fish and Wildlife Service (USFWS). 2022. Eastern Prairie Fringed Orchid.
<https://www.fws.gov/species/rufa-red-knot-calidris-canutus-rufa>
- U.S. Fish and Wildlife Service (USFWS). 2001. Shiawassee National Wildlife Refuge
Comprehensive Conservation Plan and Environmental Assessment. Region 3, U. S. Fish
and Wildlife Service, Milwaukee, WI. 198 pp.
- U.S. Fish and Wildlife Service (USFWS). 2013. Shiawassee National Wildlife Refuge Habitat
Management Plan. U.S. Fish and Wildlife Service, Region 3, Shiawassee National Wildlife
Refuge, Saginaw, MI. 79 pp.
- U.S. Fish and Wildlife Service (USFWS). 2022. Rufa Red Knot.
<https://www.fws.gov/species/rufa-red-knot-calidris-canutus-rufa>
- UGLCCS. 1988. Upper Great Lakes Connecting Channels Study Management Team. Upper Great
Lakes Connecting Channels Study. Vol. II, Final Report.
- Washburn, B. E. 2002. Using Imazapic and Prescribed Fire to Enhance Native Warm-Season
Grasslands in Kentucky. *Natural Areas Journal* 22:20-27.

Appendix A

This Appendix lists all applicable statutes, regulations, and executive orders not otherwise addressed specifically within the “Affected Environment and Environmental Consequences” section of this environmental assessment, as well as how the proposed action and environmental assessment analysis comply with each, and any additional compliance steps taken by FWS.

Cultural Resources

- Archaeological Resources Protection Act of 1979, 16 U.S.C. 470aa-470mm; 18 CFR Part 1312; 32 CFR Part 229; 36 CFR Part 296; 43 CFR Part 7
- National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470-470x-6; 36 CFR Parts 60, 63, 78, 79, 800, 801, and 810

The only physical disturbance to the ground would occur using specialty tracked equipment when conducting ground applications or traveling through areas with hydric soil, are frequently wet, or are seasonally flooded. If a known or suspected cultural site is in the application area and ground disturbance could occur, the Regional Historic Preservation Office will be contacted for a determination for specific application projects. This will ensure compliance with the Archaeological Resources Protection Act and National Historic Preservation Act. No ground applications with tracked equipment will occur in areas with known cultural resources to avoid any adverse effects. It is determined there would be no adverse effects to cultural resources as the Preferred Alternative is described given the site-specific compliance that will take place if cultural resources are present in the application area. There are no impacts to cultural resources under the proposed action given this site-specific review that will occur in special circumstances and the nature of the proposed action.

Fish and Wildlife

Impacts to wildlife and aquatic species under the Preferred Alternative is described in detail on pages 15-18 of this environmental assessment. As indicated in the Preferred Alternative section of this document (pages 10-11), Federal law requires all herbicide applications follow product label restrictions to minimize the potential contamination of air, soil, and water and effects on non-target organisms. Additionally, Best Management Practices identified in the refuge Integrated Pest Management Plans and pages 11-12 of the Alternatives section of this document employ herbicide application methods that protect wildlife and the resources on which they rely, while also controlling non-native, invasive or undesirable plant species Service policy also requires review and approval of a Pesticide Use Proposal (PUP) prior to the application of any herbicide. These PUPs must consider potential impacts to protected

resources and environmental quality and implement mitigation measures such as restricting timing of application to assure no take of migratory birds or eagles and ensure compliance with the Gold and Bald Eagle Protection Act and the Migratory Bird Treaty Act The approval of PUPs ensures compliance with the laws and Executive orders listed above not specifically mentioned in this more detailed description.

Bald and Golden Eagle Protection Act, as amended, 16 U.S.C. 668-668c, 50 CFR 22

The Bald and Golden Eagle Protection Act prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald or golden eagles, including their parts (including feathers), nests, or eggs.

The proposed action will mitigate any harm or disturbance done to bald eagles by taking place outside of their nesting areas or after their breeding season, typically in the fall. Golden eagles are seldom observed on the refuge and not known to breed at the refuges.

