ENVIRONMENTAL ASSESSMENT

OF

THE MICHIGAN KARNER BLUE BUTTERFLY

HABITAT CONSERVATION PLAN AND INCIDENTAL TAKE PERMIT

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1. PURPOSE AND NEED

1.1 Purpose

The Michigan Department of Natural Resources (DNR) has developed the Michigan Karner Blue Butterfly Habitat Conservation Plan (hereafter, Comprehensive HCP; Michigan DNR 2007) to facilitate the conservation of the Oak Savanna Ecosystem, Karner blue butterfly (*Lycaeides melissa samuelis*; KBB) and other associated species of concern on non-federal land in Michigan. It outlines activities that will be conducted to maintain the early-successional habitat conditions necessary to support savanna species and communities. It also integrates diverse land uses with conservation objectives by outlining measures to avoid, minimize and mitigate take of KBB and other species that could be caused by activities in occupied KBB habitat. In this way, the Comprehensive HCP supports the issuance of an incidental take permit (ITP) pursuant to section 10(a)(1)(B) of the Federal Endangered Species Act of 1973, as amended (87 Stat 884, 16 U.S.C. § 1531 et seq.; ESA).

This Environmental Assessment (EA) evaluates issuance of an ITP under the proposed action (Comprehensive HCP) and under other alternatives for potential impacts to KBB and the human environment.

1.2 Need

KBB is listed as an endangered species under authority of the ESA. Take of endangered species is restricted by section 9 of the ESA. Under the ESA, 'take' means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect a federally listed threatened or endangered species or to attempt to engage in any such conduct. KBB require early-successional habitats (U.S. Fish and Wildlife Service 2003a), and management needed to maintain these habitats may result in take of individuals. The take restriction therefore limits the options available to manage habitat and it precludes other types of land uses in areas occupied by KBB.

Under certain circumstances, however, section 10 of the ESA allows exceptions from the restriction on take. An ITP under section 10(a)(1)(B) allows incidental take associated with otherwise lawful activity. An HCP, intended to minimize and mitigate take authorized by an ITP, must be submitted with the permit application. By law, the U.S. Fish and Wildlife Service (USFWS) can not issue a permit that would jeopardize the continued existence of a listed species. In consultation with the USFWS, the Michigan DNR identified an ITP as the most appropriate regulatory instrument to facilitate conservation of occupied KBB habitat in Michigan. Accordingly, the Comprehensive HCP identifies measures to avoid, minimize and mitigate the adverse effects of incidental take of KBB and thus supports the issuance of an ITP.

In the absence of a Comprehensive HCP and associated ITP, land managers and landowners would need to obtain incidental-take authorization on an individual, project-specific basis to legally conduct the activities listed above. This situation would result in a patchwork of projects conducted with little or no coordinated planning or consideration of range-wide impacts to KBB and other species of concern. By contrast, projects implemented under the Comprehensive HCP would be authorized by a single ITP. Projects would be implemented according to consistent

conditions, and HCP management partners would coordinate management activities and benefit from predictable regulatory approaches. The Comprehensive HCP would therefore facilitate efforts to evaluate and minimize the cumulative adverse impacts of individual projects to particular KBB populations.

Activities that would be conducted under the Comprehensive HCP would not be expected to either increase or decrease the amount of occupied KBB habitat in Michigan; rather, they would be conducted to help prevent the loss of occupied KBB habitat on non-Federal land. Maintenance of existing populations is a critical component of the KBB conservation program in Michigan. It is also consistent with objectives of the Federal Recovery Plan, which outlines a strategy for "maintaining extant populations" and "improving and stabilizing populations where the butterfly is imperiled" (USFWS 2003a:52). In this way, the Comprehensive HCP is a necessary complement to other, recovery-directed activities that are designed to increase the distribution of the species in the State.

1.3 Decisions that Need To Be Made

The USFWS will evaluate the proposed action (Comprehensive HCP) and other alternatives considered in detail and will determine whether this Environmental Assessment is adequate to support a Finding of No Significant Impact, or whether an Environmental Impact Statement will need to be prepared.

1.4 Background

Historically, habitats within the Oak Savanna Ecosystem were maintained in an early-successional state by a natural disturbance regime that included frequent fire, windthrow, wild herbivore grazing, and insect and disease outbreak (Nuzzo 1986, Grundel et al. 1998, Ritchie et al. 1998, Fuhlendorf and Engle 2001). The practice of widespread fire suppression that began following European settlement interrupted the primary mechanism that historically maintained this ecosystem (Haney and Apfelbaum 1990, Faber-Langendoen 1991, Abrams 1992, O'Connor 2006). The Oak Savanna Ecosystem has been reduced to fragmented and often-degraded remnants as a result of land conversion and fire suppression (Nuzzo 1986, O'Connor 2006).

Many savanna-dependent species, including KBB (Andow et al. 1994), declined or were locally extirpated as habitat was degraded or destroyed (Leach and Ross 1995). The range-wide decline prompted the 1992 classification of KBB as federally endangered (U.S. Fish and Wildlife Service 1992).

Throughout the period of widespread population decline, however, KBB populations in Michigan and Wisconsin remained comparatively robust (USFWS 2003a). Many of these KBB populations survived on a public land base, where land-management practices designed to benefit wildlife like white-tailed deer (*Odocoileus virginianus*), wild turkey (*Meleagris gallopavo*) and ruffed grouse (*Bonasa umbellus*) also benefited KBB.

Within Michigan, KBB is currently known to occur on approximately 3,900 acres within 10 counties in the western Lower Peninsula (Fettinger 2005; Figure 1). The Federal Karner Blue

Butterfly Recovery Plan (USFWS 2003a) divides existing KBB range within the state into four Recovery Units. Additional areas with potential to contribute to the long-term recovery of the species have also been identified (Figure 2).

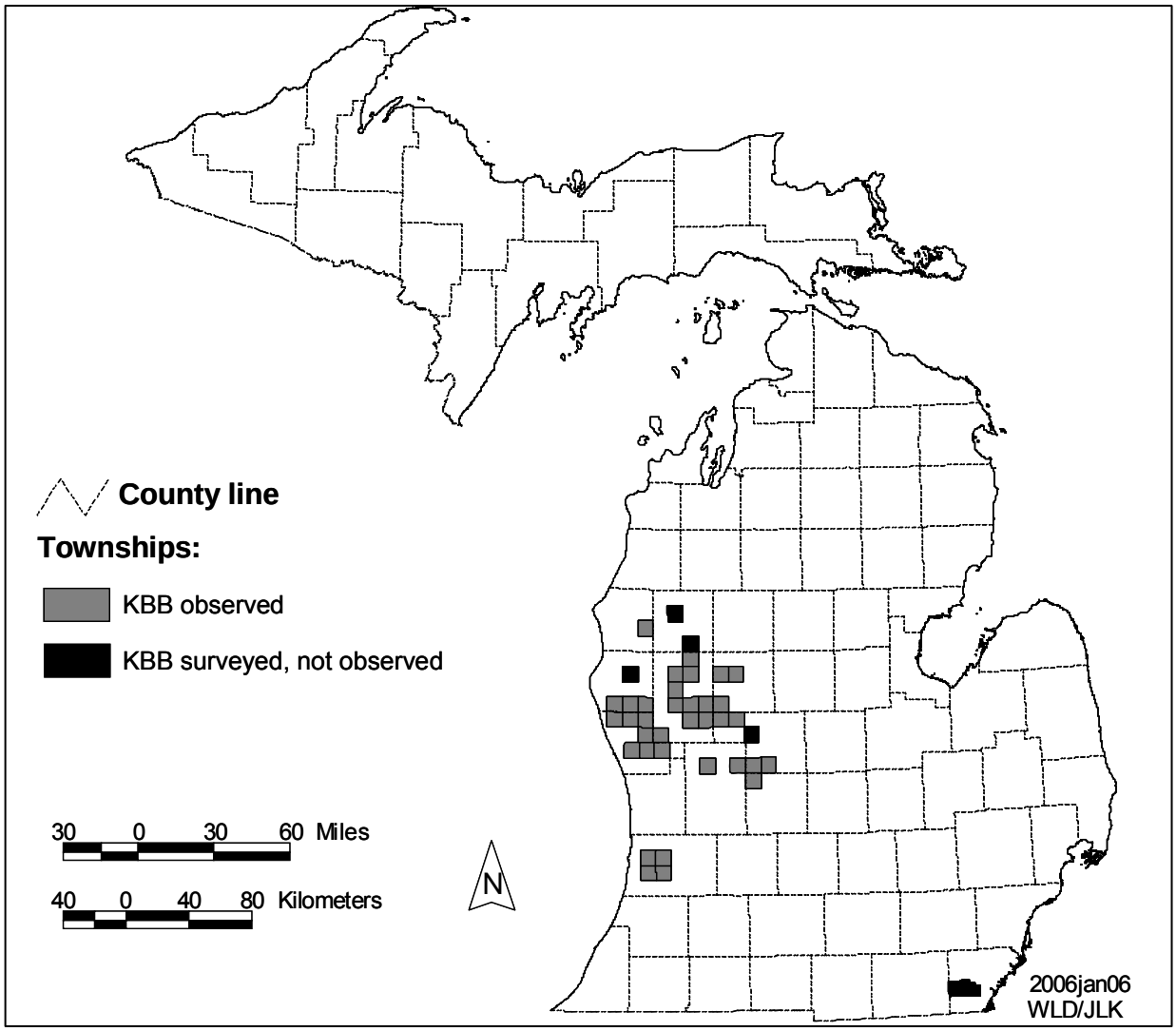

Figure 1. Townships in Michigan with known occurrences of Karner blue butterfly (adapted from Fettinger 2005).

Occupied KBB habitat in Michigan is almost equally divided between public (51%) and private (49%) land (Table 1). On public land, federal land encompasses 57% of all known occupied habitat. The remaining 43% of occupied KBB habitat on public land occurs within a mix of State, county and local ownerships. Non-public land encompassing occupied KBB habitat includes ownerships by non-governmental organizations, utility companies, railroad companies, and other private entities. The majority of non-public land with occupied KBB habitat consists of many small, privately owned parcels.

Figure 2. Karner blue butterfly Recovery Units, Recovery Unit Annexes, and Potential Recovery Units in Michigan.

Currently, major threats to the Oak Savanna Ecosystem, KBB and other associated species of concern in Michigan are: 1) habitat succession due to suppression of the natural disturbance regime; 2) management and maintenance practices that are incompatible with the conservation of those natural features; and 3) habitat conversion and fragmentation due to development and other land uses. The Michigan DNR developed the Comprehensive HCP to help minimize and mitigate these threats on both private and non-federal public land throughout the distribution of KBB in Michigan.

Table 1. Acres of occupied Karner blue butterfly habitat currently known to occur on public and non-public land within each Recovery Unit.

		Recovery Unit				
Ownership	**Owner**	**Allegan**	**Ionia**	**Muskegon**	**Newaygo**	**Total**
Public	Federal	-	-	1,010	105	1,115
	State	585	161	8	37	791
	County	26	-	<1	-	26
	Local	-	-	7	58	65
Public Total		611	161	1,025	200	1,997
Non-public	Power Co.	317	-	51	52	420
	Roadside	16	1	14	231	262
	Railroad	-	-	-	19	19
	NGO[a]	-	-	-	41	41
	Other private	46	121	392	554	1,113
Non-public Total		379	122	457	849	1,855
Grand Total		990	283	1,482	1,097	3,852

[a] Non-governmental organization.

2. ALTERNATIVES AND ASSOCIATED TAKE ACTIONS, INCLUDING THE PROPOSED ACTION

Alternatives for KBB conservation in Michigan were identified following a review of other, existing HCPs (e.g., Wisconsin Department of Natural Resources 2000), after consultation with scientific and management experts, and following focused public involvement. These alternatives were then evaluated for their ability to help achieve the following goals: 1) support persistence of a functioning Oak Savanna Ecosystem in Michigan; 2) support maintenance of oak-savanna habitats in a condition and configuration necessary to sustain existing populations of KBB and other associated species of concern; and 3) integrate diverse land uses with the conservation of the Oak Savanna Ecosystem, KBB and other associated species of concern.

2.1 Alternatives Not Considered for Detailed Analysis

Alternatives not considered for detailed analysis would be unlikely to meet objectives identified for the conservation of KBB and other oak-savanna species of concern. They are offered here to provide perspective on the alternatives that were carried forward for detailed analysis.

2.1.1 Mitigation Banking

Under this alternative, land-management impacts to KBB, other species of concern, and their habitats would be mitigated through permanent habitat maintenance, restoration or creation. The need for mitigation would largely derive from activities conducted on numerous, small private parcels that tend to be highly fragmented and heavily impacted by development and land-management practices. Establishing mitigation banks and ensuring connectivity between habitats on so many parcels would be difficult, costly and probably ineffective for the long-term conservation of KBB and other species of concern. A conservation strategy that recognizes

habitat shifts on the landscape and that focuses on public lands and large private holdings would ultimately be more effective. Moreover, the incidental take anticipated as a result of proposed management of oak savanna is expected to result from short-term impacts of projects that would cause no net loss of KBB numbers, occupied habitat area, or habitat connectivity. Therefore, mitigation for those short-term impacts may not be necessary. Mitigation banking may be more appropriate for long-term impacts; however, even long-term impacts may be more appropriately mitigated through other approaches.

2.1.2 Provision of Refuges

Under this alternative, attempts would be made to conserve KBB and other species of concern through establishment of permanent refuges. Although this approach would offer assurances that land would be set aside for conservation of these species, management would also be required to maintain them in a successional state that meets their respective habitat needs. The use of refuges to conserve these species would also concentrate them within focused sites and thereby increase risks associated with local disturbances and catastrophic events (Saunders et al. 1991). Moreover, KBB may have occurred historically in metapopulations that existed on the landscape as dispersed subpopulations (Givnish et al. 1988, USFWS 2003a); these subpopulations would have occurred in a shifting mosaic consisting of discrete but transient habitat sites connected by dispersal corridors that facilitated habitat-site re-colonization following local extirpations. With this metapopulation structure, subpopulations would have shifted over the landscape as disturbance and succession either created or eliminated patches of suitable habitat. Therefore, an approach that permanently restricts populations to discrete, isolated areas does not consider the ecological processes that may be required by KBB and other species of concern. However, when used in conjunction with other management approaches, refuges do have value and are recognized as a part of a viable strategy that is employed in both the Comprehensive HCP (2.2.1) and Reduced-scope HCP (2.2.3) alternatives.

2.1.3 Zoning Restrictions

Under this alternative, KBB and other species of concern would be conserved through habitat protection resulting from restrictions in statute or zoning that limit or restrict development or land use. Although restrictions in statute or zoning have been used in green-space planning, ordered community development, and clustered subdivision development, the approach has not yet been used to conserve rare species on a landscape scale. Establishing the legal framework for implementing this alternative may be sufficiently complex to prevent a timely solution. Considering the need to actively manage areas to meet the habitat needs of KBB and other species of concern, the need to provide a land base on which to provide suitable habitat, and the need for managed habitat to occur at multiple interconnected sites on a landscape, conservation through this alternative alone would be unlikely to succeed.

2.2 Alternatives Carried forward for Detailed Analysis

This section describes two action alternatives (2.2.1 and 2.2.3) and the No Action alternative (2.2.2). The action alternatives are similar in that the Reduced-scope HCP alternative includes a subset of those incidental take activities that would be conducted under the Comprehensive HCP

alternative. The Comprehensive HCP alternative could apply to all occupied KBB habitat on non-federal land in Michigan and would facilitate coordination among a wide diversity of management partners. The Reduced-scope HCP could apply only to a subset of occupied KBB habitat on non-federal land and would facilitate coordination among a smaller number of partners. The No Action alternative would include activities in occupied KBB habitat that have already been authorized through other processes.

2.2.1 Alternative A: Comprehensive HCP (Proposed Action)

The Comprehensive HCP area could include all occupied KBB habitat on non-federal land in Michigan (approximately 2,700 acres). Any additional occupied KBB habitat created or discovered in the future also could be included in the HCP area and would be covered by the ITP.

Authorized by a 20-year ITP, a coalition of management partners would cooperate to implement the Comprehensive HCP. Management partners could include state, county and local government agencies, non-governmental organizations, utility and transportation right-of-way managers, private land developers, and other private landowners. Landowners and land managers would not be required to participate in implementation of the HCP. Rather, participation would be offered as a reasonable and practical option for those agencies, organizations and individuals that seek authority for incidental take of KBB. Activities under the Comprehensive HCP would not be conducted on any particular parcel of land without the participation and explicit permission of the landowner.

Activities that would be conducted under the Comprehensive HCP fall into three general categories: 1) habitat management; 2) utility and transportation right-of-way maintenance; and 3) development.

2.2.1.1 Habitat Management

Habitat management would involve simulation of natural processes to maintain the conditions required by KBB and other species associated with the Oak Savanna Ecosystem. Natural processes historically included fire, windthrow, wild herbivore grazing, and insect and disease outbreaks (Nuzzo 1986, Grundel et al. 1998, Ritchie et al. 1998, Fuhlendorf and Engle 2001). Management techniques that would be used to mimic these processes include:

- prescribed burning
- mowing/hydroaxing
- manual vegetation removal
- chemical vegetation removal
- soil scarification
- seeding and planting
- livestock grazing

Disturbance levels associated with use of these techniques would occur within the natural range of variability. The techniques could be used separately or in combination, and would be

expected to have short-term (<2 growing seasons) adverse impacts but long-term benefits to KBB, other species of concern, and the Oak Savanna Ecosystem. To avoid or minimize incidental take of KBB and other species of concern, these techniques would be conducted according to the following conditions.

General

Habitat-management techniques that could cause take of KBB would usually be applied to no more than one-third of any particular occupied KBB habitat patch within a calendar year. Treatment would be conducted first on the most degraded third of a patch. This approach would reduce take of KBB and other species of concern, and it would facilitate re-colonization of recently treated portions. The entirety of a patch or metapopulation complex would not be treated until the initially treated portion benefits from two growing seasons and monitoring confirms densities of KBB, lupine and flowering nectar plants that exceed pre-treatment levels.

Treatment of more than one-third of any particular occupied KBB habitat patch within a calendar year may be conducted under any of the following conditions:

- treatment of a larger area is necessary to prevent the spread of invasive species and disease outbreaks that threaten the viability of a KBB population.
- a large viable KBB metapopulation is identified, expanding the focus for treatment from the level of individual habitat patches to the level of the metapopulation complex as a whole. In this case, treatment within a calendar year would be limited to one-third of the area of the metapopulation complex.
- an occupied habitat patch is less than 1 hectare. A patch this size may be treated in its entirety within a single calendar year if a suitably connected source population exists within 1 kilometer.
- experimental management techniques require testing.
- take of KBB would not occur on more than one-third of the patch (e.g., when mowing over snow cover, spot-spraying for invasive species).

Whenever take of KBB would occur on more than one-third of an occupied habitat patch for the preceding reasons, project-specific approval from the Michigan DNR and the USFWS would be required prior to implementation.

With rare exception, management that could result in take would not occur when adult KBB are present, typically between May 15 and August 15. Management that could result in take may be conducted during this period only if it is necessary to achieve KBB habitat-management objectives or to test experimental management techniques, or when new information indicates take would not exceed that which would occur during other periods. Take activities that would occur between May 15 and August 15 would require specific authorization from the Michigan DNR and the USFWS.

Surveys would be used to determine the presence and distribution of KBB within proposed treatment areas where the species is likely to occur. Whenever pre-treatment surveys are not conducted in areas where the species has been observed recently (i.e., in the past 5 years),

presence of KBB throughout the treatment areas would be assumed. Pre-treatment habitat assessments would also be used to identify the most degraded habitat portions on which to focus treatment.

To the extent possible, foot and vehicle traffic would avoid occupied KBB habitat and other lupine patches outside treatment areas.

All employees and contractors working in occupied habitat would be trained on KBB life history and habitat requirements, and instructed on the measures required to minimize or avoid take of the species.

Prescribed Burning

Prescribed burning would be used to suppress undesirable plant species, enhance the diversity and abundance of desirable plant species, reduce soil nitrogen and organic matter, raise soil pH, expose mineral soils, and reduce woody plant cover and thus increase incident sunlight at ground level (Wright and Bailey 1982, Tester 1989, Haney and Apfelbaum 1990, Lane 1994, Payne and Bryant 1994, Neary et al. 2005). Soil-disturbance measures required as a part of this activity would conform to specifications described under the subsequent heading for soil scarification.

Prescribed burning may be conducted throughout the Michigan range of KBB, but it would not be used when it could pose a threat to human safety, property, or the safe and reliable use of utility infrastructure. Public-safety, property and infrastructure concerns would be addressed through existing requirements to secure permits from the appropriate state or local agencies prior to burning. Additionally, prescribed burning would conform to National Wildfire Coordinating Group (NWCG) Standards, and burns would be conducted by Certified Burn Managers pursuant to Michigan law (Public Act 451 of 1994, Part 515). This law deals comprehensively with codified prerequisites, certifications and processes for prescribed burning, and is compatible NWCG Standards.

As required by Michigan law, prescribed burning would be conducted under a system of redundant containment and control measures, wherein appropriate firebreaks, ignition strategies, and suppression equipment (e.g., fire plows, pump trucks, bulldozers) would be used by trained personnel to safely and effectively conduct burns. In addition, modeling of expected fire intensity would be used to assist in optimizing application of containment measures. Finally, local fire departments would be informed of all prescribed fire plans and burn dates in case there is need to mobilize them. These measures would help ensure prescribed fires remain under control, and would thus ensure a high degree of safety and prevent the burning of more occupied KBB habitat than intended.

Mowing/Hydroaxing

Mowing and hydroaxing would be used to mimic certain effects of fire, wild herbivore grazing and browsing, and insect and disease outbreaks (Sinclair et al. 1987, Payne and Bryant 1994, Ritchie et al. 1998, Fuhlendorf and Engle 2001). It would suppress herbaceous and woody plants and increase incident sunlight at ground level. Tools used in this activity would include rotary

mowers (e.g., mowers, brushogs, hydroaxes) powered and propelled by rubber-tired or tracked vehicles (e.g., tractors, skidders, dozers, all-terrain vehicles).

Take of KBB due to mowing or hydroaxing can be entirely avoided when at least 4 inches of snow cover the ground or when cutting equipment would directly avoid lupine; thus, entire patches or patch portions may be treated without take. These activities would be scheduled to occur under these conditions whenever possible. When mowing over snow is not possible, mowing and hydroaxing would be restricted to periods when adult KBB are not present. To avoid or minimize impacts to lupine and KBB eggs and larvae, equipment would be operated to achieve a cutting height of at least 6 inches above the ground.

Where aggressive vegetation (e.g., bracken fern: *Pteridium aquilinum*) threatens to shade out lupine throughout the lupine growing season, mowing may be conducted during periods when adult KBB are present, on as much as one-third of the area each year, provided Michigan DNR and USFWS approval has been received.

Manual Vegetation Removal

Manual vegetation removal would be used to mimic certain effects of fire, wild herbivore grazing and browsing, and insect and disease outbreaks (Sinclair et al. 1987, Payne and Bryant 1994, Ritchie et al. 1998, Fuhlendorf and Engle 2001). This activity would remove or suppress individual herbaceous or woody plants and increase incident sunlight at ground level.

Compared to mowing and hydroaxing, this activity is more selective with regard to the plants that are removed: lupine and KBB nectar plants would not be removed with this technique. It would be conducted through plant cutting, plant pulling, or application of heat to individual plants (e.g., propane-torch removal). Tools used in this activity would include various forms of hand-operated and power-assisted hand-directed implements (e.g., axes, saws, weed whips, spades, loppers) and various forms of hand-held torches and gas-fueled torches mounted on all-terrain vehicles (ATVs). The torches would be used to direct heat to individual plants when the immediately surrounding environment is too wet to burn. On-site fire-suppression capabilities (e.g., hand pumps, ATV-mounted sprayers, extinguishers) would provide for contingency response in case of fire persistence and would help prevent the unintentional ignition of lupine and KBB nectar plants.

Chemical Vegetation Removal

Chemical vegetation removal would be used to mimic certain effects of fire, wild herbivore grazing and browsing, and insect and disease outbreaks (Sinclair et al. 1987, Payne and Bryant 1994, Ritchie et al. 1998, Fuhlendorf and Engle 2001). It would involve application of chemicals to remove or suppress individual herbaceous or woody plants and to increase incident sunlight at ground level.

Broadcast application (spray or wick) would involve application of herbicide to a target area, and would be conducted according to the general guidelines outlined previously. Spot spraying would involve selective application of herbicide to the target plants while avoiding drift into

areas occupied by lupine. Because lupine impacts and KBB take would be avoided with this technique, spot spraying may be conducted throughout an occupied site when it would be most effective for achieving KBB habitat-management objectives.

Tools used in this activity would include various forms of hand-held, ATV-mounted, and machine-driven applicator tools. Herbicides would be applied by certified applicators in compliance with label directions.

Soil Scarification

Soil scarification would mimic certain effects of fire by exposing mineral soils, reducing organic material, and providing sunlit seed beds to promote germination and growth of lupine and nectar plants (Tester 1989, Payne and Bryant 1994, Neary et al. 2005). Tools used in this activity would include hand-operated and power-driven implements (e.g., blades, rakes, thatchers, discs, harrows). This activity would be used when lupine or nectar plant densities are insufficient to meet KKB habitat-management objectives. This technique would often be followed by seeding or planting.

Livestock Grazing

Livestock grazing could be used to mimic effects of wild herbivore grazing and browsing (Sinclair et al. 1987, Payne and Bryant 1994, Ritchie et al. 1998, Fuhlendorf and Engle 2001). This activity would suppress herbaceous and woody plants, expose mineral soils, and increase incident sunlight at the soil surface through the clipping of above-ground parts and limited trampling. This activity would be conducted through the release of grazing animals on up to one-third of occupied KBB habitat patches that are greater than 1 acre. To minimize damage to lupine and KBB eggs and larvae, grazing would be conducted on short rotation; livestock would be removed before non-woody vegetation is reduced to an average height of approximately 6 inches.

Seeding and Planting

This activity would involve planting of seed, vegetative parts, and plugs of lupine and KBB nectar plants, often following prescribed burning, mowing/hydroaxing, manual and chemical vegetation removal, and soil scarification. Equipment used in this activity would include seeders, drills, planters and spades.

Only native species would be seeded or planted. When feasible, seeds would be collected locally. When seed or plants are purchased from commercial sources, efforts would be made to obtain and use local genotypes. Seeding and planting would typically occur in areas not yet re-colonized by KBB following treatment. Therefore, these activities would cause no take or other adverse impacts to KBB.

Treatment Combinations

A combination of activities, often applied in sequence, could be used to maintain occupied KBB habitat by increasing lupine coverage, increasing plant diversity, reducing woody cover, and reducing occurrence of invasive species. These combinations would involve application of two or more of the listed habitat-management techniques. These treatment combinations would comply with the restrictions set forth for the individual habitat-management techniques. This practice would often result in a more protracted treatment period for selected habitat-patch portions while remaining patch portions are retained in an untreated condition.

Landowner Incentive Program Habitat Management

Under this alternative, the Michigan Landowner Incentive Program (LIP) would continue to conduct or provide funding for habitat-management designed to maintain or restore KBB habitat. Management activities could be conducted on all occupied KBB habitat on private land throughout the state. However, approximately 100 acres of occupied KBB habitat would probably be treated by the LIP in any given calendar year.

Funding for the LIP is provided by the Federal Land and Water Conservation Fund and is administered by the USFWS. Federal authorization to conduct habitat management that may result in take of KBB was obtained through a section 7 consultation completed in May 2005 (USFWS 2005a), and authority under an ITP is not necessary to continue this habitat management. Thus, the description of habitat-management activities under the LIP is more appropriately provided under the description of the No Action Alternative (2.2.2.1).

2.2.1.2 Utility and Transportation Right-of-Way Maintenance

Utility and transportation right-of way maintenance would involve activities that maintain vegetation and infrastructure in conditions appropriate for the intended purpose of rights-of-way. Vegetation-manipulation techniques available to right-of-way managers would include:

- prescribed burning
- mowing/hydroaxing
- manual vegetation removal
- chemical vegetation removal
- soil scarification
- seeding and planting
- livestock grazing

Although these activities would be conducted for the primary purpose of maintaining rights-of-way, they would be implemented in ways to maintain habitat for KBB. To achieve both purposes while minimizing take of KBB, vegetative manipulation would, to the extent possible, be conducted according to the conditions outlined under 2.2.1.1 (Habitat Management). Conducted in this manner, these activities would be expected to have short-term (<2 growing seasons) adverse impacts but long-term benefits to KBB, other species of concern, and the Oak Savanna Ecosystem. Vegetation manipulation not consistent with the conditions outlined above

may have long-term adverse impacts to KBB and therefore may occur only if mitigation is conducted according to the requirements outlined in 2.2.1.4 (Mitigation).

A second category of right-of-way maintenance activity would include activities that would result in habitat disturbance not expected to provide long-term benefits to KBB. This type of habitat disturbance is associated with infrastructure replacement and repair, and includes:

- heavy-equipment operation/traffic
- soil excavation

To avoid or minimize incidental take of KBB, these techniques would be conducted according to the following conditions.

General

With rare exception, activities in occupied KBB habitat that could result in take would not occur when adult KBB are present, typically between May 15 and August 15.

Prior to treatment, surveys would be used to determine the presence and distribution of KBB within rights-of-way where the species is likely to occur. Whenever pre-treatment surveys are not conducted in areas where the species has been observed recently (i.e., in the past 5 years), presence of KBB throughout the treatment area would be assumed.

Prior to treatment, areas that contain lupine immediately adjacent to treatment areas would be flagged or otherwise marked; workers would not stockpile materials, park vehicles, or otherwise cause adverse impacts in those areas.

All employees and contractors working in project sites would be trained on KBB life history and habitat requirements, and instructed on the measures required to avoid or minimize take of the species.

Maintenance activities may deviate from the preceding conditions in emergency situations involving an existing or imminent threat to utility operation, the safety of utility workers, or the safety of the public. In such situations, measures would be taken to minimize take of KBB, and long-term adverse impacts would be subsequently mitigated according to requirements of 2.2.1.4 (Mitigation).

