BIOLOGICAL OPINION

Effects to the Eastern Massasauga Rattlesnake from the Carlyle Lake Operations and Maintenance Project (2016 Master Plan Update) in Bond, Clinton, Fayette Counties, Illinois

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TABLE OF CONTENTS

INTRODUCTION 3
CONSULTATION HISTORY 3
DESCRIPTION OF THE PROPOSED ACTION 4
Action Area 4
Proposed Actions 5
Conservation Measures 8
STATUS OF THE SPECIES 10
General Habitat Requisites 10
Requirement for Connectivity Between Microhabitats 11
Habitat Requirements for Successful Reproduction 11
Rangewide distribution and abundance 12
Threats 13
Status of the Eastern Massasauga in Illinois 17
Critical Habitat 17
Conservation Needs of the Species 17
ENVIRONMENTAL BASELINE 17
Status of the Species in the Action Area 18
Habitat Conditions in the Action Area 18
Conservation Needs of the Species in the Action Area 19
EFFECTS OF THE ACTION 19
Direct and Indirect Effects 19
Summary of Effects of the Proposed Action 27
Cumulative Effects 27
Summary of Effects 29
CONCLUSION 31
INCIDENTAL TAKE STATEMENT 31
AMOUNT OR EXTENT OF TAKE ANTICIPATED 32
EFFECT OF THE TAKE 32
REASONABLE AND PRUDENT MEASURES 33
TERMS AND CONDITIONS 33
REPORTING REQUIREMENTS 34
CONSERVATION RECOMMENDATIONS 34
REINITIATION NOTICE 35
APPENDIX A – EMR BEST MANAGEMENT PRACTICES CARLYLE LAKE 42
APPENDIX B – OBSERVED TAKE TABLE 49
APPENDIX C – FINAL BURN DATES 50
APPENDIX D - TIERED CONSULTATION APPROACH 51

INTRODUCTION

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the U.S. Army Corps of Engineers (USACE) Carlyle Lake Operations and Maintenance (Updated 2016 Master Plan) Project, located in Bond, Clinton, and Fayette Counties, Illinois. The biological opinion addresses the potential beneficial and adverse effects of the Project on the eastern massasauga rattlesnake (Sistrurus catenatus; EMR) in accordance with Section 7(a)(2) of the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq*.). The USACE request for formal consultation was received on November 20, 2017, along with a biological assessment (BA) for the Project.

This biological opinion (BO) is based on information provided in the BA, information provided in the U.S. Fish and Wildlife Service's programmatic biological opinion on actions undertaken by the U.S. Fish and Wildlife Service related to habitat management for the EMR (USFWS 2018), as well as the Species Status Assessment for the EMR (Szymanski *et al.* 2016, USFWS 2015, 2016a, b). Additional information included the U.S. Fish and Wildlife Service's final rule of September 30, 2016, listing the eastern massasauga rattlesnake as a threatened species that was published in the *Federal Register* **(81FR 67193),** and other available literature. A complete administrative record of this consultation is on file at our office and has been assigned log number [2019-R3-SISO-1].

This biological opinion addresses the operation and maintenance activities at Carlyle Lake. Recovery related activities (research and captive management) being conducted at Carlyle Lake are covered by issuance of Section 10(a)1(A) recovery permits and are addressed in a Biological Opinion signed March 28, 2017.

CONSULTATION HISTORY

- October 20, 2016 – Meeting held to discuss Updated Master Plan and consultation.
- February 1, 2017 – Meeting held to discuss the EMR management plan for Carlyle Lake.
- March 8, 2017 – Carlyle Lake Master Plan draft BA provided to the Service for review.
- March 16, 2017 – Technical assistance response provided to USACE on the draft BA.
- September 5, 2017 – Conference call to discuss changes to the Master Plan draft BA.
- November 20, 2017 – Carlyle Lake O&M Project BA provided to the Service.
- November 20, 2017 – Call held to discuss formal consultation timeline. USACE and Service agreed to delay start date until the EMR management plan for Carlyle Lake was updated and the USFWS EMR Land Management BO was completed.
- February 29, 2018 – Meeting held to discuss USACE EMR management plan
- August 3, 2018 – USFWS EMR Land Management BO sent to the USACE along with a request for the most recent version of the EMR management plan.
- August 8, 2018 – Draft EMR management plan is provided to the Service.
- August 22, 2018 – Formal Consultation initiated with letter sent to USACE.

- November 30, 2018 – Draft BO provided to USACE for review.
- December 19, 2018 – Due date for completion of the BO extended to January 31, 2018 to allow for further coordination.
- January 30, 2019 – Due date for completion of the BO extended to February 15, 2019.
- February 6, 2019 – Meeting held to discuss draft BO and completion of the document.
- February 12, 2019 – Revised Draft BO provided to USACE for review.
- February 13, 2019 – BO acceptance letter provided by USACE to the Service

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

As defined in the ESA Section 7 regulations (50 CFR 402.02), "action" means "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas." The direct and indirect effects of the actions and activities must be considered in conjunction with the effects of other past and present federal, state, or private activities, as well as the cumulative effects of reasonably certain future State or private activities within the action area.

The following project background and area description is summarized from the BA. The USACE prepared the BA to address operations and maintenance at the Carlyle Lake USACE Project Area, relative to full implementation of the 2016 Master Plan. The original Master Plan was approved in 1962, then revised in 1974 and updated in 1979, 1986, and 1997. The Master Plan guides and articulates USACE responsibilities pursuant to Federal Laws to preserve, conserve, restore, maintain, manage and develop Carlyle Lake Project lands. Carlyle Lake was authorized by Congress through the Flood Control Act of 1938 and modified by the Flood Control Act of 1958. The authorized purposes of the Project include flood control on the Kaskaskia and Mississippi rivers, navigation releases for the Kaskaskia and Mississippi rivers, domestic and industrial water supply, water quality enhancement, fish and wildlife conservation, and recreation.

Carlyle Lake is a 26,000 acres reservoir largely located in Clinton County, Illinois, with smaller portions of the lake within Bond and Fayette counties. The Carlyle Lake Project has a 135-mile project boundary. The Main Dam site is located on the Kaskaskia River about 50 miles east of St. Louis, Missouri. Carlyle Lake is the largest man-made lake in the state and is approximately 12 miles long, 1-3 miles wide, and has approximately 24,710 acres of water surface at summer pool elevation 445.0 feet National Geodetic Vertical Datum. There are 88 miles of shoreline and approximately 12,800 acres of public land associated with the Project.

Action Area

The action area is defined as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action. For the purposes of this BO, the action

area includes all federal lands owned and managed by the USACE at Carlyle Lake.

Proposed Actions

Mowing

- *Recreation Areas and Roadsides* – The Carlyle Lake Project currently maintains 15.4 miles of public roads (paved, gravel) and 7.6 miles of service roads (Saddle Dam III, Keyesport Levee, East Spillway, and West Spillway). The shoulders of the roads and recreation areas are mowed in 15 or more cycles (i.e., each area mowed at given time around the Project) from March through October. Administration areas and recreation areas will be mowed using an industrial riding mower, during daylight hours, to a turf height of 2-4 inches. Roadsides will be mowed (depending on location) either with an industrial riding mower or a lightweight, tractor-pulled, batwing mower, during daylight hours, to a turf height of 2-4 inches. Recreational mowing occurs on approximately 415 acres within the project area.
- *Main Dam, Saddle Dams II & III and Keyesport Levee* – The Main Dam, Saddle Dams II and III and the Keyesport Levee are mowed five to six times per year (between April and October). At high water conditions, additional mowing may be necessary to monitor dam and levees and do inspections in conjunction with the Carlyle Lake Flood Plan. These arrangements will be coordinated with the St. Louis District Dam Safety Office. Weed eating is also part of the maintenance. Structures will be mowed using a lightweight, tractor-pulled, 15-foot batwing mower, during daylight hours, to a turf height of 6-8 inches. Every effort will be made to cut less frequently, if conditions permit.
- *Controlled Hunting Areas* –The IDNR controlled hunting area at Hazlet State Park will be mowed, during daylight hours, using a light-weight, tractor-pulled, 15-foot batwing mower and/or smaller light-weight, tractor-pulled 6-foot mower, to a turf height of 8 inches. These areas will be mowed in late October for the annual pheasant hunt, which occurs from November through January.
- *Agricultural Mowing/Food Plots* - Mowing is conducted in sunflower food plots during August for dove management fields. After duck/goose hunting season, around April, all fields are mowed to make remaining food available to wildlife and to prepare the ground for spring crop planting. These fields are mowed with a tractor batwing mower.
- *Succession Control* – This mowing is done on an as needed basis during the fall/winter (November through February) of the year when the ground is frozen or firm. This mowing is primarily to control woody vegetation to keep Eastern Massasauga rattlesnake (EMR) habitat in an early successional stage and occurs on approximately 330 acres.

Invasive Species Removal

- *Mechanical* – A forestry mower will be used in several areas in the fall/winter, when the ground is frozen, to remove invasive species such as autumn olive and bush honeysuckle. A forestry mower is a skid steer mower with a rotary drum mulcher on the front.
- *Hand Removal* – Hand removal can also be used in the same areas and during the same time period to remove Autumn Olive and Bush Honeysuckle. In areas where the EMR is not known to exist, hand removal of these invasive species can occur all year round.
- *Prescribed Burns* – Prescribed burning will be conducted in several areas to control woody vegetation in general – small saplings and other species other than Autumn Olive and Bush Honeysuckle. When conducted, timing of prescribed burns is weather dependent to avoid mortalities to the EMR.
- *Herbicide* – Herbicide spraying (e.g., Roundup, PastureGard) will primarily be conducting in some of the same areas as mowing, hand removal, and prescribed burning to control encroaching new growth woody vegetation. The site manager will determine if herbicide application is more practical than the other methods – herbicide spraying is more suited for "spot" application. These may also be used to aerial spray for Autumn Olive and Bush Honeysuckle. Tordon Ready-To-Use (RTU) stump killer will be used as a follow-up treatment to prevent stumps from re-sprouting in areas where mechanical or hand removal has been implemented. Approximately 625 potential herbicide acres.

Prescribed Burn (approximately 990 potential burn acres within the project area)

- *Hibernacula Areas* – Prescribe burning will be conducted in several areas known to contain EMR hibernacula. These burns are used to assist EMR research scientists and land managers during the study of the EMR population. Timing of the prescribed burns will be conducted during the EMR hibernation period.
- *Woody Vegetation Control* – As described above, prescribed fire is the primary tool for land managers to control woody vegetative growth in grasslands.
- *Campground Maintenance/Leaf Burning* – The primary reason for this action is to remove heavy leaf litter accumulation in campgrounds and day-use areas. This helps with turf health as well as keeping drainage ditches and culverts clear for more efficient drainage. Burns also provide a level of safety from the potential spread of campfires. These burns will only occur in the mowed areas.

Agricultural/Wildlife Food Plots

- *Soil Preparation and Planting* – These Actions will be conducted at several areas around the Project from early spring to late summer. Some areas will be planted in winter wheat or clover in the late fall.
- *Fertilize* – Fields will be fertilized in early spring using appropriate application rates.

- *Herbicide* – Herbicides will be applied when needed to control unwanted and/or invasive species.
- *Mowing* – Mowing will be conducted as described above - in sunflower food plots during August for dove management fields and after the duck/goose hunting season (Exact dates are variable, duck season ends January 9 and goose season ends January 31 this year). These fields are mowed with a tractor "batwing" mower.

Existing roads and road maintenance within the Carlyle Lake Project Area

- As mentioned above, the Carlyle Lake Project currently maintains 15.4 miles of public roads (paved, gravel) and 7.6 miles of service roads (Saddle Dam III, Keyesport Levee, East Spillway, and West Spillway). Road maintenance is necessary to preserve the integrity of the existing roads, protect users and prevent future construction costs. Road maintenance is performed as needed when funding is available or an immediate safety concerns exist. Road surface repairs, mowing along roadways, drainage system maintenance, snow removal, herbicide spraying, and emergency storm and flood debris removal are common O&M activities performed on Corps of Engineers' public and service roads at Carlyle lake. On gravel service roadways, herbicide spraying is performed to prevent weed and grass growth on top of the appurtenant structures (levees and dams). Also, gravel service roads may be graded with a road grader to smooth the road surface.