Endangered Species Act of 1973, as amended, 16 U.S.C. 1531-1544; 36 CFR Part 13; 50 CFR Parts 10, 17, 23, 81, 217, 222, 225, 402, 450

The purpose of the ESA is to conserve federally endangered and threatened species and the ecosystems upon which they depend. Pursuant to Section 7 of the ESA, Federal agencies shall, in consultation with the Secretaries of the Interior or Commerce, ensure that any action that they authorize, fund, or carry out is not likely to jeopardize the continued existence of any federally endangered or threatened species, or result in the destruction or adverse modification of designated critical habitat. Before initiating an action, the Federal agency, or its non-Federal permit applicant, must determine if any threatened, endangered, proposed, or candidate species, or designated critical habitat, may be present in the project area.

Impacts to threatened and endangered species that may occur on the refuge is described in detail on pages 18-25 of this environmental assessment. An ESA Section 7, Intra-Service Consultation analyzing the potential effects herbicide applications, by either ground application equipment, or aerial application equipment has been submitted to the local Ecological Services Field Station for concurrence. The language of potential effects on threatened and endangered species in this Environmental Assessment are the same determination of effects in the herbicide application ESA Section 7 consultation. This analysis and Section 7 consultation meets requirements under the ESA. The Indiana bat, the northern long-eared bat, tri-colored bat, rufa red knot, piping plover, Karner blue butterfly, northern riffleshell, the eastern massasauga rattlesnake, and the eastern prairie fringed orchid occur in proximity to the refuges (Table 1). No federally listed species are known to occur at SNWR or DRIWR. Eastern prairie fringed orchid, Northern long-eared bat, piping plover and rufa red knot have been recorded at ONWRC. The piping plover and rufa red knot can occur during migration seasons but have not been recorded nesting on refuge lands. The proposed action will not be implemented in the

habitats of northern long-eared bat, piping plover, or rufa red knot. Herbicide application near eastern prairie fringed orchid populations will take place after the species has senesced for the year. No critical habitat for listed species occurs on the refuges. However, the monarch butterfly is a candidate species that occurs on all three refuges. The proposed action will benefit monarch butterflies by reducing woody plant cover in prairies, thereby increasing habitat for milkweed, the monarch caterpillar's host plant.

Fish and Wildlife Act of 1956, 16 U.S.C. 742a-m

The Fish and Wildlife Act of 1956 establishes a comprehensive national fish and wildlife policy and authorizes the Secretary of the Interior to take steps required for the development, management, advancement, conservation, and protection of fisheries resources and wildlife resources through research, acquisition of refuge lands, development of existing facilities, and other means.

The purpose of the proposed action is to improve habitat by reducing the overgrowth of woody vegetation in the refuge, which benefits the conservation and protection of wildlife resources.

Migratory Bird Treaty Act, as amended, 16 U.S.C. 703-712; 50 CFR Parts 10, 12, 20, and 21

The MBTA protects all migratory birds and their eggs, nests, and feathers and prohibits the taking, killing, or possession of migratory birds.

The proposed action will benefit migratory birds by reducing invasive plant cover, which can directly and indirectly harm migratory birds. Herbicide-related harm to migratory birds will be mitigated by timing treatments to take place after bird breeding seasons.

Executive Order 13186 – Responsibilities of Federal Agencies to Protect Migratory Birds, 66 Fed. Reg. 3853 (2001)

This EO directs government agencies to support migratory bird conservation through habitat protection, analysis of migratory bird populations, and cooperation with conservation organizations, among other methods.

The proposed action will benefit migratory birds by reducing invasive plant cover, which can directly and indirectly harm migratory birds. Herbicide-related harm to migratory birds will be mitigated by timing treatments to take place after bird breeding seasons.

Natural Resources

Clean Water Act compliance is not specifically required for this action as there is no discharge of a pollutant from a point source. Herbicide application is considered a non-point

source for introducing a pollutant into the environment. As indicated in the Preferred Alternative section of this document (pages 10-11), Federal law requires all herbicide applications follow product label restrictions to minimize the potential contamination of air, soil, and water and effects on non-target organisms. Additionally, Best Management Practices identified in the refuge Integrated Pest Management Plans and pages 11-12 of the Alternatives section of this document employ herbicide application methods that protect wildlife and the resources on which they rely, while also controlling non-native, invasive or undesirable plant species. Service policy also requires review and approval of a Pesticide Use Proposal (PUP) prior to the application of any herbicide. These PUPs must consider potential impacts to protected resources and environmental quality. The approval of PUPs ensures compliance with the laws and Executive orders listed above.

