4.19 MA 19 – Williamsburg Moraine Management Area

Summary of Use and Management

Vegetation management in the Williamsburg Moraine management area (MA) (Figure 4.19.1) will provide various forest products; maintain or enhance wildlife habitat; protect areas of unique character and threatened, endangered and special concern species; and provide for forest-based recreational uses. Timber management objectives for this management area for this 10-year planning period include improving the age-class structure of aspen, regenerating oak and the continuation of management through selection or restarting harvests of red pine and upland hardwood communities. Wildlife habitat management objectives include increasing the structural complexity of upland hardwood communities for forest interior species; perpetuating early-successional communities for young-forest-dependent species, hunting and other wildlife-related recreation opportunities; maintaining soft and hard mast sources including oak; and preserving the biodiversity value of the Skegemog high conservation value area. Expected trends within this 10-year planning period are: increased recreational pressure, especially on established trails; increased oil and gas development; introduced pests and diseases, especially beech bark disease and emerald ash borer; an increased need to regenerate oak and red pine; and the decreased dominance of pure oak types to mixed oak/pine types.

The current predominant cover types, acreages and projected harvest acres in the management area are shown in Table 4.19.1.

Introduction

This management area is located just east of Traverse City near Williamsburg and Kalkaska in Grand Traverse and Kalkaska counties and contains 19,015 acres of state forest (Figure 4.19.1). The primary attributes which identify the Williamsburg Moraines management area include:

- The historic forest communities dominated by mesic northern forests and dry-mesic northern forests.
- The current forest communities dominated by northern hardwoods, aspen and planted red pine.
- Landforms of steep, broken moraine ridges.
- Alignment with Albert's Williamsburg sub-region, the smallest sub-region in northern Lower Michigan (Albert, 1995).
- Proximity to population centers leading to an emphasis on social and economic values.
- Inclusion of the Skegemog Lake Wildlife Area (a high conservation value area).
- A history of white-tailed deer, ruffed grouse, woodcock, river otter, black bear and bobcat harvest.
- Individuals and populations of threatened, endangered or special concern species including eastern massasauga rattlesnake, bald eagle, osprey, northern goshawk, spotted turtle and red-legged spittlebug, primarily in the portion of the management area near Lake Skegemog.
- Portions of the Vasa cross country ski trail, single-track bike trail and North Country Trail.
- A history of oil and gas exploration associated with the Niagaran and Antrim shale formations.

Landforms in the management area are dominated by rich moraines bordering a broad outwash plain to the south. The western portion of the management area includes areas of transition between moraines and outwash and is dominated by excessively drained mesic to dry-mesic sandy soils where much of the aspen and red pine occurs. Aspen density and distribution expanded significantly following the initial harvest of the forest around the turn of the last century and has been perpetuated in this landscape through even-aged management. Much of the red pine found its origin in department's efforts to reforest "barren" lands during the 1950s and 60s and is now beginning to reach economic maturity.