Park Development, General Maintenance and Construction

- The Master Plan describes future (within the next 10-15 years) renovation, repair, replacement, and new construction activities within the project area (Chapter 5, Master Plan). These Actions include such things as campsite renovation, sewer and water maintenance, renovation of vault toilets, renovation of shower facilities, boat ramp repair, etc. Actions with the potential to adversely impact candidate, threatened, or endangered species will require separate consultation with the USFWS, and will be addressed in a project-specific BA where the potential impacts will be considered and measures will be developed, in coordination with the USFWS, to avoid and minimize impacts.

General Considerations

- It must be noted that any future construction projects or modifications to the Master Plan, or other non-standard O&M Actions, will be addressed, in consultation with the USFWS, if they rise to a level of impact. Impacts will then be considered and, if needed, measures will be developed to avoid and minimize impacts to any federally listed candidate, threatened, or endangered species.

Conservation Measures

Conservation measures are those actions taken to benefit or promote the recovery of the species. **These actions taken by the federal agency or the applicant that serve to minimize or compensate for project effects on the species under review are included as an integral portion of the proposed action and thus are mandatory**. The Carlyle Lake Operation and Maintenance Project incorporates a number of conservation measures designed to protect and enhance the EMR population at Carlyle Lake. Conservation measures identified in this BO are summarized from the BA, specific to Carlyle Lake O&M, and are based on the *Carlyle Lake Eastern Massasauga Management Plan* (EMRMP) (USACE 2016). The conservation measures and protocols are applicable to all Federal lands at Carlyle Lake in an effort to minimize and compensate potential negative impacts to the EMR resulting from the O&M Actions. The conservation measures are based on published and unpublished literature, coordination with private and public individuals familiar with the life history of the EMR and personal experience of Carlyle Lake staff and biologists. Conservation measures are included below:

Mowing

- *Controlled Hunting Areas* – Required mowing will be limited to hunter walking paths for safety. Future mowing contracts will have specific language concerning the contractor's responsibilities for the protection of the Eastern Massasauga. Mower operators, both in-house and contractors will be given training on snake identification and will report all sightings of EMRs. They will be instructed to specifically avoid killing any snakes and to report accidental fatalities. All EMRs killed during mowing will be provided to the Carlyle Lake Management Office for preservation.

- *Main Dam, Saddle Dams II & III, Keyesport Levee, Recreation Areas and Roadsides* – Future mowing contracts will have specific language concerning the contractor's responsibilities for the protection of the Eastern Massasauga. Mower operators, both in-house and contractors, will be given training on snake identification and will report all sightings of EMRs. They will be instructed to specifically avoid killing any snakes and to report accidental fatalities. All EMRs killed during mowing will be provided to the Carlyle Lake Management Office for preservation.

Cutting Woody Vegetation/Brush/Invasive Species Removal

- Cutting with machinery will be limited to 16 October through 15 May.

Herbicide Application

- Caution will be exercised during the application of herbicides in areas known to have EMRs. Herbicides with low toxicity and a short half-life will be used when possible. If

there are uncertainties regarding the potential effects of an herbicide, and application in EMR sites cannot be avoided, again, it will be restricted to the period when the snakes are most likely to be underground (mid- November through mid-April).

Prescribed Burn

- Any deliberate burning will be conducted by burning before spring egress (March and April) of EMR. Prescribed burns will be targeted to occur on cold, cloudy winter mornings when possible. If the air temperature is above 50 degrees F, a visual search will be conducted to ensure that snakes are not active in the areas to be burned. If early spring burning is necessary surveys of the area will be conducted prior to the burn. If snakes are observed, the prescribed burn will be postponed until conditions are suitable for burning. Burn rotations and partially burning sites will be used to reduce mortality by leaving some cover for snakes emerging in the spring to avoid predation (Mauger and Wilson 1999, Dreslik et al. 2011). Pre- and post-burning surveys for EMR will be conducted.

- Any prescribed burn applications in controlled hunting areas will be restricted to the period when the snakes are most likely to be underground (mid-November through mid-April), on cold, cloudy winter mornings (Dreslik 2005). If the air temperature is above 50 degrees F, burning will not be conducted.

Existing roads and road maintenance within the Carlyle Lake Project Area

- Road signage throughout the Carlyle Lake Project area currently informs the public of the presence of EMRs and the need to slow down for wildlife and these signs will be maintained.

- The USACE is currently evaluating potential locations for placement of new EMR signage along roadways with a number of recent sightings of snakes on the road.

- The USACE is currently designing a brochure for the visitor center that would educate recreationists on the ecological importance of the EMR, its vulnerability to road traffic, and safety precautions (Only two known incidents, over the life of the Carlyle Lake Project (1967- present), of people being bitten by the EMR were due to handling the snake.) The message is don't mess with them and they won't mess with you, and they are important to the ecosystem and deserve our respect and protection.

- The EMR has been and will continue to be an important environmental educational topic at ranger-led campground presentations. The USACE will continue to focus on this species. This is an opportunity to educate the public concerning the impacts of road kills on EMR populations at Carlyle Lake.

STATUS OF THE SPECIES

This section presents the biological or ecological information relevant to formulating the biological opinion. The purpose is to provide the appropriate information on the species' life history, its habitat, and its range-wide distribution and conservation status for analyses in later sections. This section also considers the effects of all past human and natural activities or events that have led to the current status of the species.

The Final Rule listing the EMR as threatened under the Endangered Species Act was published in the Federal Register on September 30, 2016. A Species Status Assessment (SSA) team prepared, and continues to update, an SSA report for the EMR (Szymanski *et al.* 2016). The SSA team was composed of U.S. Fish and Wildlife Service biologists, who developed the report in consultation with other species experts. The SSA represents a compilation of the best scientific and commercial data available concerning the status of the species, and an assessment of the impacts of past, present, and future factors (both negative and beneficial) affecting the EMR. The SSA and other materials relating to EMR listing proposal can be found on the Midwest Region website at http://www.fws.gov/midwest/Endangered/ and at http://www.regulations.gov under docket number FWS–R3–ES–2015–0145.

General Habitat Requisites

The EMR is active in the spring, summer, and fall and inactive in the winter when it hibernates. Therefore, depending on whether the snake is active or inactive determines what type of habitat is required. Active season habitat consists of thermoregulatory or *basking* sites, *retreat* sites, and *foraging* sites. Inactive season habitat consists of hibernacula, often within wetlands or in cavities that allow snakes to retreat to the upper portion of the water table (Reinert 1978). EMR have been found in a variety of wetland habitat types across their range, including bogs, fens, shrub swamps, wet meadows, marshes, moist grasslands, wet prairies, peatlands, coniferous forests and floodplain forests (Minton 1972, Seigel 1986, Hallock 1991, Weatherhead and Prior 1992, Johnson 1995, Kingsbury 1996, Harding 1997, Sage 2005). At many locations, individual EMR may also move from wetlands to drier upland sites during certain parts of the year to forage, disperse, gestate, and even hibernate in some cases (Bissel 1006, Johnson 1995, King 1997, Reinert and Kodrich 1982, Seigel 1986, Weatherhead and Prior 1992). Suitable upland habitat types range from forest edges and openings, savannahs and prairies to meadows, old fields and some agricultural lands. During the active season, EMR need highly intermixed and interspersed opportunities to bask and retreat from sun, hide from predators, attack prey without a chase, find mates, and travel to and from hibernacula seasonally through corridors that lack potentially lethal barriers such as roads.

During the winter months EMR occupy hibernacula. These hibernation sites can occur in wetland, wetland edges, wet prairie, closed canopy forests with mossy substrates (DeGregorio 2008), wet grassland, and sedge meadow (Mauger and Wilson 1999). Across its range, EMRs have been reported to hibernate for up to six months of the year. Crayfish burrows are commonly used over much of the range, though mammal burrows, rocky crevices, rodent holes, hummocks, old stumps, rotten logs, and tree and shrub root systems are also used, (Dreslik 2005, Harvey and

Weatherhead 2006, Johnson 1995, Johnson and Leopold 1998, Mauger and Wilson 1999, McCumber and Hay 2003, Sage 2005, Wright 1941) as may be any cavity that reaches the water table (Reinert 1978; Dr. B. Kingsbury, personal communication to M. Redmer and C. Tansy March 7, 2017). Hibernacula may be either dispersed, with individual EMR emerging from dormancy across large areas (for example, areas of >20ha in southwest Michigan, M. Redmer, personal observation) or communal or concentrated, with numbers of individual EMR emerging from adjacent burrows in high densities (for example areas of <2ha at hibernacula in southern and northeastern Illinois, and <1ha in southwest Michigan, M. Redmer, personal observation). While communal hibernacula are difficult to find and delineate, when they are found they should be noted by land managers because a large percentage of the EMR in a population may use them. Thus knowing where communal hibernacula occur is beneficial to planning actions or timing of actions in a way that allows avoiding or minimizing adverse effects to the EMR that use them. While EMR may use the burrows of more than one species of burrowing crayfish, the burrows of one species (the devil crayfish, *Cambarus diogenes*) in which EMR commonly hibernate are known to reach depths of up to 5m below the surface, though usually depth is associated with actual depth of the water table (Grow and Merchant, 1980). Consistent hydrology at winter hibernacula sites is important in maintaining conditions that support EMR over-winter survival. To survive the winter, each individual EMR requires a suitable hibernation site which is critical to avoid lethally low temperatures and reduce the risk of desiccation (Reinert and Kodrich 1982). Consequently, hibernation sites must provide insulated and moist subterranean spaces below the frost line where individuals can avoid freezing and dehydration (Sage 2005). Most EMRs will either return to the same hibernacula annually (Johnson *et al.* 2000) or to an area within roughly 100 m (328 ft) of their previous hibernation site (Sage 2005; Harvey and Weatherhead 2006).

Requirement for Connectivity Between Microhabitats

EMR need corridors between microhabitats (basking sites, retreat sites, and foraging areas) and between seasonal habitats. EMRs can traverse corridors most successfully (reduced likelihood of mortality) between habitats when there are no barriers such as roads, rivers, or anything that can act as a barrier to snake movement. The absence of roads is an important criterion because roads are a strong barrier to EMR movement due to road mortality (Choquette 2011, Shepard et al, 2008a,b) or road avoidance behavior. Connectivity between the active season (summer) habitat and inactive season (winter) habitat is crucial for population sustainability. Similarly, when temperatures shift the snakes must have the unimpeded ability to either access or retreat to a particular (summer or winter) habitat.

Habitat Requirements for Successful Reproduction

Males may use chemical cues to simultaneously trail and pursue individual females during the mating season (Johnson 1989). Because mature male EMRs often occur in higher numbers than receptive females, competition for mates can be intense. Male EMR may exhibit prolonged periods of mate searching, longer daily movements, and defensive female polygyny during the mating season (Jellen 2005; Johnson 2000). During their searches for receptive females, the extensive movements of male EMR may be even greater in areas with marginal habitat, or at the peripheries of the species range (DeGregorio et al., 2011). Greater movements increase risk of

exposure to predators or mortality while crossing barriers (such as roads and trails).

Thermoregulation is so important to gravid female EMR that they spend the majority of the gestation period within open-canopy areas (Reinert and Kodrich 1982). This type of habitat has significantly higher mean soil temperature than early to mid-successional wetlands (Foster *et al.* 2009). Depending on the location of the population, gestation habitat of gravid female EMRs could be rock outcroppings, open grassland, shoreline, sedge meadow, barrens, or any suitable land characteristic that provides the snake the ability to thermoregulate and avoid predators.