The executive orders for wetland and floodplain management do not apply to this action as there will not be adverse effects to floodplains or wetlands and no loss or degradation of wetlands.

Clean Air Act, as amended, 42 U.S.C. 7401-7671g; 40 CFR Parts 23, 50, 51, 52, 58, 60, 61, 82, and 93; 48 CFR Part 23

The CAA regulates air emissions from stationary and mobile sources to protect human health and the environment. Any activities associated with the restoration projects that result in air emissions (such as aircraft or ATV/UTV operation) will be in compliance with the CAA and any local air quality ordinances.

Federal Water Pollution Control Act (CWA; 33 USC § 1251 et seq.)

The CWA is intended to protect surface water quality and regulates discharges of pollutants into waters of the United States.

Impacts to water quality will be mitigated through the use of herbicide approved for aquatic use and by following best practices and prescribed mitigation measures

Occupational Safety and Health Act of 1970, as amended (OSHA; 29 USC §§ 651 et seq.)

The OSHA governs the health and safety of employees from exposure to recognized hazards, such as exposure to toxic chemicals, excessive noise, mechanical dangers, and unsanitary conditions.

Any and all staff and partners applying herbicide will be licensed to do so and will wear appropriate personal protective equipment. Necessary personal protective equipment will also

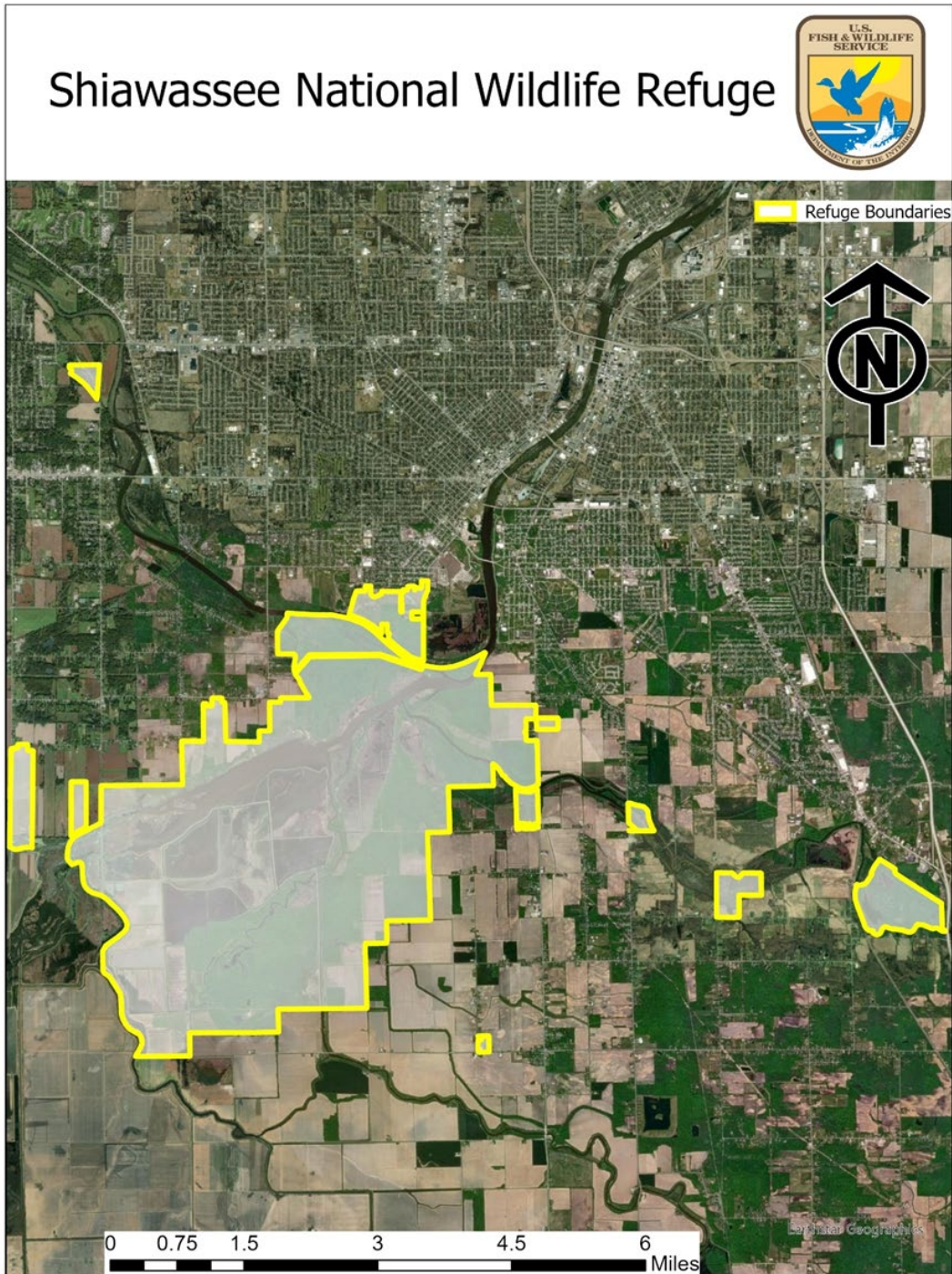
be worn while operating vehicles and machinery as well. All relevant safety regulations and best management practices will be implemented to ensure employee safety.