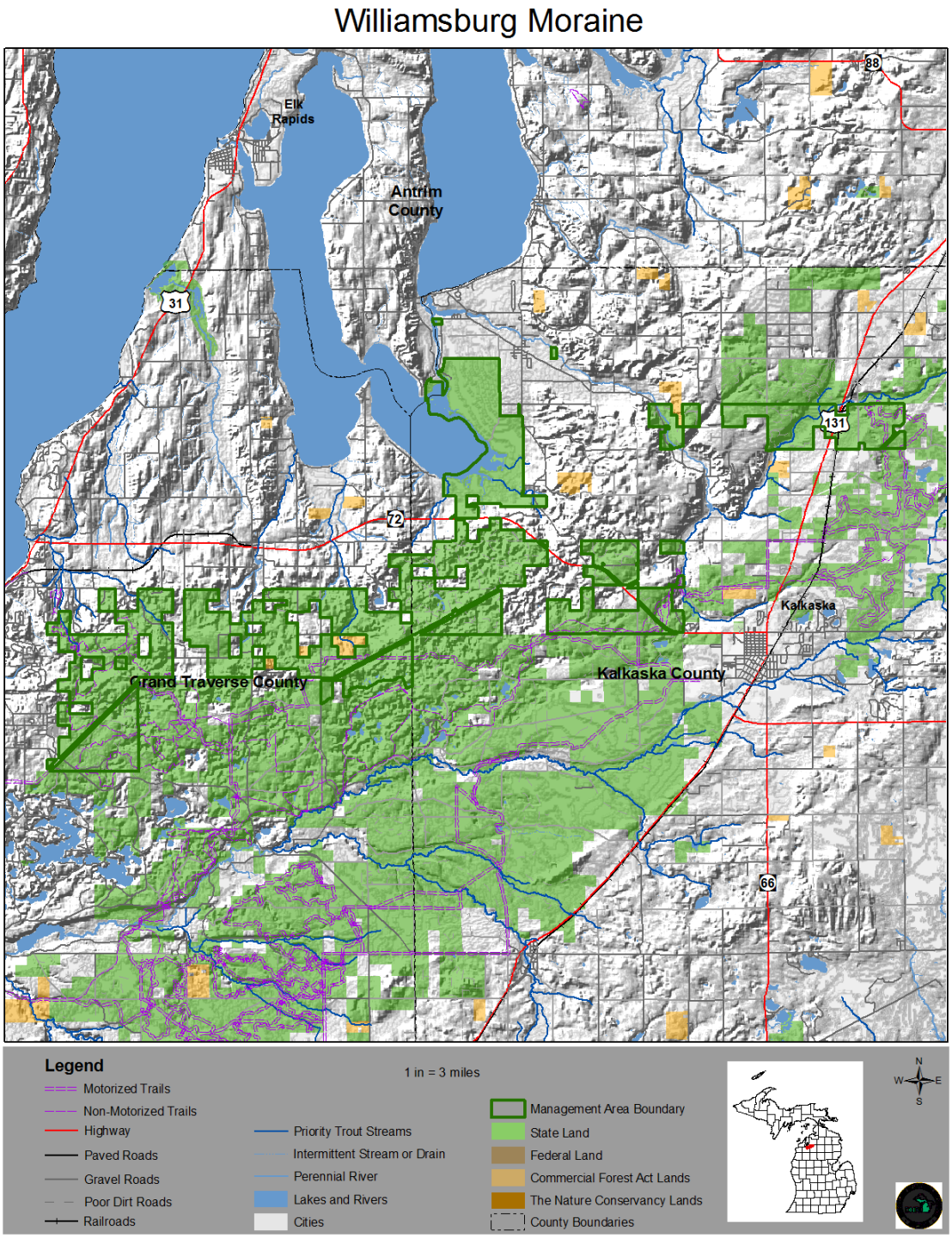

Figure 4.19.1. Location of the Williamsburg Moraine management area (dark green boundary) in relation to surrounding state forest and other lands in Grand Traverse and Kalkaska counties, Michigan.

The eastern portion of the management area (with the exception of the Skegemog Swamp) has a prevalence of well drained loamy sand and sandy loam soils and is dominated by upland (northern) hardwoods. Hardwoods in the management area are significantly different from their pre-logging condition where white pine and hemlock were dominant components and stands were primarily uneven aged and contained a high proportion of dead wood. Presently, stands are even aged and conifer is a minor component. In addition, hardwood stands contain fewer snags, large trees and downed woody material.

Table 4.19.1. Current cover types, acreages, projected harvests and projected acreages at this ten-year planning end of the period for the Williamsburg Moraines management area, northern Lower Peninsula ecoregion (2012 Department of Natural Resources inventory data).