Usually gravid females will remain near their winter hibernacula until parturition in late July or early August and then move to other foraging locations (Marshall *et al.* 2006; Johnson 1995). Foster *et al.* (2009) identified "the importance of accessible early/mid-successional upland areas adjacent to wetlands for the reproductive success of *S. c. catenatus*. This vegetation type apparently provides gravid females with favorable thermal conditions, which ultimately may enhance *S. c. catenatus* productivity." Local gestation sites may be used by several females in a given season and appear to be used by the same individuals in successive breeding years. While at their chosen gestation sites, gravid female snakes generally engage exclusively in basking behavior, forfeiting opportunities for other essential behaviors such as feeding (Keenlyne and Beer 1973; Marshall *et al.* 2006; Weatherhead and Prior 1992). Since gravid females feed very little, if at all, it appears that they maintain themselves on reserved body energy (fat) throughout their pregnancies (Keenlyne and Beer 1973). In the fall, gravid females continue to thermoregulate more than males or non-gravid female snakes, despite giving birth in late summer (Harvey and Weatherhead 2011).

Rangewide distribution and abundance

The EMR historically occupied sections of western New York, western Pennsylvania, southeastern Ontario, the upper and lower peninsulas of Michigan, the northern two thirds of Ohio and Indiana, the northern three quarters of Illinois, the southern half of Wisconsin, extreme southeast Minnesota, east central Missouri, and the eastern third of Iowa. The limits of the current range of the EMR are similar to the historical range; however, the geographic distribution of extant localities has been restricted by the loss of the populations from much of the area within the boundaries of that range (Szymanski *et al.* 2016).

Historically and rangewide there were 558 known EMR populations. Currently, 266 of these are known to be extant, 211 are extirpated or likely extirpated, and 84 are of uncertain status (Szymanski *et al.* 2016). The EMR Species Status Assessment (Szymanski *et al.* 2016) grouped the current number of extant rangewide EMR populations (263) with the current number of EMR populations of unknown status (84) and considered these populations in total as currently being "presumed extant". Therefore the total number of currently presumed extant EMR populations is 347 (263 + 84). The EMR has been extirpated from Minnesota and Missouri and from counties in every state across the range, and the Canadian Province of Ontario (Fig. 1). The range of the EMR is divided into three analysis units (western analysis unit (WAU), central analysis unit (CAU), and eastern analysis unit (EAU)). These three geographic "analysis units" correspond to broad scale genetic differences across the EMR range and represent areas of unique adaptive

diversity. The EMR occupied spatial extent rangewide has declined by a northeasterly contraction in the range and by the loss of area occupied within each analysis unit. Overall, there has been more than 41% reduction in the extent of occurrence rangewide. This loss has not been uniform, with most of this decline occurring in the WAU (70% reduction in the extent of occurrence). However, losses of 33% and 26% in the CAU and EAU, respectively, are notable as well. Of those rangewide populations presumed extant, 139 (40%) are presumed to be quasi-extirpated while 105 (30%) are presumed to be demographically, genetically, and physiologically (DGP) robust (Redford *et al.* 2011). Of these, 105 presumed DGP robust populations, only 53 EMR populations range-wide are considered to be self-sustaining (Szymanski *et al.* 2016). The greatest decline has occurred in the western analysis unit where only one population (of 20 presumed extant) is considered to be self-sustaining (Szymanski *et al.* 2016). In the central analysis, only 47 populations are considered to be self-sustaining, while the eastern analysis unit has only six self-sustaining populations (Szymanski *et al.* 2016).

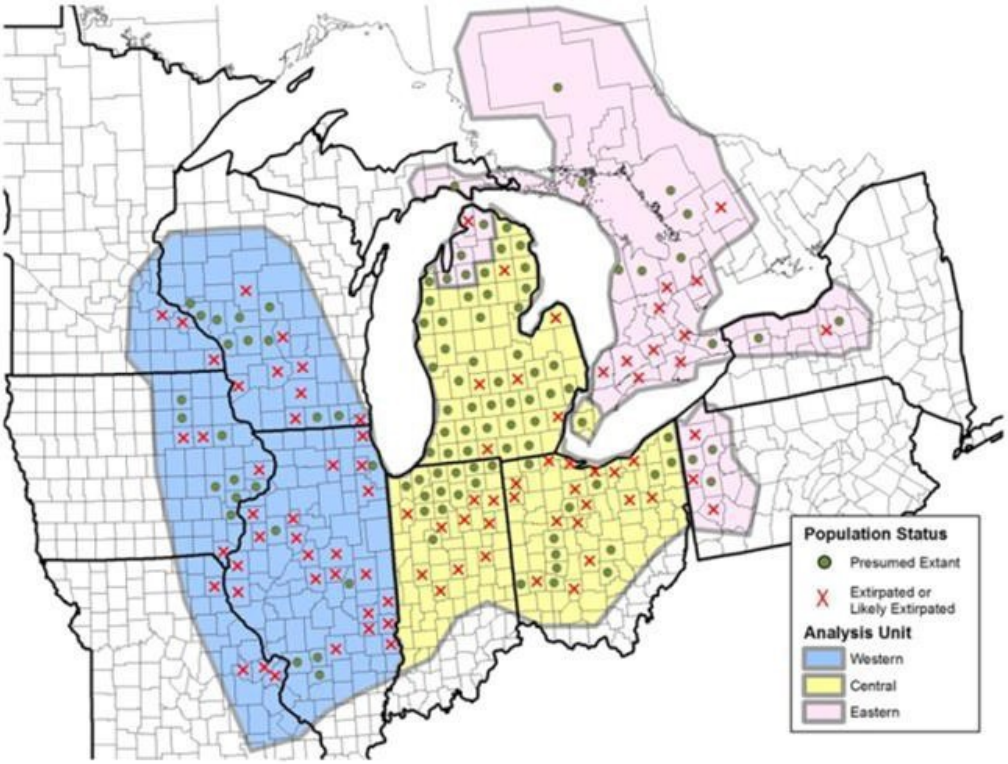

Figure 1. The geographic distribution of presumed extant (extant and unknown status) and extirpated EMR populations over the entire range and within each analysis unit (Szymanski *et al.* 2016). Solid dots represent presumed extant EMR populations. Red Xs represents extirpated or likely extirpated EMR populations.

Threats

The most prominent threats include: habitat loss and fragmentation through development and vegetative succession; mortality of individuals as a result of roads, hydrologic alteration resulting in drought or flooding; persecution; collection; and post-emergent prescribed fire, mowing, and disking.

Disease is a relatively recent threat with still unknown consequences. The effects of threats on extinction risk to EMR populations were included in model evaluations by Faust et al. (2011), while the Species Status Assessment (Szymanski et al., 2016) considered the total number of sites range wide where specific threats were reported.

Habitat Loss and fragmentation

The effects of past, widespread wetland loss continue to impact EMR populations. Development and agricultural practices continue to cause habitat loss, although to a lesser degree than in the past. Habitat loss increases the distance between populations and can isolate seasonally used habitats within individual populations, can restrict gene flow, and other effects of small population dynamics, as well as increase exposure to sources of mortality. In addition, urban encroachment has disrupted the natural disturbance processes (such as hydrological cycles and fire frequency), and subsequently, changes in habitat structure and vegetative composition have occurred. Prolonged flood conditions may make wetlands too deep for use by EMR, while prolonged drought conditions may affect crayfish populations and thus reduce the number of suitable hibernacula (crayfish burrows) available for EMR.

Vegetative Succession

Woody succession, especially by introduced species such as Eurasian buckthorn, that results in EMR's preferred gramminoid (grasses, sedges, and rushes) dominated habitat becoming too shaded may reduce or eliminate these sites as suitable places for EMR to bask and thermoregulate. Unmanaged vegetative succession is the most commonly cited (81%) threat by species experts (Faust et. al. 2011), and is the third most common factor occurring at 31% of sites (Szymanski et al. 2016).

Post-emergent land management practices (prescribed fire, mowing, and disking)

The dependence of EMR on early to mid-successional stage gramminoid (grasses, sedges, and rushes) dominated plant communities necessitates that these communities be managed in a manner that controls woody species from dominating them. One of the most commonly used management techniques for this is prescribed fire, since it is a relatively inexpensive technique and mimics the natural fire processes that would have regulated these plant communities prior to European settlement. However, although EMR likely evolved in these fire dependent communities, direct mortality of EMR can result from exposure to fire if burning occurs when the snakes are out of their hibernacula (post-emergent fire) (Cross 2009; Cross *et al.* 2015; Dreslik 2005; Dreslik *et al*. 2011)**.** In Missouri, Durbian (2006) observed the mortality of 8 western massasauga rattlesnakes on a 16.6 ha (41 ac) prairie after a burn conducted on April 18, 2000.

Mowing is another strategy often used in conjunction with prescribed burning, to control woody vegetation and invasive species encroachment. Durbian and Lenhoff (2004) postulated that pre-burn mowing may potentially reduce fire related mortality of EMRs and other snake species by negatively modifying the occupied habitat forcing the snakes to leave the area or seek refuge

below ground. Durbian (2006) subsequently found that pre-burn mowing at a height of 20 cm (8 in) resulted in the direct mortality of 3 of 7 radio-marked EMRs (*in* Szymanski *et al.* 2016). After the burn, 3 unmarked individuals in the burned area were killed by the fire itself indicating that a number of EMRs did not leave the site after mowing as hypothesized by Durbian and Lenhoff (2004). Durbian (2006) concluded that mowing prior to burning results in additional direct mortality to EMRs beyond that incurred by prescribed burning and advises to conduct burns while EMRs are hibernating until methods that effectively reduce mortality while achieving the treatment objectives are identified (Durbian 2006).

Road Mortality

EMR are more sedentary than other snakes and they move more slowly which increases the probability of being killed while crossing roads (Andrews and Gibbons 2005), and snakes in general are more often intentionally struck by motorists (Ashley et al. 2007). Road mortality is potentially one of the most significant non-natural causes of mortality to this species (Baker et al 2016).

Hydrologic alteration resulting in drought or artificial flooding

Individual populations of EMR often occur in riparian areas, wet prairies, or other places that are prone to fluctuations in hydrology. While EMRs are to a degree adapted to natural hydrological fluctuation, altered flood and drought cycles, or naturally occurring floods and droughts can have effects on EMR or the burrowing crayfish they rely upon for hibernacula. Prolonged flood conditions in a Missouri population of the western massasauga (*Sistrurus tergeminus*) led to changes in population and reproductive characteristics as well as an immediate effect on body condition (Seigel et al., 1999). Conversely, prolonged drought or drawdown conditions may affect water table and burrowing crayfish populations and thus reduce the number of suitable hibernacula (crayfish burrows) available for EMR.

Persecution / Collection

Persecution and collection of EMR are documented threats (Szymanski *et al.* 2016), with several populations having been collected beyond a recoverable threshold. Generally, people have a negative view of snakes and snake encounters frequently result in snake mortality. Poaching and the illegal collection of snakes for the pet trade is also a factor that contributes to the species decline. In Wisconsin, illegal collecting has been documented despite many years of legal protection (Christiansen 1993, Wisconsin Department of Natural Resources 2011). An Indiana Department of Natural Resources law enforcement investigation in 1998 uncovered a well-organized multi-state effort to lauder State Protected reptile species (including EMR). The investigation concluded with the indictment of 40 defendants. Another investigation of illegal reptile trafficking concluding in 2009 uncovered a shipment of EMR collected at a single location in Canada, and that were then smuggled into the United States in violation of laws in both nations (USFWS 2010).

Disease

Snake fungal disease (SFD) is an emerging and significant threat to EMR populations (Allender *et al.* 2011c). Recently, a growing number of snakes have been found in the U.S. with severe and often fatal fungal infections. The number of species of snakes with documented or suspected cases of the disease, and the geographic area the disease has been found, continues to increase annually. A causative agent, *Ophidiomyces ophidiicola* (formerly *Chrysosporium ophidiicola*) was first described from an Eastern Rat Snake (*Pantherophis obsoletus*) in Georgia (Rajeev *et al.* 2009). Five individuals from three sites in Michigan tested positive for SFD in 2013 and 2014 and two EMR were confirmed to be infected in 2015 in the Grayling area. Both died within a few weeks of capture. In the wake of the devastating impacts on amphibians due to Chytrid beginning in 1996 (caused by the fungus *Batrachochytrium dendrobatidis*) (Longcore *et al.* 1999), and White Nose Syndrome (caused by the fungus *Pseudogymnoascus destructans*) on bats beginning in 2005 (Gargas *et al.* 2009), there may be genuine cause for concern that the emerging fungal disease in snakes could have a significant impact on EMR populations.