Wilderness Act, 16 U.S.C. 1131 et seq. And Wild and Scenic Rivers Act, 16 U.S.C. 1271 et seq.

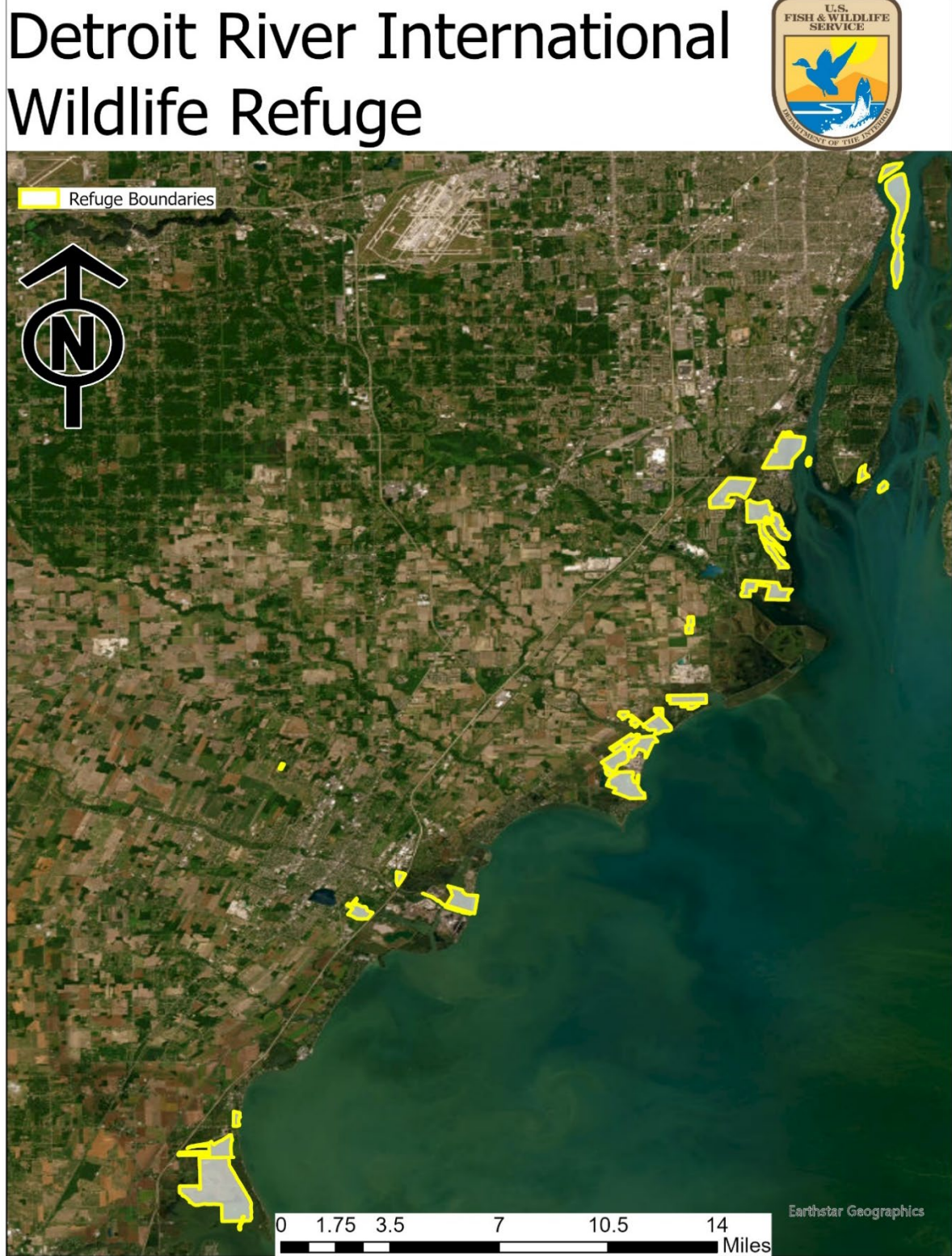
The treatment area does not have any designated wilderness or wild and scenic rivers and as such there would be no effect to these resources and is in compliance with these laws. West Sister National Wildlife Refuge is designated wilderness and part of Ottawa National Wildlife Refuge Complex, but will not be aerially treated with herbicide with this Environmental Assessment.