Cover Type	Cover %	Current Acreage	Hard Factor Limited Acres	Manageable Acres	10 Year Projected Harvest (Acres)		Projected Acreage in 10 Years	Desired Future Harvest (Acres)	
					Final Harvest	Partial Harvest		Final Harvest	Partial Harvest
Northern Hardwood	22%	4,133	65	4,068		1,940	4,133		1,940
Aspen	14%	2,674	161	2513	791		2,674	359	
Red Pine	12%	2,242	40	2202	582	1,224	2,242	245	1,224
Mixed Upland Deciduous	8%	1,592	423	1169	474	479	1,592	167	479
Oak	7%	1,262	601	661	141	229	1,262	60	258
White Pine	6%	1,068	10	1058	197	447	1,068	96	447
Cedar	5%	961	961				961		
Lowland Conifers	4%	747	598	149	17		747	17	
Natural Mixed Pines	3%	659	162	497	29	90	659	45	90
Upland Open/Semi-Open Lands	8%	1,478		1478			1,478		
Lowland Open/Semi-Open Lands	1%	284		284			284		
Misc Other (Water, Local, Urban)	3%	611		611			611		
Others	7%	1,301	422	879	102	28	1,301	112	68
Total		19,012	3,443	15,569	2,332	4,437	19,012	1,101	4,506

4.19.1 Forest Cover Type Management Direction

The following sections contain information on vegetation management direction in the form of **Desired Future Conditions, 10-Year Management Objectives and Long-Term Management Objectives** for each of the major cover types or forest communities within the management area. This information applies to those portions of the forest where active management (e.g., timber harvest, prescribed fire, planting or mowing) will be conducted. In other portions of the state forest, natural succession will achieve ecological objectives. While most stands have a variety of trees species and other vegetation, stands or communities are classified by the species which has the dominant canopy coverage.

4.19.1.1 Forest Cover Type Management – Northern Hardwoods

Current Condition

Northern hardwood acres total 4,133 acres or 22% of the management area on habitat class PArVVb, AFO and AFOCa sites (Table 4.19.1) (see Appendix E). Forest communities dominated by northern hardwoods in this management area are valued ecologically as sources of habitat for numerous species of wildlife including bear, white-tailed deer and various song birds, commercially for pulp and saw logs and for a wide range of forest recreation. Current data show that 65 acres of northern hardwood have met harvest criteria (Figure 4.19.2), but have site conditions that limit harvest (hard factor limited acres). There are 33 acres that have a final (regeneration) harvest pending and these acres are included in the 0-9 year-old age class. There are 631 acres with a partial harvest pending and these acres are included in their current age class.