Climate change

Climate change is one of several factors believed to be actively leading to declines in reptile populations (Gibbons *et al.* 2000). The EMR scored Highly Vulnerable to climate change in an analysis using the NatureServe Climate Change Vulnerability Index tool (Hoving *et al.* 2013). Poor dispersal ability, landscape barriers, and drought sensitivity all contributed to the highly vulnerable score (Hoving, unpublished). Another assessment modeled demographic rates under past and future climate scenarios. They found that past climate change explained the observed recent range contraction, and suggested that the range contraction would continue. Only populations in northern Michigan and Ontario were likely to persist to mid-century (Pomara *et al.* 2014). While these studies suggest that EMR populations in southern Michigan are not viable, there is some uncertainty about this prediction. Although additional models suggest drying in southern Michigan, nearly as many models suggest a wetter climate.

Conclusion

In assessing the occurrence of these threats or risk factors, Szymanski *et al.* (2016) found that 94% of EMR populations have at least one risk factor currently affecting the site. Habitat loss or modification is the most common risk factor occurring at 55% of the sites with 3% of these sites at risk of total habitat loss. The second most common risk factor is fragmentation which occurs at 49% of the sites. Unmanaged vegetative succession is the most commonly cited (81%) threat by species experts (Faust et. al. 2011), and is the third most common factor occurring at 31% of sites (Szymanski et al. 2016).

Among the other factors considered, road mortality occurs at 20%, collection or persecution occurs at 17%, water fluctuation at 7 %, and pre or post-emergent fire at less than 1% of sites (Szymanski *et al.* 2016). The risk factors most likely to push a population to quasi-extirpation within 25 years (high magnitude risk factors) are late-stage vegetative succession, high habitat fragmentation, moderate habitat fragmentation, total habitat loss, and moderate habitat loss or modification.

Status of the Eastern Massasauga in Illinois

Historically, EMR occurred throughout the northern two-thirds of the state. Today, the range is greatly reduced, and extant populations are isolated. Of the 29 historical populations, only 4 are considered extant, 22 are extirpated, and 3 more are considered likely extirpated (Szymanski *et al.* 2016). Of the 4 extant populations, 3 are considered at risk for extirpation and only 1 population is considered potentially stable. The largest and most viable known population (possibly only) of the EMR in Illinois is found in sparse areas of highly fragmented habitat around the southern periphery of Carlyle Lake, Clinton County, on the federal lands under the USACE jurisdiction (Dreslik 2005, Baker 2016). Imminent threats, limited habitat, and small population size threaten the continued survival of the massasauga in Illinois.

Critical Habitat

Critical habitat has not been proposed for the EMR.

Conservation Needs of the Species

The species' conservation needs define what is needed in terms of reproduction, numbers, and distribution to ensure the species is no longer in danger of extinction. The conservation needs should be defined in the species' recovery outline or plan. Since there is no recovery plan or recovery outline available at this time, we will outline the conservation needs based on information from the Species Status Assessment (Szymanski *et al.* 2016).

"For survival and reproduction at the individual level, the EMR requires appropriate habitat, which varies depending on the season and life stage. During the winter (generally October through March), EMRs occupy hibernacula, such as crayfish burrows. Intact hydrology at EMR sites is important in maintaining conditions that support their over-winter survival. During their active season (after they emerge from hibernacula), they require low canopy cover and sunny areas (intermixed with shaded areas) for thermoregulation (basking and retreat sites), abundant prey (foraging sites), and the ability to escape predators (retreat sites). Habitat structure, including early successional stage and low canopy cover, appears to be more important for EMR habitat than plant community composition or soil type.

"At the population level, the EMR requires sufficient population numbers and population growth (controlled by survivorship, recruitment, population structure, and size). Populations also require a sufficient quantity of high quality microhabitats with intact hydrology and ecological processes that maintain suitable habitat, and connectivity among these microhabitats."

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action.

Status of the Species in the Action Area

Populations of the EMR occur in scattered locations primarily at the southern one-third of Carlyle Lake. For example, Eldon Hazlet State Park (leased by the IDNR from the USACE) has an extant population of EMR. Although this area is leased by the IDNR, according to the lease, the IDNR must comply with any laws, regulations, conditions or instructions that apply to any Federal agency. In this case, management of the State Park, or any other project lands leased from the USACE, must be in compliance with Section 7 of the Endangered Species Act, as defined through this consultation.

Research by Dreslik et al. (2017) indicated that the population at South Shore State Park within the Carlyle Lake Project area had remained "at best" stable from 1999 to 2011 and numbers ranged from 18-69 individuals depending on the model utilized. Since 2012, surveys by staff of the Illinois Natural History Survey have shown a downward trend in population size for the EMR at Dam East and West, and the former South Shore State Park, but a spike in the population since 2014 for Eldon Hazlet State Park.

A population viability and sensitivity analysis by Baker (2016) for the South Shore State Park population indicated a positive population growth potential, but also a 65% probability of extinction in 50 years. Sensitivity analyses (Baker 2016; Mills and Lindberg 2002) show that reproductive characteristics (proportion of breeding females, litter size, and offspring sex ratio) and carrying capacity have the greatest impact on population trajectory. Thus, conservation strategies for the EMR should focus on restoring additional habitat to increase carrying capacity, and use more manipulative measures only if the population growth rate becomes negative (Baker 2016).

Habitat Conditions in the Action Area

Habitat that EMR use at Carlyle Lake is limited to areas around the southern periphery of the lake and consists mainly of grassland/wetted prairie habitats but at times also consists of wooded/shrub scrub edges with greater canopy cover along the perimeter of the wetted prairie (Dreslik 2005). In general, EMRs tend to use areas with a mix of sparse plant cover and sunny areas so they can bask in the sun to regulate their temperature, but they also need shady areas nearby for protection from predators and as a source of prey (Dreslik2005). The hibernation habitat is characterized as low-lying with abundant crayfish burrows and having lower canopy cover and woody vegetation distribution; although, hibernating EMR also may be found under logs and tree roots or in small mammal burrows in wet habitat with open canopies (Phillips et al. 2002; Dreslik 2005). Suitable habitat patches at Carlyle Lake are often surrounded by agriculture fields and isolated due to the lake, the river channel below the dam, the city of Carlyle, roads, and other human development (Baker 2016). Grassland habitats in the project area are generally fallow fields or restored prairies and invasive/woody species encroachment is a concern for most EMR areas within the project area.

Conservation Needs of the Species in the Action Area

The conservation needs of the species in the action area are similar to the needs rangewide.

EFFECTS OF THE ACTION

Potential effects to the EMR include direct and indirect effects. Direct effects occur when EMR are present while the activities are being conducted; indirect effects are caused by the proposed action and occur later in time, but are still reasonably certain to occur. Effects will vary based on the type of the proposed activity. Potential effects of the proposed action as well as conservation measures are described below.

Direct and Indirect Effects

Death/Injury

Risk of death or injury of individual EMR from operation and management actions varies depending on the timing of activities, the location, and extent of the action. Activities outside of EMR summer habitat or away from hibernacula will likely not result in death or injury to individuals. The greatest risk of take is associated with projects within known EMR home ranges (calculated from radio telemetry or estimated based on capture of EMR). As discussed in the Environmental Baseline, the potential exists for individual EMRs to be present within the Carlyle Lake Project area.

Mowing

Mowing can have adverse effects on EMR by crushing them under the tires of the mower or by killing them with mower blades (Durbian and Lenhoff 2004; Durbian 2006). Mowing in EMR habitat should be avoided during the species active season (Durbian 2006). For some woody invasive species, mowing may be effective during the winter. This is not always possible because treating some high-priority invasive species must take place during the growing season. Thus, mowing for habitat management can take place year round, though it is most common during the growing season (when snakes such as the EMR are active above ground). In addition to its use to manage habitat, mowing can take place to manage areas used primarily by humans, for example to set back growth of invasive woody or herbaceous plant species, or to maintain roadsides, trails, picnic groves, or administrative areas in turfgrass or other short vegetative structure, which may require more frequent mowing. However, by maintaining short (heights of six inches or less) grass, mowing around roadsides may also help to discourage EMR from approaching close enough that they may then attempt crossing a road, thus lessening the risk of mortality from vehicle strikes (Dr. M.J. Dreslik, personal communication to M. Redmer, 31 August 2017). In administrative areas (e.g., campgrounds, picnic areas, or other areas where turfgrass is maintained adjacent to EMR habitat), mowing and maintaining the grass height at approximately 6 inches or less throughout the growing season should discourage EMR from entering such areas, and would have the side benefit of reducing encounters between EMR and humans using these areas.

Mowing at Carlyle Lake is used to eliminate growth of woody vegetation to maintain early successional stages and used for maintaining a manicured appearance on trails, in camgrounds in picnic areas, and along roadways. Mowing is also used on the saddle dam areas to allow for visual structural integrity and safety inspections and in the controlled hunting areas to provide paths for hunter access. These actions may be beneficial to EMR by maintaining suitable habitat conditions and potentially reducing risk of mortality from vehicle strikes; however, these actions may also result in short term adverse effects to the species through incidental take in the form of injury or mortality. Recreational mowing occurs on approximately 415 acres within the project area and successional mowing occurs on approximately 330 potential acres.

During studies (Phillips et al. 2002; Dreslik 2005; Baker et al. 2016; Joe Smothers, pers. comm. with USACE) conducted between 2000-2011 in the Carlyle Lake region, mowing/trimming of recreational lands accounted for seven known mortalities. On one occasion in the spring of 2001, mowing of a ~10 m^2 area at one hibernaculum resulted in three deaths; two EMR were killed by mower blades and were found on 27 April 2000 and one was crushed by a mower tire and was found on 28 April 2001 (Dreslik 2005). The remaining four individuals were recorded from mowing or weed-eating activities on 18 July 2000, 17 September 2002, 31 August 2006, and 23 November 2010 (Joe Smothers, pers. comm. with USACE). In the Carlyle Lake region, mowing of saddle dams has not accounted for any known mortalities (Phillips et al. 2002; Dreslik, 2005, Joe Smothers pers. comm., Scott Ballard pers. comm. with USACE). However, because EMRs are known to occasionally use saddle dams for foraging and cover (Dreslik 2005), there is potential for incidental mortality. According to Phillips et al. (2002), and Dreslik (2005), mowing of hunting trails has not accounted for any known EMR mortalities (Phillips et al. 2002; Dreslik 2005; Baker et al. 2016).

Based on the past mortality information and proposed conservation measures, the Service estimates incidental take of up to 1.0 EMR per year on average will occur as a result of mowing within the Carlyle Lake Project area. This number may be considerably lower with implementation of the mandatory conservation measures and is likely offset by the improved habitat conditions, reduced road mortality, and potential reduced risk of human interaction resulting from the proposed actions.

Cutting Woody Vegetation/Brush/Invasive Species Removal

Tree or brush removal is used to increase, and connect the open habitat preferred by EMR. A study in western Pennsylvania similarly found that tree removal is most effective when cutting or harvesting standing timber directly adjacent to high quality EMR habitat (Kowalski 2010). Cutting of woody species is normally done to reduce canopy coverage or dominance in a plant community due to succession. While this often happens when exotic woody species (e.g., buckthorns, Rhmanus spp., or autumn olive, Eleagnus ubellata) invade more open habitats, some native species (e.g., dogwoods, Cornus spp., maples/box elders, Acer spp., cottonwoods/aspens, Populus spp.) may also become invasive in habitats favored by EMR. Personnel on foot using hand tools (which reduces or nearly eliminates the likelihood of incidental take of EMR) are often employed to cut brush. Cutting using heavy equipment (for example tractors or other

vehicles using brush cutting attachments, such as Fecon®, HYDRO-AX, Feller-Bunchers, etc.) can allow much greater areas to be covered, but also increases risk that individual EMR would be crushed during the active season or entombed (due to soil compaction) in burrows while hibernating.

Cutting is used at Carlyle Lake to control invasive species and eliminate growth of woody vegetation and is an opportunity based action that is dependent on the appropriate ground, habitat, and weather conditions. A forestry mower will be used in several areas in the fall/winter, when the ground is frozen and hand removal can also be used in the same areas and during the same time. In areas where the EMR is not known to exist, hand removal of these invasive species can occur all year round. Although, injury or mortality is possible, no mortality of the EMR is known to have occurred from brush hogging or hand clearing (USACE 2016).