Appendix B

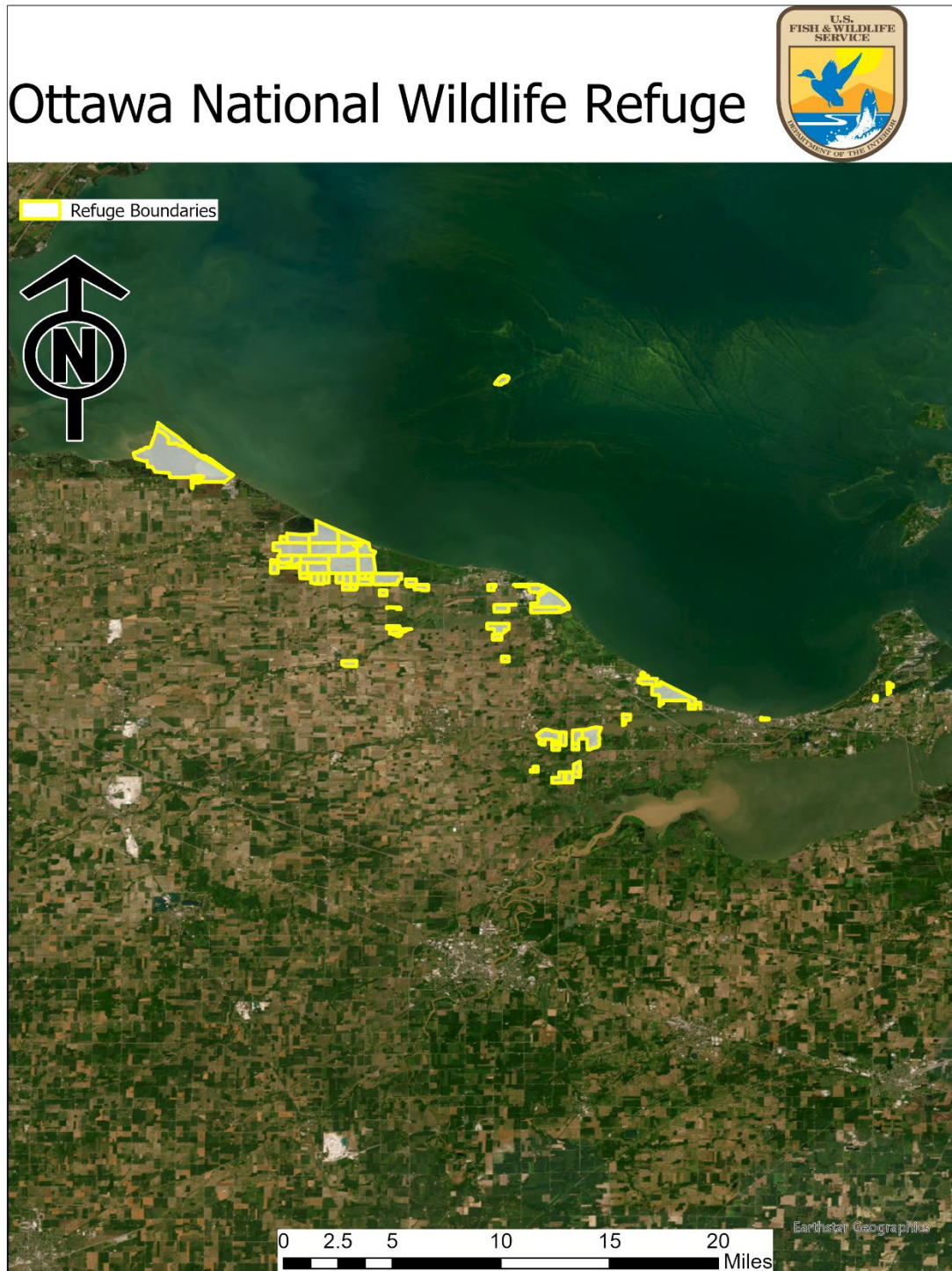
Location of Shiawassee National Wildlife Refuge in Saginaw County, mid-Michigan, west of I-75 and on the south side of the city of Saginaw, MI (6975 Mower Rd, Saginaw, MI 48601). The refuge boundaries are indicated with yellow in this figure.