Heavy-equipment Operation/Traffic

This activity would involve the operation of vehicles and use of heavy machinery in occupied KBB habitat for the purpose of repairing or replacing physical structures such as pipelines, towers, transmission lines, electrical conductors, signs, fencing, railroad rails and ties, roadways and culverts. To the extent possible, truck and heavy-equipment traffic would be limited to existing disturbed areas, such as access roads that run within a right-of-way. When traffic must leave existing routes to conduct maintenance activities, steps would be taken to avoid lupine areas and to minimize the extent of new disturbance. During replacement and repair of

infrastructure, existing structures would be dismantled in place or otherwise repaired in ways to avoid impacts to lupine to the extent possible.

Posts driven into the ground (e.g., sign posts) without excavation represent minimal habitat disturbance and would not be expected to result in take of KBB. Therefore, posts could be driven in occupied KBB habitat during any time of the year if the associated equipment operation and human trampling would not be expected to adversely affect lupine or KBB.

If disturbance of lupine areas in occupied KBB habitat could not be avoided by heavy-equipment traffic or operation, mitigation would be conducted according to the requirements outlined in 2.2.1.4 (Mitigation).

Soil Excavation

Soil excavation would involve the removal or disruption of the soil profile. It could be conducted for the purposes of repairing or replacing structures such as pipelines, towers, signs, railroad rails and ties, roadways and culverts. When soil excavation would occur in lupine areas, efforts would be made to minimize the footprint of the area disturbed. To the extent possible, displaced soils would be deposited away from lupine areas and within the smallest possible side-cast areas needed for temporary storage. Following repair or replacement of structures, excavated areas would be backfilled using the original soil that was deposited in temporary storage areas. Additional mitigation would also be required according to the requirements outlined in 2.2.1.4 (Mitigation).

2.2.1.3 Development

Development activities could include:

- commercial, residential and public-facility construction
- agriculture, horticulture and intensive forestry
- road and utility development

Commercial, residential and public-facility construction could involve construction of buildings, parking lots, recreational complexes, and other artificial structures, as well as all land modifications necessary to support those infrastructures. Activities could involve: removal of native plant communities; disturbance of the soil profile; partial or complete covering of occupied KBB habitat with structures and hardened surfaces (e.g., buildings, pavement); introduction of foreign soils, plants and chemicals for landscaping purposes (e.g., lawns, ornamentals, fertilizers, pesticides); and fragmentation and isolation of remaining habitat patches. In addition, these activities could be accompanied by an increase in human activity.

Agriculture, horticulture and intensive forestry could involve land conversion for crop and livestock production, plant cultivation, and timber harvest and regeneration. Activities could involve: removal of native plant communities; disturbance of the soil profile; introduction of foreign soils, plants and chemicals (e.g., crops, cultivated plants, fertilizers, pesticides);

introduction of livestock; planting and seeding of trees; creation of access routes; and fragmentation and isolation of remaining habitat patches.

Road and utility development could involve construction of new rights-of-way for transportation and utility purposes. Rights-of-way could include roadways, railways, and pipeline and power-line corridors. Activities could involve: removal of native plant communities; disturbance of the soil profile; partial or complete covering of occupied KBB habitat with structures and hardened surfaces (e.g., poles and towers, rails and ties, pavement); and changes in connectivity among habitat patches.

The primary objectives of these three types of development generally do not include maintenance of KBB habitat. Under the Comprehensive HCP, these activities could have long-term impacts that convert at least portions of occupied KBB habitat patches into conditions incompatible with sustaining KBB. However, impacts of these activities would be minimized and mitigated (see 2.2.1.4) in ways to ensure no long-term net reduction in KBB population sizes, area of occupied KBB habitat, or connectivity of occupied KBB habitat patches. To avoid or minimize incidental take of KBB, any development activities would be conducted according to the following conditions.

Any development in occupied KBB habitat would be planned to avoid or minimize adverse impacts to KBB to the extent possible. For example, project footprints would be minimized or configured to retain lupine areas wherever possible. Where it would help reduce overall adverse impacts to KBB, development would not occur between May 15 and August 15. Development in occupied KBB habitat would not proceed until project planning demonstrated that adverse impacts would be adequately avoided or minimized and mitigated according the requirements outlined in 2.2.1.4 (Mitigation).

In areas where the species is likely to occur, surveys would be used to determine the presence and distribution of lupine and KBB prior to project planning and implementation. Whenever pre-development surveys are not conducted in areas where the species has been observed recently (i.e., in the past 5 years), presence of KBB throughout the area to be developed would be assumed.

Prior to treatment, adjacent lupine areas that would not be developed would be flagged or otherwise marked; workers would not stockpile materials, park vehicles, or otherwise cause adverse impacts in those areas.

All employees and contractors working in project sites would be trained on KBB life history and habitat requirements, and instructed on the measures required to avoid or minimize take of the species.

No invasive plant species would be introduced into developed areas.

The specific acreage of occupied KBB habitat that would be impacted by development would be limited by developer interest, zoning, and opportunity and funding for adequate mitigation. Mitigation would be required to ensure activities conducted under the Comprehensive HCP do

not cause a long-term net reduction in KBB population sizes, area of occupied KBB habitat, or connectivity of occupied KBB habitat patches. Given an expected time lag between initiation of mitigation and actual replacement of lost occupied KBB habitat, development that would cause occupied KBB habitat on non-Federal land to be reduced by more than 1% at any given time would not be permitted. Given the currently known KBB distribution and this restriction, the amount of occupied KBB habitat that might be developed in any given year ranges from 0 acres to 27 acres.

2.2.1.4 Mitigation

Mitigation would be required when activities within occupied KBB habitat would have adverse impacts, either short-term or long-term, that would not be expected to ultimately enhance KBB habitat or otherwise provide a net benefit to KBB. Thus, habitat management performed specifically to enhance KBB habitat according to the prescribed conditions generally would not require mitigation. Similarly, activities conducted primarily for other purposes (e.g., right-of-way vegetation manipulation) but implemented in ways to maintain habitat for KBB (see 2.2.1.1) would not require mitigation. Mitigation would most often be required where activities, such as development, lead to permanent conversion of occupied KBB habitat.

Mitigation for any particular project would be sufficient to ensure no long-term net reduction in KBB population sizes, area of occupied KBB habitat, or connectivity of occupied KBB habitat patches. The type and amount of mitigation required for individual projects would depend upon a combination of several factors, including:

- area of occupied habitat to be disturbed or converted
- density of KBB in the disturbed habitat
- quality of the habitat disturbed (e.g., lupine density)
- degree to which disturbance would reduce patch connectivity
- nature of the disturbance;
- expectation for recovery of the disturbed habitat and resident KBB subpopulation
- role of the affected KBB subpopulation within a larger metapopulation
- expectation for KBB habitat enhancement and subpopulation establishment within a proposed mitigation area

In some cases where impacts would be minimal and habitat would be expected to recover within the same growing season, required mitigation could entail nothing more than monitoring to document that no discernible impacts to KBB occurred. In other cases, required mitigation could include habitat restoration (repair or re-establishment of an oak savanna opening with lupine) on-site as well as creation of suitable KBB habitat in other areas. Long-term or permanent destruction (conversion) of occupied KBB habitat would typically require creation of suitable KBB habitat elsewhere.

When possible, mitigation would include restoration of the entire disturbed area as well as creation of additional suitable KBB habitat equal in size to 25–50% of the disturbed area. Restoration and creation of a total area greater than that which is disturbed would help ensure no

net loss of KBB habitat; if all restoration is successful, it could yield a net increase in KBB habitat.

The required area of suitable KBB habitat creation would vary inversely with the proportion of the disturbed occupied habitat to be restored. That is, as less of the disturbed area can be restored, more habitat creation would be required. A mitigation land-exchange ratio of up to 3:1 (3 acres of habitat created for every 1 acre of occupied KBB habitat disturbed and not restored) would be the upper limit for mitigation under the Comprehensive HCP. If an area three times the size of an occupied patch is not expected to provide sufficient habitat to compensate for the loss of the occupied patch, the project would not qualify under the HCP. This circumstance could occur when a project would result in the complete loss of a large core KBB population within a metapopulation or when created habitat would not adequately replace the function of lost patches.

When possible, suitable habitat would be created in areas adjacent to disturbed occupied patches, provided:

- ecological conditions are suitable
- immediate threats to KBB and the habitat are not present
- a neighboring source KBB population (within 1 km) is expected to colonize the created habitat

This practice would maximize the chance of natural colonization, help ensure long-term population viability, and maintain metapopulation structure. If habitat creation is not possible in areas adjacent to disturbed occupied patches, new patches would be created in other, disjunct areas where:

- ecological conditions are suitable
- immediate threats to KBB and the habitat are not present
- a neighboring source KBB population (within 1 km) is expected to colonize the created habitat
- habitat creation would maintain or improve patch connectivity
- habitat creation would replace the metapopulation function of the lost patch

Sites with created habitat would be protected (e.g., through conservation easement or donation to a land trust) and not used for purposes inconsistent with persistence of KBB. Purchase and protection of occupied KBB habitat could be considered as mitigation if accompanied by additional habitat expansion or if habitat management necessary to maintain existing populations is assured.

Except in emergency situations (see 2.2.1.2), surveys to determine baseline habitat conditions and KBB population densities would precede all activities that require mitigation, and all mitigation areas would be monitored to determine habitat and population impacts and restoration success (see 2.2.1.5).

The need for mitigation could be met in advance of specific projects by applying a concept similar to that of a Safe Harbor Agreement. To do so, a baseline of existing occupied KBB habitat would be established. If the amount of habitat increased more than 25% above baseline, then treatment/disturbance of occupied KBB habitat could occur without need for further mitigation, provided the amount of occupied habitat remains at least 25% above baseline and habitat patch function is not compromised. Retaining a total area greater than baseline level would help ensure no net loss of KBB habitat, as well as offset any indirect impacts associated with disturbance of adjacent areas.

2.2.1.5 Monitoring and Reporting

Monitoring would be conducted to help evaluate KBB distribution and to assess effects of HCP activities on KBB populations and habitat. Monitoring associated with specific projects would be funded by the management partners that conducted the treatments/disturbances. It would be conducted by qualified personnel, either on management-partner staff or contracted through other organizations. Monitoring would be conducted at a subset (approximately one-third) of treated sites following habitat management and right-of-way vegetation manipulation; each of the treatment types used would be adequately represented within the subset of sites monitored. Monitoring would be conducted in all restored and created habitats associated with mitigation for development and right-of-way management.

The objectives of monitoring would be to:

- quantify habitat conditions before and after treatment/disturbance
- assess KBB numbers before and after treatment/disturbance
- evaluate techniques for their success in enhancing KBB habitat
- evaluate techniques for compatibility with KBB persistence
- assess success of mitigation efforts
- track KBB take at the statewide level

Monitoring would include two components: habitat monitoring and population monitoring. Data for both components would be collected prior to treatment/disturbance and during years 1 and 2 following treatment/disturbance (Pre-treatment/disturbance monitoring may not be required in rare circumstances; in these cases, presence of KBB throughout the area to be affected would be assumed if the species has been observed in the area recently (i.e., in the past 5 years.)). Habitat monitoring and population monitoring would be conducted at least once during the second KBB flight (July–August) during each of these years. Habitat monitoring would quantify the area and estimated density of lupine and nectar plants. Population monitoring would document presence/absence and relative abundance (if present) of KBB.

With USFWS approval, the quantitative monitoring required above could be replaced by qualitative assessments following designation of particular management techniques as ‘proven’ (A management technique may be considered ‘proven’ when the USFWS concludes it consistently results in improved habitat and maintenance of KBB populations under a variety of conditions.). These qualitative assessments could be as simple as walks through occupied patches during the peak of the second KBB flight to count the number of KBB encountered per

unit effort and to characterize lupine coverage. These assessments would be conducted to ensure that wild lupine and KBB are abundant following treatment. Quantitative monitoring would resume if anything suggested a proven technique was not achieving objectives.

Determination of the relationship between KBB abundance and habitat quality in occupied sites could allow habitat quality to be used as a predictor of KBB abundance and thus eliminate the need to conduct direct population surveys. However, this approach would be used only after the method has been rigorously tested and approval from the USFWS has been received.

A report of activities and monitoring results would be submitted to the USFWS by January 31 each year the ITP is in effect. At a minimum, the report would include:

- a summary of annual activities resulting in take of KBB, including acres treated/disturbed.
- a summary of habitat monitoring conducted at treated/disturbed sites.
- a summary of presence/absence and relative abundance surveys conducted at treated/disturbed sites.
- an analysis of the effect of management techniques on habitat quality at a subset of treated sites. The analysis would include comparison of pre- and post-treatment/disturbance conditions.
- an analysis of the effect of management techniques on KBB populations at a subset of treated sites. The analysis would include comparison of pre- and post-treatment/disturbance population estimates.
- a description of known and assumed take. Known take is take of KBB individuals that is directly observed; assumed take would be reported indirectly as area of occupied habitat treated/disturbed.

2.2.1.6 Federal Endangered Species Act Section 7 Compliance

The USFWS would conduct an internal section 7 consultation prior to issuance of the ITP. This consultation would address impacts to KBB and other federally listed and candidate species that may occur due to HCP implementation. Federally listed species that could occur in or near occupied KBB habitat addressed by this alternative currently include KBB, Kirtland's warbler (*Dendroica kirtlandii*), Indiana bat (*Myotis sodalis*) and Pitcher's thistle (*Cirsium pitcheri*). The only candidate species that could occur in or near occupied KBB habitat is the eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*).

Projects conducted under authority of the ITP would not take or otherwise adversely affect federally listed species other than KBB. Prior to implementation of any project, the potential presence of these species would be evaluated based on review of the Biotics data base (Michigan Natural Features Inventory; MNFI 2007), consideration of known species distributions, assessment of current habitat characteristics, and site surveys as necessary. Occupied KBB habitat does not typically overlap with occupied Kirtland's warbler, Indiana bat, or Pitcher's thistle habitat in Michigan; thus, the potential for impacts to these species would be small. In the rare event any of these species occurred or would be likely to occur in or near a project area while they were listed, the project could proceed only if it would not adversely affect the species.

Adverse effects might be avoided by reconfiguring activity areas, adjusting timing of activities, or modifying the nature of the activity. Projects that could not avoid adverse effects would not be authorized.

A small subset of occupied KBB habitats addressed by this alternative could be occupied by eastern massasauga rattlesnake, and certain activities conducted under authority of the ITP could result in injury or mortality to a small number of massasaugas. However, the conditions required to avoid or minimize take of KBB would also generally minimize adverse impacts to massasaugas. Consequently, activities conducted under the ITP would not jeopardize the continued existence of the species. Indeed, activities that maintained KBB habitat would usually improve conditions for massasaugas as well.

2.2.1.7 Protection of Cultural and Paleontological Resources

Cultural and paleontological resources protection is a function of the Michigan Department of State, Bureau of History. The State Historic Preservation Office (SHPO) maintains files of known cultural and paleontological site occurrences. Similar files are maintained with the Tribal Historic Preservation Office (THPO). The SHPO is integrated with the National Historic Preservation Office to extend protection to known sites of federal concern. Archaeologists are available to review land-management plans to note potential threats to occupied sites.

Before implementing any soil-disturbance activities covered under the ITP, management partners would consult with the SHPO and the THPO, as appropriate, to ascertain whether known cultural or paleontological resources could be threatened. In the event a proposed project would potentially threaten cultural or paleontological resources, management partners would modify proposed activities to eliminate any threats before proceeding with implementation. In addition, if previously unknown cultural or paleontological relicts were discovered during implementation of any particular project, the project would be suspended immediately and consultation with the SHPO/THPO would be initiated.

2.2.2 Alternative B: No Action

An ITP would not authorize activities conducted specifically under this alternative. Activities resulting in legal KBB take would include: 1) KBB habitat management authorized by existing 10(a)(1)(A) permits issued to the Michigan DNR and the Michigan Chapter of The Nature Conservancy; 2) habitat management conducted under the LIP; and 3) any development or right-of-way maintenance authorized separately under existing federal, state and local regulations.

If the LIP was provided sufficient resources, it could hypothetically conduct management on all occupied KBB habitat on private land in Michigan. Thus, habitat management conducted under the No Action alternative could involve almost as much land as the Comprehensive HCP alternative. Realistically, however, the No Action alternative would be limited initially to approximately 900 acres of occupied KBB habitat. This acreage would increase through time as the LIP continued to include additional parcels in its management. Activities specifically authorized under this alternative would not be conducted on any particular parcel of land without the participation and explicit permission of the landowner.

2.2.2.1 Habitat Management

DNR Habitat Management under 10(a)(1)(A)

The 10(a)(1)(A) permit held by the Michigan DNR is valid from October 2004 through December 2008. It authorizes the DNR and its designated agents to take KBB for recovery-directed habitat management on occupied sites on state-owned or state-managed lands throughout the Flat River, Allegan and Muskegon State Game Areas.

Activities authorized by the permit would continue to be conducted according to the following conditions (adapted from USFWS 2004a).

- Survey and monitoring activities would be conducted in a manner to minimize disturbance to KBB and wild lupine. Netting and handling of adults and larvae for survey purposes would be kept to a minimum. Current appropriate scientific monitoring protocols would be used and would include a variety of transect methodologies, including, but not limited to Pollard–Yates transects, Thomas transects, straight-line transects and mark-release-recapture techniques.

- All individuals conducting permitted management activities would carry a copy of the permit and be knowledgeable about KBB, its habitat requirements, and conservation measures pertinent to habitat management.

- Land-management activities would be conducted on the specified State-owned properties in accordance with Michigan DNR management prescriptions, the Federal Karner Blue Butterfly Recovery Plan (USFWS 2003a), and other current and appropriate scientific protocols with the understanding that management could be further adapted to benefit KBB as new information becomes available.
    - Land-management activities in occupied lupine areas would occur during the dormant season to the maximum extent possible. Lupine growing-season management would occur when necessary to achieve management objectives. The permit defines the lupine growing season as April 16 through August 14.
    - Management techniques would include, but would not be limited to, prescribed burning, mowing, mechanized or hand brush removal, timber harvest, soil scarification and herbicide application.
    - Regardless of management technique, no more than one-third of any occupied habitat patch larger than 0.25 hectare would be treated during a calendar year. Occupied patches equal or less than 0.25 hectare at risk of loss could be treated in their entirety with techniques that minimized direct harm to KBB.
    - Herbicides would be used to control encroaching vegetation to enhance barrens habitat and lupine patches. Herbicides would be applied by certified pesticide applicators using methods consistent with pesticide labels and applicable terms of the permit.

- In reference to the disposition of dead specimens of KBB:
    - All specimens obtained under the authority of the permit would remain the property of the United States Government and would be clearly identified as such.
    - KBB that died from natural or accidental causes would be preserved according to standard museum practices and submitted to the University of Michigan Museum of Zoology.

- If the size of an adult KBB population in habitat managed under authority of the permit declined, the Michigan DNR would work with the USFWS to determine the cause of the decline and to implement measures beneficial to KBB and lupine habitat.

- A report of activities would be submitted to the USFWS by January 31 each year the permit is in effect. At a minimum, the report would include:
    - a summary of the sites surveyed for KBB and population or relative abundance estimates resulting from survey and monitoring activities. The method used to derive population or relative abundance estimates would be provided.
    - a summary of annual management activities, including acres treated (e.g., burned, mowed, treated with herbicide) and an estimate of the increase in KBB habitat. The date, time and weather conditions associated with the treatments would be included in the report.
    - an analysis of the effect of management regimes on KBB populations at a representative subset of treated sites. Post-treatment KBB monitoring data would span at least 2 years and include monitoring of the second (summer) brood adult population.
    - an evaluation of the vegetative response to the treatments (i.e., response of wild lupine, key nectar plants, and exotics and resultant vegetative mosaic/structure). The evaluation would include a description of pre- and post-treatment site conditions.
    - recommendations for future management activities at the sites to promote recovery of KBB.
    - additional qualified people anticipated to be involved in survey activities.
    - a description of known and assumed take. Known take is take of individuals directly observed by the permittee and would be reported as individual butterflies. Assumed take would be reported indirectly as hectares (or acres) of occupied habitat treated.
    - a list of KBB specimens collected, pertinent location data, and the date specimens were sent to the University of Michigan Museum of Zoology. This list would identify where voucher specimens were being held (the number and locations) and the persons responsible for their care.

The Nature Conservancy Habitat Management under 10(a)(1)(A)

The 10(a)(1)(A) permit held by the Michigan Chapter of The Nature Conservancy (TNC) is valid from March 2005 through December 2007. It authorizes TNC to take KBB for recovery-directed

habitat management on 41 acres of occupied KBB habitat in Newaygo County (Unit 1 of the Clawson Tract).

Activities authorized by the permit would continue to be conducted according to the following conditions (adapted from USFWS 2005b).

- In reference to spotted knapweed (*Centauria maculosa*) control in occupied KBB habitat:
    - Prescribed burning and spot herbicide treatment would be performed to discourage spotted knapweed growth, and to encourage the spread of prairie grasses and forbs. Any prescribed burning would be conducted in accordance with the methods described in Part IV-A of the permit application and with TNC January 13, 2000 Fire Management and Alien Weed Plan for Clawson Tract **(**McGowan-Stinski 2000). Supplemental knapweed control by hand-pulling or spot-burning during the growing season could occur at the permittee's discretion per Part IV-B of the permit application.
    - Prior to burning or herbicide treatment, TNC would consult with the appropriate staff of the USFWS East Lansing Field Office and obtain written approval of the Field Supervisor.

- In reference to plant reintroductions/establishment in proposed or occupied KBB habitat:
    - Seed would be collected from areas not occupied by KBB whenever possible.
    - If seed would be collected from areas occupied by KBB, trampling of lupine would be minimized, and seed-collection data (species, quantity, location) and results of seeding efforts would be included in monitoring and annual reports.

- The results of management conducted under the permit would be monitored according to the methods described in Part IV-C of the permit application. Monitoring results would be included in the annual report.

- In reference to the disposition of dead specimens of KBB:
    - All specimens obtained under the authority of the permit would remain the property of the United States Government and would be clearly identified as such.
    - KBB that died from natural or accidental causes would be preserved according to standard museum practices and submitted to the University of Michigan Museum of Zoology.

- If the size of the adult KBB population in habitat managed under authority of the permit declined, TNC would work with the USFWS to determine the cause of the decline and to implement measures beneficial to KBB and lupine habitat.

- An annual report of activities conducted under authority of the permit would be submitted to the USFWS by January 31 following each year the permit is in effect. The report would include:
    - a complete discussion of habitat-management activities undertaken and their results, including data collected during monitoring as required above.

- a complete description of injuries and/or mortalities to listed species observed by the permittee, the dates of occurrence, and any circumstances surrounding the incidents, and a description of any steps taken to reduce the likelihood that such injuries and/or mortalities would occur in the future.
- a description of the disposition of dead specimens of KBB.
- legible photocopies of all field-data and monitoring sheets.
- a complete list of any sightings of any other species listed under the ESA or any potential violations of federal environmental laws.

Landowner Incentive Program Habitat Management

The Michigan LIP would continue to conduct or provide funding for habitat management designed to maintain or restore KBB habitat. Funding for this program is provided by the Federal Land and Water Conservation Fund and is administered by the USFWS. Federal authorization to conduct habitat management that may result in take of KBB was obtained through a Section 7 consultation completed in May 2005 (USFWS 2005a).

Habitat management under the LIP could hypothetically be conducted in all occupied KBB habitat on private land throughout the state. However, given available resources, approximately 100 acres of occupied habitat would probably be treated in any given calendar year. Habitat-management activities for the LIP would continue to be conducted in occupied KBB habitat according to the following conditions (adapted from Michigan DNR 2004).

- Brush/tree/herbaceous vegetation removal
  - Brush/tree/herbaceous vegetation removal would be conducted through physical, mechanical and chemical means.
  - Brush/tree/herbaceous vegetation removal would occur during the KBB dormant season (August 16 through April 14) when consistent with the objective of improving habitat for KBB.
  - Brush/tree/herbaceous vegetation removal may occur during the active season (April 15 through August 15) but would be performed on no more than one-third of the occupied habitat once per calendar year.
  - Where aggressive vegetation (e.g., bracken fern) threatens to shade out lupine throughout the lupine growing season, mowing may be conducted throughout the year, on as much as one-third of the area each year.
  - Equipment used would be chosen for the least amount of impact to KBB.
  - Brush and tree removal would leave at least 5% of the woody structure, with the goal being 15%, in a scattered pattern.
  - When treating an entire site, mowing/brush-hogging would occur during the dormant season. Treatments necessary to prevent certain invasive weeds from setting seed before herbicide control later in the summer or fall may be conducted during the KBB active season.
  - Spot spraying would be conducted throughout an occupied KBB patch at the time of the year it would be most effective for achieving management objectives. Broadcast application (spray or wick) would take place on no more than 50% of

an area in any one year. Herbicides would be applied according to all product label directions.

- Prescribed burning
  - Burning would be used in portions of occupied KBB habitat when sites are larger than 5 acres.
  - In areas where KBB presence has not been recorded within the past 5 years, potential areas of occupied KBB habitat would be identified prior to conducting a prescribed burn.
  - No more than one-third of occupied KBB habitat at a site would be burned during a calendar year.
  - The same portion of occupied KBB habitat would not be burned in consecutive years.

- Livestock grazing
  - Grazing could be conducted on sites with more than 1 acre of occupied KBB habitat.
  - Up to one-third of occupied KBB habitat could be grazed during a calendar year.
  - Any grazing would be conducted on short rotation; livestock would be removed before habitat is reduced to a height of 6 inches.
  - Any grazing would occur during the KBB dormant season to the maximum extent possible. Grazing may occur during the KBB active season, but not on more than one-third of occupied KBB habitat once per calendar year.

- Planting
  - Tree, grass and forb planting would be conducted by hand using hand tools throughout occupied KBB sites.
  - Tree, grass and forb planting would be conducted using heavy equipment such as tractors and no-till drills.
  - Planting with heavy equipment would be conducted throughout occupied KBB sites during the dormant season (typically between early October and late March).
  - Planting with heavy equipment could occur during the lupine growing season (late March to early October). When conducted during this period, planting would be conducted on no more than one-third of occupied KBB habitat once per calendar year.

- Other considerations
  - Up to 50% of all occupied KBB sites could be managed each year.
  - Habitat monitoring would be used to evaluate the effectiveness of the habitat management. Monitoring would include vegetation sampling before and after management activities, with emphasis on the presence of lupine.
  - An annual report would detail the monitoring and management activities, any incidental take of KBB, and acres of occupied KBB habitat improved.
  - Managers would use site conservation plans when available to prioritize management activities. Activities would be consistent with recommended activities in the KBB recovery plan (USFWS 2003a).

2.2.2.2 Utility and Transportation Right-of-Way Maintenance

Right-of-way maintenance in occupied KBB habitat would not be specifically authorized under this alternative. However, maintenance would still be necessary to preserve the primary functions of existing rights-of-way. Legal, incidental take associated with maintenance of rights-of-way would therefore require authorization on an individual, project-by-project basis under existing federal, state and local regulations.

2.2.2.3 Development

Development in occupied KBB habitat would not be specifically authorized under this alternative. However, development would be expected to continue within the KBB range. Regional and local rates of development under this alternative would not be expected to differ from those that would occur under the Comprehensive HCP alternative. Under the No Action alternative, legal, incidental take associated with development in occupied KBB habitat would require authorization on an individual, project-by-project basis under existing federal, state and local regulations.

2.2.2.4 Mitigation

No mitigation would be conducted for any activities authorized by 10(a)(1)(A) permits or performed by the LIP. Mitigation for other projects would be conducted according to the requirements of any federal, state and local permits issued on an individual, project-by-project basis.

2.2.2.5 Monitoring and Reporting

Monitoring following habitat management authorized by 10(a)(1)(A) permits or performed by the LIP would be conducted according to the protocols outlined under 2.2.2.1 (Habitat Management). Monitoring and reporting for other projects would be conducted according to the requirements of any federal, state and local permits issued on an individual, project-by-project basis.

2.2.2.6 Federal Endangered Species Act Section 7 Compliance

The process for ESA Section 7 compliance and the types of impacts to federally listed and candidate species would be the same as those outlined within the description of the Comprehensive HCP alternative (2.2.1.6).

2.2.2.7 Protection of Cultural and Paleontological Resources

Cultural and paleontological resources would be protected according to the process outlined within the description of the Comprehensive HCP alternative (2.2.1.7).

2.2.3 Alternative C: Reduced-scope HCP

The Reduced-scope HCP alternative differs from the Comprehensive HCP alternative in the:

- scope of affected lands
- number and diversity of management partners
- types of activities conducted

Under this alternative, as under the Comprehensive HCP, a coalition of management partners would cooperate to implement a KBB HCP authorized through a 20-year ITP. Whereas the Comprehensive HCP could focus conservation efforts on all non-federal land with occupied KBB habitat in Michigan, a Reduced-scope HCP could involve only a subset of those habitats. That subset would be limited to occupied KBB habitat owned and managed by state agencies, local governments, and conservation-oriented non-governmental organizations (approximately 900 acres). A Reduced-scope HCP would not address occupied KBB habitat on land owned by private transportation and utility companies, private-land developers, and other private landowners. Accordingly, the coalition of management partners would be smaller than that under the Comprehensive HCP, reflecting the smaller scope of affected land.

Landowners and land managers would not be required to participate in implementation of the Reduced-scope HCP. Rather, participation would be offered as a reasonable and practical option for those agencies and organizations that seek authority for incidental take of KBB. Activities under the Reduced-scope HCP would not be conducted on any particular parcel of land without the participation and explicit permission of the landowner.

Activities resulting in KBB take that would occur under a Reduced-scope HCP fall into two general categories: habitat management and public right-of-way maintenance. Although not addressed by a Reduced-scope HCP, additional activities resulting in legal take of KBB under this alternative would include: 1) habitat management conducted under the Michigan Landowner Incentive Program and 2) any development or private right-of-way maintenance authorized separately under existing Federal, State and local regulations.

Habitat management under the LIP could hypothetically be conducted in all occupied KBB habitat on private land throughout the State. However, given available resources, approximately 100 acres of occupied habitat would likely be treated in any given calendar year. Thus, habitat management and right-of-way maintenance conducted under this alternative could initially occur on a total of approximately 1,000 acres of occupied KBB habitat. This acreage would increase through time as the LIP continued to include additional parcels in its management.