Given that a forestry mower is being utilized for this activity the estimated incidental take for this activity will be combined with the take estimated for mowing. The likelihood of any take from this activity is minimal with implementation of the mandatory conservation measures and if this action is located primarily on the periphery of hibernacula habitat and/or hand removal is conducted in core hibernacula areas. In addition, any incidental take is likely offset by maintaining or improving habitat conditions.

Herbicide Application

In gramminoid-dominated habitats preferred by EMR, herbicide application reduces or eliminates invasive herbaceous and woody vegetation from a habitat. For EMR, herbicide application would usually be used in conjunction with other actions, for example cutting invasive woody species, in order to enhance habitat by creating a more open vegetative structure. This is accomplished through applications of herbicide to the foliage of herbaceous species, the basal or cut bark of standing woody vegetation, or to the recently cut stumps or stems of invasive woody species to prevent them from clonal re- sprouting. Because the Service has no information related to the direct effects that common herbicides (e.g., Glyphosate) used in habitat restoration may have on the EMR, we urge managers to use caution when applying these in known EMR habitat. In cases where herbicide application is done by personnel on foot hand operated applicators (e.g., backpack sprayers) or application techniques (e.g., wicking or rubber glove application), workers can easily avoid harming individual EMR by watching where they apply herbicide. Broadcast applications (e.g., from booms pulled behind equipment or from aerial platforms) are also used when widespread coverage is required, for example to prepare an old field for seeding of native species, or to efficiently cover large patches of invasive plants. In cases where herbicide is broadcast, the likelihood that herbicide drift could land on an EMR would increase. However, because there are no available data on the direct effects of herbicide (e.g., from drift that may land on a snake) on EMR, and we thus cannot estimate resulting take. However, use of machinery (e.g., tractors) to broadcast herbicides during the active season of the EMR would increase the likelihood that individual snakes would be injured or crushed.

Herbicide application at Carlyle Lake is primarily used in the same areas as mowing, hand removal, and prescribed burning to control encroaching new growth woody vegetation and to

control invasive species. The site manager will determine if herbicide application is more practical than the other methods – herbicide spraying is more suited for "spot" application. Herbicides may also be used to aerial spray for Autumn Olive and Bush Honeysuckle and as a follow-up treatment to prevent stumps from re-sprouting in areas where mechanical or hand removal has been implemented. There are no known mortalities associated with the use of herbicides to control vegetative growth at Carlyle Lake (Scott Ballard pers. comm. with USACE). Herbicide could be utilized on approximately 625 acres within the project area.

Based on the information provided and the proposed conservation measures, the Service believes that incidental take from herbicide application is highly unlikely and thus is not likely to adversely affect the species.

Prescribed Fire

Historically, fire was a natural process in gramminoid dominated plant communities, including those occupied by the EMR. Fire kills or temporarily sets back the growth of woody vegetation, retards the growth of undesirable species, and rapidly stimulates the response of prairie/gramminoid species that result in vegetative structure and varied microhabitats. Prescribed fire (set by resource managers) is a common tool used to mimic the natural process. Because it suppresses woody growth (and especially of invasive species) and encourages the gramminoid/herbaceous structure preferred by EMR (Johnson *et al.* 2000, Dovčiak et al., 2013), prescribed fire is recognized as an essential tool for managing EMR habitat. While prescribed fire is an essential tool for managing EMR habitat, direct mortality of the EMR can result from exposure to fire if burning occurs when the snakes are out of their hibernacula (post-emergent fire). Studies into the wintering biology have attempted to better understand the environmental or weather conditions that trigger EMRs to emerge from hibernation, and their response to fire during the active season (Cross 2009, Cross *et al* 2015; Dreslik 2005; Dreslik et. al 2011; Hileman 2016; Sage 2005). The primary consideration in using prescribed fire to manage habitat occupied by EMR in a way that avoids or minimizes the risk of incidental take is timing to avoid periods when most of an EMR population is active in the habitat to be burned. In general, most EMR in a population will enter (ingress) hibernacula between October (in the northern part of the range) and early November (in the southern part of the range) and emerge (egress) from their hibernacula from between early March (in the southern part of the range) until as late as early May (in the northern part of the range). However, across the range of the EMR, ingress into hibernation, and especially egress from hibernation may vary greatly from year to year depending on when and how rapidly spring temperatures rise, and local thaws progress.

While EMRs that egress in the spring may re-enter burrows for short periods of time to avoid early season cold periods, this behavior is not predictable, and it should not be presumed that prescribed fires can be ignited during cold period that follow a period of egress. In March 2007, following unseasonably warm temperatures (several consecutive days in excess of 27°C) EMR were monitored at two sites in Illinois after emerging 2-3 weeks earlier than observed during previous years. At the first site during a subsequent period of cold weather in April, one radio telemetered EMR was observed to stay on the surface, sheltering under dead vegetation rather than re-entering a hibernaculum. The snake survived several days when low air temperatures

dropped to ca. -4°C and during which time >9.6cm (4 inches) of snow covered the top of its shelter (M. Redmer, personal observation, March and April 2007). At the other Illinois site, land managers assumed that the same period of cold weather caused EMR to return to their hibernacula, and ignited a prescribed fire. During a 6.9 hectare (17 acres) prescribed fire in April 2008, two EMRs were killed in Illinois (Dreslik et al., 2011; Eric Smith, Illinois Department of Natural Resources, personal communication February 2, 2018).

Prescribed fire at Carlyle Lake is conducted in several areas known to contain EMR hibernacula. to assist EMR research scientists and land managers during the study of the EMR population and to improve EMR habitat by removing unwanted invasive species and woody encroachment in to known EMR habitat. Prescribed fire is also the primary tool for land managers to control woody vegetative growth in grasslands and is used to remove heavy leaf litter accumulation in campgrounds and day-use areas. Prescribed fire was historically utilized on a 1-2 or 2-3 year cycle; however, it has been more recently been utilized on a 3-5 year cycle and partial burns have been utilized to maintain cover from predation. Prescribed fire could be used on approximately 990 potential acres within the project area.

Direct mortality can occur to the species from fire exposure during prescribed burns (Durbian 2006; Baker et al. 2016). During the three-year telemetry study in the Carlyle Lake region, prescribed fire accounted for two known EMR mortalities; one on 2 March 2000 and one on 8 April 2002, with the latter being found well after the burn was conducted (Dreslik 2005). An additional three EMR are known to have been killed by prescribed fires in the Carlyle Lake region, one on 4 March 2009 and two on 24 March 2011. It should also be noted that prescribed burning may indirectly increase the risk of predation to the EMR (Durbian (2006), specifically by reducing cover sites and attracting avian predators (Durbian 2006; Wylie et al. 2014).

Based on the past mortality information and proposed conservation measures, the Service estimates incidental take of up to 1 EMR per year on average will occur as a result of prescribed fire within the Carlyle Lake Project area. This number may be considerably lower or close to zero with implementation of the mandatory conservation measures and given that this action occurs on a more infrequent basis (i.e. every 3-5 years). In addition, any incidental take is likely offset by maintaining or improving habitat conditions.

Agricultural/Wildlife Food Plots/Disking

Disking is most commonly used by natural resources managers to set back natural succession by cutting up grassy vegetation, thus preventing an area from maturing into briars, shrubs, and trees. It can eliminate or reduce a thick mat or carpet of grass, such as fescue, brome, or reed canary grass, and can also be used to encourage growth by annual plants. Disking requires use of larger tractors that could crush EMR if they are present, and the disks themselves could lead to direct mortality of EMR by cutting them, turning them under the soil, or by cutting off exits from underground refugia (e.g., crayfish burrows). While there is little known about direct effects of disking and field plowing on burrowing crayfishes, if done when EMR are hibernating these practices would likely kill some snakes in their burrows. This is known to happen to the crayfish frog, *Lithobates areolatus*, another grassland species that occupies crayfish burrows (Wright and

Wright, 1995). In addition, strips that were disked within a wildlife management area occupied by a population of crayfish frogs remained devoid of burrows for up to four years following the time the strips were disked (Dr. M.J. Lannoo, personal communication to M. Redmer, January 13, 2017). Thus, it is similarly assumed that disking in areas with EMR hibernacula could result in loss of a significant part of the population. Disking may also be used to allow continued cultivation prior to conversion to habitat, or following cessation of cultivation so that an area can be seeded to unoccupiedgrassland habitat that may be beneficial to EMR. There may be times when it is prescribed for use in or adjacent to occupied EMR habitat. If this occurs, there is still some chance that individual EMR could be killed by crushing or by being disked up with the soil.

Planting/disking at Carlyle Lake is limited to agriculture/food plots around the Project area and occurs from early spring to late summer. Some areas will be planted in winter wheat or clover in the late fall. In general, these areas are bare soil or cultivated crops and not suitable habitat for EMR. If disking occurs in vegetated areas than there is an increased risk that EMR could be killed by crushing or by being disked up with the vegetation. There are no known mortalities associated with the use of planting/disking at Carlyle Lake and these actions are located primarily in areas that known to be utilized by EMR.

The likelihood of any take from this activity is minimal given that this action is located primarily in areas that EMR are not known to occur at Carlyle Lake. However, there is potential for EMR to be present if they are moving between habitats or their population expands into areas where these activities occur. If disking is necessary in areas with EMR and/or their hibernacula are present, than additional coordination should occur.

Hydrologic Management

Consistent hydrology at EMR sites is important to maintain conditions that support EMR over-winter survival, and the effects of drought and flood cycles are one of the most significant threats to EMR (Seigel et al. 1998, Pomara et al., 2014, Szymanski et al 2016). Extreme fluctuations in the water table may negatively affect body condition the following active season, cause early emergence, or direct mortality (Harvey and Weatherhead 2006; Johnson etal. 2000; Kingsbury 2002, Seigel et al 1999, Smith 2009) when the snakes are underwater hibernating. The water in the hibernacula protects the snakes from dehydration and freezing, thus dropping the levels in the winter leaves the snakes vulnerable to both (Kingsbury 2002; Michigan DNR 2015; Moore and Gillingham 2006; Smith 2009). Draining removes the heat sink capabilities of the water and weakens the thermal link to warmer areas further underground (Michigan DNR, 2015). Flooding that leads to water levels that prevent hibernating EMR from being able to reach the water's surface to breathe can lead to individuals either drowning, or exiting hibernacula prematurely (Dr. M. Dreslik, personal communication to M. Redmer, 29 August, 2017).

Hydrologic management to return or modify the physical characteristics of wetland soils within EMR habitat may be necessary in some circumstances to ensure the success of other actions that lead to habitat enhancement. Consistent hydrology at EMR sites is important to maintain conditions that support EMR over-winter survival. In areas where hydrology is managed for

other wildlife (waterfowl attraction for example) but where EMR are known to occur, maintaining existing flood-drawdown cycles may be sufficient if it is known that EMR have persisted through those management cycles. Similarly, if mechanisms (e.g., water controls structures, valves installed in farm tile networks) are in place, these may be used to the benefit of populations of both burrowing crayfishes and EMR by holding water and maintaining more hydrated soils than may be otherwise possible in times of drought. Thus, in areas where EMR are known to hibernate, if hydrology can be managed EMR should be taken into consideration when annual hydrology management plans are devised. Maintaining a high water table, but not one where the openings of crayfish burrows are submerged during the dormant season (generally November through February in the southern part of the EMR's range) should be a goal at sites where EMR occur. Where hydrological management will result in levels that are higher than the openings to crayfish burrows or other potential EMR hibernacula, a high amount of take is likely, and individual project managers should request consultation with their Ecological Services Field Office.

The likelihood of any take from this activity is minimal given that the managed waterfowl areas at Carlyle Lake are located primarily in areas that EMR are not known to occur. However, there is potential for EMR to be present if their population expands into areas where these activities occur. If hydrologic management is necessary in areas with EMR and/or their hibernacula are present, than additional coordination should occur.