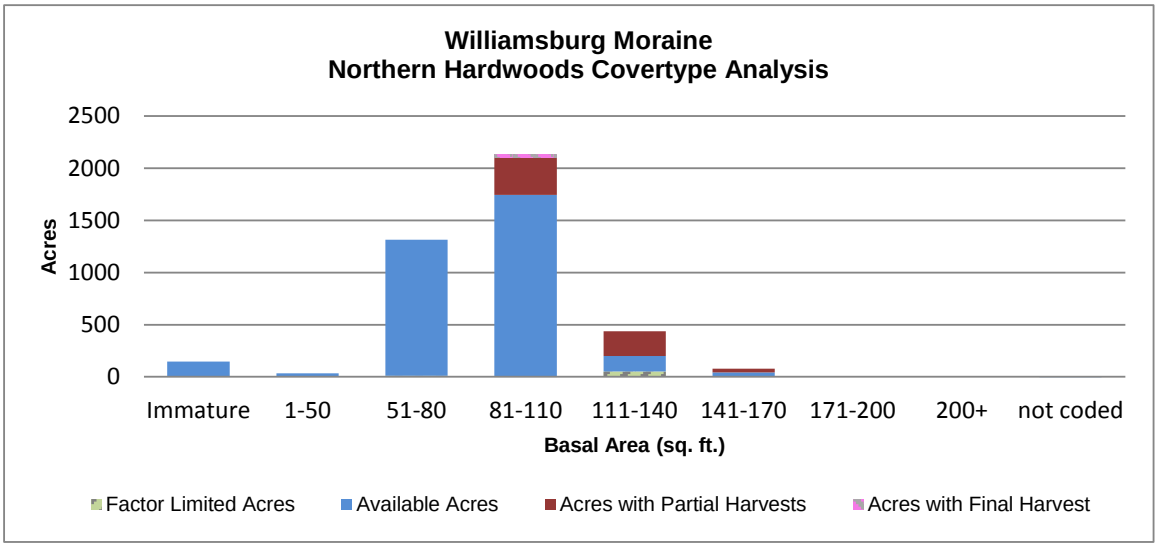

Figure 4.19.2. Basal area distribution for northern hardwoods in the Williamsburg Moraines management area (2012 Department of Natural Resources inventory data).

Desired Future Condition

- Northern hardwood stands will continue to transition to an uneven-aged condition through selection harvests. The conifer component and coarse woody debris will be increased over current levels.

10-Year Management Objectives

- A projected 1,940 acres will be harvested through selection harvests to continue the transition to uneven-aged stands.

Long-Term Management Objectives

- Continue to conduct salvage harvests of beech affected by beech bark disease and ash where present and affected by emerald ash borer, using Beech Bark Disease Guidelines and Emerald Ash Borer Guidelines;
- Consider the need to delay further selection harvesting due to resultant lower than normal residual basal area in post-salvage harvest stands; and
- Desired future harvest levels for partial harvest are projected at 1,940 acres per 10-year period to continue the transition to uneven-aged stands.

4.19.1.2 Forest Cover Type Management – Aspen

Current Condition

Aspen acres total 2,674 acres or 14% of the management area (Table 4.19.1). Forest communities dominated by big-tooth and quaking aspen in this management area are valued ecologically as sources of habitat for numerous species of wildlife including ruffed grouse, chestnut-sided warbler, golden-winged warbler, and white-tailed deer, commercially for pulp and saw logs and recreationally by hunters and mushroom hunters.

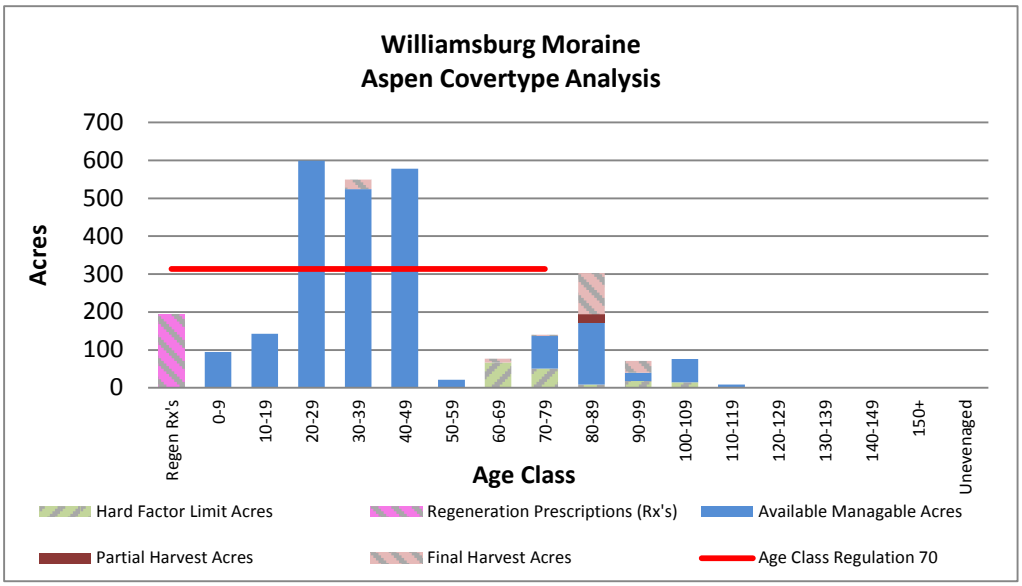

Figure 4.19.3. Age-class distribution for aspen in the Williamsburg Moraines management area (2012 Department of Natural Resources inventory data).