2.2.3.1 Habitat Management

Habitat-management activities authorized by an ITP pertinent to a Reduced-scope HCP would be conducted according to conditions outlined under the Habitat Management heading within the description of the Comprehensive HCP alternative (2.2.1.1).

Under this alternative, the LIP would continue to conduct or provide funding for habitat management to maintain or restore KBB habitat. Funding for the LIP is provided by the Federal Land and Water Conservation Fund and is administered by the USFWS. Federal authorization to conduct habitat management that may result in take of KBB was obtained through a Section 7 consultation completed in May 2005 (USFWS 2005a), and authority under an ITP is not necessary to continue this habitat management. Thus, the description of habitat-management activities under the LIP is more appropriately provided under the description of the No Action Alternative (2.2.2.1).

2.2.3.2 Public Utility and Transportation Right-of-Way Maintenance

Public right-of-way maintenance would be conducted according to conditions outlined under the Habitat Management (2.2.1.1) and Utility and Transportation Right-of-Way Maintenance (2.2.1.2) headings within the description of the Comprehensive HCP alternative. Public right-of way maintenance would occur only on land managed by state and local governments.

Under this alternative, no private right-of-way maintenance would be authorized under the ITP issued in association with the Reduced-scope HCP. However, maintenance would still be necessary to preserve the primary functions of existing private rights-of-way. Legal, incidental take associated with maintenance of those rights-of-way would therefore require authorization on an individual, project-by-project basis under existing federal, state and local regulations.

2.2.3.3 Development

Under this alternative, no development would be authorized under the ITP issued in association with the Reduced-scope HCP. However, development would be expected to continue within the KBB range. Regional and local rates of development under this alternative would not be expected to differ from those that would occur under the Comprehensive HCP alternative. Under the Reduced-scope HCP alternative, legal, incidental take associated with development in occupied KBB habitat would require authorization on an individual, project-by-project basis under existing federal, state and local regulations.

2.2.3.4 Mitigation

Mitigation for activities authorized by the ITP pertinent to a Reduced-scope HCP would be conducted according to conditions outlined under the Mitigation heading (2.2.1.4) within the description of the Comprehensive HCP alternative. Mitigation for other projects not pertinent to the Reduced-scope HCP would be conducted according to the requirements of any federal, state and local permits issued on an individual, project-by-project basis.

2.2.3.5 Monitoring and Reporting

Within occupied KBB habitats treated or disturbed under authority of the ITP, monitoring and reporting would be conducted according to the protocol outlined under the Monitoring heading (2.2.1.5) within the description of the Comprehensive HCP alternative. Monitoring and reporting for other projects not pertinent to a Reduced-scope HCP would be conducted according

to the requirements of any federal, state and local permits issued on an individual, project-by-project basis.

2.2.3.5 Monitoring and Reporting

Monitoring and reporting would be conducted according to conditions outlined under the Monitoring and Reporting heading (2.2.1.5) within the description of the Comprehensive HCP alternative.

2.2.3.6 Federal Endangered Species Act Section 7 Compliance

The process for ESA Section 7 compliance and the types of impacts to federally listed and candidate species would be the same as those outlined within the description of the Comprehensive HCP alternative (2.2.1.6).

2.2.3.7 Protection of Cultural and Paleontological Resources

Cultural and paleontological resources would be protected according to the process outlined within the description of the Comprehensive HCP alternative (2.2.1.7).

2.3 Summary of Alternative Actions Table

Table 2. Summary of the alternative actions carried forward for detailed analysis.

	Alternative A: Comprehensive HCP	**Alternative B: No Action**	**Alternative C: Reduced-scope HCP**
Statewide ITP	Yes	No	Yes
ITP Duration	20 years	Not applicable	20 years
Relevant Habitat	All known occupied KBB habitat on non-Federal land in Michigan	Occupied KBB habitat on 3 State Game Areas Occupied KBB habitat on The Nature Conservancy property Occupied KBB habitat managed under the Landowner Incentive Program	All known occupied KBB habitat on non-Federal public land Occupied KBB habitat on some NGO[a] land Occupied KBB habitat managed under the Landowner Incentive Program
Area[b, c]	2,700 acres	900 acres	1,000 acres
Habitat Management	Authorized by the ITP	Authorized by 10(a)(1)(A) permits and ESA Section 7 consultation	Authorized by the ITP
Right-of-Way Maintenance	Authorized by the ITP	Not specifically authorized	The ITP authorizes public right-of-way maintenance only
Development	Authorized by the ITP	Not specifically	Not specifically

		authorized	authorized
Management Partners	State, county and local governments Non-governmental organizations Public transportation and utility managers Private transportation and utility managers Private land developers Other private entities	Michigan DNR The Nature Conservancy Private landowners participating in the Landowner Incentive Program	State, county and local governments Conservation-oriented non-governmental organizations Public transportation and utility managers

[a] Conservation-oriented non-governmental organization.
[b] Based on currently known KBB distribution.
[c] On which activities specifically authorized under the alternative would be anticipated.

3. AFFECTED ENVIRONMENT

The affected environment includes four KBB Recovery Units (Allegan, Ionia, Muskegon and Newaygo) that are located in the western portion of Michigan's Lower Peninsula and extend from the Indiana State line nearly to Traverse City (Figure 2). These Recovery Units correspond to the landscapes defined by Albert (1995) as the Allegan, Ionia, Manistee and Newaygo Outwash Plains Subsections and contain all currently known KBB occurrences in Michigan. Counties with known occupied habitat include Allegan, Ionia, Kent, Lake, Mason, Mecosta, Montcalm, Muskegon, Newaygo and Oceana. As a part of contingency planning, the rest of the State was assigned to either a Recovery Unit Annex or a Potential Recovery Unit (Figure 2). Any additional occupied KBB habitat created or discovered in the future would automatically be included in the HCP area, regardless of whether it occurred in a Recovery Unit, Recovery Unit Annex, or Potential Recovery Unit.

3.1 Physical Characteristics

3.1.1 Climate

The climate in Michigan is strongly influenced by its mid-continental location, the Great Lakes, and latitude (Dickmann and Leefers 2003). The Great Lakes moderate inland temperature fluctuations, and Michigan experiences cooler summers and warmer winters than do other States at similar latitudes. Snowfall declines, growing seasons shorten, and the range of extreme temperatures becomes larger with increasing distance from Great Lakes shorelines (Dickmann and Leefers 2003). Changes associated with increasing latitude include shorter growing seasons, cooler mean temperatures, longer periods of snow cover, reduced average relative humidity, lower temperature extremes, and fewer heating-degree days (Albert 1995). Table 3 provides more-specific climatic information for each of the four Recovery Units.

3.1.2 Topography and Soils

Topography of KBB range in Michigan includes flat expanses and moderately rolling relief of glacial outwash plains and end moraines (Cohen 2000, 2001, 2004). Soils of KBB habitats are typically well-drained, infertile or moderately fertile, slightly acidic or neutral sands or loamy sands with high water infiltration rates (Cohen 2000, 2001, 2004). The combination of flat to moderate slopes and well-drained soils results in little surface runoff from KBB habitat. Table 3 provides more-specific information for each of the four Recovery Units.

3.1.3 Hydrology

Michigan falls almost entirely within the Great Lakes Basin: Michigan rivers flow directly into Lakes Michigan, Huron, Erie and Superior (Eagle et al. 2005). A small portion of the far western Upper Peninsula falls within the Mississippi River Basin. Most rivers in the State have attained a medium to large size at the points where they empty into the Great Lakes (Eagle et al. 2005). Michigan rivers generally have fairly stable flows relative to other rivers across the country, due largely to groundwater contributions and climatic conditions (Poff and Ward 1989, Richards 1990, Wiley et al. 1997). Approximately one-third of river reaches in the Lower Peninsula receives extensive groundwater inputs and another one-third receives moderate groundwater inputs (Seelbach et al. 1997). Groundwater recharge is, in part, facilitated by the coarse-textured soils that are typical of much of the Lower Peninsula (Seelbach et al. 1997, Zorn et al. 1998), including most of the current Michigan range of KBB. These coarse soils encourage water infiltration rather than surface runoff. River basins within the current Michigan KBB range include the Kalamazoo, Muskegon and Manistee Rivers, which have 'superstable' flows, and the Grand River, which has 'stable' flows (Richards 1990). These stable flow conditions are indicators of the large groundwater contributions these rivers receive (Richards 1990, Wehrly et al. 1998).

Table 3. Physical aspects of the Oak Savanna Ecosystem within each Recovery Unit (adapted from Albert 1995).

	Recovery Unit				
	Allegan	**Ionia**	**Muskegon**	**Newaygo**	**Combined**
Growing Season (days)	150–170	130–150	140–150	120–140	120–170
Average Annual Precipitation (inches)	32–38	30–32	32–34	32	30–38
Average Annual Snowfall (inches)	70–100	50–70	100–140	70–140	50–140
Extreme Minimum Temperature (° F)	-22 to -34	-26 to -30	-32 to -42	-32 to -48	-22 to -48
Dominant Landform	Flat lakeplain	Sloping ground moraine	Sand lakeplain	Outwash plain	Outwash plain/ lakeplain

Dominant Soils	Sands	Sands/ loamy sands	Sands	Sands	Sands/loamy sands
Glacial Drift Thickness (feet)	50–350	350–400	400–700	300–600	300–700
Topography	Flat to gently rolling	Generally hilly	Gently to moderately sloping	Gently sloping	Flat to moderately sloping

3.1.4 Water Quality

The major watersheds in occupied KBB habitat in Michigan include the Kalamazoo, Grand, Muskegon, White and Pere Marquette Rivers. Water quality within these watersheds is variable, ranging from good or excellent to highly degraded (Michigan Department of Environmental Quality 2004). Several lakes and rivers do not meet State water-quality standards due to a variety of chemical contaminants, including mercury and polychlorinated biphenyls (Michigan Department of Environmental Quality 2004). Three water bodies within the region are considered Great Lakes Areas of Concern due to poor water or sediment quality caused by toxic chemical contamination. They are: 1) the lower 80 miles of the Kalamazoo River from Morrow Dam to Lake Michigan; 2) Muskegon Lake at the mouth of the Muskegon River before it enters Lake Michigan; and 3) White Lake and a one-quarter-mile-wide zone around the lake at the mouth of the White River before it enters Lake Michigan. Great Lakes Areas of Concern are defined by the United States–Canada Great Lakes Water Quality Agreement (Annex 2 of the 1987 Protocol) as "geographic areas that fail to meet the general or specific objectives of the agreement where such failure has caused or is likely to cause impairment of beneficial use of the area's ability to support aquatic life."

3.1.5 Air Quality

All KBB areas in Michigan meet national air-quality standards for lead, ozone, sulfur dioxide, carbon monoxide, and particulates (U.S. Environmental Protection Agency; USEPA 2005a) and have pollutant concentrations at levels that are generally considered ‘good’ (USEPA 2003a).

3.2 Biological Environment

3.2.1 Habitat and Vegetation

Activities in occupied KBB habitat in Michigan would be conducted within the Oak Savanna Ecosystem. An oak savanna is a sparsely treed plain supporting drought-tolerant plants. In oak savannas, the number of trees per acre ranges from 4 to 50, and canopy cover ranges from 5% to 60% (O’Connor 2006). In Michigan, savannas often occur as discrete openings linked through a network of corridors within a forest matrix. Savannas occupy areas that are generally more fire-dependent, subject to greater summer temperature extremes, less fertile, and droughtier compared with the habitat types immediately surrounding them. In Michigan, the Oak Savanna Ecosystem consists of a complex of oak barrens, oak–pine barrens, pine barrens, oak openings, lakeplain oak openings, and bur oak plains (O’Connor 2006).

Savannas in the continental interior reached their greatest extent 4,000 to 6,000 years ago during the hypsithermal period and have declined in extent since that time (Cohen 2004). In the early 1800s, more than two million acres of grasslands, including oak savanna and tall grass prairie, still occurred in Michigan (Comer et al. 1995, O'Connor 2006). Most of these grasslands occurred in the southern portion of the state. Following European settlement, conversion to agriculture and fire suppression severely reduced the area encompassed by these habitats (Abrams 1992, O'Connor 2006). More recently, residential and municipal development has increasingly threatened this community type. As a result of these practices, more than 99% of high-quality, native Michigan savannas have been lost (Comer et al. 1995, Cohen 2004). Remnant savannas generally persist on the landscape in small, isolated patches.

Black oak (*Quercus velutina*), white oak (*Quercus alba*), northern pin oak (*Quercus ellipsoidalis*), pignut hickory (*Carya glabra*), white pine (*Pinus strobus*), red pine (*Pinus resinosa*) and jack pine (*Pinus banksiana*) are trees most commonly associated with Michigan savanna (Cohen 2000, 2001, 2004, O'Connor 2006). Understory and shrub layers tend to be poorly developed and often include American hazelnut (*Corylus americana*), gray dogwood (*Cornus foemina*), serviceberry (*Amelanchier* spp.), huckleberry (*Gaylussacia baccata*), blueberry (*Vaccinium angustifolium*) and sweet fern (*Comptonia peregrina*) (Cohen 2000, 2001, 2004, O'Connor 2006). By contrast, ground layers are generally well developed and composed of a variety of plant species dominated by warm-season grasses and forbs. Grasses most commonly present include big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), Indian grass (*Sogrhastrum nutans*), Pennsylvania sedge (*Carex pensylvanica*), poverty grass (*Danthonia spicata*) and June grass (*Koelaria macrantha*) (Cohen 2000, 2001, 2004, O'Connor 2006). Common forbs include wild lupine, hawkweeds (*Hieracium* spp.), puccoons (*Lithospermum* spp.), butterfly-weed (*Asclepias tuberosa*), blazing-stars (*Liatris* spp.), spurges (*Euphorbia* spp.), cinquefoils (*Potentilla* spp.), and coreopsis (*Coreopsis* spp.) (Cohen 2000, 2001, 2004, O'Connor 2006).

KBB larvae feed exclusively on wild lupine, and suitable KBB habitat always includes this plant (Rabe 2001, U.S. Fish and Wildlife Service 2003a). In Michigan, this perennial occurs as far north as the 46th parallel (Dirig 1994) and can be found throughout the Lower Peninsula and southern areas of the Upper Peninsula. Wild lupine maintains a deep taproot. It begins growing in late April and begins blooming in middle to late May. Seeds begin to mature in late June. The plant gradually senesces as the seeds mature; complete senescence occurs by late July or early August.

Although wild lupine can reproduce by seed, most lupine reproduction occurs through vegetative propagation. Once a plant is established, it typically spreads to form a clump of stems growing from rhizomatous buds provided by the parent plant. The rate of spread is slow, and lupine often comprises a small proportion (<10%) of the ground cover within oak-savanna openings, where it typically grows in clusters (USFWS 2003a).

High-quality KBB sites generally have at least 500 lupine stems (USFWS 2003a) and dense lupine patches of at least 20 plants intermixed with other nectar plants and basking perches (Fettinger 2005). Male KBB generally spend more time in open areas, where lupine tends to be more abundant (Grundel et al. 1998). In partially shaded areas, lupine is less abundant but

individual plants may grow larger. KBB larvae prefer to feed on larger lupine plants, and KBB females oviposit and forage more frequently in partially shaded areas (Lane and Andow 2003). One study found that oviposition frequency was highest under 30–60% canopy cover (Grundel et al. 1998).

In addition to lupine, other important KBB habitat factors include availability of nectar plants, open canopy cover, and a diverse vegetative structure (USFWS 2003a, Fettinger 2005). Adult KBB feed on a variety of nectar-producing plants (Table 4). KBB presence is more likely when a large number of nectar plant species are available (Fettinger 2005). KBB adults often perch and bask on grasses and shrubs and other vegetation that is taller than lupine (USFWS 2003a), so some vegetative structural complexity is important; however, suitable habitat usually has a woody canopy cover that is less than 50–60% (Grundel et al. 1998, Fettinger 2005).

KBB habitat patches are generally discrete units clearly separated from each other by unsuitable habitat. Historically, some early-successional openings gradually succeeded into forested conditions as other areas became more open due to fire or other natural disturbance. The result was a landscape where the location of KBB habitat fluctuated over space and time, but the amount of habitat remained relatively stable, with enough openings and sufficient connectivity to provide for healthy, viable KBB populations. In this dynamic landscape, KBB may have maintained a metapopulation structure within a shifting mosaic of early-successional habitat patches (Givnish et al. 1988, USFWS 2003a).

Many oak savannas have been destroyed through conversion for agriculture, residential and municipal development, and other land uses. Moreover, suppression of wildfire has removed the primary mechanism that historically maintained early-successional oak-savanna habitats (Abrams 1992, O'Connor 2006). These practices have resulted in the loss or degradation of the majority of KBB habitat in Michigan (Cohen 2000, Cohen 2001, Rabe 2001, USFWS 2003a).

Table 4. Nectar plant species reported to be used by KBB (reproduced from USFWS 2003a). Scientific names follow Ownby and Morley (1991), Gleason and Cronquist (1991) or Swink and Wilhelm (1994).

Scientific name	Common name	Location	Reference
----------First brood adult nectar sources----------			
----------Herbaceous species----------			
Achillea millefolium L.	Common yarrow	WI, IN	2,7,14,15
Anenome cylindrical	Gray Thimbleweed	WI,IN	7,15
Arabis lyrata L.	Sand-cress	IN,MN,ON,WI	2,5,7,8,10,9,14, 15
Arenaria serpyllifolia L.	Thyme-leaved sandwort	ON	10
Baptisia bracteata var. *glabrescens* (Larisey) Isely (*leucophaea*)	Prairie wild indigo	WI	2,14
Berteroa incana (L.) DC.	Hoary alyssum	WI	2,7
Centaurea biebersteinii (*maculosa*) DC.	Spotted knapweed	WI	7
Cerastium sp.	Chickweed	WI	7
Chrysanthemum leucanthemum L.	Ox-eye daisy	WI	7
Commandra umbellata (L.) Nutt.	Bastard toadflax	MI	11,13
Coreopsis lanceolata L.	Lance-leafed coreopsis	IN	8,15
Coreopsis tripteris *L*.	Tall coreopsis	IN	15

Erigeron strigosus Muhl.	Daisy fleabane	WI	2
Euphorbia corollata L.	Flowering spurge	WI,IN	9,15
Euphorbia podperae (*esula*) Croizat	Leafy spurge	WI	7,9
Fragaria virginiana	Duchesne Strawberry	NY,WI,IN	3,7,15
Gaylussacia baccata (Wang.) K. Koch	Huckleberry	IN	15
Geranium maculatum L.	Wild geranium	ON	10
Hedyotis (Houstonia) longifolia (Gaetrn.) Hook.	Longleaved houstonia	MN,WI	5,7,9,14
Helianthemum canadense (L.) Michx.	Frostweed	NH,IN	1,15
Hieracium aurantiacum L.	Orange hawkweed	WI	2,7,9,14
Hieracium sp.	Hawkweed	ON,NH,WI	1,2,10
Krigia biflora (Wlt.) Blake	Two-flowered Cynthia	WI	2,14
Liatris Spp.	Blazing star	IN	15
Lithospermum canescens (Michx.) Lehm.	Hoary puccoon	IN	15
Lithospermum caroliniense (Walt.) MacM.	Hairy puccoon	ON,WI,IN	2,10,15
Lupinus perennis L.	Wild lupine	MI,NH,ON,WI, IN	1,2,7,9,10,11,14,15
Medicago lupulina L.	Black medic	WI	2,7
Melilotus officinalis (L.) Pallas	Yellow sweet clover	IN,WI	2,7,8
Pedicularis canadensis L.	Lousewort	WI	2,14
Phlox pilosa L.	Downy phlox	IN	8,15
Potentilla recta L.	Rough-fruited cinquefoil	WI	2
Potentilla simplex Michx.	Common cinquefoil	WI,MI,IN	2,7,13,14,15
Potentilla sp.	Cinquefoil	MI,NY	3,11
Rosa Carolina L.	Carolina rose	IN	15
Rumex acetosella L.	Sheep sorel	WI	2
Senecio pauperculus Michx.	Ragwort	WI	7
Senecio sp.	Ragwort	WI	2,9
Smilacina racemosa (L.) Desf.	False spikenard	WI	2,7
Smilacina stellata (L.) Desf.	Star-flow. fals. sol. seal	WI	2,14
Solidago sciaphila	Steele Cliff goldenrod	WI	7
Tephrosia virginiana (L.) Pers.	Goat's rue	NY	3
Tradescantia ohiensis Raf.	Spiderwort	IN	15
Trifolium hybridum L.	Alsike clover	WI	2,14
Trifolium pratense L.	Red clover	WI	7
Trifolium repens L.	White clover	WI	2
Viccia villosa Roth.	Hairy vetch	WI	2
Viola pedata L.	Bird foot violet	NY,WI	2,3,13
Zizia aurea (L.) Koch	Golden alexanders	WI	2
----------Woody species----------			
Amelanchier sp.	Juneberry	ON	10
Ceanothus herbaceus (ovatus) Raf.	Red root	WI	7
Ceanothus sp.	New jersey tea	WI	2
Physocarpus opulifolius (L.) Maxim.	Common ninebark	WI	7
Prunus sp.	Wild plum	NY	3
Rubus allegheniensis Porter	Blackberry	WI	7
Rubus flagellaris Willd.	Dewberry	IN,MI,WI	7,6,8,13,15
Rubus sp. or spp. (IN)	Bramble	IN,MI,MN,WI	2,5,8,11,9,14,15
Salix humilis Marsh.	Prairie willow	WI	2, 7
Vaccinium sp.	Blueberry	NY,IN	3,15
Vitis riparia Michx.	River grape	MN	5

----------Second brood adult nectar sources----------			
----------Herbaceous species----------			
Achillea millefolium L.	Common yarrow	IN,MI,MN,WI	2,5,7,8,11,14
Amorpha canescens Pursh	Lead plant	WI	2,7,9,14
Apocynum androsaemifolium L.	Spreading dogbane	NH,NY	1,12
Arabis lyrata L.	Sand-cress	IN,WI	2,7,8,14
Asclepias incarnata L.	Swamp milkweed	IN	15
Asclepias syriaca L.	Common milkweed	NH,NY,WI	2,7,12
Asclepias tuberosa L.	Butterfly-weed	IN,MI,MN,NY, ON,WI	2,3,4,5,6,7,8,10,11, 13,15
Asclepias verticillata L.	Whorled milkweed	MI,WI,IN	2,7,8,11,9,13,15
Aster sp.	Aster	WI	2,13
Aureolaria pedicularia (L.) Raf.	Fern-leave false foxglove	WI	2
Aureolaria sp.	False foxglove	WI	2,13
Berteroa incana (L.) DC.	Hoary alyssum	NY,WI	2,4
Campanula rotundifolia L.	Harebell	MN,WI	1,2,9,14
Centaurea biebersteinii (maculosa) DC.	Spotted knapweed	MI,NY,WI	2,3,4,7,11,13,14
Chrysanthemum leucanthemum L.	Ox-eye daisy	WI	7
Coreopsis lanceolata L.	Lance-leaved coreopsis	MI	11
Coreopsis palmata Nutt.	Stiff tickseed	WI	7,9,14
Coreopsis sp.	Coreopsis	WI	2
Dianthus armeria L.	Deptford pink	MI	11
Erigeron annuus (L.) Pers.	Daisy fleabane	MI,MN	5,11
Erigeron canadensis		WI	9
Erigeron strigosus Muhl.	Daisy fleabane	WI,IN	2,7, 9,15
Erigeron sp.	Fleabane	IN,WI,MI	2,8,13,14
Euphorbia corollata L.	Flowering spurge	IN,MI,MN,WI	1,2,5,6,7,8,11,13, 14, 15
Euphorbia podperae (esula) Croizat	Leafy spurge	WI	2,7
Euthamia graminifolia (*Solidago graminifolia*) (L.) Nutt	Grass-leaved goldenrod	NH,WI	2,12,14
Froelichia floridana (Nutt.) Moq.	Cottonweed	WI	7
Galium sp.	Bedstraw	WI	2,14
Gnaphalium obtusifolium L.	Sweet everlasting	MN,WI	1,2,5,9,14
Hackelia deflexa (Wahlenb.) Opiz	Stickseed	MN	5
Hedyotis (Houstonia) longifolia (Gaetrn.) Hook.	Longleaved houstonia	WI	2,14
Helianthemum canadense (L.) Michx.	Frostweed	WI	9
Helianthus divaricatus L.*	Woodland sunflower	IN,MI	8,11,15
Helianthus occidentalis Riddell	Western sunflower	MN,WI,IN	2,5,7,9,14,15
Helianthus sp.	Sunflower	NH,NY,MI,WI	2,11,12,14
Hieracium aurantiacum L.	Orange hawkweed	WI	2,7,9,14
Hieracium pilosella L.	Mouse ear hawkweed	MI	11
Hieracium sp.	Hawkweed	MI	11
Hypericum perforatum L.	Common St.John's wort	MI	11
Krigia biflora (Walt.) Blake	Two-flowered Cynthia	WI	2,14
Lespedesa capitata Michx.	Bush clover	WI	2,14
Liatris aspera Michx.	Rough blazing star	MI,WI	2,6,7,11,9,14
Liatris cylindracea Michx.	Dwarf blazing-star	ON,WI	2,7,9,12,14
Liatris sPP.	Blazing-star	IN	15
Lilium philadelphicum L.	Wood lily	NH	1
Linaria canadensis (L.) Dum.-Cours.	Old-field toad flax	WI	2
Linaria vulgaris Hill	Butter-and-eggs	WI	2

Lithospermum caroliniense (Walt.)MacM	Hairy puccoon	WI	2
Lobelia spicata Lam.	Pale-spike lobelia	WI	7
Lotis corniculatus L.	Birdsfoot trefoil	MI,WI	2,11,14
Lupinus perennis L.	Wild lupine	NY,WI	2,12,14
Lycopus americanus Muhl.	Water-horehound	IN	15
Lysimachia sp.	Loosestrife	WI	2,14
Lythrum alatum Pursh.	Winged loosestrife	IN	15
Medicago lupulina L.	Black medic	WI	2,7,9
Medicago sativa L.	Alfalfa	WI	2
Melilotus alba Medic.	White sweet clover	IN,MN,WI	2,5,7,8,9,14,15
Melilotus officinalis (L.) Pallas	Yellow sweet clover	MN,WI	2,5,7
Monarda fistulosa L.	Wild bergamot	IN	8,9,14,15
Monarda punctata L.	Horsemint	IN,MI,MN,NY, ON, WI	2,3,4,5,6,7, 8, 9, 10,11,14,15
Oenothera sp.	Evening primrose	WI	2,13
Petalostemon candidum (Willd.) Michx.	White prairie clover	WI	2,7,9
Petalostemon purpureum (Vent.) Rydb.	Purple prairie clover	WI	2,7
Phlox pilosa L.	Downy phlox	IN	15
Polygala polygama Walt.	Racemed milkwort	MI	11
Polygonum sp.	Knotweed	WI	2,14
Potentilla recta L.	Rough-fruited cinquefoil	IN	15
Potentilla simplex Michx.	Common cinquefoil	WI	2,14
Pycanthemum virginianum L.	Mountain-mint	IN	15
Rosa Carolina L.	Carolina rose	IN	15
Rosa sp.	Wild rose	WI	2,14
Rudbeckia hirta (serotina) L.	Black-eyed susan	MI,MN,ON,WI, IN	2,5,7,9,10,11,14,15
Saponaria officinalis L.	Soapwort	NY,IN	3,15
Scutellaria epilobiifolia	Marsh skullcap	IN	15
Smilacina stellata (L.) Desf.	Star-flow. fals. sol. seal	WI	2,14
Solidago ptarmicoides (Nees) Boivin (*Aster ptarmicoides*)	Upland white aster	WI	2,9
Solidago speciosa Nutt.	Showy goldenrod	WI,IN	13,15
Solidago sp.	Goldenrod	IN,NH,WI	1,2,8,14
Spiraea tomentosa L.	Meadowsweet	WI	14
Talinum rugospermum Holz.	Fameflower	WI	2
Tephrosia virginiana (L.) Pers.	Goat's rue	IN	8,14,15
Tradescantia ohiensis Raf.	Spiderwort	IN	15
Tradescantia virginiana L.*	Virginia spiderwort	MI	11
Trifolium arvense L.	Rabbit-foot clover	WI	2,14
Trifolium hybridum L.	Alsike clover	WI	2,14
Trifolium pratense L.	Red clover	WI	2,7,14
Trifoliium repens L.	White clover	WI	2,7,14
Vicia villosa Roth.	Hairy vetch	WI	2,14
----------Woody species----------			
Ceanothus americanus L.	New Jersey tea	IN,NH,NY,ON,WI	1,2,3,4,8,10,14, 15
Ceanothus herbaceus (ovatus) Raf.	Red root	ON	10
Rhus copallinia	Winged sumac	IN	14

References: 1= Bidwell, in Helmbolt and Amaral 1994, 2 = Bleser 1992, 3 = Dirig 1976, 4 = Fried 1987, 5 = Lane, pers. comm. 1994, 6 = Lawrence 1994, 7 = Leach 1993, 8 = Martin 1994, 9 = Maxwell and Givnish 1994, 10 = Packer 1987, 11 = Papp 1993, 12 = Schweitzer, pers. comm. 1994, 13 = Sferra et al. 1993, 14 = Swengel and Swengel 1993, 15 = Grundel and Pavlovic 2000.

3.2.2 Listed, Proposed, and Candidate Species

Federally threatened or endangered species that could occur in or near occupied KBB habitat currently include KBB, Kirtland's warbler, Indiana bat, and Pitcher's thistle. The only candidate species that could occur in or near occupied KBB habitat is the eastern massasauga rattlesnake.

3.2.2.1 Karner Blue Butterfly

The KBB is classified as endangered under federal law and as threatened under Michigan law. It has a historic range from Maine to Minnesota, south to Iowa and Pennsylvania, and north to southern Ontario, Canada (USFWS 2003a). Within Michigan, KBB is currently known to occur on approximately 3,900 acres within 10 counties in the western Lower Peninsula (Fettinger 2005; Figure 1). KBB was also found in Monroe County in southeastern Michigan as recently as 1986, but is now believed to be extirpated from that portion of the state. The butterfly was recently reintroduced to Petersburg State Game Area in Monroe County in 2008.