Existing roads and road maintenance within the Carlyle Lake Project Area

Snakes may be found on roads either because they are using them to thermoregulate or crossing them to move between habitat areas (Andrews and Gibbons 2005). Crossing roads could result in mortality while staying in one habitat patch restricts gene flow between patches, which may reduce population viability (Epps et al. 2005; Shepard et al. 2008; Baker et al. 2016). Dreslik (2005) suggests that mortality rates are higher on road segments that fragment patches of grassland habitat, compounding the negative effects of reduced gene flow, inbreeding, and lack of migration. The high degree of habitat fragmentation created by roads around Carlyle Lake means snakes are either forced to cross roads when searching for mates, suitable foraging, and hibernation sites or remain restricted to one habitat patch (Shine et al. 2004). It has also been observed that some people appear to go out of their way run over snakes when they encounter them (Langley et al. 1989; Ashley et al. 2007).

The Carlyle Lake Project currently maintains 15.4 miles of public roads (paved, gravel) and 7.6 miles of service roads (Saddle Dam III, Keyesport Levee, East Spillway, and West Spillway). Road maintenance is necessary to preserve the integrity of the existing roads, protect users and prevent future construction costs. Road maintenance is performed as needed when funding is available or an immediate safety concerns exist. Road surface repairs, mowing along roadways, drainage system maintenance, snow removal, herbicide spraying, and emergency storm and flood debris removal are common O&M activities performed on Corps of Engineers' public and service roads at Carlyle lake.

Road mortality is one of the leading sources of observed mortality (Shepard 2008; Baker et al.

2016) and considered a significant threat to the EMR population at Carlyle Lake (Baker et al. 2016). Baker et al. (2016) documented 49 automobile mortalities occurring at Carlyle Lake between 2000 and 2011. Most of the mortalities occur in the summer and fall when snakes are most active (Baker et al. 2016). A majority of the automobile mortalities (42) were encountered during a study conducted between 2000 and 2002 (Shepard et al. 2008). Of the 42 mortalities encountered, roughly half occurred within the boundaries of the project area.

It is difficult to estimate potential incidental take from road mortality given it is dependent on several variables including weather conditions, traffic patterns, and population size. Road operation and maintenance within the project area is not expected to result in any direct take of individual EMR; however, incidental take is likely to occur as an indirect effect of the proposed action. Based on the past mortality information and proposed conservation measures, the Service estimates that the proposed operation and maintenance of existing roadways may indirectly result in the incidental take of up to 7 EMR per year on average within the Carlyle Lake Project area. This number may be lower with implementation of the mandatory conservation measures and is likely driven by the population size within the project area. In addition, the incidental take is partially offset by maintaining or improving habitat conditions within the project area.

Park Development, General Maintenance and Construction/Earthmoving

Earthmoving usually involves use of heavy, wheeled or tracked equipment and thus may pose a crushing risk when used in areas where EMR are present, and may also alter the contour or upper soil horizons within their habitat. At the scale of most development/construction projects that may be proposed within EMR habitat, earthmoving often occurs on a localized basis. Thus, the work zones themselves may be small enough to allow measures to minimize or avoid incidental take to EMR. If earthmoving is necessary when EMR may be hibernating, and is proposed in areas with EMR and their hibernacula are present, individual project managers should request consultation with the Service. However, if earthmoving can take place during the active season, and conservation measures for this action are implemented, take would be less likely than if earthmoving occurs when snakes are hibernating.

The Carlyle Lake Master Plan describes future (within the next 10-15 years) renovation, repair, replacement, and new construction activities within the project area (Chapter 5, Master Plan). These Actions include such things as campsite renovation, sewer and water maintenance, renovation of vault toilets, renovation of shower facilities, boat ramp repair, etc. The vast majority of proposed actions will occur in highly developed areas and will have no effect on EMR. Actions with the potential to adversely impact EMR will require separate consultation with the Service, and will be addressed in a project-specific BA where the potential impacts will be considered and measures will be developed, in coordination with the Service, to avoid and minimize impacts (Appendix D). The Service does not anticipate any incidental take from these actions with implementation of the appropriate avoidance and minimization measures.

Currently, the USACE has planned a road relocation at the former South Shore State Park. The existing road runs through an EMR population and would be closed. The replacement road would run through an area that is not known to support EMRs. The existing road is a barrier to

snake movement, an automobile mortality threat, and creates a predation threat to snakes basking or attempting to cross the road. Removal of the road would provide the opportunity to develop additional EMR habitat. An Environmental Assessment and Biological Assessment have been prepared and coordinated with the Service for this proposed project.

Handling Individual EMR

Several of the actions above include a conservation measure that may include walking a work area to search for and remove individual EMR prior to the action occurring. The most common tool used for handling venomous snakes are animal handling tongs. Older designs had no pressure release and could potentially act like scissors and crush or cut snakes in half if the handle is squeezed too tightly. Many modern animal handling tongs (e.g., Midwest Tongs, Inc., Gentle Giant ®; Stoney, Inc., Animal Equipment, Inc. or similar) that are engineered with pressure release springs, wide surface area jaws, and rubberized/padded coating should be used to grab snakes encountered in the wild. These designs ensure a secure grip while minimizing or even eliminating the risk of injury caused by crushing or cutting snakes when they are seized with the tongs. Briefly handling EMR in this fashion and in order to remove them from situations where they may present a hazard does not require additional permission as discussed in two previous Service documents (USFWS 2016b, 2017).

The Service anticipates that operations and maintenance activities will result in handling of EMR when they are encountered in a work area or present a hazard. However, we anticipate that this will happen at a much lower frequency than would happen during field studies when individual EMR are targeted for capture. We estimate that 5 or fewer EMR will be captured and handled annually in the implementation of actions considered in this BO. Based on this, if precautions are taken to carefully handle EMR (using methods described above) we estimate that fewer than one EMR per year will be injured or killed due to precautionary handling.

Summary of Effects of the Proposed Action

The effects due to the proposed actions, discussed above, may result in harassment, reduced fitness, injury, and mortality of individual EMRs. However, the proposed operations and maintenance actions will be conducted using conservation measures designed to ensure that the level of incidental take from the activities is minimized and potentially offset by EMR habitat improvements.

Cumulative Effects

Cumulative effects include the effects of future state, local, or private actions that will not be subject to section 7 consultation in the areas being considered in this Biological Opinion. Future Federal actions that are unrelated to the proposed action are not being considered in this Biological Opinion, since they would require a separate consultation pursuant to section 7(a)(2) of the ESA, as amended.

Road Mortality

Road mortality is one of the leading sources of observed mortality (Shepard 2008; Baker et al. 2016) and considered a significant threat to the EMR population at Carlyle Lake (Baker et al. 2016). Baker et al. (2016) documented 49 automobile mortalities occurring at Carlyle Lake between 2000 and 2011. A majority of the automobile mortalities (42) were encountered during a study conducted between 2000 and 2002 (Shepard et al. 2008). Of the 42 mortalities encountered, roughly half occurred within the boundaries of the project area and the other half occurred on state and county roads within the project area. Road mortality outside of the project area is likely to continue and it is unclear if additional coordination with county and state partners would lead to measures to reduce this additional risk of mortality.

Persecution / Collection

Persecution and collection of EMR are documented threats (Szymanski *et al.* 2016), with several populations having been collected beyond a recoverable threshold. It is unclear what effect persecution/collection is having on the population at Carlyle Lake. There is only one known case of persecution within the Carlyle Lake project area although additional persecution is believed to have occurred (USACE 2016).

Disease

Snake fungal disease (SFD) is an emerging and significant threat to EMR populations (Allender *et al.* 2011c). Recently, a growing number of snakes have been found in the U.S. with severe and often fatal fungal infections. Health surveys and an ophidian paramyxovirus investigation have been conducted for EMR populations at Carlyle Lake (Allender et al. 2006; Allender et al. 2008). In 2008, three EMRs died from a keritinophilic fungal infection *Ophidiomyces ophidiicola* (SFD). Since 2008, six EMRs from the Carlyle Lake population (3 in 2008, 1 each in 2009, 2010, and 2012) have been diagnosed with an *O. ophidiicola* infection. Despite treatment with anti-fungal medications in the last three cases, all infections proved fatal (Allender et al. 2011a). Although, disease mortality is natural, the extent of this infection within the population is unknown (Allender et al 2011b). The factors responsible for the fungal disease are unknown (immune suppression from environmental conditions is a leading candidate cause), and the extent of the infection and population ramifications at Carlyle Lake are unknown.

Research

Although past studies at Carlyle Lake have provided valuable information concerning the life history of the species, they have also been a source of mortality. Surgical complications represented approximately 4% of the observed EMR mortalities at Carlyle Lake (Baker et al. 2016), although the value may be higher if mortalities in other categories (i.e., predation, died in captivity, illness, unknown, etc.) were either directly or indirectly associated with transmitter implantation. Research is ongoing at Carlyle Lake; however, there are no current studies being conducted that involve surgical implantation of radio-transmitters and the practice has been discontinued indefinitely.

Habitat Loss and fragmentation

The effects of past, widespread wetland loss continue to impact EMR populations including the population at Carlyle Lake. Development and agricultural practices continue to cause habitat loss, although to a lesser degree than in the past. These actions reduce habitat favorability for the EMR, forcing isolation of populations to islands of favorable habitat (Dreslik 2005). It is unclear how much development will occur near the project area in the future and what effect that will have on the EMR population.

Climate change

Climate change is one of several factors believed to be actively leading to declines in reptile populations (Gibbons *et al.* 2000). The EMR scored Highly Vulnerable to climate change in an analysis using the NatureServe Climate Change Vulnerability Index tool (Hoving *et al.* 2013). Poor dispersal ability, landscape barriers, and drought sensitivity all contributed to the highly vulnerable score (Hoving, unpublished). Another assessment modeled demographic rates under past and future climate scenarios. They found that past climate change explained the observed recent range contraction, and suggested that the range contraction would continue. It is unclear what effect climate change may be having on the population at Carlyle Lake.

Predation

Predation was the second greatest source of observed mortality at Carlyle Lake between 2000-2011 (Baker et al. 2016). Without additional radio-telemetry data, a number of annual mortalities will likely go undetected such as predation (Baker et al. 2016). Thus it is unclear what effect future predation will have on the EMR population at Carlyle Lake.

Summary of Effects

Our analysis of effects for EMR entails: (1) evaluating individual EMR exposure to action-related stressors and response to that exposure; (2) integrating those individual effects (exposure risk and subsequent response) to discern the consequences to the populations to which those individuals belong; and (3) determining the consequences of any population-level effects to the species rangewide. If, at any point, we demonstrate that the effects are unlikely, we conclude that the agency has insured that their action is not likely to jeopardize the continued existence of the species and our analysis is completed.

Impacts to Individuals

Implementation of the Carlyle Lake operations and maintenance Project may result in some adverse fitness consequences for individuals occurring within the action area. These adverse consequences are most likely to be as either injury or death of individual EMR from direct or indirect exposure to project actions. However, we expect the potential for death or injury to be minimized with adherence to the proposed conservation measures and some of the impacts will potentially be offset by EMR habitat improvements within the project area. Of specific concern

is the potential indirect effect of road operation and maintenance on EMRs in the project area.

While analyzing the effects of the proposed action, we identified the life stages that would be exposed to the stressors associated with the proposed action, and analyzed how those individuals would respond upon exposure to the stressors. From this analysis, we determined that:

1) There is no proposed critical habitat for the EMR, and thus, none will be adversely affected.

2) All life stages of EMR will be exposed to various project stressors and are likely to adversely respond to some of them.

In summary, there may be impacts to individual EMR in either their annual survival or reproductive rates.

Impacts to Populations

As we have concluded that individual EMR are likely to experience reductions in either their annual or lifetime survival or reproductive rates, we need to assess the aggregated consequences of the anticipated reductions in fitness (i.e., reproductive success and survival), of the exposed individuals on the population(s) to which these individuals belong.

There are significant stressors impacting the population of EMR in the project area including habitat fragmentation/population isolation, road mortality, and predation and additional stressors that are somewhat unknown but just as potentially significant including disease and persecution/collection. Thus, any additive mortality from the proposed action is likely to result in population level impacts.