Although aspen occurs throughout the area, including the moraine ridges, moraines and till areas on habitat class PArVHa, PArVVb, and AFO sites, it is primarily concentrated on dry-mesic sites on the west side of the management area. Aspen has been consistently harvested over the last 60 years with the greatest harvest activity occurring 20-50 years ago. Some of the stands beyond 60 years of age may be located on steep slopes or in close proximity to recreational trails which may limit treatment options. Aspen in this landscape, especially big-tooth aspen, is of exceptional quality and vigor, providing opportunity for extending the rotational age to 70 years. Extending rotation age has multiple benefits, including providing sawlog quality timber, providing greater opportunity for snag and large woody debris formation, improving stand structure by allowing for increased understory growth and development and providing for increased site recovery and nutrient loading. There are 161 acres of aspen that have met harvest criteria (Figure 4.19.3), but have site conditions that limit harvest (hard factor limited acres). There are approximately 192 acres of stands that have a regeneration harvest pending and these acres are shown in the regeneration prescription class. There are approximately 23 acres with a partial harvest pending and these acres are shown in their current age class. Figure 4.19.3 displays the projected number of acres converted to the cover type as a result of treatments that remove an overstory species resulting in the release of aspen. These acres are shown in the 0-9 year-old age class.

Desired Future Condition

- Aspen-dominated forest communities will be maintained as even-aged stands with acres balanced between 0 and 79 years of age to provide for regulated harvest, wildlife habitat and recreation opportunity.

10-Year Management Objectives

- Conduct final harvests to regenerate aspen on a projected 791 acres in this 10-year planning period;
- Concentrate harvests on the oldest age classes first; and
- Where necessary and feasible, consider harvesting stands from other age classes and below the rotation age to expedite the balancing of age-class distributions.

Long-Term Management Objectives

- A desired future harvest level for final harvest is projected at 359 acres per 10-year period to continue balancing the age-class structure.

4.19.1.3 Forest Cover Type Management – Red Pine

Current Condition

Red pine acres total 2,242 acre or 12% of the management area, with most being 40-60 years old (Table 4.19.1). Red pine dominated communities in this management area are valued commercially for pulp, saw logs and utility poles. Nearly all of the pine is of planted origin occurring on dry-mesic (habitat class PArVVb) sites where red pine has the potential to occur naturally and on mesic or hardwood sites (habitat class AFO, AFOCa). Red pine regeneration efforts will be focused on dry-mesic sites.