KBB is bivoltine, meaning two broods are produced annually. First-brood larvae hatch from eggs in mid to late April and feed exclusively on wild lupine for 3–4 weeks. During this time, they pass through four instars. First-brood pupation occurs in May and early June, typically on leaf litter, stems or twigs. Pupation may last 7–11 days (Dirig 1976). First-brood adults first emerge in late May. Emergence may continue for weeks, but individual KBB live an average of 5 days (USFWS 2003a).

After emergence, adult KBB feed on a variety of nectar plants (Table 4). Male KBB generally spend more time in open areas, where they forage, mate and patrol their territories (Grundel et al. 1998). Female KBB spend similar amounts of time in open and partially shaded areas. Grundel et al. (1998) found that oviposition occurred most frequently under 30–60% canopy cover. Lupine stem density is often lower in partially shaded areas, but the larger size of individual plants in these areas is preferred by feeding larvae (Grundel et al. 1998). First-brood females typically lay their eggs on lupine leaves, petioles or stems, but they may also lay eggs on other plants in proximity to lupine (USFWS 2003a).

Second-brood eggs hatch in June and July, and larvae feed on lupine until pupation. Late instars of second-brood larvae are often tended by ants, resulting in higher larval survival rates (Lane 1999). Adult emergence begins in mid July and may continue until late August. Second-brood females lay eggs on materials close to the ground, typically on grasses, sedges, lupine and leaf litter (Lane 1999). These eggs do not hatch until the following spring, and closeness to the ground offers protection during winter conditions (Bernays and Chapman 1994). The first brood is typically smaller than the second brood, in part due to high mortality rates of overwintering eggs (USFWS 2003a).

KBB are not particularly strong fliers. Their movements have been characterized as a series of frequent, low, short flights of 5 meters or less (USFWS 2003a). KBB within-patch movements are usually less than 300 m and within a 2.5-hectare (6.2-acre) area; however, individuals may range over as much as 32 hectares (79 acres), and a subset of individuals (typically less than 10%) disperse from their natal habitat patch (USFWS 2003a).

KBB dispersal corridors include nectar plants, grasses for roost sites, exposure to the sun for much of the day, and a woody vegetation border. KBB dispersal is higher when the dispersal landscape is open and when more nectar sources are available in the intervening habitat (USFWS 2003a). The presence of lupine in a dispersal corridor may join two otherwise separate habitat patches. Greater numbers of butterflies disperse from larger subpopulations and from habitat units that are declining in quality (USFWS 2003a).

Dispersal between habitat patches greater than 2.3 km apart is probably rare, but one female was documented to move at least 6.6 km (4.1 mi; USFWS 2003a). In Michigan, KBB are more likely to occupy high-quality habitat when it occurs within 1,000 m of another occupied patch (Fettinger 2005). Given current knowledge of dispersal potential, lupine patches within 200 m of each other can reasonably be considered to be occupied by the same subpopulation (and are thus within the same habitat patch). Separation distances less than 2.0 km are generally expected to allow occasional inter-patch dispersal.

3.2.2.2 Kirtland's Warbler

The currently known breeding range of the Kirtland's warbler, a Federal and State endangered species, occurs entirely within Michigan. Territorial males have been observed in Wisconsin, Ontario and Quebec, but no nesting activity has been documented. The current range of the Kirtland's warbler breeding area includes Alcona, Clare, Crawford, Grand Traverse, Iosco, Kalkaska, Montmorency, Ogemaw, Oscoda, Otsego, Presque Isle and Roscommon Counties in the Lower Peninsula and Baraga, Chippewa, Delta, Luce, Marquette and Schoolcraft Counties in the Upper Peninsula (Michigan DNR 2005a, 2006b).

The Kirtland's warbler nests in large, dense stands of jack pine growing on poor, well-drained sandy soils (USFWS 1985). Availability of suitable nesting habitat is further restricted by the availability of ground vegetation under overhanging branches. Trees in nesting areas are typically 5–20 years old (Olson 2002**)**. As trees grow larger, the overlapping branches reduce sunlight to lower branches, causing them to die. As lower branches and ground cover are lost, the area becomes unsuitable for Kirtland's warbler nesting. Once this occurs, warblers do not use the site again until disturbance removes the old trees and allows younger trees to grow.

The practice of fire suppression that began early in the 20th century reduced or removed the primary natural process that historically maintained jack-pine habitats in conditions suitable for Kirtland's warbler nesting. The loss of nesting habitat due to succession and nest parasitism caused by brown-headed cowbirds (*Molothrus ater*), are the primary threats to the species (USFWS 1985). In response to management that addresses these threats, the Kirtland's warbler population has increased steadily since the mid 1980s.

Currently, the ranges of KBB and Kirtland's warbler do not overlap. Management practices for each species generally preclude the presence of the other: the habitats currently supporting nesting Kirtland's warblers do not contain documented occurrences of the lupine required by KBB; no occupied KBB habitat contains the density of jack pine required for Kirtland's warbler

nesting. Thus, occasional occurrence of a migrating Kirtland's warbler in occupied KBB habitat is possible but extended residence is unlikely.

3.2.2.3 Indiana Bat

The Federal and State endangered Indiana bat has a Midwest distribution that extends south to Kentucky, Missouri and Oklahoma (USFWS 1999). Michigan represents the northern periphery of the species range. In Michigan, Indiana bat has been known to occur at scattered locations throughout much of the southern Lower Peninsula and in the northwest Lower Peninsula within and around the Manistee National Forest (Kurta and Rice 2002).

Indiana bats roost under exfoliating bark or in crevices of tree snags or live trees (Kurta et al. 1996, Kurta and Rice 2002, Kurta et al. 2002), usually within lowland or riparian forests (Humphrey et al. 1977, Kurta and Rice 2002, Kurta et al. 2002) but also within savannas or upland woodlands near edges or openings (Clark et al. 1987, Gardner et al. 1991, Brack 2006). Most maternity colonies are found in trees with diameters larger than 9 inches (22 cm) (Menzel et al. 2001, Kurta et al. 2002, Kurta 2004). Sunlight seems to be an important component in snag selection in Michigan; snags with heavy canopy cover tend to be avoided, except during exceptionally warm weather (Kurta et al. 1996, 2002). A variety of tree species are used for roost and maternity sites. Ash trees (*Fraxinus* spp.) are the primary roost trees in Michigan (Kurta et al. 1993, Kurta et al. 1996), but maples (*Acer* spp.) and elms (*Ulmus* spp.) are also frequently used (Kurta and Rice 2002). Indiana bats generally change roost trees every few days, so they require areas where multiple suitable roost trees are available (Kurta et al. 1996, 2002, Foster and Kurta 1999). Specific natural communities in Michigan where Indiana bat may be found include floodplain forests, southern swamps, oak barrens and oak–pine barrens.

When dispersing, Indiana bats generally follow linear forested features like river corridors or fence rows (Murray and Kurta 2004, Winhold et al. 2005). At night, they feed on insects over streams, rivers, ponds and other small wetlands or in forest openings or along forest edges (USFWS 1999, Murray and Kurta 2002).

Except for one hibernation site at Tippy Dam in Manistee County, known hibernacula occur south of Michigan in karst areas of the east-central United States. Indiana bats emerge from hibernation and arrive in Michigan as early as mid April (Viele 1994, Viele et al. 2002, Kurta and Rice 2002). Females form maternity colonies in May and young are born in late June or early July (Kurta and Rice 2002). Males may disperse widely or remain near their hibernacula and generally roost individually or in small groups (Kurta 2004). Indiana bats are highly philopatric, returning to the same breeding area in subsequent years (Kurta and Murray 2002, Winhold et al. 2005). Indiana bats that presumably migrate to hibernacula south of the State have been known to remain in southern Michigan until as late as October 11 (Kurta and Rice 2002). The summer range and migration characteristics of the Indiana bats that hibernate in Tippy Dam are unknown.

3.2.2.4 Pitcher's Thistle

The federal and state threatened Pitcher's thistle is endemic to the Great Lakes region. Its entire range occurs along or in close proximity to the shorelines of Lakes Michigan, Huron and Superior (USFWS 2002). Pitcher's thistle occurs on open sand dunes and occasionally on partially open dunes or lag gravel areas associated with dunes (Higman and Penskar 1999).

Pitcher's thistle is monocarpic (once-flowering) with a rosette that matures to flowering in 5–8 years, after which the plant dies (Higman and Penskar 1999, USFWS 2002). Seeds germinate in May or June. The taproot of this thistle, which can reach 2 m in length, enhances the plant's ability to survive the often-desiccating conditions of its dune habitat (Higman and Penskar 1999). Pitcher's thistle blooms from approximately late June to early September (Higman and Penskar 1999).

Pitcher's thistle occurs within a dynamic dune ecosystem and therefore occurrences and densities of the species vary considerably over space and time (USFWS 2002). Pitcher's thistle colonizes open, windblown areas of dunes and gradually declines as vegetative succession occurs (USFWS 2002). Established individuals can persist within a patch with moderate vegetation densities, but new seedlings will not establish without significant areas of open sand (McEachern 1992).

The long-lived nature of Pitcher's thistle combined with its dependence upon a rare and dynamic dunal ecosystem make it highly susceptible to shoreline alteration (USFWS 2002). Development of shoreline habitat is probably the most serious threat to this species, but other activities such as off-road vehicle traffic and heavy foot traffic can result in extirpation (Higman and Penskar 1999, USFWS 2002).

Pitcher's thistle is not known to occur in occupied KBB habitat in Michigan, but the two species do overlap at the Indiana Dunes National Lakeshore (Indiana Dunes National Lakeshore 2000). The potential for overlap in Michigan may exist in some rare circumstances.

3.2.2.5 Eastern Massasauga Rattlesnake

The eastern massasauga rattlesnake, a federal candidate species, occurs from southeastern Minnesota, eastern Iowa and northeastern Missouri east to southern Ontario, western New York and northwestern Pennsylvania (Harding 1997). The eastern massasauga has declined dramatically throughout its range. Michigan remains as a last stronghold for this species (Szymanski 1998). Historically, eastern massasaugas in Michigan were found throughout the Lower Peninsula and on Bois Blanc Island, Mackinac County (Szymanski 1998, Lee and Legge 2000). The species still maintains this general distribution, but threats such as persecution, habitat loss and habitat fragmentation have caused extirpation of individual populations and significant declines in others (Szymanski 1998, Michigan DNR 2005b).

Massasaugas are usually associated with wetlands, including both wooded communities like swamps and riverine corridors, and herbaceous communities including marsh borders and wet prairies (Szymanski 1998, Lee and Legge 2000). In summer, they also move into immediately adjacent upland herbaceous communities including grasslands, shrubby old fields, and pasture

and hay fields (Szymanski 1998, Lee and Legge 2000). Young are born in August and early September (Harding 1997, Lee and Legge 2000). Massasaugas usually retreat to wetlands in late September or October, overwinter in crayfish and mammal burrows from late October to April, and return to upland habitats in June (Szymanski 1998, Lee and Legge 2000).

Opportunities for massasaugas to use KBB habitat occur where suitable wetlands are adjacent to oak savannas. Therefore, during summer, massasaugas could occasionally occur in KBB habitats identified for treatment or disturbance.

3.2.2.6 Michigan State-listed Species

At least 17 wildlife species and 16 plant species classified as threatened or endangered under Michigan law (Public Act 451 of 1994, Part 365) could occur in or near occupied KBB habitat (Tables 5 and 6). The following text provides information on those state-listed species (animals and plants grouped separately; arranged alphabetically by scientific name) that are not also classified as federal threatened, endangered or candidate species.

Table 5. Wildlife species classified as threatened or endangered under Michigan law that potentially occur in or near occupied KBB habitat.

Common name	Scientific name	Status
Dusted skipper	*Atrytonopsis hianna*	State threatened
Three-staff underwing	*Catocala amestris*	State endangered
Spotted turtle	*Clemmys guttata*	State threatened
Least shrew	*Cryptotis parva*	State threatened
Prairie warbler	*Dendroica discolor*	State endangered
Kirtland's warbler	*Dendroica kirtlandii*	Federal endangered; State endangered
Persius dusky wing	*Erynnis persius persius*	State threatened
Bald eagle	*Haliaeetus leucocephalus*	State threatened
Ottoe skipper	*Hesperia ottoe*	State threatened
Frosted elfin	*Incisalia irus*	State threatened
Migrant loggerhead shrike	*Lanius ludovicianus migrans*	State endangered
Great Plains spittlebug	*Lepyronia gibbosa*	State threatened
Karner blue butterfly	*Lycaeides melissa samuelis*	Federal endangered; State threatened
Prairie vole	*Microtus ochrogaster*	State endangered

Indiana bat	*Myotis sodalis*	Federal endangered; State endangered
Phlox moth	*Schinia indiana*	State endangered
Regal fritillary	*Speyeria idalia*	State endangered

Dusted Skipper (Atrytonopsis hianna)

The state-threatened dusted skipper has been known to occur as a locally uncommon species at scattered locations in the northern and west-central Lower Peninsula and in Monroe County. The entire range of the species encompasses much of eastern and central North America. This skipper occurs in oak savannas and dry sand prairies where larvae feed on little bluestem (Wilsman 1994). Adults nectar on strawberry (*Fragaria* spp.), raspberry (*Rubus* spp.) and clover (*Trifolium* spp.) from late May to early or mid June. Dusted skipper appears to be secure across its range, but it is considered to be vulnerable, imperiled or critically imperiled in most States within its range (NatureServe 2006).

Three-staff Underwing (Catocala amestris)

In Michigan, the state-endangered three-staff underwing is known to be extant in only one location in Barry County. Although this species is not known to occur within the range of KBB, few surveys for this species have been conducted, and it may be more widespread than currently believed. It occurs in dry to mesic sand prairies and other prairies with loamy soils where leadplant (*Amorpha canescens*) is abundant, including in rights-of-way (Wilsman 1994). Leadplant is the only known larval host plant in Michigan. Larvae feed from late May through June and adults are most often found from late July to early August. Range-wide, this species appears to be in little or no danger of extinction (NatureServe 2006).

Spotted Turtle (Clemmys guttata)

The state-threatened spotted turtle is known from much of Michigan's Lower Peninsula, particularly the southern half of the state. It generally occurs in clear, shallow water with mud or muck bottoms; it is commonly found in aquatic and emergent vegetation associated with shallow ponds, wet meadows, tamarack swamps, bogs, fens, marsh channels, sphagnum seepages, and slow streams. Spotted turtles often wander on land, particularly in search of nesting areas. June is the primary month for females to seek sunny open areas with sandy or loamy soil. They have also been known to nest in grassy sites in the tops of grass or sedge hummocks. Hatchlings emerge in August or September. Spotted turtles reach maturity at 8–10 years. They typically hibernate in shallow water from mid October to late March. Protection of upland nesting habitat adjacent to identified and active core wetland habitats is required for the continued survival of this species. Spotted turtles occur throughout much of eastern North America. They are secure across much of their range (NatureServe 2006).

Least Shrew (Cryptotis parva)

The state-threatened least shrew is considered rare in Michigan and has been known to occur at scattered locations in the southern Lower Peninsula. It occurs in a variety of grassland areas including old fields, fence rows, wet meadows, orchards and forest edges (Evers 1994). Feral house cats may pose a threat to this species. Populations are difficult to survey; more surveys are needed to determine existing occurrences of this species.

Prairie Warbler (Dendroica discolor)

The state-endangered prairie warbler has been known to nest at scattered locations throughout the Lower Peninsula, as well as a few locations in the Upper Peninsula. It prefers scrub–shrub habitats, including old fields, young jack pine stands, oak clearcuts, and powerline rights-of-way (Cooper 2000). This species has gradually declined after peaking in abundance in the 1950s and 1960s. The primary threats to the prairie warbler include habitat loss, nest parasitism from brown-headed cowbirds, and nest predation. Beneficial management includes prescribed fire, clearcutting, and intermediate succession of old fields.

Persius Dusky Wing (Erynnis persius persius)

The state-threatened Persius dusky wing has been reported in southern Michigan, as far north as Lake County. This uncommon skipper occurs locally in oak savannas. The larval food source is wild lupine. The single-brooded adults live from May through early June and nectar on a variety of plant species. Larvae probably mature by mid July, at which time they enter diapause. Following lupine senescence, larvae overwinter below ground. Individuals are sensitive to fire, but populations are most threatened by loss of oak savanna due to fire suppression and development. Persius dusky wing are secure throughout much of northwestern North America, but the eastern subspecies is highly imperiled throughout northeastern North America and is believed to be extirpated from several States (NatureServe 2006).

Bald Eagle (Haliaeetus leucocephalus)

The state threatened bald eagle breeds throughout most of Michigan, with breeding activity increasing from south to north (Michigan Natural Features Inventory; MNFI 2007, USFWS 2006). Bald eagle nesting locations are patchily distributed within the Michigan KBB range (Michigan DNR 2006a, MNFI 2006, USFWS 2006). Bald eagles typically nest in forested areas (>10% forest cover) with at least a few large trees that are located near water and away from significant human activity (USFWS 1983, Bowerman et al. 2005, Michigan DNR 2006a). Adults often return to historic nest sites (USFWS 1983) and initiate nesting in mid February to mid March (Michigan DNR 2006a). Nesting activity continues until late summer (generally August) when chicks fledge (Michigan DNR 2006a). Bald eagle populations declined greatly across their range after World War II due primarily to the widespread use of DDT and other organochlorine insecticides, which resulted in egg-shell thinning and high rates of reproductive failure (USFWS 1983). Following the ban on the use of such chemicals in the early 1970s, bald eagle numbers in Michigan began to increase in the early 1980s (Michigan DNR 2006a). Since

then, Michigan's eagle population has continued to increase and expand across its historic range (Eagle et al. 2005, Michigan DNR 2006a, USFWS 2006).

Ottoe Skipper (Hesperia ottoe)

The state-threatened Ottoe skipper ranges from southern Manitoba through the continental Midwest to northern Texas. It has been reported in southwestern Michigan, as far north as Newaygo County. This skipper is localized in its occurrence, and is almost always found close to larval food plants including little bluestem and fall witchgrass (*Leptoloma cognatum*). In Michigan, this skipper occurs in dry sand prairies and oak savannas, often in association with wild lupine. The single-brooded adults are active from late June through mid August. Eggs hatch and develop to fourth instar larvae before late summer or fall hibernation in buried shelters. Additional information can be found in Nielsen (1999) and Cuthrell (2001). Ottoe skipper is vulnerable to extinction throughout its range and is considered to be imperiled or critically imperiled in most states within its range (NatureServe 2006).

Frosted Elfin (Incisalia irus)

The state-threatened frosted elfin has been reported in southern Michigan, as far north as Mason and Iosco counties. The range of the species encompasses much of eastern North America. The single-brooded adults nectar on blueberry (*Vaccinium* spp.) from late April to early June. This elfin occurs in oak savannas where larvae feed on wild lupine flowers. Larvae develop through all subadult life stages and pupate at the base of lupine plants where they overwinter at or below ground level. Frosted elfin is vulnerable to extinction throughout its range and is considered to be imperiled or critically imperiled in most States within its range (NatureServe 2006).

Migrant Loggerhead Shrike (Lanius ludovicianus migrans)

The state-endangered migrant loggerhead shrike has been documented from numerous locations in the Lower Peninsula, mostly in counties bordering the Great Lakes. It can be found in a variety of habitats, including pastures, old fields, rights-of-way, and other grassy areas with perches from which to search for food. They feed on insects, small mammals, small birds, reptiles and amphibians. They nest in a variety of vegetation, but seem to prefer short trees and shrubs that offer a tangle of protective branches or thorns. Loggerhead shrikes arrive in Michigan in early spring and depart in August or September. Shrike numbers declined through the 1960s and 1970s in Michigan, possibly in response to the use of pesticides. Range-wide, migrant loggerhead shrikes have a spotty distribution, have experienced steep declines, and may be vulnerable to extinction (NatureServe 2006).

Great Plains Spittlebug (Lepyronia gibbosa)

The Great Plains spittlebug is a state-threatened species in Michigan. It is known from numerous locations in eight counties in western and southwestern Michigan, where it is often locally abundant (Dunn et al. 2002). The Great Plains spittlebug occurs in mesic portions of sand-prairie and oak-savanna communities (Wilsman 1994, Dunn et al. 2002). It appears to use a variety of host plants as nymphs, but may be limited to big bluestem and little bluestem as adults.

This single-brooded insect appears as an adult as early as June and persists throughout the summer, probably laying eggs in the late summer or early fall. It appears to be sensitive to fire in all life stages; however, fire is important for the maintenance of its habitat. This species is also found in Indiana and Ontario where it is believed to be highly imperiled (NatureServe 2006).

Prairie Vole (Microtus ochrogaster)

The state-endangered prairie vole is known to occur only in the southwestern corner of Michigan, where it is extremely rare. It occurs in a variety of upland grasslands including old fields, hayfields, fence rows, rights-of-way and oak savannas (Evers 1994). Habitat loss and feral cats may pose threats to this species. The prairie vole has probably always been rare in the state.

Phlox Moth (Schinia indiana)

In Michigan, the state-endangered phlox moth is known from only three locations in Newaygo and Montcalm Counties. It occurs in oak savannas and dry prairie areas. As juveniles, this moth feeds on the flowers and developing seed pods of downy phlox (*Phlox pilosa*); adults spend most of their time on these plants (Wilsman 1994). Phlox moth appears to have a flight period determined by the length of the flowering period of the phlox. Adults have been recorded from late May through early July. Pupae spend August through April at or below the soil surface, where they are less susceptible to mortality from fire. Phlox moth occurs across much of central North America, but is believed to be very rare throughout much of its range and it may be imperiled range-wide. Additional surveys are necessary to determine its distribution and abundance in Michigan.

Regal Fritillary (Speyeria idalia)

The state-endangered regal fritillary was known to occur historically throughout much of southern Michigan and in Newaygo and Montcalm Counties. It occurs in prairies, savannas and old field grasslands, and may occasionally be found in KBB habitat (Wilsman 1994). Adults begin emerging in late June and live through most of the summer. Larvae feed on a variety of violets (*Viola* spp.) and adults feed on a variety of species, but usually seek tall plants such as milkweed (*Asclepias* spp.). Males wander widely but both sexes actively avoid trees (Wilsman 1994). Vegetative succession due to fire suppression has probably been a significant contributor to the decline of this species. Regal fritillary has not been observed in Michigan since 1980 and may be extirpated from the state. It has experienced a recent range-wide contraction of approximately 30%; this large-scale decline may be ongoing (NatureServe 2006). It is probably extirpated from approximately 15 states within its historic range.

Table 6. Plant species classified as threatened or endangered under Michigan law that potentially occur in or near occupied KBB habitat.

Common name	Scientific name	Status
Rock-jasmine	*Androsace occidentalis*	State endangered

Beach three-awned grass	*Aristida tuberculosa*	State threatened
Silky aster	*Aster sericeus*	State threatened
Canadian milk-vetch	*Astragalus canadensis*	State threatened
Side-oats gramma	*Bouteloua curtipendula*	State threatened
Pitcher's thistle	*Cirsium pitcheri*	Federal threatened; State threatened
Rattlesnake master	*Eryngium yuccifolium*	State threatened
White gentian	*Gentiana flavida*	State endangered
Downy gentian	*Gentiana puberulenta*	State endangered
Prairie smoke	*Geum triflorum*	State threatened
Wild potato-vine	*Ipomoea pandurata*	State threatened
Virginia flax	*Linum virginianum*	State threatened
Leiberg's panic-grass	*Panicum leibergii*	State threatened
Smooth beard-tongue	*Penstemon calycosus*	State threatened
Missouri goldenrod	*Solidago missouriensis*	State threatened
Blue curls	*Trichostema dichotomum*	State threatened

Rock-jasmine (Androsace occidentalis)

The state-endangered rock-jasmine is known from a single location in the southwestern Lower Peninsula. This species is most likely to be found in dry sand prairies and oak savannas in sandy soils in Michigan (MNFI 2006). This species may persist in the State in habitat remnants in southern portions of the Lower Peninsula, where it may be easily overlooked.

Beach Three-awned grass (Aristida tuberculosa)

The state-threatened beach three-awned grass is known from two locations in the southwestern Lower Peninsula. It can be found in dry sand prairies or oak savannas in sandy soils (Michigan Natural Features Inventory 2006). This species may have been historically rare in Michigan, but loss and degradation of habitat may have resulted in a decline in occurrences in the state. Fire is probably required to maintain habitat for this species.

Western Silvery Aster (Aster sericeus)

The state-threatened silvery aster is known from dry sand prairie (MNFI 2006). Loss and degradation of habitat is the primary threat to this species. Protection of existing prairie

remnants and restoration of prairie and savanna areas through prescribed fire and brush removal are necessary for conservation of this species.

Canadian Milk-vetch (Astragalus canadensis)

The state-threatened Canadian milk-vetch has been known to occur in scattered locations throughout the southern Lower Peninsula and in Delta County in the Upper Peninsula. It occurs in oak-savanna and alvar grassland areas, usually in moist soil conditions (MNFI 2006). Many historic records for this species in the State exist, but the present status is poorly understood.

Side-oats Gramma (Bouteloua curtipendula)

The state-threatened side-oats gramma has been known to occur in the southeastern Lower Peninsula and in Kalamazoo and Kent counties in southwestern Michigan. It occurs in oak savannas and hillside prairies in Michigan and has been found in alvar elsewhere (MNFI 2006). Primary threats to this species are habitat loss and habitat degradation due to woody succession and proliferation of invasive species. Brush removal and prescribed fire are needed to restore habitat for this species.

Rattlesnake Master (Eryngium yuccifolium)

The state-threatened rattlesnake master has been known to occur in the southwestern Lower Peninsula. It occurs in prairie fens, dry sand prairies, mesic prairies, and wet-mesic prairies (MNFI 2006). Threats to this species include habitat loss and degradation through vegetative succession. Prescribed fire and other techniques to maintain openings are needed for the conservation of this species.

White Gentian (Gentiana flavida)

The state-endangered white gentian has been known to occur in scattered locations across the southern Lower Peninsula. It occurs in dry or moist prairies and oak savannas (MNFI 2006). Threats to this species include habitat loss and degradation of habitat through vegetative succession. Prescribed fire and other techniques to maintain openings are needed for the conservation of this species.

Downy Gentian (Gentiana puberulenta)

The state-endangered downy gentian has been known to occur in the southeastern Lower Peninsula and in Kent and Allegan counties in southwestern Michigan. It occurs in oak savannas, often along coastal plain marshes (MNFI 2006). Alteration of natural disturbance regimes leading to habitat loss is the primary threat to this species. Prescribed fire and brush removal are needed to restore habitat for this species.

Prairie Smoke (Geum triflorum)

The state-threatened prairie smoke has been known to occur in the west-central Lower Peninsula and in Chippewa County in the Upper Peninsula. It occurs in dry sand prairies and oak savannas (Choberka et al. 2000). It flowers in mid May and bears fruit from late May to mid June. Threats to this species include off-road-vehicle traffic, invasive species, habitat loss and vegetative succession.

Wild Potato-vine (Ipomoea pandurata)

The state-threatened wild potato-vine is known only from a few scattered locations in the southern Lower Peninsula, including Kent County. It is generally found in oak savannas and rights-of-way (MNFI 2006). This sprawling ground-vine has been known to grow to 6 feet long and blooms in late summer. The status of this species in the state is generally unknown; more surveys are needed to determine current distribution.

Virginia Flax (Linum virginianum)

The state-threatened Virginia flax is known from scattered locations in the southern Lower Peninsula, including Kent County. It can be found in oak savannas and other woodland openings (MNFI 2006). This perennial plant flowers from mid to late summer. Large-scale vegetative succession to a woody canopy is probably the major threat to this species.

Leiberg's Panic-grass (Panicum leibergii)

The state-threatened Leiberg's panic-grass is known from scattered locations in the southern Lower Peninsula, including Ionia County. It is found in dry to wet prairie remnants, including dry sand prairies, hillside prairies, oak openings and rights-of-way (Penskar and Crispin 2004). It flowers in June and fruiting usually occurs in July but occasionally persists into August or September. Prescribed fire is needed to mimic the natural disturbance regime that historically provided habitat for this species.

Smooth Beard Tongue (Penstemon calycosus)

The state-threatened smooth beard tongue is known from three counties in Michigan: Menominee County in the western Upper Peninsula, St. Clair County in southeastern Michigan, and Kent County in southwestern Michigan. Throughout its range, it occurs in prairies, meadows, rocky slopes, and sparsely vegetated woodlands (Penskar 2004). More information is needed on the distribution of this species in the state. This species would likely benefit from prescribed fires in the prairie communities where it is found.

Missouri Goldenrod (Solidago missouriensis)

The state-threatened Missouri goldenrod occurs in dry sand prairies (MNFI 2006). This drought-tolerant perennial plant flowers in summer or early fall. More surveys are needed in Michigan to

determine its status and distribution in the state. This species would likely benefit from prescribed fires in the prairie communities where it is found.

Blue Curls (Trichostema dichotomum)

The state-threatened blue curls or bastard pennyroyal is known to occur in oak savannas in the southern Lower Peninsula (MNFI 2006). It flowers in late summer or fall. The open, early-successional habitat it requires was historically maintained by natural disturbance, especially fire. Prescribed fires would probably benefit this species.

3.2.3 Other Wildlife Species

Oak savanna is a species-rich environment. More than 30 species of butterflies and skippers alone are known to occupy savannas in Michigan. This insect diversity attracts insect predators including birds, dragonflies and bats which, in turn, attract second-level predators including hawks and owls. Although the wildlife remains diverse, habitat loss and degradation has had detrimental impacts on many savanna species. Taken together, prairie and savanna comprise the habitat type that supports the greatest number of rare and declining species in Michigan (Eagle et al. 2005).

Michigan's Wildlife Action Plan (Eagle et al. 2005) identified 75 Species of Greatest Conservation Need (SGCN) that are associated with savannas in the Lower Peninsula, where KBB in Michigan currently occurs (Table 7). Species of Greatest Conservation Need include wildlife species classified as federally or State endangered, species identified by MNFI (2002) as 'special concern species,' and other species in need of conservation due to declining populations or other characteristics that make them vulnerable (Eagle et al. 2005).