Given the amount of lethal take anticipated from the proposed actions, cumulative effects of other actions in the vicinity of the project area, and the baseline of the species (assumed declining baseline of the population), we expect the EMR population in the project area to decline and trend towards extirpation as suggested by Baker (2016). However, there is opportunity within the project area and with project actions to benefit the species, potentially offset future losses, and reverse the downward trend of the population. There is also opportunity to collaborate with partners in the project area to reverse the assumed decline in the population.

Impacts to the Species

As reductions in the population and associated population fitness are anticipated to occur, we must assess the impacts to the likelihood to both survival and recovery of the species as a whole. This analysis requires evaluating the impacts to the conservation needs (what is needed for in terms of the survival and recovery of EMR). There is no recovery plan for the EMR; however, we have outlined EMR conservation needs (see Status of the Species Section and below).

"At the population level, the EMR requires sufficient population numbers and population

growth (controlled by survivorship, recruitment, population structure, and size). Populations also require a sufficient quantity of high quality microhabitats with intact hydrology and ecological processes that maintain suitable habitat, and connectivity among these microhabitats."

While the proposed actions along with other cumulative effects are likely to result in the continued decline of the population within the project area, they will not likely result in the extirpation of the Carlyle Lake population over the life of the project (10-15 years). In addition, the potential decline of the population is unlikely to decrease the overall reproduction, numbers, or distribution of the EMR rangewide. Therefore, we do not anticipate a reduction in the likelihood of both survival and recovery of the species as a whole. As stated above, there is opportunity within the project area and with project actions to benefit the species, potentially offset future losses, and reverse the downward trend of the population.

Based on the analysis above, the proposed action should not decrease the reproduction, numbers, or distribution of the EMR in a way or to the extent that would cause an appreciable reduction in the likelihood of both survival and recovery of the species as a whole.

CONCLUSION

After reviewing the current status of EMR, the environmental baseline for the action area, the effects of the proposed actions, and the cumulative effects, we conclude that the proposed action is not likely to reduce reproduction, numbers, or distribution of EMR to such an extent as to reduce appreciably the likelihood of survival and recovery of the species. It is our biological opinion that the proposed action will not jeopardize the continued existence of EMRs. No critical habitat has been designated for this species; therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 CFR § 17.3). Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR § 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

AMOUNT OR EXTENT OF TAKE ANTICIPATED

If EMR are present or utilize an area proposed for a project action, incidental take of EMR could occur. The table (below) provides an illustration of potential take levels that may be associated with possible project actions. Due to the difficulty in estimating future incidental take from project actions, the estimates below are purposely high to account for variability in the extent and density of the species within the action area and variable exposure to project actions. In addition, the incidental take estimates are based on past observations which may be underestimated given that the individuals occupy summer and winter habitats where they are difficult to find and thus finding dead or injured specimens during or following project implementation may be difficult. In some cases incidental take will be non-lethal and undetectable.

Estimated Take Table. Estimated annual incidental take (mortality or injury of eastern massasauga rattlesnakes).

Activity (Forms of Take)	Metric	Estimated Average Annual Take
Mowing (Direct Harm or Kill)	Number of individuals	≤1
Cutting Woody Vegetation/Brush (Direct Harm or Kill)	Number of individuals	Unlikely (included in mowing take)
Herbicide Application (Direct Harm or Kill)	Number of individuals	Unlikely
Prescribed Fire (Direct/Indirect Harm or Kill)	Number of individuals	≤1
Disking/Planting (Direct Harm or Kill)	Number of individuals	Unlikely
Hydrologic Management (Harm or Kill)	Number of individuals	Unlikely
Road (Indirect Harm or Kill)	Number of individuals	≤7
Earthmoving (Direct Harm or Kill)	Number of individuals	Unlikely Separate Consultations
Search and removal of EMR (Pursuit and Capture)	Number of individuals	≤1/unlikely
Total		*≤10

*With implementation of the mandatory conservation measures, this number could be considerably lower.

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the EMR. No critical habitat has been designated for the EMR, so none would be impacted.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measure(s) are necessary and appropriate to minimize impacts of incidental take of eastern massasauga:

1. Ensure that proposed EMR management activities will result in the maximum benefit to the species and that the proposed operation and maintenance activities are conducted to minimize any direct or indirect take necessary to accomplish project objectives.

2. Decrease possible adverse impacts to EMR's through compliance with Terms and Conditions set forth below.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, the USACE must comply with the following terms and conditions, which implement the reasonable and prudent measures. These terms and conditions are non-discretionary.

1. To reduce the possible impacts to EMRs, the following is necessary:

a) During site-specific project planning, the effects of management actions on EMR and their habitat must be considered and avoided or minimized to the greatest extent possible. This can be accomplished through implementation of the proposed conservation measures and best management practices (BMP) described in Appendix A for each project action and additional site-specific measures as deemed appropriate. Unless identified as a "recommended" practice, the BMP's are necessary when an action is implemented within or adjacent to documented EMR habitat. Documented EMR habitat is based on known EMR home ranges (calculated from radio telemetry or estimated based on capture of EMR).

b) We anticipate circumstances where a BMP that was planned cannot be implemented. For example walking/scanning a work area for EMR prior to work commencing may not be practical later in the season, when vegetation is too high and dense to detect EMRs. When such circumstances are encountered, they should be described and included with an analysis of whether the proposed action with modified BMPs will still be protective of EMRs and their habitat. This analysis should be provided to the Service when warranted to determine if a separate consultation is necessary.

c) Provide to personnel of the Service's Southern Illinois Ecological Services Field Office an opportunity to conduct site visits to evaluate compliance with the proposed

conservation measures and BMP's. Site visits will be scheduled by mutual consent of the USACE and Ecological Services' staff.

d) Finally, the state of knowledge about BMPs practices to avoid and minimize incidental take of the EMR is constantly improving. As new information becomes available, we may reinitiate this consultation and periodically revise the BMPs provided by this programmatic Biological Opinion.

REPORTING REQUIREMENTS

1. To ensure that the anticipated level of incidental take is not exceeded; the incidental take that occurs shall be recorded annually and reported to the Service using the Observed Take Table (Appendix B). Accurate and timely reporting of incidental take that occurs as a result of the proposed action will help to validate the ongoing accuracy of the analysis conducted in the biological opinion.

2. When dead EMR that may have been killed in the course of implementing a project action are found, USACE shall contact the Service's Southern Illinois Sub-Office (SISO) to report such mortality within five (5) business days of discovery.

3. The USACE shall make all reasonable efforts to educate personnel to report any sick, injured, and/or dead EMR located within the Carlyle Lake Project area and vicinity immediately to the lead USACE biologist/site manager. The USACE point of contact will subsequently report to the Service's Southern Illinois Sub-Office (SISO) (618-998-5945). No one, with the exception of trained staff or researchers contracted to conduct EMR monitoring activities, should attempt to handle any live EMR, regardless of its condition.

4. Care must be taken in handling dead specimens to preserve biological material in the best possible state. In conjunction with the care of sick and injured fish or wildlife and the preservation of biological materials from dead specimens, the USACE has the responsibility to ensure that information relative to the date, time, and location of EMR, when found, and possible cause of injury or death of each is recorded and provided to the Service.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened

species. Conservation recommendations are discretionary agency activities to minimize or avoid the adverse effects of a proposed action on listed species or critical habitat, to help carry out recovery plans, or to develop information.

The Service has identified the following actions that, if undertaken by the USACE, would further the conservation of the EMR. We recognize that limited resources and other agency priorities may affect the ability of the USACE to conduct these activities at any given time.

1. Implement measures identified in the June 2018 Eastern Massasauga Management Plan for Carlyle Lake including the following:
    a) Education and Outreach Programs
    b) Conservation Land Management to Maintain, Enhance, and Create EMR Habitat
    c) IDNR/University of Illinois Research Program – Corps Assistance
    d) Reduce Persecution Related Mortality
    e) Reduce Road Mortality
    f) Reduce Illegal Collection
    g) Reduce Natural Mortality (Disease)
    h) Operation and Maintenance Activities for Land Management
    i) Construction Activities

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the conservation recommendations carried out.

REINITIATION NOTICE

This concludes formal consultation for the USACE actions outlined in your request dated November 20, 2017. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over an 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 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 is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such a take must cease pending reinitiation.

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APPENDIX A – EMR BEST MANAGEMENT PRACTICES CARLYLE LAKE

The following BMPs, terms and conditions, are designed to ensure that the level of incidental take from the operation and maintenance actions are minimized and potentially offset by the potential benefit of habitat management activities. The BMPs are based on our review of research publications and gray literature titles relating to habitat practices and their potential to result in incidental take of individual EMRs, and the effects (both beneficial and adverse) of habitat practices on EMR persistence.

Unless identified as a "recommended" practice, the BMP's are necessary when an action is implemented within or adjacent to documented EMR habitat. Documented EMR habitat is based on known EMR home ranges (calculated from radio telemetry or estimated based on capture of EMR).We anticipate circumstances where a BMP that was planned cannot be implemented. When such circumstances are encountered, they should be described and included with an analysis of whether the proposed action with modified BMPs will still be protective of EMRs and their habitat. This analysis should be provided to the Service when warranted to determine if a separate consultation is necessary.

A. Mowing

1. Avoid use of heavy machinery to mow in EMR habitat during the species' activeseason. All-terrain vehicles, small mowers/tractors or tracked vehicles should be used when possible.

2. Recommended: Sickle bar and disk mowers should be used because they do not create a vacuum effect, which has been shown to injure or kill snakes (Durbian, 2006).

3. Recommended: Mowers with a wider wheelbase should be used as they will require fewer passes through the areas and reduce the probability of crushing snakes (Durbian, 2006).

4. Raise mower decks when mowing during the active season to a height no lower than 9 inches and ideally keep the mower blades above 12 inches, or if shorter turf grass in administrative areas (campgrounds, roadsides, etc.) must be maintained, attempt to do so by mowing during the hottest part of mid-day when EMR are least likely to be present.

5. In situations which require mowing in EMR habitat during the EMR active season and where feasible, persons familiar with methods to safely handle venomous snakes, and carrying should conduct a "walk through" to search for and remove EMR a short distance (generally <200m, and into adjacent habitat) from the work zone just prior to mowing. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

6. In areas where known EMR hibernacula or concentrations of crayfish burrows occur within known EMR habitat, avoid using heavy equipment (tractors or trucks) to mow. When mowing is planned in these areas, use hand tools, hand power tools, or light equipment.

7. Recommended: When administrative areas (e.g., campgrounds, roadsides, picnic areas, or other areas where turfgrass is maintained adjacent to EMR habitat), regular mowing and maintaining the grass height at approximately 6 inches or less throughout the growing season should discourage EMR from entering such areas, and would provide a net benefit of reducing encounters between EMR and humans using these areas.

B. Cutting Woody Vegetation/Brush

1. Recommended: When possible, brush cutting should be conducted in months when EMR are likely to be dormant (November through February in most of the range).

2. Recommended: If brush cutting during the EMR active season, contractors or other individuals working with hand or power tools in known EMR habitat should be made aware of the species presence prior to commencing work, and trained to identify this or other species of snakes on site that may be of similar appearance.

3. Recommended: If brush cutting during the EMR active season, contractors or other individuals shall be instructed on how to avoid encounters with the species, and to not harm or kill individual EMR they encounter.

4. Avoid use of heavy machinery to cut brush in EMR habitat during the species' active season. Although dates when EMR are active above ground can vary, it is recommended that brush cutting with heavy machinery should be confined to the months of November through February (or when ground is hard frozen) throughout the range of the EMR.

5. Recommended: Managers in the southern portion of the range should be aware of unseasonably early warm periods during the usual dormant season (for example early warm weather in February) which may draw a few EMR to the surface, and avoid use of heavy machinery at such times.

6. In areas where known EMR hibernacula, or concentrations of crayfish burrows occur within known EMR habitat, avoid using heavy equipment (tractors or trucks) to cut brush. When brush cutting is planned in these areas, use hand, power tools, or light equipment instead.

7. Use heavy machinery to cut brush in EMR habitat only during prolonged periods of sub-freezing temperatures, when the surface soil is hard frozen. If the soil is hard frozen light all-terrain vehicles, small trucks/tractors or tracked vehicles may be used to cut brush in EMR habitat.