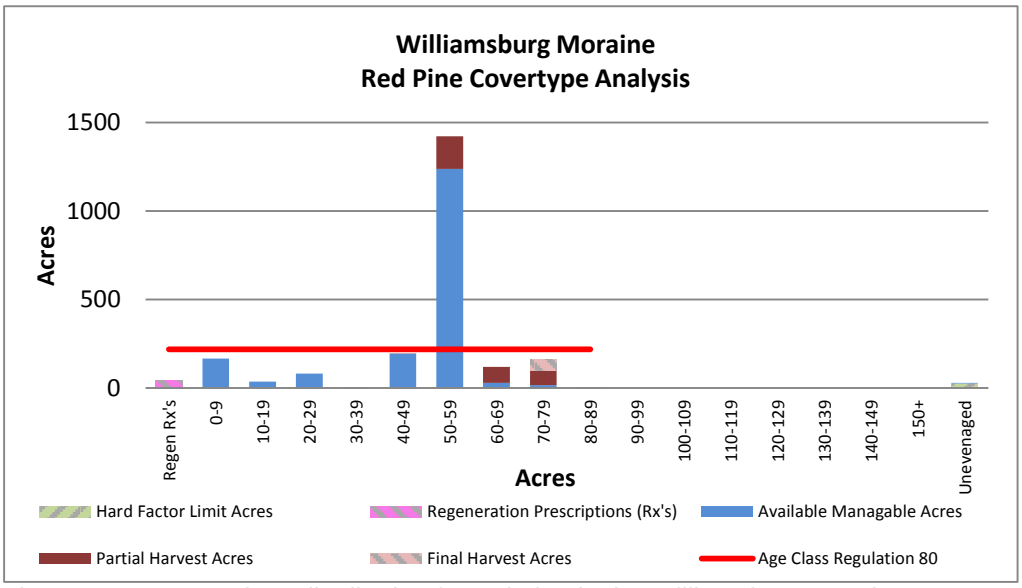

Figure 4.19.4. Age-class distribution for red pine in the Williamsburg Moraines management area (2012 Department of Natural Resources inventory data).

Planted pine responds well on these sites, though red maple is often a competitor to regeneration. There are approximately 63 acres of stands that have a regeneration harvest pending and these acres are shown in the 0-9 year-old age class (Figure 4.19.4). There are approximately 359 acres with a partial harvest pending and these acres are included in their current age class.

Desired Future Condition

- Red pine stands will be maintained and managed through thinning until stand replacement harvests at economic maturity, with acres balanced between 0-89 years of age to provide for a sustainable harvest, wildlife habitat and recreational opportunities.

10-Year Management Objectives

- Follow the Red Pine Management Guidelines, which recommends growing red pine on suitable sites and balancing age-class distribution between the ages of 0 and 89;
- Conduct partial harvests on a projected 1,224 acres on the younger age classes to improve the quality and size class; and
- Conduct regeneration harvests on a projected 582 acres in the older age classes to help balance the age-class distribution.

Long-Term Management Objectives

- A desired future harvest level for final harvest is projected at 245 acres per 10-year period to continue balancing the age-class distribution;
- A desired future harvest level for partial harvest is projected at 1,224 acres per 10-year period to improve the volume and value;
- Consider opportunities to manage red pine in mixed stands with oak or other species;
- On quality northern hardwood sites or sites where advanced northern hardwood species are present, consider whether to allow these sites to convert to northern hardwood; and
- Red pine found in riparian buffers or other sensitive sites may remain until biological maturity.

4.19.1.4 Forest Cover Type Management – Oak

Current Condition

Oak acres total 1,262 acres or 7% of the management area (Table 4.19.1) and are located on habitat classes: PArVVb, AFO and AFOCa. White and red oak (northern red, northern pin and black) dominated communities in this management area are valued ecologically as sources of habitat for numerous species of wildlife (particularly as a source for hard mast) and commercially for pulp and saw logs. The age class-distribution (Figure 4.19.5) is dominated by stands 70-100+ years old, though tree vigor is high and mortality is much lower than in other portions of the ecoregion.

Young oak is poorly represented in these stands, though red maple and white pine frequently occupy the understory.

Oak distribution in the management area is much greater than stated here as it is an understory or minor component in many stands classified as other types. There are 601 acres of oak have met harvest criteria, but have site conditions that limit harvest (hard factor limit acres). There are 68 acres of oak that have a partial harvest pending.

Desired Future Condition

- Oak will be represented by mixed cover types and as a component in stands throughout the management area through management to provide for timber products, wildlife habitat and recreational opportunities.

10-Year Management Objectives

- Conduct partial harvests on a projected 229 acres;
- Conduct restarting harvests on a projected 141 acres; and
- Maintain or expand oak as a component in stands throughout the management area through retention and management for natural regeneration on other cover types. This will be beneficial to wildlife species including, but not limited to turkey, black bear and deer (featured species in this management area).

Long-Term Management Objectives

- A desired future harvest level for final harvest is projected at 60 acres per 10-year period to regenerate oak stands;
- A desired future level for partial harvest is projected at 258 acres per 10-year period to maintain oak as a component in other cover types or in mixed stands;

- Continue to seek opportunities to maintain or expand oak as a component of stands throughout the management area; and
- It is acceptable that some oak stands may become mixed stands through partial removal of an oak overstory, planting pine in oak stands or through natural regeneration of other species.