Thirty-two insect species associated with savannas in the Lower Peninsula have been identified as SGCN. Many other insect species commonly occur in Michigan savannas. Some of them include many mound-building ant species (e.g., ants in the Forminicinae family), many butterflies and moths, such as coral hairstreak (*Harkenclenus titus*), Edward's hairstreak (*Satyrium edwardsii*), sleepy duskywing (*Erynnis brizo)* and hummingbird clearwing moth (*Hemaris thysbe*), a variety of tiger beetles (e.g., *Cicindela formosa*), grasshoppers (e.g., *Schistocerca emarginata*), and cicada killers (e.g., *Sphecius speciosus*) (J. Kleitch, Michigan DNR, personal communication).

Table 7. Species of Greatest Conservation Need associated with savannas in the Lower Peninsula of Michigan (adapted from Eagle et al. 2005).

Taxon group	Common name	Scientific name
Insects	Barrens locust	*Orphulella pelidna*
	A spur-throat grasshopper	*Melanoplus eurycercus*
	Blue-legged locust	*Melanoplus flavidus*
	Secretive locust	*Appalachia arcana*
	Davis's shield-bearer	*Atlanticus davisi*
	Hebard's green-legged locust	*Melanoplus viridipes*

	Atlantic-coast locust	*Psinidia fenestralis*
	Conehead grasshopper	*Neoconocephalus retusus*
	Great Plains spittlebug	*Lepyronia gibbosa*
	A spittlebug	*Philaenarcys killa*
	Red-legged spittlebug	*Prosapia ignipectus*
	A leafhopper	*Flexamia reflexus*
	Wild indigo duskywing	*Erynnis baptisiae*
	Persius duskywing	*Erynnis persius persius*
	Grizzled skipper	*Pyrgus wyandot*
	Ottoe skipper	*Hesperia ottoe*
	Dusted skipper	*Atrytonopsis hianna*
	Pipevine swallowtail	*Battus philenor*
	Northern hairstreak	*Fixsenia favonius ontario*
	Karner blue butterfly	*Lycaeides melissa samuelis*
	Henry's elfin	*Callophrys henrici*
	Frosted elfin	*Callophrys irus*
	Gorgone checkerspot	*Chlosyne gorgone carlota*
	Tawny crescent	*Phyciodes batesii*
	Barrens buckmoth	*Hemileuca maia*
	Sprague's pygarctia	*Pygarctia spraguei*
	Boreal fan moth	*Brachionych borealis*
	Doll’s merlolonche	*Merolonche dolli*
	Three-staff underwing	*Catocala amestris*
	Quiet underwing	*Catocala dulciola*
	Blazing star borer	*Papaipema beeriana*
	Phlox moth	*Schinia Indiana*
Birds	Sharp-tailed grouse	*Tympanuchus phasianellus*
	Northern bobwhite	*Colinus virginianus*
	Cooper’s hawk	*Accipiter cooperii*
	Northern goshawk	*Accipiter gentilis*
	Merlin	*Falco columbarius*
	Yellow-billed cuckoo	*Coccyzus americanus*
	Short-eared owl	*Asio flammeus*
	Common nighthawk	*Chordeiles minor*
	Red-headed woodpecker	*Melanerpes erythrocephalus*
	Northern flicker	*Colaptes auratus*
	Least flycatcher	*Empidonax minimus*
	Eastern kingbird	*Tyrannus tyrannus*
	Migrant loggerhead shrike	*Lanius ludovicianus Migrans*
	Northern shrike	*Lanius excubitor*

	Purple martin	*Progne subis*
	Sedge wren	*Cistothorus platensis*
	Northern mockingbird	*Mimus polyglottos*
	Brown thrasher	*Toxostoma rufum*
	Prairie warbler	*Dendroica discolor*
	Eastern towhee	*Pipilo erythrophthalmus*
	Field sparrow	*Spizella pusilla*
	Vesper sparrow	*Pooecetes gramineus*
	Dickcissel	*Spiza americana*
	Bobolink	*Dolichonyx oryzivorus*
	Western meadowlark	*Sturnella neglecta*
Mammals	Least shrew	*Cryptotis parva*
	Prairie vole	*Microtus ochrogaster*
	Woodland vole	*Microtus pinetorum*
	Southern bog lemming	*Synaptomys cooperi*
	Deer mouse	*Peromyscus maniculatus gracilis*
Amphibians	Smallmouth salamander	*Ambystoma texanum*
	Tiger salamander	*Ambystoma tigrinum*
	Fowler's toad	*Bufo fowleri*
	Northern leopard frog	*Rana pipiens*
Reptiles	Blue racer	*Coluber constrictor foxii*
	Black rat snake	*Elaphe obsolete obsolete*
	Eastern hognose snake	*Heterodon platirhinos*
	Smooth green snake	*Liochlorophis vernalis*
	Six-lined racerunner	*Apidoscelis sexlineatus*
	Eastern massasauga	*Sistrurus catenatus catenatus*
	Spotted turtle	*Clemmys guttata*
	Blanding's turtle	*Emydoidea blandingii*
	Eastern box turtle	*Terrapene carolina carolina*

Twenty-five bird SGCN are associated with Michigan savannas in the Lower Peninsula. Some of the other birds that commonly occupy Michigan savannas include: Lincoln's sparrow (*Melospiza lincolnii*), indigo bunting (*Passerina cyanea*), eastern bluebird (*Sialia sialis*), chipping sparrow (*Spizella passerina*), field sparrow (*Spizella pusilla*), blue-winged warbler (*Vermivora pinus*), Nashville warbler (*Vermivora ruficapilla*), sharp-shinned hawk (*Accipter striatus*), upland sandpiper (*Bartamia longicauda*), ruffed grouse, red-tailed hawk (*Buteo jamaicensis*), American goldfinch (*Carduelis tristis*), killdeer (*Charadrius vociferus*), lark sparrow (*Chondestes grammacus*), American kestrel (*Falco sparverius*), Baltimore oriole (*Icterus galbula*), wild turkey, eastern screech owl (*Otus asio*) and mourning dove (*Zenaida macroura*) (Cohen 2000, 2001, 2004).

Five mammal species associated with savannas in the Lower Peninsula have been identified as SGCN. Some other mammals frequently associated with this habitat include coyote (*Canis latrans*), meadow vole (*Microtus pennsylvanicus*), white-tailed deer, fox squirrel (*Sciurus niger*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), badger (*Taxidea taxus*), red fox (*Vulpes vulpes*) and jumping meadow mouse (*Zapus hudsonia*) (Cohen 2000, 20001, 2004).

Thirteen amphibian and reptile SGCN are associated with savannas in the Lower Peninsula. Some of the other, more-common species associated with this habitat include American toad (*Bufo americanus*), common garter snake (*Thamnophis sirtalis*) and milk snake (*Lampropeltis triangulum*) (Cohen 2000, 20001, 2004).

3.3 Land Use

3.3.1 Statewide

Approximately 20% of Michigan's 36.4 million acres are managed by federal, state or local governments. More than seven million acres are in state and federal ownership.

The Michigan DNR manages 4.5 million acres as State Forests, State Wildlife Areas, and State Parks and Recreation Areas. These areas provide wildlife habitat, opportunities for outdoor recreation such as hunting, wildlife viewing and boating, and resources for timber and mineral extraction. An additional 375,000 acres are managed by the Michigan Department of Transportation and Department of Military and Veterans Affairs. The state government also holds title to approximately 25 million acres of Great Lakes bottomlands.

The federal government manages 3.1 million acres in Michigan for a variety of purposes, including provision of wildlife habitat, protection of rare natural features, provision of recreational opportunities, and resource extraction. This land includes 2.85 million acres of National Forest managed by the U.S.D.A. Forest Service, 730,000 acres within two National Lakeshores and one National Park managed by the National Park Service, and 115,000 acres within three Federal Refuges managed by the USFWS.

Local governments manage approximately 114,000 acres in Michigan, primarily for recreational purposes.

Approximately, 80% (29 million acres) of land in Michigan is privately owned. Planning and use decisions affecting these lands occur at local levels; state law grants authority to local governments to determine the extent, rate and types of development that will occur in individual municipalities and counties. Compared to other states, local land-use planning in Michigan is especially fragmented. Whereas most states have between 300 and 500 local government units possessing authority to engage in planning, Michigan has more than 1,800 of these units (Public Sector Consultants 2002). Local governments typically do not coordinate at regional levels: as of 2002, only 25 of 83 counties had adopted countywide zoning ordinances (Public Sector Consultants 2002). Consequently, local planning for private lands in Michigan tends to produce a patchwork of disparate development and land-use schemes across the landscape.

From the early 1800s through the middle of the 20th century, Michigan acreage in agricultural production steadily and rapidly increased. Following this expansion, this acreage began to decline due to conversion to urban and suburban areas and abandonment of farmland, which was often allowed to succeed to forested lands. In 1978, 29% of Michigan acreage was agricultural land (Smyth 1995); between 1982 and 1997, farmland acreage decreased by almost 1.5 million acres, or 13.3% (Norris and Soulé 2003); between 1997 and 2002, Michigan lost an additional 3% of its farmland (U.S. Department of Agriculture 2002). If current trends continue, Michigan will lose 25% of its fruit-producing land and 1.9 million acres of other farmland in the next 40 years (Public Sector Consultants 2002).

In 1978, 6% of Michigan's land area was defined as urban (Smyth 1995). By 2002, the acreage of developed land increased by more than 30% (Public Sector Consultants 2002). If present development trends continue, between 1.5 and 2 million additional acres of un-built land could be urbanized by 2020 and the acreage of developed land could increase by 178% by the year 2040 (Public Sector Consultants 2001).

3.3.2 Oak Savannas

Historic land use of oak savannas following European settlement focused around logging, which first became a common practice in those habitats in the 1800s (Dickmann and Leefers 2003). Although few trees occurred in the savannas themselves, these openings served as log landings and supported a trail infrastructure over which forest products could be removed. In the 1900s, these openings were appealing to farmers who were the first to intensively use the land. Vestiges of both of these historic land uses remain apparent. Where soil fertility permits, farming has generally continued.

Savannas are fire-dependent communities, and wildfires once shaped and maintained them (O'Connor 2006). However, the occurrence of wildfire precluded other land uses like residential and business development. Beginning in the 1920s, wildfire control activities reduced the impact of fire on the Michigan landscape (Abrams 1992). Wildfire is now largely eliminated as a shaping force on natural communities. Although not a land use in the classical sense, this process was a mandatory precursor to most current land uses.

Forestry practices have also changed the character of these savannas. These practices include planting of pine and hardwood plantations, fertilizing established plantations, harvesting trees, and chemically treating or scarifying soils.

Development of residences and businesses, together with their associated road and utility infrastructure, has also reduced and fragmented savanna. Expansion of urban and suburban areas is and will continue to be a major factor in reducing natural communities, including savannas (Skole et al. 2002). Indeed, the counties of Allegan, Kent, Muskegon and Ottawa, situated between the urban centers of Grand Rapids, Holland and Muskegon, are among the most rapidly growing populations in the State (Skole et al. 2002).

Outdoor recreational activities such as hunting, fishing, hiking and bird watching are important to the regional economy and the quality of life of local residents. Other recreational activities

like off-road vehicle use and horseback riding are also important, but have reduced the function of savannas in some cases.

Due to the combined impacts of all of these land uses, high-quality savannas have been reduced to less than 1% of their pre-European settlement extent (Comer et al. 1995, Cohen 2004). The potential for restoration exists in only a small fraction of the degraded savannas. Thus, the outlook for savannas in Michigan is one of a limited number of treed openings bounded within a matrix of forest and lands converted to other human uses.

3.4 Cultural/Paleontological Resources

Information on cultural and paleontological resources in Michigan is maintained by the Michigan State Historic Preservation Office and the Tribal Historic Preservation Office and is too extensive to describe here. Inasmuch as oak savanna is typically supported on well-drained flat to modestly rolling topography over deep sand soils, the likelihood of encountering paleontological resources is small. Moreover, occupied KBB habitat tends to be slightly lower than surrounding landscape features and was less likely to be selected for prehistoric or historic encampments. Therefore, few cultural resources are expected to occur within occupied KBB habitat.

3.5 Local Socio-economic Conditions

On average, Michigan has approximately 175 people per square mile, but this population is disproportionately distributed: residents of the 14 Upper Peninsula counties represent 3% of the total state population, whereas the three southeastern Detroit-metro counties (Oakland, Macomb and Wayne) account for 40% of the total state population (U.S. Census Bureau 2005). Other significant population centers in southern Michigan include: Kent County (6%), Genesee County (4.4%) and Washtenaw County (3.4%).

The 2000 United States census estimated Michigan's human population to be just under 10 million people. This figure represented an increase of 6.9% since 1990, but was less than the national average of 13.1% (U.S. Census Bureau 2005). The impact of development on the landscape has been disproportionate to population growth. 'Built' (developed) land area in Michigan increased 25% from 1980 to 1995, a rate that is eight times the estimated population growth rate (3%) during the same period (Public Sector Consultants 2001). This increase was accompanied by a decline in average population density in developed areas, from 3.8 persons per acre in the early 1980s to 2.8 persons per acre in the late 1990s (Norris and Soulé 2003). This shift has accelerated the rate of land conversion, because low-density housing developments in the suburbs require more area for each individual household. Between 1990 and 2000, significant emigration was experienced by several Michigan cities (with percent population change): Detroit (-7.5%); Flint (-12%); Saginaw (-11.6%) (Michigan Land Use Leadership Council 2003). During the same period, outlying areas experienced unprecedented development.

Michigan's economy was dominated by fur trapping, farming, lumbering and mining in the 19th century, but became highly industrialized in the 20th century as Michigan grew to be the major center of the United States automobile industry. Manufacturing continues to be a significant

industry in the State, comprising 20.7% of the Gross State Product in 2002 (U.S. Department of Commerce 2005). Other major industries include agriculture and tourism (Michigan Economic Development Corporation 2005).

Industry employment forecasts produced by the Michigan Department of Labor and Economic Growth (2005) predict a small decrease (2.3%) in the overall number of individuals employed in manufacturing from 2000 to 2010, but an increase (7.6%) of those employed in manufacturing of lumber and wood products. They also predict a decrease in mining (3.7%), and increases in construction (13.6%), agricultural services (19.2%), amusement and recreation services (26.6%), real estate (10.0%), and transportation, communications and utilities (6.8%).

4. ENVIRONMENTAL CONSEQUENCES

4.1 Alternative A: Comprehensive HCP (Proposed Action)

Under this alternative, a coalition of management partners would cooperate to implement a statewide KBB HCP authorized through a 20-year ITP. The Comprehensive HCP could apply to all occupied KBB habitat on non-federal land in Michigan. Based on the currently known distribution of KBB, approximately 2,700 acres of occupied KBB habitat could be impacted by the HCP. Activities that would be conducted under this alternative fall into three general categories: 1) habitat management; 2) utility and transportation right-of-way maintenance; and 3) development.

4.1.1 Physical Impacts

Potential physical impacts of habitat management, utility and transportation right-of-way maintenance, and development are described under the following headings. Physical features considered include climate, topography and soils, hydrology, water quality and air quality.

4.1.1.1 Habitat Management

Habitat management would be conducted to maintain habitat for KBB and other species of concern by maintaining and restoring early-successional plant communities. This would be achieved by simulating or replacing the natural processes that historically maintained the Oak Savanna Ecosystem.

Compared to the physical impacts of the No Action and Reduced-scope HCP alternatives, the physical impacts due to habitat management under the Comprehensive HCP would occur on a larger area. The Comprehensive HCP could impact approximately 2,700 acres, whereas the No Action and Reduced-scope HCP alternatives could impact approximately 900 acres and 1,000 acres, respectively. However, the character of the physical impacts caused by habitat management under all the alternatives would be similar, if not the same.

Climate

Habitat management would have no measurable impact on regional climate. Some management activities would alter microclimate in ways that simulate conditions under a natural disturbance regime.

Elevated levels of carbon dioxide are contributing to global climate change (Vitousek 1994, Karl and Trenberth 2003), and prescribed burning would introduce additional carbon dioxide into the atmosphere. Given the currently known distribution of KBB on non-federal land in Michigan and the management conditions outlined under 2.2.1.1, no more than 900 acres of occupied KBB habitat could be burned in any single year. The acreage that would actually be burned in any year would probably be much lower. Thus, the amount of carbon dioxide introduced by prescribed burning would be negligible compared to that introduced by vehicle and industrial emissions and by the tens of thousands of acres of wildfires that annually occur elsewhere in the United States (Vitousek 1994, Karl and Trenberth 2003).

Similarly, vehicles used during management activities (e.g., mowers, ATVs) would introduce carbon dioxide and other greenhouse gases into the atmosphere. However, a small number of vehicles (<10) would be used at the same time, and they would be operated for only a few days per year in any given habitat patch. Therefore, the emissions from these vehicles would be negligible compared to emissions from other local sources.

Habitat management would create the range of microclimate conditions that occurred historically in oaks savannas under a natural disturbance regime. The presence of a range of thermal environments is beneficial to KBB and other insects (Lane and Andow 2003, Grundel and Pavlovic in press), and canopy cover would be managed in a pattern that provided both open and shaded areas. In areas where openings were created, average incident sunlight and temperatures at ground level would increase and average relative humidity would decrease. These changes would occur at the microhabitat level, and would not affect climate conditions at a broader scale. Moreover, localized changes would be of short duration: in the absence of perpetual management, ecological succession would increase canopy cover and shading through time.

Topography and Soils

Habitat management would not alter natural topography. Thus, the flat expanses and moderately rolling relief of KBB habitat would remain unchanged. However, habitat management could have minor, temporary, and localized impacts on soil features.

Within managed habitat patches, prescribed burning would reduce soil nitrogen and organic matter, raise pH, and expose mineral soils (Tester 1989, Payne and Bryant 1994). These changes occurred historically under a natural disturbance regime, and they would counter the detrimental impacts of fire-suppression practices that have occurred since the 1920s (Abrams 1992).

Soil compaction due to management-vehicle traffic (e.g., ATVs) would be negligible because: 1) sandy soils are resistant to compaction; 2) only a small number of vehicles would be used during

management activities; and 3) management vehicles would be operated for only a few days per year in any given habitat patch.

If used, livestock grazing would expose mineral soils and increase soil nutrients. These impacts would be similar to those that occurred prior to European settlement, when wild herbivores sometimes congregated in oak savannas and helped inhibit succession (Ritchie et al. 1998, Fuhlendorf and Engle 2001). Soil compaction would be expected to be negligible because sandy soils are resistant to compaction and livestock would be introduced at low densities and on short rotation schedules. All impacts associated with livestock grazing would be of short duration and low intensity because livestock would be removed from any single habitat patch before non-woody vegetation is reduced to an average height of approximately 6 inches.

Soil scarification would disturb the upper soil profile, expose mineral soils and reduce organic material. Scarified areas would provide seed beds to promote germination and growth of lupine and nectar plants (Tester 1989, Payne and Bryant 1994, Neary et al. 2005). These impacts would be similar to those that occurred historically as a result of wildfires and wild herbivore activity.

Hydrology

With rare exception, habitat management would be conducted in upland habitats, and no measurable impacts to hydrology would be expected. Due to sandy, well-drained soils and minimal slopes, water infiltration rates would remain high regardless of whether vegetation and other organic matter were removed. Where tree density and canopy cover were reduced, less water would be lost through evapotranspiration, but the difference would not be expected to be significant. Therefore, groundwater inputs to lotic systems would not be expected to change as a result of management in occupied KBB habitat patches. Hydrological impacts due to soil compaction associated with management-vehicle traffic (e.g., ATVs) and livestock grazing would be negligible because sandy soils are resistant to compaction and traffic and livestock impacts would be of short duration and low intensity. Given the topographic and soil features of occupied KBB habitats, erosion is not expected to increase as a result of habitat management.

Water Quality

Habitat management would be expected to have no measurable impacts on water quality. Oak savanna occurs in upland areas with sandy, well-drained soils and minimal slopes. Even though some habitat-management activities would remove organic matter, runoff would still be negligible. No contaminants would be introduced to local water bodies. All herbicide application would conform to label specifications; accordingly, no herbicide would be applied closer than the required setback distance from any water body. Moreover, negligible runoff and high infiltration rate of the sandy soils would provide high retention rates, allowing for onsite chemical breakdown. Given the upland locations and negligible runoff of managed habitats, livestock would not contaminate water sources.

Air Quality

Effects on air quality due to habitat management would be expected to be minor, temporary and localized. Most management activities would have no impact on air quality. Vehicle emissions associated with management (e.g., mowers, ATVs) would be negligible compared to emissions from other local sources. Moreover, most vehicle operation would occur from September to May, when air-pollutant (e.g., ozone) levels pose less of a health risk. Prescribed burning would comply with Michigan's smoke management plan (Public Act 451 of 1994, Part 515), which confines emissions within parameters established by National Ambient Air Quality Standards (USEPA 2005b) and addresses local smoke-management concerns. Additionally, prescribed burning would be conducted in ways that would not cause a reduction in U.S. Environmental Protection Agency Air Quality Index (USEPA 2003b) levels for local areas.

4.1.1.2 Utility and Transportation Right-of-Way Maintenance

Utility and transportation right-of-way maintenance would involve activities that maintain vegetation and infrastructure in conditions appropriate for the intended purpose of rights-of-way. Activities that involve vegetative manipulation would be conducted for the primary purpose of maintaining rights-of-way, but would be implemented in ways that simulate or replace the natural processes that historically maintained the Oak Savanna Ecosystem. Vegetation manipulation would generally be conducted according to the conditions outlined under 2.2.1.1 (Habitat Management). Thus, the physical impacts of vegetation manipulation within rights-of-way would be the same as those outlined under 4.1.1.1 (Habitat Management). Additional activities conducted for right-of-way maintenance would include infrastructure repair and replacement, and could involve heavy-equipment traffic/operation and soil excavation. The physical impacts of these additional activities are provided under the following headings for climate, topography and soils, hydrology, water quality, and air quality.

Compared to the physical impacts of the No Action and Reduced-scope HCP alternatives, the physical impacts due to right-of-way maintenance under the Comprehensive HCP would occur on a larger area. This activity under the Comprehensive HCP could impact approximately 800 acres. Under specific authority of the No Action alternative, no impacts due to right-of-way maintenance would occur. Under the Reduced-scope HCP, right-of-way maintenance could impact less than 100 acres. Although the area of impact differs, the character of the physical impacts caused by right-of-way maintenance under the Comprehensive HCP and the Reduced-scope HCP would be similar, if not the same.

Climate

Increased levels of greenhouse gases are contributing to global climate change (Vitousek 1994, Karl and Trenberth 2003), and heavy equipment used during maintenance activities (e.g., trucks, backhoes) would introduce greenhouse gases into the atmosphere. However, a small number of vehicles would be used at the same time, and they would be operated for only a few days per year in any given habitat patch. Therefore, the emissions from heavy equipment would be negligible compared to emissions from other local sources. Therefore, heavy-equipment

operation/traffic would have no measurable impact on regional climate. Soil excavation conducted under this alternative would not have impacts on regional climate.

Repair and replacement of existing structures within rights-of-way would not be expected to alter shading patterns or the range of thermal environments. Therefore, these activities would not be expected to change microclimate conditions.

Topography and Soils

Infrastructure repair and replacement would not alter the natural topography of KBB habitat. Thus, the flat expanses and moderately rolling relief of KBB habitat would remain unchanged. However, infrastructure repair and replacement could have minor, temporary, and localized impacts on soil features.

Soil compaction due to heavy-equipment traffic/operation would be negligible for four reasons: 1) sandy soils are resistant to compaction; 2) to the extent possible, truck and heavy-equipment traffic would be limited to existing disturbed areas, such as access roads that run within a right-of-way; 3) only a small number of vehicles would be used during maintenance activities; and 4) heavy equipment would be operated for only a few days per year in any given habitat patch.

Soil excavation would disrupt the soil profile in localized areas of occupied KBB habitat patches. Compared to soil scarification, soil excavation would generally occur on a smaller area of an occupied patch, but the depth of soil disturbance could be greater. To the extent possible, displaced soils would be deposited away from lupine areas and within the smallest possible side-cast areas needed for temporary storage. Following repair or replacement of structures, excavated areas would be backfilled using the original soil that was deposited in temporary storage areas. Thus, the composition of soils in occupied KBB habitat patches would not be expected to change as a result of soil excavation.

Hydrology

No measurable impacts to hydrology as a result of infrastructure repair and replacement would be expected. Hydrological impacts due to soil compaction associated with heavy-equipment operation/traffic would be negligible because sandy soils are resistant to compaction and operation/traffic would be of short duration and low intensity. Due to sandy, well-drained soils, minimal slopes, and relatively small areas of impact, erosion would not be expected to increase as a result of soil excavation.

Water Quality

Infrastructure repair and replacement would not be expected to have measurable impacts on water quality. Right-of-way managers implement safety protocols to prevent spills or leaks (e.g., of petroleum products) associated with heavy equipment and pipelines, and no such accidents would be expected. However, in the event a spill or a leak did occur, the upland locations, well-drained soils, and minimal slopes of occupied KBB habitats would minimize runoff and help prevent contamination of local water bodies.

Air quality

No measurable impacts to air quality as a result of infrastructure repair and replacement would be expected. Emissions associated with heavy-equipment operation/traffic would be negligible compared to emissions from other local sources. Moreover, most equipment operation would occur from September to May, when air-pollutant (e.g., ozone) levels pose less of a health risk.

4.1.1.3 Development

Development activities could include: commercial, residential and public-facility construction; agriculture, horticulture and intensive forestry; and road and utility development.

The specific acreage of occupied KBB habitat that would be impacted by development would be limited by developer interest, zoning, and opportunity and funding for adequate mitigation. Mitigation would be required to ensure activities conducted under the Comprehensive HCP did not cause a long-term net reduction in KBB population sizes, area of occupied KBB habitat, or connectivity of occupied KBB habitat patches. Given an expected time lag between initiation of mitigation and actual replacement of lost occupied KBB habitat, development that would cause occupied KBB habitat on non-federal land to be reduced by more than 1% at any given time would not be permitted. Given the currently known KBB distribution and this restriction, the amount of occupied KBB habitat that might be developed under specific authority of the ITP in any given year ranges from 0 to 27 acres.

The specific physical impacts of 0 to 27 additional acres of developed land per year would depend on the types of development that would occur. However, the impacts would be small in comparison to those already being caused by development elsewhere within the Michigan KBB range.

Without the Comprehensive HCP, development within the Michigan KBB range would be expected to continue, either legally, following other authorization processes, or illegally with regard to the ESA. Even though development conducted under the Comprehensive HCP could have localized impacts to physical features, the type and scale of those impacts would not differ regionally from those that would otherwise occur. Under the Comprehensive HCP, however, adverse impacts to KBB and occupied KBB habitat would be offset by required mitigation measures. Oak savanna that was restored or created as part of mitigation would not be eligible for future development. Thus, adverse impacts of development in one area would be balanced with the habitat protection offered in another (i.e., habitat that could have otherwise been developed legally would be protected).

Climate

Elevated levels of greenhouse gases are contributing to global climate change (Vitousek 1994, Karl and Trenberth 2003), and increased traffic and industrial emissions associated with some types of development (e.g., commercial, residential and public-facility construction) would introduce more of these gases into the atmosphere. Other types of development (e.g.,

agriculture, horticulture and intensive forestry) would not necessarily increase greenhouse gas emissions, and may even help remove some greenhouse gases from the atmosphere.

The climate impacts of a maximum of 27 additional acres of developed land per year are difficult to predict, in part because the impacts would depend on the type of development. In any case, those impacts would be negligible compared to the climate impacts of ongoing development within the region and across the United States (Vitousek 1994, Karl and Trenberth 2003). Moreover, given that the rate of development within the Michigan KBB range would not be expected to be different in the absence of the Comprehensive HCP, any regional climate impacts under this alternative would not differ from those that would otherwise occur.

Topography and Soils

Development could affect topographic and soil features in several ways, including: disruption of the soil profile due to grading, excavation or agriculture; soil compaction due to construction of infrastructure and traffic; alteration of soil chemistry due to hardened-surface runoff, agriculture and horticulture; increased erosion due to increased soil exposure and alteration of flow patterns; and modification of organic-matter levels and nutrient availability. The nature and scope of these impacts would depend on the site-specific details of individual development projects.

Hydrology

With its sandy, well-drained soils and upland locations, oak-savanna habitats are less susceptible than other habitat types to changes in hydrology due to development. The primary sources of impacts associated with development could be: 1) the creation of hardened surfaces that are impervious to precipitation or otherwise alter infiltration rates or flow patterns; and 2) irrigation for agricultural or horticultural purposes. These sources could affect surface runoff, groundwater flow, and groundwater recharge. The nature and scope of these impacts would depend on the site-specific details of individual development projects.

Water Quality

Water quality could be adversely affected by several factors related to development, including hardened-surface runoff, erosion, entrainment of contaminants, and industrial, agricultural and municipal pollution. The nature and scope of impacts would depend on the site-specific details of individual development projects.

Air Quality

Some types of development (e.g., commercial, residential and public-facility construction) could increase vehicle and industrial emissions and thus introduce additional pollutants into the atmosphere. Other types of development (e.g., agriculture, horticulture and intensive forestry) would not necessarily lead to an increase in atmospheric pollutants. The nature and scope of impacts would depend on the site-specific details of individual development projects.

4.1.2 Biological Impacts

Potential biological impacts of habitat management, utility and transportation right-of-way maintenance, and development are described under the following headings.

4.1.2.1 Habitat Management

Many detrimental changes have occurred within the Oak Savanna Ecosystem since European settlement (Abrams 1992). Fire suppression resulted in succession of many open oak savannas to closed-canopy forests. In many cases, this transition occurred within the span of a few decades (e.g., Curtis 1959). Oak savannas that have succeeded to closed-canopy forest often have a diminished graminoid component as a result of reduced light availability at ground level and the accumulation of thick litter layers (Abella et al. 2001). The overstory is often simplified due to selective timber harvest (Minc and Albert 1990). Native floristic diversity is often reduced as a result of fire suppression, sustained livestock grazing, woody encroachment, and the establishment of invasive species such as spotted knapweed (*Centaurea maculosa*) (Cohen 2000, 2001, 2004). These changes in structure and vegetation were accompanied by declines of many wildlife species that are associated with oak savanna (Eagle et al. 2005, O'Connor 2006).