Location of Detroit River International Wildlife Refuge in Wayne and Monroe Counties, southeast Michigan, along the Detroit River and western Lake Erie, between Wyandotte and Erie Twp, MI (5437 W Jefferson Ave, Trenton, MI 48183). The refuge boundaries are indicated with yellow in this figure.



Location of Ottawa National Wildlife Refuge Complex in Lucas and Ottawa Counties, northeastern Ohio, north of I-90 along the south side of western Lake Erie, between Niles Beach and Lakeside, Ohio (14000 OH-2, Oak Harbor, OH 43449). The refuge boundaries are indicated with yellow in this figure



Appendix C

Table 3. Birds of Conservation Concern that occur within the counties that contain Shiawassee NWR, Ottawa NWRC, and Detroit River IWR. All three refuges are located within Bird Conservation Region (BCR) 23, Prairie Hardwood Transition, though some islands that belong to Detroit River IWR are part of BCR 13, Lower Great Lakes/St. Lawrence Plain. Because of this, some BCC listed as occurring only in DRIWR below may also be found at the other refuges, though not considered to be of conservation concern.

Species	Breeding Season	Habitat	Refuge
American Golden-plover (<i>Pluvialis dominica</i>)	Breeds elsewhere	Shorelines, mudflats	All
Belted Kingfisher (<i>Megaceryle alcyon</i>)	Breeds March 15 to July 25	Lakes and rivers	DRIWR
Black Tern (<i>Chlidonias niger</i>)	Breeds May 15 to Aug 20	Marshes near open water	All
Black-billed Cuckoo (<i>Coccyzus erythrophthalmus</i>)	Breeds May 15 to Oct 10	Forests	All
Blue-Winged Warbler (<i>Vermivora pinus</i>)	Breeds May 1 to June 30	Shrub swamps and thickets, forest edges	DRIWR
Bobolink (<i>Dolichonyx oryzivorus</i>)	Breeds May 20 to Jul 31	Tallgrass prairies	All
Canada Warbler (<i>Cardellina canadensis</i>)	Breeds May 20 to Aug 10	Mixed hardwood-conifer swamps	All
Cerulean Warbler (<i>Dendroica cerulea</i>)	Breeds Apr 22 to Jul 20	Unfragmented mature forest	All
Chimney Swift (<i>Chaetura pelagica</i>)	Breeds March 15 to Aug 25	Chimneys, cavities, and caves	All
Eastern Meadowlark (<i>Sturnella magna</i>)	Breeds Apr 25 to Aug 31	Prairies	DRIWR
Eastern Whip-poor-will (<i>Antrostromus vociferus</i>)	Breeds May 1 to Aug 20	Dry to mesic forest	DRIWR ONWRC
Evening Grosbeak (<i>Coccothraustes vespertinus</i>)	Breeds May 15 to Aug 10	Coniferous forest	DRIWR