8. Where feasible individuals familiar with the EMR shall walk through the work area where the cutting will occur, but prior to it starting, to visually scan for and remove individual EMR that

may be present. Any EMR that present a hazard shall be removed from a work area and released on adjacent habitat not greater than 200 meters from the point of capture. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

C. Herbicide Application

1. Recommended: When possible (e.g., with woody species), conduct herbicide applications in months when EMR are likely to be dormant.

2. Recommended: Contractors or other individuals working during the EMR active season, and in known EMR habitat should be made aware of the species presence prior to commencing work, and trained to identify this or other species of snakes on site that may be of similar appearance.

3. Recommended: Contractors or other individuals should be instructed on how to avoid encounters with the species, and to not harm or kill individual EMR they encounter.

4. Recommended: Avoid use of heavy equipment and broadcast applications (including aerial) of herbicide in occupied EMR habitat.

5. When heavy equipment or broadcast applications must be used in areas known to be occupied by EMR, follow the same seasonal guidelines provided for practices listed above to avoid soil compaction or crushing EMR.

6. Avoid using heavy equipment or other broadcast applications (e.g., aerial) in areas where known EMR hibernacula or large concentrations of crayfish burrows are known to occur in occupied EMR habitat. In these areas use hand application techniques instead.

7. In situations where control of target invasive species require herbicide applications using heavy equipment during the EMR active season, persons familiar with methods to safely handle venomous snakes, shall conduct a "walk through" to search for and remove EMR a short distance (generally <200m, and into adjacent habitat) from the work zone prior to mowing. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

8. Avoid using heavy equipment or other broadcast applications (e.g., aerial) in areas where known EMR hibernacula or large concentrations of crayfish burrows are known to occur in occupied EMR habitat. In these areas use hand application techniques instead.

D. Prescribed Fire: When Weather/Soil Climate Stations are Not Available

1. Timing of burns shall be determined after consulting dates in Appendix C.

2. Burns may be conducted outside of these dates if the crew has soil climate data available for their latitude band, and can document it prior to igniting a fire.

3. Recommended: leave unburned areas adjacent to prescribed burns to serve as snake refugia whenever possible.

4. Prescribed burn plans will use back burning as the primary ignition strategy. The approach will minimize entrapping snakes between flame fronts. However, the burn manager may make the judgement during a burn treatment, that encirclement ignition or strip firing is necessary to protect human safety or property.

5. A scientific fire behavior model, such as the United States burn model, the Canadian burn model or equivalent shall be used to formulate a burn prescription for a maximum rate of spread no faster than 16 chains per hour (17.6 feet per minute) with an average targeted rate 10 chains per hour or less (11 feet per minute), except in known hibernacula areas. A slower rate of spread may allow snakes within the burn unit adequate time to find refugia.

6. Fire shall will be established following existing features (such as roads, streams, and trails) to the extent possible. Cultivation (disking or rototilling) of burn breaks will be minimized to the extent that human health and safety are not jeopardized. Cultivation and mowing fire breaks will be established during the inactive season to the extent possible.

E. Prescribed Fire: (Recommended/Preferred Practice) When Weather/Soil Climate Stations are Available. The best predictor of EMR egress in spring is in inversion of subsurface soil temperatures at the depths of 30cm and 60cm, as soil temperatures near the surface become warmer than the deeper soil temperatures (Hileman 2016).

1. At least two weeks prior to anticipated start of a burn season in their area, and before burning at known EMR sites, land managers/burn bosses shall access and monitor the soil climate data at or from the nearest adequately equipped (e.g., with soil temperature probes) weather station to track and provide real-time temperatures at 1 meter, 0.6 meter, 0.3 meter depths, and at soil surface.

2. After the tenth day (cumulative) in spring when the temperature at the 0.3 meter depth has exceeded that at the 0.6 meter depth, no prescribed burn shall be conducted within in delineated wetlands known or believed to have EMR hibernacula, nor within 100 meter buffer of the delineated wetlands.

3. Land managers/burn bosses may continue to conduct prescribed burns in adjacent upland habitats beyond the 100 meter buffer for an additional two weeks/14 days following the date when wetland burns were discontinued. To avoid take of EMR dispersing into adjacent uplands, prescribed burns shall discontinued after the 14th day following the date when burns were discontinued in the wetlands as described in best practice 2, above.

4. If the above soil climate and science-based practices are followed, prescribed fire within EMR habitat would be unlikely to lead to incidental take of the EMR, and would likely allow an extended (over dates provided in Table 1, below) burn season in most years. However, because adequately equipped and accessible weather stations that allow the above practices to be followed are not yet commonly available, the Service intends to work closely with state and local partners to establish a network of such stations that could be remotely accessed (e.g., by internet or cellular applications). Until such a network is available, a set of predetermined dates for planning times to use prescribed burns at EMR sites may be used as an interim measure (Appendix C).

F. Disking

1. Recommended: Contractors or other individuals working in EMR habitat shall be made aware of the species presence prior to commencing work, and trained to identify this or other species of snakes on site that may be of similar appearance.

2. Recommended: Contractors or other individuals shall be instructed on how to avoid encounters with the species, and to not harm or kill individual EMR they encounter.

3. Disking in EMR habitat should be minimized or avoided during the active season, or areas that are to be disked during the active season should be mowed during the inactive season to less than 15 cm (6 in) in height so that they are unattractive to snakes the following spring, and the mowing should be continued until the disking is to take place.

4. If mowing can't be done prior to disking, personnel familiar with EMR should walk the work zone prior to work commencing, to visually scan for and remove any EMR found where heavy equipment will drive. Any EMR found could be relocated a short distance (generally <200m, and into adjacent habitat) from the work zone. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

5. Areas currently in row-crop agriculture, but to be converted to EMR habitat by disking should be continuously maintained as row-crop agriculture until such time that they may be seeded to native grasslands or similar habitat that may be beneficial to EMR.

G. Hydrologic Management (EMR present)

1. Water levels in EMR managed habitat shall not be drawn down during the inactive season, except for human health and safety reasons

2. Water levels may not be raised for more than two continuous weeks during a single inactive season, except for health and safety concerns. Water levels may be raised during the active season.

3. Hydrology should be managed to ensure that EMR are able to hibernate within retreat into the water table in crayfish burrows, or other locally available cavities.

H. Development/Construction/Earthmoving

1. If earthmoving is planned within occupied EMR habitat, equipment shall be offloaded from the closest point to the work zone as practicable, on a service road, parking lot etc.

2. From the offloading point, provide a short, direct route through which equipment operators can traverse to get to the work zone as quickly as possible.

3. Where the route would traverse through EMR habitat, it should be mowed in advance (see above best practices for mowing administrative areas) to a grass height of less than 6 inches to discourage EMR from using the path from the offload site to the work zone.

4. Personnel familiar with EMR should walk the work zone prior to work commencing, to visually scan for and remove any EMR found where heavy equipment will drive. Any EMR found could be relocated a short distance (generally <200m, and into adjacent habitat) from the work zone. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

5. <u>Recommended</u>: If the work period may be prolonged (>7 days) the work zone could be visually scanned as described above, just prior to commencing work, and a trenched-in silt fence shall be erected around the work zone to prevent re-entry by individual EMRs that are in the proximity. Once the area is scanned and found to be free of EMR, work can commence without impediment.

I. Handling Individual EMR

1. When walking a work area to search for and remove individual EMR prior to a management treatment occurring, handlers shall use only modern animal handling tongs (e.g., Midwest Tongs, Inc., Gentle Giant ®; Stoney, Inc., Animal Equipment, Inc. or similar) that are

engineered with pressure release springs, wide surface area jaws, and rubberized/padded coating shall be used to grab snakes encountered in the wild.

2. Any individual EMR removed from a work area shall be immediately released in adjacent habitat no greater than 200 meters form the point of capture. Briefly handling EMR in this fashion and in order to remove them from situations where they may be at risk or may present a hazard does not require additional permission as discussed in two previous Service documents (USFWS 2016b, 2017).

APPENDIX B – OBSERVED TAKE TABLE

OBSERVED TAKE TABLE. Format for reporting the amount of incidental take that occurred annually as a result of project implementation.

Activity (Forms of Take)	Metric	Amount and Extent of Incidental Take
Search and removal of EMR (Pursuit and Capture)	Number of individuals	
Mowing (Harm or Kill)	Number of individuals	
Cutting Woody Vegetation/Brush (Harm or Kill)	Number of individuals	
Herbicide Application (Harm or Kill)	Number of individuals	
Prescribed Fire (Harm or Kill)	Number of individuals	
Disking/Planting (Harm or Kill)	Number of individuals	
Earthmoving (Harm or Kill)	Number of individuals	
Road (Harm or Kill)	Number of individuals	
Hydrologic Management (Harm or Kill)	Number of individuals	

Insert "n/a" for any activity that is not applicable in a given year; for relevant activities that are reasonably likely to result in incidental take, describe the amount or extent of incidental take using either the number of individual eastern massasauga or the relevant surrogate.

APPENDIX C – FINAL BURN DATES

Final Burn Dates Table. Final burn dates within one-degree latitude bands across the range of the eastern massasauga rattlesnake in the United States. Example locations with known/occupied eastern massasauga rattlesnake sites nearby are provided for reference.

Latitude			
Min	Max	Final Burn Date	Example Locations
38.3	39.3	March 1	Carlyle, IL
39.3	40.3	March 7	Monticello, IL
40.3	41.3	March 13	Delong, IL; Ft. Wayne, IN; Marion, OH; Butler, PA
41.3	42.3	March 19	Cedar Rapids, IA; Chicago, IL; Cassopolis, Ann Arbor, MI; Ashtabula, OH
42.3	43.3	March 25	Delevan, Portage WI; Grand rapids, MI; Rochester, Syracuse, NY;
43.3	44.3	March 31	Nelson, WI; Ludington, MI;
44.3	45.3	April 5	Camp Grayling, MI
45.3	46.3	April 11	Bois Blanc Island, MI

APPENDIX D - TIERED CONSULTATION APPROACH

To assess the effects of future actions and to facilitate the USACE section 7(a)(2) responsibilities, a tiered programmatic consultation approach will be implemented for new construction/development projects. The Tier I level is the review of how the actions in the Updated 2016 Master Plan will impact listed species over the life of the plan. This programmatic BO constitutes the Tier I level review. The Tier 2 level is the review of how the site-specific future actions will affect listed species. As individual construction/development projects are proposed under the Updated 2016 Master Plan, the USACE will do the following:

- Site-specific projects will incorporate all applicable conservation measures identified in the Carlyle Lake Operations and Maintenance Project BA, Carlyle Lake EMR Management Plan and all of the terms and conditions associated with the reasonable and prudent measures outlined in this opinion.

- Site-specific biological assessments (or biological evaluations) will be submitted to the Service and tier to the programmatic documents. As such, much of the information regarding the life history of listed species and other information can be referred back to the programmatic documents. The status of the species should be updated as appropriate.

- Site-specific biological assessments (or biological evaluations) will clearly describe the proposed action, identify the species that may be present, describe the site-specific effects of the project to the listed species that may be affected by the project, and contain the appropriate site-specific determination of effects (i.e., no effect, not likely to adversely affect, wholly beneficial effects, or likely to adversely affect).

- Site-specific biological assessments will contain a statement that identifies all applicable conservation measures, terms and conditions and other conservation-related commitments being implemented and contain a statement indicating that the site-specific project is fully compliant with the Tier 1 Programmatic Biological Opinion.

The Service will review the information provided by the USACE for each site-specific project. We will confirm the species that may be affected and assess how the action may affect the species, including ensuring that the level of effect is commensurate with the effects contemplated in the Program-level BO. During this review, if it is determined that an individual proposed project is not likely to adversely affect listed species, the Service will complete its documentation with a standard concurrence letter that refers to this BO, the Tier 1 programmatic document, and specifies that the Service concurs that the proposed project is not likely to adversely affect listed species or designated critical habitat. If it is determined that the proposed project is likely to adversely affect listed species or designated critical habitat, then the Service will complete a Tier 2 biological opinion with a project specific incidental take statement.