Habitat management would help prevent or reverse many of these detrimental impacts by simulating or replacing the natural processes that historically maintained the Oak Savanna Ecosystem. Thus, habitat management would be used to restore the natural community structure and ecological function of oak savannas.

Fire was the primary mechanism that historically maintained oak savannas in early-successional conditions and provided suitable habitat for many savanna-dependent species (Abrams 1992, O'Connor 2006). Prescribed burning would be used to mimic the effects of fire that occurred under a natural disturbance regime. Prescribed burning would reduce canopy cover and the density of woody stems (Pauly 1997). It would increase light availability at ground level and increase nutrient availability, which would help maintain high levels of graminoid and forb diversity (Tester 1989). It would also reduce litter layers and help prevent the establishment and spread of invasive herbaceous and woody species (Chapman et al. 1995).

Oak savannas often burn patchily, especially when burns are conducted in the spring. This patchiness would provide natural refugia for fire-sensitive species (Chapman et al. 1995). Moreover, only one-third of an occupied KBB habitat patch would be burned within a single calendar year. With this approach, ample refugia would be available to allow re-colonization of burned areas by fire-sensitive species.

Mowing and hydroaxing, manual vegetation removal, chemical vegetation removal, livestock grazing, and soil scarification would be used to mimic certain effects of fire, wild herbivore grazing and browsing, and insect and disease outbreaks (Sinclair et al. 1987, Payne and Bryant 1994, Ritchie et al. 1998, Fuhlendorf and Engle 2001). These activities would suppress herbaceous and woody plants and increase incident sunlight at ground level. Some of these activities would expose mineral soils, reduce organic material, provide sunlit seed beds, and thus promote germination and growth of lupine and nectar plants (Tester 1989, Payne and Bryant

1994, Neary et al. 2005). All of these activities would simulate processes that occurred historically under a natural disturbance regime, and would help counter some of the detrimental impacts that have occurred since European settlement.

Individuals of some oak-savanna species could be sensitive to the effects of mowing and hydroaxing, manual vegetation removal, chemical vegetation removal, livestock grazing, and soil scarification. Accordingly, these activities would generally be conducted during times of the year when adverse impacts could be avoided or minimized. When impacts could not be avoided with timing, only a portion (generally one-third) of an occupied KBB habitat patch would be treated within a single calendar year. This approach would provide refugia from treatment effects and would allow re-colonization of treated areas by oak-savanna species.

The local and regional diversity of plant and wildlife species is not expected to change as a result of the proposed habitat management. Rather, existing diversity would be maintained by preventing losses associated with the degradation of oak savannas. By contrast, if management was not conducted, species diversity would be expected to decline locally or regionally because loss and fragmentation of early-successional habitat patches could result in the extirpation of several species (Eagle et al. 2005).

Oak savannas are not particularly productive environments due to their harsh physical features (e.g., low nutrients, droughty soils); however, many wildlife species frequently use these areas for foraging due to the structural complexity and the presence of specific (e.g., host plants) or high-quality (e.g., acorns) food sources. Management would help maintain productivity at levels normal for a functioning savanna. Without the management of oak-savanna habitat outlined in the Comprehensive HCP, food sources for some species could be lost and productivity could subsequently decline.

Habitat management under the Comprehensive HCP could impact approximately 2,700 acres, whereas the No Action and Reduced-scope HCP alternatives could impact approximately 900 acres and 1,000 acres, respectively. Therefore, threats to biological structure, function, diversity and productivity associated with degradation of oak-savanna habitats would be addressed on a larger scale by the Comprehensive HCP. Within areas of treatment, the biological impacts of habitat management would be similar, if not the same for all alternatives.

4.1.2.2 Utility and Transportation Right-of-Way Maintenance

Activities that involve vegetation manipulation would be conducted for the primary purpose of maintaining rights-of-way, but would be implemented in ways that simulate or replace the natural processes that historically maintained the Oak Savanna Ecosystem. Vegetation manipulation would generally be conducted according to the conditions outlined under 2.2.1.1 (Habitat Management). Thus, the biological impacts of vegetation manipulation within rights-of-way would generally be the same as those outlined under 4.1.2.1 (Habitat Management).

Additional activities conducted for right-of-way maintenance would include infrastructure repair and replacement, and could involve heavy equipment traffic/operation and soil excavation. These activities could result in take of individual plants and animals. However, given their

localized nature, short duration, and associated requirements to minimize adverse effects (see 2.2.1.2), the impacts of these activities would be expected to be smaller in scope than those of vegetation manipulation. These activities would be expected to have negligible impacts on biological structure, function, diversity and productivity.

Right-of-way maintenance under the Comprehensive HCP could impact approximately 800 acres. Under specific authority of the No Action alternative, no impacts due to right-of-way maintenance would occur. Under the Reduced-scope HCP, right-of-way maintenance could impact less than 100 acres. Therefore, threats to biological structure, function, diversity and productivity associated with succession of oak-savanna habitats would be addressed on a larger scale by the Comprehensive HCP. Within areas of treatment, the biological impacts of right-of-way maintenance would be similar, if not the same, for the Comprehensive HCP and the Reduced-scope HCP alternatives.

4.1.2.3 Development

Development activities could include: commercial, residential and public-facility construction; agriculture, horticulture and intensive forestry; and road and utility development.

Generally, as development occurs, some oak-savanna habitats are lost, species diversity declines locally and regionally, and productivity for some species may decline. However, some types of development, such as creation of utility rights-of-way, may have positive biological impacts by creating corridors that link existing occupied habitats or by expanding existing habitat patches.

The specific acreage of occupied KBB habitat that would be impacted by development would be limited by developer interest, zoning, and opportunity and funding for adequate mitigation. Mitigation would be required to ensure activities conducted under the Comprehensive HCP do not cause a long-term net reduction in KBB population sizes, area of occupied KBB habitat, or connectivity of occupied KBB habitat patches. Given an expected time lag between initiation of mitigation and actual replacement of lost occupied KBB habitat, development that would cause occupied KBB habitat on non-Federal land to be reduced by more than 1% at any given time would not be permitted. Given the currently known KBB distribution and this restriction, the amount of occupied KBB habitat that might be developed under specific authority of the ITP in any given year ranges from 0 to 27 acres.

The specific biological impacts of 0 to 27 additional acres of developed land per year would depend on the types of development that would occur. However, the impacts would be small in comparison to those already being caused by development elsewhere within the Michigan KBB range.

No development would be conducted under specific authority of the No Action and Reduced-scope HCP alternatives. However, under those alternatives, development within the KBB range would be expected to continue, either legally, following other authorization processes, or illegally with regard to the ESA. Even though development conducted under the Comprehensive HCP could have localized impacts to biological features, the type and scale of those impacts would not differ regionally from those that would have otherwise occurred. Under the

Comprehensive HCP, however, adverse impacts to KBB and occupied KBB habitat would be offset by required mitigation measures. Oak savanna that was restored or created as part of mitigation would not be eligible for future development. Thus, adverse impacts of development in one area would be balanced with the habitat protection offered in another (i.e., habitat that could have otherwise been developed legally would be protected).

4.1.3 Listed, Proposed and Candidate Species

4.1.3.1 Karner Blue Butterfly

KBB is currently known to occur on approximately 2,700 acres of non-federal land in Michigan (Fettinger 2005). Activities under this alternative could be conducted to maintain KBB throughout that area.

Habitat Management

Under this alternative, habitat management would be conducted to maintain habitat for KBB and other species of concern by maintaining and restoring early successional plant communities. This would be achieved by simulating or replacing the natural processes that historically maintained the Oak Savanna Ecosystem. Thus, KBB habitat features would fluctuate within the natural range of variability. Habitat management would:

- suppress woody and invasive plants
- enhance the diversity and abundance of desirable plants
- increase incident sunlight at ground level
- raise soil pH
- reduce soil nitrogen
- remove excess organic material
- expose mineral soils
- establish lupine and nectar plants where necessary

Together, these activities would increase the coverage of lupine and nectar plants in individual habitat patches. As a result, likelihood of KBB persistence in existing occupied habitat would increase. At a larger scale, this habitat management would maintain connectivity among patches, allowing the persistence of functioning metapopulations.

Habitat management conducted under authority of the ITP would not be expected to either increase or decrease the amount of occupied KBB habitat in Michigan; rather, it would be conducted to help ensure no net loss of occupied KBB habitat on non-federal land. Habitat management performed in unoccupied KBB habitat may yield an increase in KBB distribution, but those activities would not be conducted under authority of the ITP.

Detrimental impacts of habitat management would generally be of short duration and include take of individual butterflies and temporary suppression of desired vegetation. Treated portions of occupied patches would generally be expected to provide suitable habitat and be re-colonized by KBB within two growing seasons following treatment. Given the required treatment

conditions (see 2.2.1), habitat management would not be expected to cause extirpation of KBB within any occupied patch (or metapopulation complex: see general guidelines under 2.2.1.1). Nevertheless, some habitat management prescriptions would result in the mortality of individual KBB. For instance, a prescribed burn through an occupied area would destroy KBB juveniles or eggs. However, even within a burn unit, mortality may not be complete, because burn intensity tends to be uneven across a patch, and some juveniles or eggs at or near ground level may survive. Take of immature forms of insects (especially eggs) is difficult to quantify; therefore, take would be indirectly quantified as acres of occupied KBB habitat that could be impacted.

Based on known occurrences, habitat management could occur on approximately 2,700 acres of occupied KBB habitat. Habitat-management techniques that could result in take would not be applied to more than one-third of any particular occupied habitat patch within a calendar year, except under the exceptions identified in 2.2.1.1. Treatment would be conducted first on the most-degraded third of any occupied patch. This approach would reduce take of KBB, and would facilitate re-colonization of recently treated portions. The entirety of a patch (or metapopulation complex) would not be treated until the initially treated portion benefited from two growing seasons and monitoring confirmed densities of KBB, lupine and flowering nectar plants in the treated portion that exceed pre-treatment levels. Given these restrictions and based on the current amount of known occupied KBB habitat, take could occur on no more than 900 acres in any single calendar year. In practice, treating as many as 900 acres in a single calendar is unlikely for several reasons (e.g., weather conditions and logistical constraints that prevent treatment, lack of complete landowner participation in the HCP, limited financial and staffing resources). If the amount of known occupied KBB habitat on non-federal land increases due to other recovery efforts, take under the ITP could occur on a larger number of acres (i.e., during a single calendar year, habitat management that could result in take could be conducted on one-third of each additional occupied KBB habitat on non-federal land that is discovered or established).

Additional treatment conditions outlined under 2.2.1.1 would further minimize take of KBB. Treatments would be generally confined to those periods when adult KBB were not present (typically August 15 to May 15). The training of all employees and contractors on KBB life history, habitat requirements, and conservation measures would help ensure the required steps were taken to avoid or minimize take of the species. Take would be avoided when mowing/hydroaxing was conducted when at least 4 inches of snow cover the ground. By maintaining a mower cutting height of at least 6 inches above the ground when snow was not present, impacts to lupine and take of eggs and larvae would be minimized. Manual vegetation removal, basal herbicide treatment, and spot herbicide spraying would involve removal of individual targeted plants; thus, potential impacts to lupine and take of KBB would be avoided entirely. Conducting grazing on a short rotation and removing livestock before non-woody vegetation was reduced to an average height of 6 inches would limit trampling of lupine, eggs and larvae.

Utility and Transportation Right-of-Way Maintenance

Based on known occurrences, right-of-way maintenance could occur in approximately 800 acres of occupied KBB habitat (This area is included in the acreage identified for potential habitat

management in 4.1.3.1; that is, total acreage under the Comprehensive HCP currently does not exceed 2,700 acres). Right-of-way maintenance techniques that could result in take would typically be applied to no more than one-third of any particular occupied KBB habitat patch (or metapopulation complex: see general guidelines under 2.2.1.1) within a calendar year. Treatment would first be conducted on the most-degraded third of the patch. This approach would reduce the risk of extirpating KBB and other species of concern, and it would facilitate re-colonization of recently treated portions. The entirety of a patch (or metapopulation complex) would not be treated until the initially treated portion benefited from two growing seasons and monitoring confirmed densities of KBB, lupine and flowering nectar plants that exceed pre-treatment levels. Given these restrictions and based on the current amount of known occupied KBB habitat in rights-of-way, take due to this activity could occur on no more than approximately 270 acres in any single calendar year. If the amount of known occupied KBB habitat in rights-of-way increased due to recovery efforts not conducted under authority of the ITP, right-of-way maintenance under the ITP could occur on a larger number of acres (i.e., one-third of each additional occupied KBB habitat that is discovered or established in rights-of-way could be treated within a single calendar year).

With rare exception, vegetation manipulation for right-of-way maintenance would be conducted according to the same conditions outlined for habitat management under 2.2.1.1. Although these activities would be conducted for the primary purpose of maintaining rights-of-way, the type of impacts to KBB would typically be the same as those caused by habitat management (see above).

Right-of-way vegetation manipulation could have long-term adverse impacts to KBB if it was not conducted in a manner consistent with prescribed conditions. For instance, long-term impacts could result if activities that could result in take occurred outside of prescribed time periods or on more than one-third of any particular occupied habitat patch (or metapopulation complex: see general guidelines under 2.2.1.1). In these situations, a long-term adverse impact to KBB might occur within a particular habitat patch, reducing subpopulation viability and placing it at greater risk of extirpation. Vegetation manipulation not consistent with the prescribed conditions may be permitted under the ITP only if mitigation is conducted according to the required conditions (see 2.2.1.4). The required mitigation would help ensure activities conducted under the Comprehensive HCP do not cause a net loss of KBB numbers, occupied habitat area or habitat connectivity.

A second category of right-of-way maintenance activity includes infrastructure replacement and repair. This activity could cause habitat disturbance due to heavy-equipment operation/traffic and soil excavation. In most cases, lupine areas would be avoided and detrimental impacts to KBB would not occur. If KBB or occupied KBB habitat would be adversely impacted by these activities, mitigation would be required (see 2.2.1.4).

Take due to infrastructure replacement and repair would be avoided or minimized by following the conditions outlined under 2.2.1.2. With rare exception, activities in occupied KBB habitat that could result in take would not occur when adult KBB were present, typically between May 15 and August 15. Activities that could cause take could be conducted during this period only in emergency situations demanding immediate repair of malfunctioning or dangerous infrastructure. In such situations, measures would be taken to minimize and mitigate take of KBB. In non-

emergency situations, areas that contain lupine immediately adjacent to treatment areas would be flagged or otherwise marked; workers would not stockpile materials, park vehicles, or otherwise cause adverse impacts in those areas. Training of all relevant employees and contractors on KBB life history, habitat requirements, and conservation measures would help ensure the required steps are taken to avoid or minimize take of the species.
Measures to avoid or minimize take would also apply to individual maintenance techniques. To the extent possible, truck and heavy-equipment traffic would be limited to existing disturbed areas, such as access roads that run within a right-of-way. When traffic must leave existing routes to conduct maintenance activities, steps would be taken to avoid lupine areas and to minimize the extent of new disturbance. During replacement and repair of infrastructure, existing structures would be dismantled in place or otherwise repaired in ways to avoid impacts to lupine to the extent possible. When soil excavation occurred in lupine areas, efforts would be made to minimize the footprint of the area disturbed. To the extent possible, displaced soils would be deposited away from lupine areas and within the smallest possible side-cast areas needed for temporary storage. Following repair or replacement of structures, excavated areas would be backfilled using the original soil that was deposited in temporary storage areas.

Heavy-equipment traffic/operation and soil excavation that could not avoid disturbance to lupine areas could result in take of KBB. When they would result in take, these activities would be permitted under the Comprehensive HCP only if mitigation in proportion to the impact was conducted according to the requirements outlined in subsection 2.2.1.4 (Mitigation). The required mitigation would help ensure activities conducted under the Comprehensive HCP do not cause a net loss of KBB numbers, occupied habitat area or habitat connectivity.

Development

When conducted in occupied KBB habitat, development can have long-term impacts that, in addition to destroying individual butterflies, convert at least portions of occupied habitat patches into conditions incompatible with sustaining KBB. However, some types of development, such as creation of utility rights-of-way, can have positive impacts on KBB by creating corridors that link existing occupied habitats or by expanding existing habitat patches.

Development in occupied KBB habitat could be specifically authorized by the ITP. However, such development could not proceed until project planning demonstrated that adverse impacts would be adequately avoided or minimized and mitigated according to the requirements outlined in 2.2.1.3 and 2.2.1.4.

When it would reduce take, development activities would not be allowed between May 15 and August 15, to avoid impacts to adult KBB. In adjacent suitable habitat not being developed, lupine would be flagged or otherwise marked prior to development activities; workers would not stockpile materials, park vehicles, or otherwise cause adverse impacts in those areas. Training of all relevant employees and contractors on KBB life history, habitat requirements, and conservation measures would help ensure the required steps are taken to avoid or minimize take of the species.

Required mitigation would help ensure no net loss of KBB numbers, occupied habitat area or habitat connectivity due to development authorized under this alternative. Restoration and creation of a total area greater than that which is developed, as required for mitigation, would help meet this requirement; if all restoration is successful, it would yield a net increase in habitat for KBB and other oak-savanna species. Furthermore, mitigation requirements would remove the option of developing in new KBB habitat that is restored or created and subsequently protected in other areas.

Given the mitigation requirements and the currently known KBB distribution, the amount of occupied KBB habitat that might be developed under specific authority of the ITP in any given year ranges from 0 to 27 acres. The extent of KBB take on any developed acres would depend on the types of development that would occur there.

4.1.3.2 Other Federally Listed and Candidate Species

Listed Species

Projects conducted under authority of the ITP would not take or otherwise adversely affect federally listed species other than KBB. Prior to implementation of any project, the potential presence of federally listed species would be evaluated based on review of the Biotics data base (MNFI 2007), consideration of known species distributions, assessment of current habitat characteristics, and site surveys as necessary. Occupied KBB habitat does not typically overlap with that of other federally listed species in Michigan; thus, the potential for impacts to those species would be small. In the rare event any federally listed species occurred or would be likely to occur in or near a project area while it was listed, the project could proceed only if it would not adversely affect the species. Adverse effects might be avoided by reconfiguring activity areas, adjusting timing of activities, or modifying the nature of activities. Projects that could not avoid adverse effects would not be authorized under the ITP.

Candidate Species

Certain habitat-management and right-of way maintenance activities conducted under authority of the ITP could result in injury or mortality to a small number of eastern massasauga rattlesnakes. For example, individuals could be killed or injured during prescribed burning, mowing, or by heavy-equipment traffic. However, only a small subset of occupied KBB habitat is likely to be occupied by massasaugas, and the conditions required to avoid or minimize take of KBB would also generally minimize adverse impacts to massasaugas. In fact, management activities conducted from late fall to early spring should avoid impacts entirely because massasaugas would be hibernating in lowland areas during that time. Consequently, habitat management and right-of-way maintenance conducted under the ITP would not jeopardize the continued existence of the species. Indeed, activities that maintained KBB habitat would usually improve conditions for massasaugas as well.

Development has occurred and is currently occurring within the overlapping range of KBB and the eastern massasauga rattlesnake, such that the landscape is becoming increasingly fragmented. Under the Comprehensive HCP, regional rates of development and fragmentation would not be

expected to differ from those that would have otherwise occurred. Development in occupied KBB habitat could be specifically authorized by the ITP; however, required mitigation would remove the option of developing in newly restored or created oak savanna in other areas. Probability of massasauga presence would not be expected to be different between areas that would be developed and areas that would be protected by mitigation measures. Thus, the threat posed by development in one area could be offset by the habitat protection offered in another (i.e., massasauga habitat that would have otherwise been developed legally would be protected). This protection could be important for the viability of the eastern massasauga in Michigan, given that neither federal nor state law protects the species against development impacts. In addition, mitigation requirements would help ensure no net increase in fragmentation of occupied KBB habitat and thus, no reduction in habitat connectivity for the eastern massasauga rattlesnake where it occurs with KBB.

4.1.3.3 Michigan State-listed Species

At least 33 species classified as threatened or endangered under Michigan law could occur in or near occupied KBB habitat (Tables 5 and 6). Prior to implementation of any project under the Comprehensive HCP, the potential presence of these species would be evaluated based on review of the Biotics data base (MNFI 2007), consideration of known species distributions, assessment of current habitat characteristics, and site surveys as necessary. If a state-listed species was determined to be present in a project area, proposed activities potentially resulting in take could proceed only if authorized under the provisions of the Michigan Endangered Species Protection Law (Public Act 451 of 1994, Part 365).

Many of the state-listed species that co-occur with KBB are also dependent upon early-successional conditions and therefore require the same management techniques to mimic natural disturbance. Thus, where other state-listed species were present, management could still occur, following consideration of any special requirements for individual species. Habitat-management activities performed to maintain occupied KBB habitat would generally improve conditions for these savanna-associated species.

Some habitat-management techniques could result in take of some state-listed species. For example, some individuals of state-listed species could be killed or injured during prescribed burning, mowing, or by heavy-equipment traffic. However, the habitat degradation (e.g., woody succession, invasive species encroachment) caused by lack of management would be more harmful than any take caused by management. Many of the conditions required to avoid or minimize take of KBB would also generally minimize adverse effects to other early-successional species.

Based on known occurrences of KBB, habitat management could occur on approximately 2,700 acres of occupied KBB habitat. Habitat-management techniques that could result in take of KBB would not be applied to more than one-third of any particular occupied habitat patch within a calendar year, except under the exceptions identified in 2.2.1.1. Treatment would be conducted first on the most-degraded third of any occupied patch. This approach would reduce the risk of adversely impacting early-successional species and would facilitate re-colonization of recently treated portions. Given treatment restrictions and based on the current amount of known KBB

occupied habitat, activities that could result in take of a state-listed species could occur on no more than 900 acres in any single calendar year. Only a small subset of occupied KBB habitat is likely to be occupied by any particular state-listed species.

4.1.4 Cultural Resources

Before implementing any soil-disturbance activities covered under the ITP, management partners would consult with the SHPO and the THPO, as appropriate, to ascertain whether known cultural or paleontological resources could be threatened. In the event a proposed project would potentially threaten cultural or paleontological resources, management partners would modify proposed activities to eliminate any threats before proceeding with implementation. In addition, if previously unknown cultural or paleontological relicts were discovered during implementation of any particular project, the project would be suspended immediately and consultation with the SHPO/THPO would be initiated.

4.1.5 Environmental Justice

The Executive Order on Environmental Justice issued by President Clinton on February 11, 1994 requires all federal agencies to assess the impacts of Federal actions with respect to environmental justice. The Executive Order states that to the extent practicable and permitted by law, neither minority nor low-income populations may receive disproportionately large and adverse impacts as a result of a proposed project.

Neither minority nor low-income populations are known to be disproportionately represented near oak-savanna habitats. No environmental justice issues exist for this alternative. No minority or low-income populations would be displaced or negatively affected in any other way by this alternative.

4.1.6 Cumulative Impacts

Cumulative impacts are considered from a historical and contemporary perspective. Historic cumulative impacts occurred prior to implementation of the activities outlined under this alternative, whereas contemporary cumulative impacts include additional impacts that could result from implementation of those activities.

4.1.6.1 Historic Cumulative Impacts

The Oak Savanna Ecosystem likely reached its greatest extent in North America during the warm, dry hypsithermal period, peaking between 4,000 and 6,000 years ago (Cohen 2004). Although little is known from this period, it is reasonable to conclude that oak savanna was both extensive and more contiguous compared with its current occurrence and character. Frequent fires, wind, wild herbivores, and insect and disease outbreaks shaped and maintained the early-successional character of this ecosystem (Nuzzo 1986, Grundel et al. 1998, Ritchie et al. 1998, Fuhlendorf and Engle 2001).

During the centuries that followed the hypsithermal period until the advent of Europeans on the continent around 1500 A.D., the climate gradually became cooler and more humid. Again, little is known from this period, but it is reasonable to conclude that oak savanna progressively declined, possibly by an order of magnitude, and became less contiguous as a result of these climatic changes. With the decline of oak savanna, KBB would have been subjected to habitat that was less extensive and more fragmented.

During this period, Native Americans strongly influenced the frequency of fires in savanna habitats (Cohen 2004, O'Connor 2006). Native Americans set fires deliberately for a variety of purposes, and they sometimes set fires accidentally (Cohen 2004, O'Connor 2006). These activities created early-successional habitats that would have been used by many savanna-associated species.

European settlement of the continent in the 1500s resulted in the introduction of human-borne diseases. These diseases spread quickly across the continent and had a profound effect on Native Americans, reducing their numbers continent-wide to a fraction of what they were prior to European settlement (Denevan 1992a). As a result, the substantial influence of Native Americans (e.g., prescribed fire) on maintenance of early-successional areas such as oak savannas sharply diminished (Denevan 1992b, Dickman and Leefers 2003).

With European settlement of Michigan in the mid 1800s, many savannas were logged and then converted to agriculture (Dickman and Leefers 2003). Some of this acreage was eventually abandoned because it was not able to support continued farming, and subsequently reverted back to degraded savanna. Many of these areas have now succeeded to forest, and in many of the savannas that remain, soil disturbance and introduction of exotic plant species have marginalized habitat suitability for many savanna-associated species.

Oak savannas in Michigan were subjected to another impact beginning in the 1920s as broad-scale control of wildfires began (Abrams 1992). This practice sharply reduced the scope and frequency of fire on the landscape, further marginalizing a force that historically maintained the early-successional conditions characteristic of oak savannas. Fire suppression resulted in succession of many open oak savannas to closed-canopy forests. In many cases, this transition occurred within the span of a few decades (e.g., Curtis 1959). Oak savannas that have succeeded to closed-canopy forest often have a diminished graminoid component as a result of reduced light availability at ground level and the accumulation of thick litter layers (Abella et al. 2001). The overstory is often simplified due to selective timber harvest (Minc and Albert 1990). Native floristic diversity is often reduced as a result of fire suppression, sustained livestock grazing, woody encroachment, and the establishment of invasive species such as spotted knapweed (Cohen 2000, 2001, 2004). These changes in structure and vegetation were accompanied by declines of many wildlife species that are associated with oak savanna (Eagle et al. 2005, O'Connor 2006).

The period from the 1920s to the present in Michigan can be characterized by gradually declining acreage in agriculture and forestry, increasing land-use conversion to residential, commercial and industrial uses, and increasing fragmentation. These changes have caused additional decreases in high-quality savanna and increased degradation and isolation of savanna

remnants. As a result, high-quality oak savanna has been reduced to less than 1% of its pre-European settlement extent (Comer et al. 1995, Cohen 2004).

Taken together, these historic cumulative impacts have had a substantial effect on both the Oak Savanna Ecosystem and its associated plant and animal species. They have also resulted in cumulative degradation in water quality, altered hydrologic patterns, changes in many soil features, and some localized degradation in air quality. The scale and degree of these impacts vary locally and regionally.

These historic cumulative impacts are the same for all of the alternatives and represent a common baseline from which contemporary cumulative impacts specific to each alternative can be assessed.

4.1.6.2 Contemporary Cumulative Impacts

Habitat management under the Comprehensive HCP would be conducted primarily to counter historic and ongoing cumulative impacts that threaten the persistence of oak-savanna habitats, KBB and other oak-savanna species. These ongoing, cumulative impacts include habitat loss and fragmentation due to land conversion (e.g., agriculture, forestry, industrial, commercial and residential development, right-of-way development), vegetative succession following removal of fire from the landscape, and the proliferation of invasive species. These cumulative impacts have contributed to regional loss and degradation of oak-savanna communities and declines in a large number of plant and animal species that depend upon them. Also impacted as a result of these ongoing, cumulative impacts are the ecological contributions of oak savannas. These impacts include a decline in species diversity and productivity. The decline in oak-savanna habitats and subsequent loss of associated species in Michigan contribute to regional declines that are occurring throughout the Midwest (Leach and Ross 1995, USFWS 2003a).

Habitat management under the Comprehensive HCP would have no known cumulative impacts because it would generally counter the ongoing impacts described above, have impacts that would be temporary, cause levels of disturbance within the natural range of variability for oak savannas, and follow guidelines developed to minimize adverse effects to KBB and other species of concern. Because habitat management would occur in upland oak-savanna sites, mimic natural disturbance regimes, and have only temporary impacts that would be within the natural range of variability, there should be negligible cumulative impacts on climate, topography and soils, hydrology, water quality and air quality.

Similar to habitat management, utility and transportation right-of-way maintenance under the Comprehensive HCP would also tend to counter the ongoing, cumulative impacts of vegetative succession and invasive species proliferation. For most right-of way maintenance activities, impacts would be temporary, within the natural range of variability, and carefully contained by following guidelines developed to minimize adverse effects to KBB and other species of concern. Therefore, they should not contribute to adverse cumulative impacts on oak savannas and related biological components, including KBB and other species of concern. When guidelines outlined in 2.2.1.1 were not followed during vegetation manipulation, or when heavy-equipment operation/traffic or soil excavation occurred in occupied KBB habitat, impacts would

be minimal and temporary, or mitigation would be required to counter the impacts. Therefore, these activities would be expected to provide negligible or no overall contribution to adverse cumulative impacts on oak savannas, KBB and other related biological components. Similarly, there should be negligible cumulative impacts on climate, topography and soils, hydrology, water quality and air quality.

Development activities specifically conducted under the Comprehensive HCP could result in the destruction of some occupied KBB habitats; therefore, they could impact existing oak savannas and related biological components, including KBB and other species of concern. Development could also have some impacts on climate, topographic and soil features, hydrology, water quality and air quality. However, those impacts would not be expected to differ from those already occurring within the KBB range. Moreover, mitigation would be required for all development that resulted in long-term adverse impacts to KBB or occupied KBB habitat. If the mitigation proposed would not, at minimum, replace the area and function of the occupied KBB habitat that would be lost, the proposed development would not be allowed under the Comprehensive HCP. Impacts to other species of concern also would be considered in the mitigation process. Moreover, because mitigation areas would not be developed, overall development rates within the region would not be expected to differ from current rates. Therefore, net cumulative impacts of development specifically authorized by the ITP on oak savannas, KBB, other biological features, climate, topography and soils, hydrology, water quality and air quality would be expected to be negligible.