Species	Breeding Season	Habitat	Refuge
Golden-winged Warbler (<i>Vermivora chrysoptera</i>)	Breeds May 1 to Jul 20	Young forests, shrub swamp	All
Henslow's Sparrow (<i>Ammodramus henslowii</i>)	Breeds May 1 to Aug 31	Large grasslands	All
King Rail (<i>Rallus elegans</i>)	Breeds May 1 to Sep 5	Marsh containing sedge tussocks	All
Kirtland's Warbler (<i>Setophaga kirtlandii</i>)	Breeds elsewhere	Early successional jack pine forest	ONWRC
Lesser Yellowlegs (<i>Tringa flavipes</i>)	Breeds elsewhere	Complexes of open forest, marsh, and open water	All
Long-eared Owl (<i>Asio otus</i>)	Breeds Mar 1 to Jul 15	Pine forests near grasslands	All
Marbled Godwit (<i>Limosa fedoa</i>)	Breeds May 1 to July 31	Short-grass prairies near wetlands	DRIWR ONWRC
Prairie Warbler (<i>Dendroica discolor</i>)	Breeds May 1 to July 31	Early to mid-successional pine barrens and isolated cottonwood stands	DRIWR
Red-headed Woodpecker (<i>Melanerpes erythrocephalus</i>)	Breeds May 10 to Sep 10	Mature, open forest	All
Ruddy Turnstone (<i>Arenaria interpres morinella</i>)	Breeds elsewhere	Shorelines, mudflats	All
Rusty Blackbird (<i>Euphagus carolinus</i>)	Breeds elsewhere	Swamps	All
Short-billed Dowitcher (<i>Limnodromus griseus</i>)	Breeds elsewhere	Variety of wetland ecosystems	All
Upland Sandpiper (<i>Bartramia longicauda</i>)	Breeds May 1 to Aug 31	Prairies, barrens, occasionally fens and bogs	ONWRC
Wood Thrush (<i>Hylocichla mustelina</i>)	Breeds May 10 to Aug 31	Mesic or dry-mesic forest	All

Table 4. Species that occur within the boundaries of Shiawassee NWR or Detroit River IWR that have been identified by the State of Michigan as threatened, endangered, or of special concern within the state. State-listed species differ between Michigan and Ohio, so the presence or absence of species on the state lists in Table 4 is not necessarily indicative of their status on refuges in other states. Habitat information is derived from species profiles by the Michigan Natural Features Inventory.

Species	State Status	Habitat	Refuge
Lake sturgeon (<i>Acipenser fulvescens</i>)	Threatened	Lakes, deep rivers, gravelly streams	SNWR DRIWR
Short-eared owl (<i>Asio flammeus</i>)	Endangered	Grasslands and savannas	SNWR DRIWR
American bittern (<i>Botaurus lentiginosus</i>)	Special Concern	Herbaceous wetlands	SNWR DRIWR
Red-shouldered hawk (<i>Buteo lineatus</i>)	Threatened	Mature hardwood forest	DRIWR
Black tern (<i>Chlidonias niger</i>)	Special Concern	Emergent marsh and open water	SNWR DRIWR
Common nighthawk (<i>Chordeiles minor</i>)	Special Concern	Bare ground	SNWR DRIWR
Marsh wren (<i>Cistothorus palustris</i>)	Special Concern	Marshes with cattail and cordgrass	SNWR DRIWR
Northern harrier (<i>Circus hudsonius</i>)	Special Concern	Prairies, grasslands, marshes	SNWR DRIWR
Trumpeter swan (<i>Cygnus buccinators</i>)	Threatened	Marshes and lakes	SNWR DRIWR
Blanding's turtle (<i>Emydoidea blandingii</i>)	Special Concern	Shallow, vegetated waterbodies	SNWR
Merlin (<i>Falco columbarius</i>)	Threatened	Open lands near coast	SNWR DRIWR
Peregrine falcon (<i>Falco peregrinus</i>)	Endangered	Open lands, nest in cliffs	SNWR, DRIWR
Common gallinule (<i>Gallinula galeata</i>)	Threatened	Evenly-mixed patches of marsh and open water	SNWR
Common loon (<i>Gavia immer</i>)	Threatened	Large inland lakes	DRIWR
Bald eagle (<i>Haliaeetus leucocephalus</i>)	Special Concern	Forests near open water	SNWR DRIWR
Caspian tern (<i>Hydropogone caspia</i>)	Threatened	Sand/gravel islands	SNWR DRIWR
Least bittern (<i>Ixobrychus exilis</i>)	Threatened	Emergent marsh and open water	SNWR