The Comprehensive HCP would offer the greatest potential for collaboration among owners of occupied KBB habitat. It would therefore result in improved coordination in efforts to conserve KBB populations and would allow for better tracking of KBB populations. It would also maximize exposure to conservation issues related to KBB, because all non-Federal occupied KBB habitat and the widest diversity of partners would be eligible for participation. This exposure would be expected to provide more protection for KBB, more information on KBB distribution, and more opportunities for pro-active management.

4.2 Alternative B: No Action

An ITP would not authorize activities conducted specifically under this alternative. Activities resulting in legal KBB take would include: 1) KBB habitat management authorized by existing 10(a)(1)(A) permits issued to the Michigan DNR and the TNC, 2) habitat management conducted under the Michigan LIP; and 3) any development or right-of-way maintenance authorized separately under existing federal, state and local regulations.

If the LIP was provided sufficient resources, it could hypothetically conduct management on all occupied KBB habitat on private lands in Michigan. Thus, habitat management conducted under the No Action alternative could involve almost as much land as the Comprehensive HCP alternative (i.e., approximately 2,700 acres). In practice, however, this alternative would be limited initially to approximately 900 acres of occupied KBB habitat. This acreage would increase through time as the LIP continued to include additional parcels in its management.

4.2.1 Physical Impacts

Potential physical impacts of habitat management, utility and transportation right-of-way maintenance, and development are described under the following headings. Physical features considered include climate, topography and soils, hydrology, water quality and air quality.

4.2.1.1 Habitat Management

Habitat management would be conducted to maintain habitat for KBB and other species of concern by maintaining and restoring early-successional plant communities. This would be achieved by simulating or replacing the natural processes that historically maintained the Oak Savanna Ecosystem.

Habitat-management techniques and conditions would be similar for all the alternatives (cf. 2.2.1.1, 2.2.2.1 and 2.2.3.1). Therefore, where habitat management occurred under the No Action alternative, the character of the impacts to climate, topography and soils, hydrology, water quality and air quality would be expected to be similar to, if not the same as, those outlined under 4.1.1.1.

Compared to those of the Comprehensive HCP, the physical impacts due to habitat management under the No Action alternative would occur on a smaller area. Habitat management under the Comprehensive HCP could impact approximately 2,700 acres, whereas habitat management under the No Action alternative could impact approximately 900 acres. Thus, habitat management under the No Action alternative would simulate natural disturbance on a smaller scale, and fewer habitats would experience the types of processes that historically shaped their features.

4.2.1.2 Utility and Transportation Right-of-Way Maintenance

Right-of-way maintenance in occupied KBB habitat would not be specifically authorized under this alternative. However, maintenance would still be necessary to preserve the primary functions of existing rights-of-way on approximately 800 acres of occupied KBB habitat. Legal, incidental take associated with maintenance of rights-of-way would therefore require authorization on an individual, project-by-project basis under existing Federal, State and local regulations.

Many techniques used to maintain rights-of-way can be implemented in ways that simulate or replace the natural processes that historically shaped physical features of oak savannas. Therefore, lack of authorization for right-of-way maintenance on approximately 800 acres of occupied KBB habitat would preclude mechanisms that simulate natural processes that are currently missing from these habitats.

4.2.1.3 Development

Development in occupied KBB habitat would not be specifically authorized under this alternative. However, development would be expected to continue within the KBB range. Legal, incidental take associated with development in occupied KBB habitat would require authorization on an individual, project-by-project basis under existing federal, state and local regulations.

Regional and local rates of development under this alternative would not be expected to differ from those that would occur under the other alternatives. The No Action alternative would not authorize development of occupied KBB habitat, but it would not prevent development in unoccupied habitat that would have otherwise been restored, created and subsequently protected according to mitigation requirements under the Comprehensive HCP. Therefore, the character and scope of physical impacts would not be expected to differ between the No Action and Comprehensive HCP alternatives.

Where development occurred, its general impacts on climate, topography and soils, hydrology, water quality and air quality would be the same as those outlined under 4.1.1.3.

4.2.2 Biological Impacts

Potential biological impacts of habitat management, utility and transportation right-of-way maintenance, and development are described under the following headings.

4.2.2.1 Habitat Management

Many detrimental changes have occurred within the Oak Savanna Ecosystem since European settlement (Abrams 1992). Fire suppression resulted in succession of many open oak savannas to closed-canopy forests. In many cases, this transition occurred within the span of a few decades (e.g., Curtis 1959). Oak savannas that have succeeded to closed-canopy forest often have a diminished graminoid component as a result of reduced light availability at ground level and the accumulation of thick litter layers (Abella et al. 2001). The overstory is often simplified due to selective timber harvest (Minc and Albert 1990). Native floristic diversity is often reduced as a result of fire suppression, sustained livestock grazing, woody encroachment, and the establishment of invasive species such as spotted knapweed (Cohen 2000, 2001, 2004). These changes in structure and vegetation were accompanied by declines of many wildlife species that are associated with oak savanna (Eagle et al. 2005, O'Connor 2006).

Where it occurred under this alternative, habitat management would help prevent or reverse many of these detrimental impacts by simulating or replacing the natural processes that historically maintained the Oak Savanna Ecosystem. Thus, habitat management would be used to restore the natural community structure and ecological function of oak savannas. Although they would occur on a smaller scale, the biological impacts of individual habitat management techniques would be virtually the same as those described under (4.1.2.1).

The diversity of plant and wildlife species would be unlikely to change in areas where habitat management would be conducted under this alternative. Rather, existing diversity would be maintained by preventing losses associated with the degradation of oak savannas. By contrast, where management would not be conducted, species diversity would be expected to decline locally or regionally because loss and fragmentation of early-successional habitat patches could result in the extirpation of several species (Eagle et al. 2005). Many species frequently use oak savanna for parts of their life stages and could undergo population declines in habitats not managed under this alternative.

Oak savannas are not particularly productive environments due to their harsh physical features (e.g., low nutrients, droughty soils); however, many wildlife species frequently use these areas for foraging due to the structural complexity and the presence of specific (e.g., host plants) or high-quality (e.g., acorns) food sources. Habitats that would be managed under this alternative would be expected to maintain productivity at levels normal for a functioning savanna. In areas where management would not be conducted, food sources for some species could be lost and productivity could subsequently decline.

Habitat management under the Comprehensive HCP alternative could involve approximately 2,700 acres, whereas habitat management under the No Action alternative could involve approximately 900 acres. Thus, habitat management under the latter alternative would simulate natural disturbance on a smaller scale, and fewer habitats would experience the types of processes that historically shaped their biological features. That is, the No Action alternative would not address biological threats associated with succession of oak-savanna habitats on approximately 1,800 acres of occupied KBB habitat on non-federal land.

4.2.2.2 Utility and Transportation Right-of-Way Maintenance

Right-of-way maintenance in occupied KBB habitat would not be specifically authorized under this alternative. However, maintenance would still be necessary to preserve the primary functions of existing rights-of-way on approximately 800 acres of occupied KBB habitat. Legal, incidental take associated with maintenance of rights-of-way would therefore require authorization on an individual, project-by-project basis under existing federal, state and local regulations.

Many techniques used to maintain rights-of-way can be implemented in ways that simulate or replace the natural processes that historically influenced community structure, diversity and productivity. Therefore, lack of authorization for right-of-way maintenance on approximately 800 acres of occupied KBB habitat would prevent mechanisms that simulate natural processes that are currently missing from these habitats.

4.2.2.3 Development

Development in occupied KBB habitat would not be specifically authorized under this alternative. However, development would be expected to continue within the KBB range. Legal, incidental take associated with development in occupied KBB habitat would require

authorization on an individual, project-by-project basis under existing Federal, State and local regulations.

Regional and local rates of development under this alternative would not be expected to differ from those that would occur under the other alternatives. The No Action alternative would not authorize development of occupied KBB habitat, but it would not prevent development in unoccupied habitat that would have otherwise been restored, created and subsequently protected according to mitigation requirements under the Comprehensive HCP. Therefore, the amount of available oak-savanna habitat would not be expected to differ between the No Action and Comprehensive HCP alternatives.

Where development occurred, its general biological impacts would be the same as those outlined under 4.1.2.3.

4.2.3 Listed, Proposed and Candidate Species

4.2.3.1 Karner Blue Butterfly

KBB is currently known to occur on approximately 2,700 acres of non-federal land in Michigan (MNFI 2007). The No Action alternative could maintain KBB on approximately 900 of those acres. Whereas the Comprehensive HCP alternative could be implemented to help ensure no net loss of occupied KBB habitat on non-Federal land, the No Action alternative would be expected to result in a loss of 1,800 acres of occupied KBB habitat on non-federal land, due to lack of legal authority to adequately manage it.

Habitat management

Where it would be conducted under this alternative, habitat management would maintain habitat for KBB and other species of concern by maintaining and restoring early successional plant communities. This would be achieved by simulating or replacing the natural processes that historically maintained the Oak Savanna Ecosystem. Thus, KBB habitat features would fluctuate within the natural range of variability. Habitat management would:

- suppress woody and invasive plants
- enhance the diversity and abundance of desirable plants
- increase incident sunlight at ground level
- raise soil pH
- reduce soil nitrogen
- remove excess organic material
- expose mineral soils
- establish lupine and nectar plants where necessary

Together, these activities would increase the coverage of lupine and nectar plants in individual habitat patches. As a result, likelihood of KBB persistence in existing occupied habitat would increase.

Detrimental impacts of habitat management would generally be of short duration and include take of individual butterflies and temporary suppression of desired vegetation. Treated portions of occupied patches would generally be expected to provide suitable habitat and be re-colonized by KBB within two growing seasons following treatment. Given the required treatment conditions (see 2.2.2.1), habitat management would not be expected to cause extirpation of KBB within any occupied patch. Nevertheless, some habitat management prescriptions would result in the mortality of individual KBB. For instance, a prescribed burn through an occupied area would destroy KBB juveniles or eggs. However, even within a burn unit, mortality may not be complete, because burn intensity tends to be uneven across a patch, and some juveniles or eggs at or near ground level may survive. Take of immature forms of insects (especially eggs) is difficult to quantify; therefore, take would be indirectly quantified as acres of occupied KBB habitat that could be impacted.

Under this alternative, habitat management could occur in approximately 900 acres of occupied KBB habitat. Habitat-management techniques would typically not be applied to more than one-third of any particular occupied KBB habitat patch within a calendar year. Therefore, take of KBB could occur on approximately 300 acres in any single calendar year.

Take would be minimized by following the treatment conditions outlined in 2.2.2.1. Treatment would first be conducted on the most-degraded third of a patch. This approach would reduce the risk of extirpating KBB and other species of concern, and it would facilitate re-colonization of recently treated portions. Treatments would be generally confined to those periods when adult KBB were not present (typically August 15 to May 15). Take would be avoided when mowing/hydroaxing was conducted when at least 4 inches of snow cover the ground. By maintaining a mower cutting height of at least 6 inches above the ground when snow was not present, impacts to lupine and take of eggs and larvae would be minimized. Manual vegetation removal, basal herbicide treatment, and spot herbicide spraying would involve removal of individual targeted plants; thus, potential impacts to lupine and take of KBB would be avoided entirely. Conducting grazing on a short rotation and removing livestock before non-woody vegetation was reduced to an average height of 6 inches would limit trampling of lupine, eggs and larvae.

On the roughly 1,800 acres of occupied KBB habitat on non-Federal land where management would not be conducted under this alternative, habitat succession would probably cause conditions to become unsuitable for wild lupine and KBB, and population extirpations could result.

Utility and Transportation Right-of-Way Maintenance

Right-of-way maintenance in occupied KBB habitat would not be specifically authorized under this alternative. However, maintenance would still be necessary to preserve the primary functions of existing rights-of-way on approximately 800 acres of occupied KBB habitat. Legal, incidental take associated with maintenance of rights-of-way would therefore require authorization on an individual, project-by-project basis under existing federal, state and local regulations.

Many techniques used to maintain rights-of-way can be implemented in ways that simulate or replace the natural processes that historically provided suitable conditions for wild lupine and KBB. Therefore, lack of authorization for maintenance of rights-of way on approximately 800 acres of occupied KBB habitat would prevent mechanisms that could help maintain KBB populations.

Development

Development in occupied KBB habitat would not be specifically authorized under this alternative. However, development would be expected to continue within the KBB range. Legal, incidental take associated with development in occupied KBB habitat would require authorization on an individual, project-by-project basis under existing federal, state and local regulations.

Regional and local rates of development under this alternative would not be expected to differ from those that would occur under the other alternatives. The No Action alternative would not authorize development of occupied KBB habitat, but it would not prevent development in unoccupied habitat that would have otherwise been restored, created and subsequently protected according to mitigation requirements under the Comprehensive HCP. Therefore, the amount of occupied KBB habitat would not be expected to differ between the No Action and Comprehensive HCP alternatives.

Where development occurred in occupied KBB habitat, it would typically have long-term impacts that, in addition to destroying individual butterflies, convert at least portions of occupied habitat patches into conditions incompatible with sustaining KBB. The average impacts per acre of development could be more severe under the No Action alternative than under the Comprehensive HCP alternative, because development under the No Action alternative would not necessarily be conducted according to the conditions under 2.2.1.3 and 2.2.1.4 that are designed to avoid or minimize and mitigate impacts to KBB and its habitat.

4.2.3.2 Other Federally Listed and Candidate Species

Listed Species

No projects authorized under this alternative would be 'likely to adversely affect' federally listed species other than KBB. Prior to implementation of any project, the potential presence of federally listed species would be evaluated based on review of the Biotics data base (Michigan Natural Features Inventory 2007), consideration of known species distributions, assessment of current habitat characteristics, and site surveys as necessary. Occupied KBB habitat does not typically overlap with that of other federally listed species; thus, the potential for impacts to these species would be small. Indeed, this alternative would involve one-third the habitat that could be involved under the Comprehensive HCP alternative; thus, this alternative would have a smaller chance of impacting habitat occupied by other federally listed species. In the rare event any federally listed species occurred or would be likely to occur in or near a project area while it was listed, the project could proceed only if it would not adversely affect the species. Adverse

effects might be avoided by reconfiguring activity areas, adjusting timing of activities, or modifying the nature of activities.

Candidate Species

Certain habitat-management activities conducted under authority of this alternative could result in injury or mortality to a small number of eastern massasauga rattlesnakes. For example, individuals could be killed or injured during prescribed burning or mowing. However, only a small subset of occupied KBB habitat is likely to be occupied by massasaugas. The chance of managing habitat occupied by massasauga would be smaller under this alternative than under the Comprehensive HCP alternative, because a smaller amount of habitat would be involved. Also, the conditions required to avoid or minimize take of KBB would also generally minimize adverse impacts to massasaugas. In fact, management activities conducted from late fall to early spring should avoid adverse impacts entirely because massasaugas would be hibernating in lowland areas during that time. Consequently, habitat management conducted under this alternative would not jeopardize the continued existence of the species. Indeed, activities that maintained KBB habitat would usually improve conditions for massasaugas as well.

Development has occurred and is currently occurring within the overlapping range of KBB and eastern massasauga rattlesnake, such that the landscape is becoming increasingly fragmented. Development in occupied KBB habitat would not be specifically authorized under this alternative, but regional rates of development and fragmentation would not be expected to differ from those that would occur under the other alternatives.

4.2.3.3 Michigan State-listed Species

At least 33 species classified as threatened or endangered under Michigan law could occur in or near occupied KBB habitat (Tables 5 and 6). Prior to implementation of any project under this alternative, the potential presence of these species would be evaluated based on review of the Biotics data base (Michigan Natural Features Inventory 2007), consideration of known species distributions, assessment of current habitat characteristics, and site surveys as necessary. The chance of managing habitat occupied by any of these species would be smaller under this alternative than under the Comprehensive HCP alternative, because a smaller amount of habitat would be involved. If a state-listed species was determined to be present in a project area, proposed activities potentially resulting in take could proceed only if authorized under the provisions of the Michigan Endangered Species Protection Law (Public Act 451 of 1994, Part 365).

Many of the state-listed species that co-occur with KBB are also dependent upon early-successional conditions and therefore require the same management techniques to mimic natural disturbance. Thus, where other state-listed species were present, management could still occur, following consideration of any special requirements for individual species. Habitat management activities performed to maintain occupied KBB habitat would generally improve conditions for these savanna-associated species.

Some habitat management techniques could result in take of some state-listed species. For example, some individuals of state-listed species could be killed or injured during prescribed burning or mowing. However, the habitat degradation (e.g., woody succession, invasive species encroachment) caused by lack of management would be more harmful than any take caused by management. Many of the conditions required to avoid or minimize take of KBB would also generally minimize adverse effects to other early-successional species.

Given treatment restrictions and the geographic scope of this alternative, activities that could result in take of a state-listed species could occur on no more than 300 acres in any single calendar year. Only a small subset of occupied KBB habitat is likely to be occupied by any particular state-listed species.

In areas where management would not occur under this alternative, succession may render habitats unsuitable for certain threatened or endangered savanna-dependent species, which could cause the extirpation of local populations.

4.2.4 Cultural Resources

Before implementing any soil-disturbance activities covered under this alternative, management partners would consult with the SHPO and the THPO, as appropriate, to ascertain whether known cultural or paleontological resources could be threatened. In the event a proposed project would potentially threaten cultural or paleontological resources, management partners would modify proposed activities to eliminate any threats before proceeding with implementation. In addition, if previously unknown cultural or paleontological relicts were discovered during implementation of any particular project, the project would be suspended immediately and consultation with the SHPO/THPO would be initiated.

4.2.5 Environmental Justice

The Executive Order on Environmental Justice issued by President Clinton on February 11, 1994 requires all federal agencies to assess the impacts of federal actions with respect to environmental justice. The Executive Order states that to the extent practicable and permitted by law, neither minority nor low-income populations may receive disproportionately large and adverse impacts as a result of a proposed project.

Neither minority nor low-income populations are known to be disproportionately represented near oak-savanna habitats. No environmental justice issues exist for this alternative. No minority or low-income populations would be displaced or negatively affected in any other way by this alternative.

4.2.6 Cumulative Impacts

Cumulative impacts are considered from a historical and contemporary perspective. Historic cumulative impacts occurred prior to implementation of the activities outlined under this alternative, whereas contemporary cumulative impacts include additional impacts that could result from implementation of those activities.

4.2.6.1 Historic Cumulative Impacts

Historic cumulative impacts are described under 4.1.6.1.

4.2.6.2 Contemporary Cumulative Impacts

Limited habitat management would be conducted primarily to counter localized historic and ongoing cumulative impacts that threaten the persistence of oak-savanna habitats, KBB and other oak-savanna species. These ongoing, cumulative impacts include habitat loss and fragmentation due to land conversion (e.g., agriculture, forestry, industrial, commercial and residential development, right-of-way development), vegetative succession following removal of fire from the landscape, and the proliferation of invasive species. These cumulative impacts have contributed to regional loss and degradation of oak-savanna communities and declines in a large number of plant and animal species that depend upon them. Also impacted as a result of these ongoing, cumulative impacts are the ecological contributions of oak savannas. These impacts include a decline in species diversity and productivity. The decline in oak-savanna habitats and subsequent loss of associated species in Michigan contribute to regional declines that are occurring throughout the Midwest (Leach and Ross 1995, USFWS 2003a).

Habitat management would have no known cumulative impacts because it would generally counter the ongoing impacts described above, have impacts that would be temporary, cause levels of disturbance within the natural range of variability for oak savannas, and follow guidelines developed to minimize adverse effects to KBB and other species of concern. Because habitat management would occur in upland oak-savanna sites, mimic natural disturbance regimes, and have only temporary impacts that would be within the natural range of variability, there should be negligible cumulative impacts on climate, topography and soils, hydrology, water quality and air quality.

Utility and transportation right-of-way maintenance that could help counter the ongoing, cumulative impacts of vegetative succession and invasive species proliferation would not be specifically authorized under this alternative. This maintenance would probably continue in some occupied KBB habitats, but it would require authorization on an individual, project-by-project basis under existing federal, state, and local regulations. Proposed mitigation associated with individual right-of-way maintenance projects may not be well-coordinated with statewide KBB conservation efforts.

Similarly, development in occupied KBB habitat would not be coordinated with statewide KBB conservation efforts and would require authorization on an individual, project-by-project basis under existing Federal, State and local regulations. Without a process to coordinate development with statewide efforts to conserve KBB, there would be fewer opportunities for public exposure to statewide KBB conservation issues, and therefore fewer opportunities for acquisition of KBB distribution information and pro-active KBB habitat management and protection.

Given the limited geographic scope (approximately 900 acres) of this alternative, the accumulation of adverse impacts due to land-use patterns, interruption of natural process, and

introduction of invasive species would generally continue in many occupied KBB habitats. Activities that could counter adverse cumulative impacts could be conducted on only one-third of known, occupied KBB habitat on non-federal land.

4.3 Alternative C: Reduced-scope HCP

Unlike the Comprehensive HCP alternative, this alternative could involve only a subset of occupied KBB habitats occurring on non-federal land within Michigan. This subset would be limited to land owned and managed by state agencies, selected county and local governments, and conservation-oriented non-governmental organizations. Whereas the Comprehensive HCP could address conservation needs on approximately 2,700 acres of occupied KBB habitat, the Reduced-scope HCP could involve approximately 900 acres of occupied habitat (An additional 100 acres of occupied KBB habitat would be managed under the LIP). The Reduced-scope HCP would not address KBB-related issues on lands owned by private transportation and utility companies, private-land developers, and other private landowners.

Activities resulting in KBB take that would be addressed in a Reduced-scope HCP fall into two general categories: habitat management and public right-of-way maintenance. Right-of-way maintenance would occur only on lands managed by state, county, and local governments.

4.3.1 Physical Impacts

Potential physical impacts of habitat management and public right-of-way management are described under the following headings. Physical features considered include climate, topography and soils, hydrology, water quality, and air quality.

4.3.1.1 Habitat Management

Habitat management would be conducted to maintain habitat for KBB and other species of concern by maintaining and restoring early-successional plant communities. This would be achieved by simulating or replacing the natural processes that historically maintained the Oak Savanna Ecosystem.

Habitat-management techniques and conditions would be similar for all the alternatives (cf. 2.2.1.1, 2.2.2.1 and 2.2.3.1). Therefore, where habitat management occurred under the Reduced-scope HCP, the character of the impacts to climate, topography and soils, hydrology, water quality and air quality would be expected to be similar to, if not the same as, those outlined under 4.1.1.1.

Compared to those of the Comprehensive HCP alternative, the physical impacts due to habitat management under the Reduced-scope HCP alternative would occur on a smaller area. Habitat management under the Comprehensive HCP could impact approximately 2,700 acres, whereas habitat management under the Reduced-scope HCP alternative could impact approximately 1,000 acres. Thus, habitat management under this alternative would simulate natural disturbance on a smaller scale, and fewer habitats would experience the types of processes that historically shaped their features.

4.3.1.2 Public Utility and Transportation Right-of-Way Maintenance

Public utility and transportation right-of-way maintenance would involve activities that maintain vegetation and infrastructure in conditions appropriate for the intended purpose of rights-of-way. Activities that involve vegetative manipulation would be conducted for the primary purpose of maintaining rights-of-way, but would be implemented in ways that simulate or replace the natural processes that historically maintained the Oak Savanna Ecosystem. Vegetation manipulation would generally be conducted according to the conditions outlined under 2.2.1.1 (Habitat Management). Thus, the physical impacts within rights-of-way would generally be the same as those outlined under 4.1.1.1. Additional activities conducted for right-of-way maintenance would include infrastructure repair and replacement, and could involve heavy-equipment traffic/operation and soil excavation. These activities would be conducted according to the conditions outlined under 2.2.1.2 and would cause the same physical impacts as those outlined under 4.1.1.2.

Under the Reduced-scope HCP alternative, right-of-way maintenance could impact less than 100 acres. That is, private rights-of-way on approximately 700 acres of occupied KBB habitat would not be maintained under the ITP issued under this alternative. However, maintenance would still be necessary to preserve the primary functions of those existing private rights-of-way. Legal, incidental take associated with maintenance of private rights-of-way would therefore require authorization on an individual, project-by-project basis under existing federal, state and local regulations.

Many techniques used to maintain rights-of-way can be implemented in ways that simulate or replace the natural processes that historically shaped physical features of oak savannas. Therefore, lack of authorization for right-of-way maintenance on approximately 700 acres of occupied KBB habitat would preclude mechanisms that simulate the effects of natural processes that are currently missing from these habitats.

4.3.1.3 Development

Under this alternative, no development would be authorized under the ITP. However, development would be expected to continue within the KBB range. Legal, incidental take associated with development in occupied KBB habitat would require authorization on an individual, project-by-project basis under existing federal, state and local regulations.

Regional and local rates of development under this alternative would not be expected to differ from those that would occur under the other alternatives. Like the No Action Alternative, the Reduced-Scope HCP alternative would not authorize development of occupied KBB habitat, but it would not prevent development in unoccupied habitat that would have otherwise been restored, created and subsequently protected according to mitigation requirements under the Comprehensive HCP. Therefore, the character and scope of physical impacts would not be expected to differ among the Reduced-scope HCP, No Action and Comprehensive HCP alternatives.

Where development occurred, its general impacts on climate, topography and soils, hydrology, water quality and air quality would be the same as those outlined under 4.1.1.3.

4.3.2 Biological Impacts

Potential biological impacts of habitat management, public utility and transportation right-of-way maintenance, and development are described under the following headings.

4.3.2.1 Habitat Management

Many detrimental changes have occurred within the Oak Savanna Ecosystem since European settlement (Abrams 1992). Fire suppression resulted in succession of many open oak savannas to closed-canopy forests. In many cases, this transition occurred within the span of a few decades (e.g., Curtis 1959). Oak savannas that have succeeded to closed-canopy forest often have a diminished graminoid component as a result of reduced light availability at ground level and the accumulation of thick litter layers (Abella et al. 2001). The overstory is often simplified due to selective timber harvest (Minc and Albert 1990). Native floristic diversity is often reduced as a result of fire suppression, sustained livestock grazing, woody encroachment, and the establishment of invasive species such as spotted knapweed (*Centaurea maculosa*) (Cohen 2000, 2001, 2004). These changes in structure and vegetation were accompanied by declines of many wildlife species that are associated with oak savanna (Eagle et al. 2005, O'Connor 2006). Where it occurred under this alternative, habitat management would help prevent or reverse many of these detrimental impacts by simulating or replacing the natural processes that historically maintained the Oak Savanna Ecosystem. Thus, habitat management would be used to restore the natural community structure and ecological function of oak savannas. Although they would occur on a smaller scale, the biological impacts of individual habitat management techniques would be virtually the same as those described under (4.1.2.1).

The diversity of plant and wildlife species would be unlikely to change in areas where habitat management would be conducted under this alternative. Rather, existing diversity would be maintained by preventing losses associated with the degradation of oak savannas. By contrast, where management would not be conducted, species diversity would be expected to decline locally or regionally because loss and fragmentation of early-successional habitat patches could result in the extirpation of several species (Eagle et al. 2005). Many species frequently use oak savanna for parts of their life stages and could undergo population declines in habitats not managed under this alternative.

Oak savannas are not particularly productive environments due to their harsh physical features (e.g., low nutrients, droughty soils); however, many wildlife species frequently use these areas for foraging due to the structural complexity and the presence of specific (e.g., host plants) or high-quality (e.g., acorns) food sources. Habitats that would be managed under this alternative would be expected to maintain productivity at levels normal for a functioning savanna. In areas where management would not be conducted, food sources for some species could be lost and productivity could subsequently decline.

Habitat management under the Comprehensive HCP alternative could involve approximately 2,700 acres, whereas habitat management under the Reduced-scope alternative could involve approximately 1,000 acres. Thus, habitat management under the latter alternative would simulate natural disturbance on a smaller scale, and fewer habitats would experience the types of processes that historically shaped their biological features. That is, the Reduced-scope HCP alternative would not address biological threats associated with succession of oak-savanna habitats on approximately 1,700 acres of occupied KBB habitat on non-federal land.

4.3.2.2 Public Utility and Transportation Right-of-Way Maintenance

Public utility and transportation right-of-way maintenance would involve activities that maintain vegetation and infrastructure in conditions appropriate for the intended purpose of rights-of-way. Activities that involve vegetative manipulation would be conducted for the primary purpose of maintaining rights-of-way, but would be implemented in ways that simulate or replace the natural processes that historically maintained the Oak Savanna Ecosystem. Vegetation manipulation would generally be conducted according to the conditions outlined under 2.2.1.1 (Habitat Management). Thus, the biological impacts within public rights-of-way would generally be the same as those outlined under 4.1.2.1. Additional activities conducted for right-of-way maintenance would include infrastructure repair and replacement, and could involve heavy-equipment traffic/operation and soil excavation. These activities would be conducted according to the conditions outlined under 2.1.2.2 and would cause the same biological impacts as those outlined under 4.1.2.2.

Under the Reduced-scope HCP alternative, right-of-way maintenance could impact less than 100 acres. That is, private rights-of-way on approximately 700 acres of occupied KBB habitat would not be maintained under the ITP issued under this alternative. However, maintenance would still be necessary to preserve the primary functions of those existing private rights-of-way. Legal, incidental take associated with maintenance of private rights-of-way would therefore require authorization on an individual, project-by-project basis under existing federal, state and local regulations.

Lack of authorization for right-of-way maintenance on approximately 700 acres of occupied KBB habitat would preclude mechanisms that simulate natural processes that are currently missing from these habitats.

4.3.2.3 Development

Under this alternative, no development would be authorized under the ITP. However, development would be expected to continue within the KBB range. Legal, incidental take associated with development in occupied KBB habitat would require authorization on an individual, project-by-project basis under existing federal, state and local regulations.

Regional and local rates of development under this alternative would not be expected to differ from those that would occur under the other alternatives. Like the No Action Alternative, the Reduced-Scope HCP alternative would not authorize development of occupied KBB habitat, but it would not prevent development in unoccupied habitat that would have otherwise been restored,

created and subsequently protected according to mitigation requirements under the Comprehensive HCP. Therefore, the amount of available oak-savanna habitat would not be expected to differ among the Reduced-scope HCP, No Action and Comprehensive HCP alternatives.

Where development occurred, its general biological impacts would be the same as those outlined under 4.1.2.3.