Species	State Status	Habitat	Refuge
Eastern pondmussel (<i>Ligumia nasuta</i>)	Special Concern	Sandy soils in standing water	SNWR
Flutedshell (<i>Lasmigona costata</i>)	Special Concern	Rivers	SNWR
Creek heelsplitter (<i>Lasmigona compressa</i>)	Special Concern	Creeks, small rivers	SNWR
Red-headed woodpecker (<i>Melanerpes erythrocephalus</i>)	Special Concern	Mature open forest	SNWR DRIWR
American lotus (<i>Nelumbo lutea</i>)	Threatened	Marsh	DRIWR
Black-crowned night heron (<i>Nycticorax nycticorax</i>)	Special Concern	Coastal marshes and coastal swamps	SNWR DRIWR
Osprey (<i>Pandion haliaetus</i>)	Special Concern	Floodplain forests, swamps	SNWR DRIWR
Eastern fox snake (<i>Pantherophis gloydi</i>)	Threatened	Open wetlands	SNWR DRIWR
Wilson's phalarope (<i>Phalaropus tricolor</i>)	Special Concern	Marshes near wet prairies	SNWR
Round pigtoe (<i>Pleurobema sintoxia</i>)	Special Concern	Medium to large rivers	SNWR
Pink heelsplitter (<i>Potamilus alatus</i>)	Special Concern	Great Lakes and coastal rivers	SNWR
Pink papershell (<i>Potamilus ohioensis</i>)	Threatened	Lakes, large rivers	SNWR
Prothonotary warbler (<i>Pronotaria citrea</i>)	Special Concern	Floodplain forests	SNWR DRIWR
Kidney shell (<i>Ptychobranthus fasciolaris</i>)	Special Concern	Creeks, rivers	SNWR
King rail (<i>Rallus elegans</i>)	Endangered	Marshes containing sedge tussocks	SNWR
Dickcissel	Special Concern	Grassland	SNWR DRIWR
Forster's tern (<i>Sterna forsteri</i>)	Threatened	Emergent marsh and open water	SNWR DRIWR
Common tern (<i>Sterna hirundo</i>)	Threatened	Sand/gravel islands	SNWR DRIWR
Russet-tipped clubtail (<i>Stylurus plagiatus</i>)	Special Concern	Shallow, sandy rivers and lakes	DRIWR
Butler's garter snake (<i>Thamnophis butleri</i>)	Special Concern	Open grassy wetlands near open uplands	SNWR

Species	State Status	Habitat	Refuge
Lilliput (<i>Toxolasma parvum</i>)	Endangered	Creeks with clay soils	SNWR
Deertoe (<i>Truncilla truncata</i>)	Special Concern	Sandy soils in rivers	SNWR
Paper pondshell (<i>Utterbackia imbecillis</i>)	Special Concern	Lakes, ponds	SNWR
Ellipse (<i>Venustaconcha ellipsiformis</i>)	Special Concern	Gravel soils in small streams	SNWR
Rainbow (<i>Villosa iris</i>)	Special Concern	Gravel soils in streams	SNWR
Yellow-headed blackbird (<i>Xanthocephalus xanthocephalus</i>)	Special Concern	Emergent marshes	SNWR DRIWR
Wild rice (<i>Zizania aquatica</i>)	Threatened	Water less than 2 feet deep with a slight current and mucky or silty substrate	DRIWR