4.3.3 Listed, Proposed and Candidate Species

4.3.3.1 Karner Blue Butterfly

KBB is currently known to occur on approximately 2,700 acres of non-federal land in Michigan (MNFI 2007). The Reduced-scope HCP alternative could maintain KBB on approximately 1,000 of those acres. Whereas the Comprehensive HCP alternative could be implemented to help ensure no net loss of occupied KBB habitat on non-federal land, the Reduced-scope HCP alternative would be expected to result in a loss of 1,700 acres of occupied KBB habitat on non-federal land, due to lack of legal authority to adequately manage it.

Habitat Management

Where it would be conducted under this alternative, habitat management would maintain habitat for KBB and other species of concern by maintaining and restoring early successional plant communities. This would be achieved by simulating or replacing the natural processes that historically maintained the Oak Savanna Ecosystem. Thus, KBB habitat features would fluctuate within the natural range of variability. Habitat management would:

- suppress woody and invasive plants
- enhance the diversity and abundance of desirable plants
- increase incident sunlight at ground level
- raise soil pH
- reduce soil nitrogen
- remove excess organic material
- expose mineral soils
- establish lupine and nectar plants where necessary

Together, these activities would increase the coverage of lupine and nectar plants in individual habitat patches. As a result, likelihood of KBB persistence in existing occupied habitat would increase.

Detrimental impacts of habitat management would generally be of short duration and include take of individual butterflies and temporary suppression of desired vegetation. Treated portions of occupied patches would generally be expected to provide suitable habitat and be re-colonized by KBB within two growing seasons following treatment. Given the required treatment conditions (see 2.2.1.1), habitat management would not be expected to cause extirpation of KBB within any occupied patch. Nevertheless, some habitat management prescriptions would result

in the mortality of individual KBB. For instance, a prescribed burn through an occupied area would destroy KBB juveniles or eggs. However, even within a burn unit, mortality may not be complete, because burn intensity tends to be uneven across a patch, and some juveniles or eggs at or near ground level may survive. Take of immature forms of insects (especially eggs) is difficult to quantify; therefore, take would be indirectly quantified as acres of occupied KBB habitat that could be impacted.

Under this alternative, habitat management could occur in approximately 1,000 acres of occupied KBB habitat. Habitat-management techniques would typically not be applied to more than one-third of any particular occupied KBB habitat patch within a calendar year. Therefore, take of KBB could occur on approximately 330 acres in any single calendar year.

Take would be minimized by following the treatment conditions outlined in 2.2.1.1. Treatment would first be conducted on the most-degraded third of a patch. This approach would reduce the risk of extirpating KBB and other species of concern, and it would facilitate re-colonization of recently treated portions. Treatments would be generally confined to those periods when adult KBB were not present (typically August 15 to May 15). Take would be avoided when mowing/hydroaxing was conducted when at least 4 inches of snow cover the ground. By maintaining a mower cutting height of at least 6 inches above the ground when snow was not present, impacts to lupine and take of eggs and larvae would be minimized. Manual vegetation removal, basal herbicide treatment, and spot herbicide spraying would involve removal of individual targeted plants; thus, potential impacts to lupine and take of KBB would be avoided entirely. Conducting grazing on a short rotation and removing livestock before non-woody vegetation was reduced to an average height of 6 inches would limit trampling of lupine, eggs and larvae.

On the roughly 1,700 acres of occupied KBB habitat on non-Federal land where management would not be conducted under this alternative, habitat succession would probably cause conditions to become unsuitable for wild lupine and KBB, and population extirpations could result.

Public Utility and Transportation Right-of-Way Maintenance

Based on known occurrences, public right-of-way maintenance under authority of the ITP could occur in approximately 100 acres of occupied KBB habitat. Right-of-way maintenance techniques would typically be applied to no more than one-third of any particular occupied habitat patch (or metapopulation complex: see general guidelines under 2.2.1.1) within a calendar year. Treatment would first be conducted on the most degraded third of the patch. This approach would reduce the risk of extirpating KBB and other species of concern, and it would facilitate re-colonization of recently treated portions. The entirety of a patch (or metapopulation complex) would not be treated until the initially treated portion benefited from two growing seasons and monitoring confirmed densities of KBB, lupine and flowering nectar plants that exceed pre-treatment levels. Given these restrictions and based on the current amount of known occupied habitat in rights-of-way, take of KBB due to this activity could occur on no more than approximately 33 acres in any single calendar year. If the amount of known occupied KBB habitat in public rights-of-way increased due to recovery efforts not conducted under authority of

the ITP, right-of-way maintenance under the ITP could occur on a larger number of acres (i.e., one-third of each additional occupied KBB habitat that is discovered or established in rights-of-way could be treated within a single calendar year).

Activities that involve vegetative manipulation would be conducted for the primary purpose of maintaining public rights-of-way, but would be implemented in ways that simulate or replace the natural processes that historically maintained habitat in conditions suitable for KBB. Vegetation manipulation within public rights-of-way would generally be conducted according to the conditions outlined under 2.2.1.1 (Habitat Management). Thus, the impacts to KBB within public rights-of-way would generally be the same as those outlined under 4.1.3.1. Additional activities conducted for right-of-way maintenance would include infrastructure repair and replacement, and could involve heavy-equipment traffic/operation and soil excavation. These activities would be conducted according to the conditions outlined under 2.1.1.2 and would cause the same impacts to KBB as those outlined under 4.1.3.1.

Right-of-way maintenance in occupied KBB habitat would not be specifically authorized under this alternative. However, maintenance would still be necessary to preserve the primary functions of existing rights-of-way on approximately 700 acres of occupied KBB habitat. Legal, incidental take associated with maintenance of rights-of-way would therefore require authorization on an individual, project-by-project basis under existing Federal, State and local regulations.

Many techniques used to maintain rights-of-way can be implemented in ways that simulate or replace the natural processes that historically provided suitable conditions for wild lupine and KBB. Therefore, lack of authorization for maintenance of rights-of way on approximately 700 acres of occupied KBB habitat would prevent mechanisms that could help maintain KBB populations.

Development

Development in occupied KBB habitat would not be specifically authorized under this alternative. However, development would be expected to continue within the KBB range. Legal, incidental take associated with development in occupied KBB habitat would require authorization on an individual, project-by-project basis under existing federal, state and local regulations.

Regional and local rates of development under this alternative would not be expected to differ from those that would occur under the other alternatives. The Reduced-scope HCP alternative would not authorize development of occupied KBB habitat, but it would not prevent development in unoccupied habitat that would have otherwise been restored, created and subsequently protected according to mitigation requirements under the Comprehensive HCP. Therefore, the amount of occupied KBB habitat would not be expected to differ among the Reduced-scope HCP, No Action and Comprehensive HCP alternatives.

Where development occurred in occupied KBB habitat, it would typically have long-term impacts that, in addition to destroying individual butterflies, convert at least portions of occupied

habitat patches into conditions incompatible with sustaining KBB. The average impacts per acre of development could be more severe under the Reduced-scope HCP alternative than under the Comprehensive HCP alternative, because development under the Reduced-scope HCP alternative would not necessarily be conducted according to the conditions under 2.2.1.3 and 2.2.1.4 that are designed to avoid or minimize and mitigate impacts to KBB and its habitat.

4.3.3.2 Other Federally Listed and Candidate Species

Listed Species

Projects conducted under authority of the ITP would not take or otherwise adversely affect federally listed species other than KBB. Prior to implementation of any project, the potential presence of federally listed species would be evaluated based on review of the Biotics data base (MNFI 2007), consideration of known species distributions, assessment of current habitat characteristics, and site surveys as necessary. Occupied KBB habitat does not typically overlap with that of other federally listed species in Michigan; thus, the potential for impacts to those species would be small. In the rare event any federally listed species occurred or would be likely to occur in or near a project area while it was listed, the project could proceed only if it would not adversely affect the species. Adverse effects might be avoided by reconfiguring activity areas, adjusting timing of activities, or modifying the nature of activities. Projects that could not avoid adverse effects would not be authorized.

Candidate Species

Certain habitat-management activities conducted under authority of the ITP could result in injury or mortality to a small number of eastern massasauga rattlesnakes. For example, individuals could be killed or injured during prescribed burning, mowing or by heavy-equipment traffic. However, only a small subset of occupied KBB habitat is likely to be occupied by massasaugas. The chance of managing habitat occupied by massasauga would be smaller under this alternative than under the Comprehensive HCP alternative, because a smaller amount of habitat would be involved. Also, the conditions required to avoid or minimize take of KBB would also generally minimize adverse impacts to massasaugas. In fact, management activities conducted from late fall to early spring should avoid adverse impacts entirely because massasaugas would be hibernating in lowland areas during that time. Consequently, habitat management conducted under this alternative would not jeopardize the continued existence of the species. Indeed, activities that maintained KBB habitat would usually improve conditions for massasaugas as well.

Development has occurred and is currently occurring within the overlapping range of KBB and eastern massasauga rattlesnake, such that the landscape is becoming increasingly fragmented. Development in occupied KBB habitat would not be specifically authorized under the ITP, but regional rates of development and fragmentation would not be expected to differ from those that would occur under the other alternatives.

4.3.3.3 Michigan State-listed Species

At least 33 species classified as threatened or endangered under Michigan law could occur in or near occupied KBB habitat (Tables 5 and 6). Prior to implementation of any project under this alternative, the potential presence of these species would be evaluated based on review of the Biotics data base (MNFI 2007), consideration of known species distributions, assessment of current habitat characteristics, and site surveys as necessary. The chance of managing habitat occupied by any of these species would be smaller under this alternative than under the Comprehensive HCP alternative, because a smaller amount of habitat would be involved. If a State-listed species was determined to be present in a project area, proposed activities potentially resulting in take could proceed only if authorized under the provisions of the Michigan Endangered Species Protection Law (Public Act 451 of 1994, Part 365).

Many of the state-listed species that co-occur with KBB are also dependent upon early-successional conditions and therefore require the same management techniques to mimic natural disturbance. Thus, where other state-listed species were present, management could still occur, following consideration of any special requirements for individual species. Habitat management activities performed to maintain occupied KBB habitat would generally improve conditions for these savanna-associated species.

Some habitat management techniques could result in take of some state-listed species. For example, some individuals of state-listed species could be killed or injured during prescribed burning, mowing, or by heavy-equipment traffic. However, the habitat degradation (e.g., woody succession, invasive species encroachment) caused by lack of management would be more harmful than any take caused by management. Many of the conditions required to avoid or minimize take of KBB would also generally minimize adverse effects to other early-successional species.

Given treatment restrictions and the geographic scope of this alternative, activities that could result in take of a State-listed species could occur on no more than 330 acres in any single calendar year. Only a small subset of occupied KBB habitat is likely to be occupied by any particular state-listed species.

In areas where management would not occur under this alternative, succession may render habitats unsuitable for certain threatened or endangered savanna-dependent species, which could cause the extirpation of local populations.

4.3.4 Cultural Resources

Before implementing any soil-disturbance activities covered under this alternative, management partners would consult with the SHPO and the THPO, as appropriate, to ascertain whether known cultural or paleontological resources could be threatened. In the event a proposed project would potentially threaten cultural or paleontological resources, management partners would modify proposed activities to eliminate any threats before proceeding with implementation. In addition, if previously unknown cultural or paleontological relicts were discovered during

implementation of any particular project, the project would be suspended immediately and consultation with the SHPO/THPO would be initiated.

4.3.5 Environmental Justice

The Executive Order on Environmental Justice issued by President Clinton on February 11, 1994 requires all federal agencies to assess the impacts of federal actions with respect to environmental justice. The Executive Order states that to the extent practicable and permitted by law, neither minority nor low-income populations may receive disproportionately large and adverse impacts as a result of a proposed project.

Neither minority nor low-income populations are known to be disproportionately represented near oak-savanna habitats. No environmental justice issues exist for this alternative. No minority or low-income populations would be displaced or negatively affected in any other way by this alternative.

4.3.6 Cumulative Impacts

Cumulative impacts are considered from a historical and contemporary perspective. Historic cumulative impacts occurred prior to implementation of the activities outlined under this alternative, whereas contemporary cumulative impacts include additional impacts that could result from implementation of those activities.

4.3.6.1 Historic Cumulative Impacts

Historic cumulative impacts are described under 4.1.6.1.

4.3.6.2 Contemporary Cumulative Impacts

Limited habitat management would be conducted primarily to counter localized historic and ongoing cumulative impacts that threaten the persistence of oak-savanna habitats, KBB and other oak-savanna species. These ongoing, cumulative impacts include habitat loss and fragmentation due to land conversion (e.g., agriculture, forestry, industrial, commercial and residential development, right-of-way development), vegetative succession following removal of fire from the landscape, and the proliferation of invasive species. These cumulative impacts have contributed to regional loss and degradation of oak-savanna communities and declines in a large number of plant and animal species that depend upon them. Also impacted as a result of these ongoing, cumulative impacts are the ecological contributions of oak savannas. These impacts include a decline in species diversity and productivity. The decline in oak-savanna habitats and subsequent loss of associated species in Michigan contribute to regional declines that are occurring throughout the Midwest (Leach and Ross 1995, USFWS 2003a).

Habitat management would have no known cumulative impacts because it would generally counter the ongoing impacts described above, have impacts that would be temporary, cause levels of disturbance within the natural range of variability for oak savannas, and follow guidelines developed to minimize adverse effects to KBB and other species of concern. Because

habitat management would occur in upland oak-savanna sites, mimic natural disturbance regimes, and have only temporary impacts that would be within the natural range of variability, there should be negligible cumulative impacts on climate, topography and soils, hydrology, water quality and air quality.

Similar to habitat management, public utility and transportation right-of-way maintenance under the Reduced-scope HCP would also tend to counter the ongoing, cumulative impacts of vegetative succession and invasive species proliferation. For most right-of way maintenance activities, impacts would be temporary, within the natural range of variability, and carefully contained by following guidelines developed to minimize adverse effects to KBB and other species of concern. Therefore, they should not contribute to adverse cumulative impacts on oak savanna and related biological components, including KBB and other species of concern. When guidelines outlined in 2.2.1.1 were not followed during vegetation manipulation, or when heavy-equipment operation/traffic or soil excavation occurred in occupied KBB habitat, impacts would be minimal and temporary, or mitigation would be required to counter the impacts. Therefore, these activities should provide negligible or no overall contribution to adverse cumulative impacts on oak savanna, KBB, and other related biological components. Similarly, there should be negligible cumulative impacts on climate, topography and soils, hydrology, water quality and air quality.

Under this alternative, private utility and transportation right-of-way maintenance that could help counter the ongoing, cumulative impacts of vegetative succession and invasive species proliferation would not be authorized by the ITP. This maintenance would probably continue in some occupied KBB habitats on private lands, but it would require authorization on an individual, project-by-project basis under existing federal, state and local regulations. Proposed mitigation associated with individual right-of-way maintenance projects may not be well-coordinated with statewide KBB conservation efforts.

Similarly, development in occupied KBB habitat would not be coordinated with statewide KBB conservation efforts and would require authorization on an individual, project-by-project basis under existing Federal, State and local regulations. Without a process to coordinate development with statewide efforts to conserve KBB, there would be fewer opportunities for public exposure to statewide KBB conservation issues, and therefore fewer opportunities for acquisition of KBB distribution information and pro-active KBB habitat management and protection.

Given the limited geographic scope (approximately 1,000 acres) of this alternative, the accumulation of adverse impacts due to land-use patterns, interruption of natural process, and introduction of invasive species would generally continue in many occupied KBB habitats. Activities that could counter adverse cumulative impacts could be conducted on only slightly more than one-third of known, occupied KBB habitat on non-federal land.

4.4 Summary of Environmental Consequences by Alternative

Table 8. Summary of environmental consequences by alternative.

Environmental Component	Activity	Alternative A: Comprehensive HCP	Alternative B: No Action	Alternative C: Reduced-scope HCP
Area [a, b]	**Habitat Management**	≤2,700 acres	≤900 acres	≤1,000 acres
	Right-of-way Maintenance	≤800 acres	0 acres	≤100 acres
	Development	0–27 acres annually	0 acres	0 acres
	Total [c]	≤2,700 acres	≤900 acres	≤1,000 acres
Physical Features	**Habitat Management**	Replacement and simulation of natural processes that historically shaped the physical features of the Oak Savanna Ecosystem Climate: no anticipated impact on regional climate; some temporary impacts on microclimate Topography and soils: no anticipated impact on topography; minor, temporary and localized impacts on soil features Hydrology: no anticipated impacts Water quality: no anticipated impacts Air quality: minor, temporary and localized impacts	Where management was authorized, impacts the same as under Alternative A, on a smaller scale Where habitat management was not authorized: -lack of processes that historically shaped the physical features of the Oak Savanna Ecosystem -no direct impacts on climate, topography and soils, hydrology, water quality or air quality	Where management was authorized, impacts the same as under Alternative A, on a smaller scale Where habitat management was not authorized: -lack of processes that historically shaped the physical features of the Oak Savanna Ecosystem -no direct impacts on climate, topography and soils, hydrology, water quality or air quality
	Right-of-way Maintenance	Same as above	No impacts specifically authorized under this alternative Lack of processes that historically shaped the physical features of the Oak Savanna Ecosystem	Same as above
	Development	Anticipated impacts the same as those already occurring within the KBB range Specific changes in climate, topography and soils, hydrology, water quality and air quality dependent on type of development	No impacts specifically authorized under this alternative	No impacts specifically authorized under this alternative

Environmental Component	Activity	Alternative A: Comprehensive HCP	Alternative B: No Action	Alternative C: Reduced-scope HCP
Biological	**Habitat Management**	Replacement and simulation of natural processes that historically maintained the Oak Savanna Ecosystem Maintenance of oak-savanna habitats in early-successional conditions required by savanna-dependent species Maintenance of biological diversity in oak savannas Maintenance of biological productivity at levels normal for functioning oak savannas	Where management was authorized, impacts the same as under Alternative A, on a smaller scale Where habitat management was not authorized: -Lack of natural processes that historically maintained the Oak Savanna Ecosystem -Loss of early-successional habitats required by savanna-dependent species -Loss of biological diversity in oak savannas -Potential decline in biological productivity	Same as under Alternative B
	Right-of-way Maintenance	Same as above, on a smaller scale Mitigation of long-term detrimental impacts to KBB or occupied KBB habitat	No impacts specifically authorized under this alternative Lack of natural processes that historically maintained the Oak Savanna Ecosystem Loss of early-successional habitats required by savanna-dependent species Loss of biological diversity in oak savannas Potential decline in biological productivity	Where maintenance was authorized, impacts the same as under Alternative A, on a smaller scale Where maintenance is not authorized, impacts the same as under Alternative B
	Development	Anticipated impacts the same as those already occurring within the KBB range: -Conversion of localized habitats into conditions unsuitable for oak-savanna species -Loss of biological diversity in oak savannas -Decline in biological productivity Potential creation of habitat corridors through right-of-way development Mitigation of long-term detrimental impacts to KBB or occupied KBB habitat	No impacts specifically authorized under this alternative	No impacts specifically authorized under this alternative

Environmental Component	Activity	Alternative A: Comprehensive HCP	Alternative B: No Action	Alternative C: Reduced-scope HCP
KBB	**Habitat Management**	Maintenance of oak-savanna habitats in conditions suitable for KBB Incidental take of KBB (on ≤900 acres per year) [a] Maintenance of existing KBB populations No net loss of KBB numbers, occupied habitat area or habitat connectivity caused by activities under specific authority of this alternative	Where management was authorized, impacts the same as under Alternative A, on a smaller scale (e.g., incidental take of KBB could occur on ≤300 acres per year)[a] Where habitat management was not authorized: -Loss of early-successional habitats required by KBB -Probable extirpation of some existing KBB populations	Where management was authorized, impacts the same as under Alternative A, on a smaller scale (e.g., incidental take of KBB could occur on ≤330 acres per year)[a] Where habitat management was not authorized: -Loss of early-successional habitats required by KBB -Probable extirpation of some existing KBB populations
	Right-of-way Maintenance	Impacts the same as above, on a smaller scale (e.g., incidental take of KBB could occur on ≤270 acres per year)[a] Mitigation of long-term detrimental impacts to KBB or occupied KBB habitat	No impacts specifically authorized under this alternative Loss of early-successional habitats required by KBB Probable extirpation of some existing KBB populations	Where maintenance was authorized, impacts the same as under Alternative A, on a smaller scale (e.g., incidental take of KBB could occur on ≤33 acres per year)[a] Where maintenance was not authorized: -Loss of early-successional habitats required by KBB -Probable extirpation of some existing KBB populations
	Development	Conversion of localized habitats into conditions unsuitable for KBB Incidental take of KBB (on 0–27 acres per year)[a] Potential creation of KBB habitat corridors through right-of-way development Mitigation of long-term detrimental impacts to KBB or occupied KBB habitat No net loss of KBB numbers, occupied habitat area or habitat connectivity caused by activities under authority of this alternative	No impacts specifically authorized under this alternative	No impacts specifically authorized under this alternative

Environmental Component	Activity	Alternative A: Comprehensive HCP	Alternative B: No Action	Alternative C: Reduced-scope HCP
Other Listed and Candidate Species	**Habitat Management**	No anticipated adverse impacts on federally listed species other than KBB Maintenance of oak-savanna habitats in conditions suitable for candidate and State-listed oak-savanna species Incidental take of candidate and State-listed oak-savanna species (on ≤900 acres per year)[a] Maintenance of existing populations of candidate and State-listed oak-savanna species	Where management was authorized, impacts the same as under Alternative A, on a smaller scale (e.g., incidental take of candidate and State-listed species could occur on ≤300 acres per year)[a] Where habitat management was not authorized: -Loss of early-successional habitats required by State-listed species -Probable extirpation of some existing populations of State-listed species	Where management was authorized, impacts the same as under Alternative A, on a smaller scale (e.g., incidental take of candidate and State-listed species could occur on ≤330 acres per year)[a] Where habitat management was not authorized: -Loss of early-successional habitats required by State-listed species -Probable extirpation of some existing populations of State-listed species
	Right-of-way Maintenance	Impacts the same as above, on a smaller scale (e.g., incidental take of candidate and State-listed species could occur on ≤270 acres per year)[a] Mitigation of long-term detrimental impacts to KBB or occupied KBB habitat	No impacts specifically authorized under this alternative Loss of early-successional habitats required by State-listed oak-savanna species Probable extirpation of some existing populations of State-listed oak-savanna species	Where maintenance was authorized, impacts the same as under Alternative A, on a smaller scale (e.g., incidental take of candidate and State-listed species could occur on ≤33 acres per year)[a] Where maintenance was not authorized: -Loss of early-successional habitats required by State-listed species -Probable extirpation of some existing populations of State-listed species
	Development	Conversion of localized habitats into conditions unsuitable for candidate and State-listed oak-savanna species Incidental take of candidate and State-listed oak-savanna species (on 0–27 acres per year)[a] Potential creation of habitat corridors through right-of-way development Mitigation of long-term detrimental impacts to KBB or occupied KBB habitat	No impacts specifically authorized under this alternative	No impacts specifically authorized under this alternative

Environmental Component	Activity	Alternative A: Comprehensive HCP	Alternative B: No Action	Alternative C: Reduced-scope HCP
Cultural Resources	**All**	No anticipated impacts	No anticipated impacts	No anticipated impacts
Environmental Justice	**All**	No environmental justice issues	No environmental justice issues	No environmental justice issues

[a] Based on currently known KBB distribution.
[b] On which impacts specifically authorized under the alternative would be anticipated.
[c] Right-of-way maintenance and development areas are included in the habitat-management area.

5. CONSULTATION AND COORDINATION WITH THE PUBLIC AND OTHERS

The consultation and coordination process focused on continuous public involvement throughout the development of the Comprehensive HCP. The process involved both outreach elements and input elements.

Outreach elements were designed to further stakeholder understanding of KBB and the HCP-development process. The John Ball Zoo took the lead in directing and coordinating outreach efforts. Outreach elements included a brochure, lupine finder card, website, numerous presentations, and field trips.

Input elements provided opportunities for the public to provide input on the HCP-development process. Input elements included statewide press releases, comment opportunities embedded within the website, advisory-group participation, project contact information, comment opportunities at public meetings, and opportunities for stakeholder review of the draft HCP.

In February and March 2004, the DNR opened a 60-day public comment period and hosted public meetings. The purpose of these input venues was to help identify and prioritize alternatives for HCP development.

The consultation and coordination process also incorporated input and insights from a scientific advisory group (Karner Blue Butterfly Working Group) and a land-management advisory group (Management Partners Workgroup). The Karner Blue Butterfly Working Group has met annually since the late 1980s and advises on scientific matters related to KBB biology and management. Inclusion in this group has remained open to anyone with an interest in KBB. Originally assembled on the recommendation of the USFWS, this Michigan-based group has provided input which has been incorporated into the Karner Blue Butterfly Recovery Plan and the HCP.

The Management Partners Workgroup was assembled in 2003 as an advisory body to provide input on development of the Comprehensive HCP. Membership in this group has been by invitation from the DNR, but attendance by other experts has added valued perspective to many discussion topics. This workgroup met quarterly and provided input during development of the Comprehensive HCP. The quarterly meetings provided an opportunity to update the group on research findings, expose the group to habitat conditions and management needs through field trips, and share information on other KBB initiatives with the group.

Management partners are stakeholders that would share in the responsibilities for implementing the Comprehensive HCP. Management partners could include State, county and local government agencies, non-governmental organizations, utility and transportation right-of-way managers, private land developers, and other private landowners. Landowners and land managers would not be required to participate in implementation of this HCP. Rather, participation would be offered as a reasonable and practical option for those agencies, organizations and individuals that seek authority for incidental take of KBB. The following list shows some of the stakeholders who have demonstrated a continuing interest in participating in

the Comprehensive HCP. Stakeholders who have land-management authority on occupied Karner blue butterfly habitat are marked with an asterisk.

- Allegan County
- Binder Park Zoo
- Brooks Township, Newaygo County*
- Consumers Energy*
- Detroit Zoo
- El Paso Pipeline Company*
- Grand Rapids Community College
- Grand Valley State University
- Huron-Manistee National Forest
- Indiana Dunes National Lakeshore
- John Ball Zoo
- Land Conservancy of West Michigan*
- Michigan Electric Transmission Company*
- Michigan Department of Military and Veterans Affairs
- Michigan Department of Natural Resources*
- Michigan Department of Transportation*
- Michigan Natural Features Inventory
- Michigan Nature Association*
- Michigan State University
- Muskegon County
- Southwest Michigan Land Conservancy*
- The Nature Conservancy*
- Toledo Zoo
- U.S. Fish and Wildlife Service
- West Michigan Butterfly Association

6. PUBLIC COMMENT ON DRAFT ENVIRONMENTAL ASSESSMENT AND RESPONSE

The USFWS published a notice announcing the availability of a draft Habitat Conservation Plan and Environmental Assessment for the Karner blue butterfly, receipt of the incidental take permit application and a request for comments on the application in the Federal Register on January 25, 2008 (Vol. 73, No. 17, pp. 4619-4620). Included in the notice, was availability of the document on the USFWS's Regional website, as well as hard copy.

Public Comment Period and Letters Received
The notice opened a 60-day comment period ending March 25, 2008, prior to the final decision by the USFWS. Several comments were received from Consumer's Energy.

The Michigan DNR and USFWS reviewed the comments and Michigan DNR prepared responses to the issues identified. Consumer's Energy (CE) concerns regarding utilities ROW maintenance and management responsibilities required under the ITP and HCP and Michigan DNR's responses are summarized below.

Consumer's Energy's Comment	**Michigan DNR's Response**
CE believes that the goal of the HCP should be just that, the KBB HCP, not Goal 1: "Support persistence of a functioning Oak Savanna Ecosystem in Michigan." Goal 1 is unnecessary if Goals 2 & 3 are met.	Goal 2 addresses the needs of rare species only whereas Goal 1 encompasses all elements of the Oak Savanna Ecosystem, including structural elements and all associated species, rare and common.
CE proposes deleting prescribed burning, soil scarification, seeding and planting, and livestock grazing. These are not active management choices used by utilities to manage vegetation along rights-of-way.	Inclusion of any of the techniques available to right-of-way (ROW) managers does not compel anyone to actually use them. Their inclusion simply maximizes the options available to manipulating vegetation in ROWs. We understand very clearly that CE will not burn under its powerlines. As written, the HCP would not in any way require CE to do so. We would agree that livestock grazing may not be a practical or realistic treatment option in many, perhaps most, circumstances. However, the HCP was developed in part, to help us test some unproven techniques. To improve clarity, the language in question has been modified.

Consumer's Energy Comments, continued	Michigan DNR response, continued
There is no factual data presented that snow cover present during mowing decreases take of KBB. Large mowers are used in habitat that is so degraded that take of KBB is unlikely. It is difficult to believe that 4 inches of snow is going to prevent damage to KBB when 40-50 pound blades of a hydroax moving at hundreds of rpm shed trees up to 8 inches in diameter.	The HCP would allow CE to mow an entire occupied patch when there is 4 inches of snow cover. If we remove the condition, CE would not be able to mow more than 1/3 of an occupied patch within a calendar year, snow or not. Modifying the text as CE suggests would cause mowing conditions to be more restrictive. The proposed blade-height restriction is consistent with the existing Biological Opinion.
CE has over 60,000 miles of ROW and all cannot possibly be assumed to have presence of KBB. The survey requirements should be modified to limit the surveys to areas where KBB is known to exist. The phrase "Imminent threat to the operation of the utility or safety of utility workers or the public", should be included under emergency situations demanding immediate repair.	The text has been modified to read: "Prior to disturbance, surveys will be used … within ROW where the species is likely to occur." To provide for greater flexibility in emergency situations, the text has been modified to address CE comments.
Each utility company should be limited to 1/3 of its ROW rather than lumped together and competing with other companies for the right to do maintenance.	The HCP allows each utility company to conduct treatments on as much as 1/3 of its ROW acreage occupied by KBB in a calendar year, regardless of the activity of other utility companies. There will be no need for competition for the right to treat ROW.
Seven monitoring trips are overly burdensome, since utility treatments properly conducted have been beneficial to preservation and expansion of KBB habitat.	The monitoring requirements have been modified: habitat monitoring and population monitoring. Data for both components will be collected prior to treatment/disturbance and during years 1 & 2 following treatment/disturbance. Habitat monitoring and population monitoring will be conducted at least once during the second KBB flight for each of these years.

7. REFERENCES CITED

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