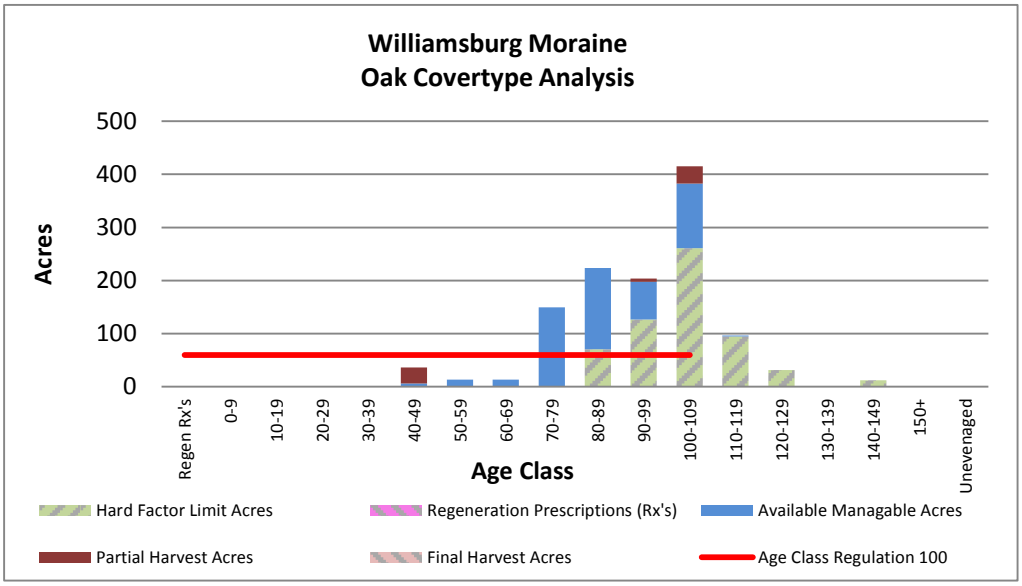

Figure 4.19.5. Age-class distribution for oak in the Williamsburg Moraines management area (2012 Department of Natural Resources inventory data).

4.19.1.5 Forest Cover Type Management – White Pine

White pine acres total 938 acres or 5% of the management area (Table 4.19.1) and are distributed throughout the management area on AFO/AFOCa habitat class sites.

The planted white pine acres are largely between the ages of 40 and 69 with the largest amount in the 50-59 year-old age class (Figure 4.19.6). White pine in this management area is valued ecologically as a source of habitat for numerous species of wildlife, particularly at young and very old stages and commercially for pulp and saw logs. Advanced white pine regeneration in association with red maple is frequently well represented in the understory of oak or other pine stands (habitat class sites PArVVb/PArVHa). There are 10 acres of white pine that have met harvest criteria, but have site conditions that limit harvest (hard factor limit acres). Figure 4.19.6 includes the projected number of acres converted to the cover type as a result of treatments that remove an overstory species resulting in release of understory white pine or final harvests and planting to white pine. These acres are included in the 0-9 year age class.

<u>Desired Future Condition</u>

- White pine will be a major forest component on this management area and may be in mixed stands along with red maple, oak and red pine.

<u>10-Year Management Objectives</u>

- Conduct a partial harvest on a projected 447 acres with a concentration on stand improvement for those stands which may yield a higher value product in the future;
- Conduct a regeneration harvest on a projected 197 acres with a concentration on those sites with poorer quality;
- In areas of extensive advanced regeneration of white pine and red maple understory, consider partial removal of the overstory species to release the understory. The projected acres of overstory removal may be reflected in the partial harvest acres for oak and red pine;
- Management should consider the impact of white pine weevil on young age-class stands of white pine; and
- Consider retaining a component of the overstory after harvests to increase stand diversity.

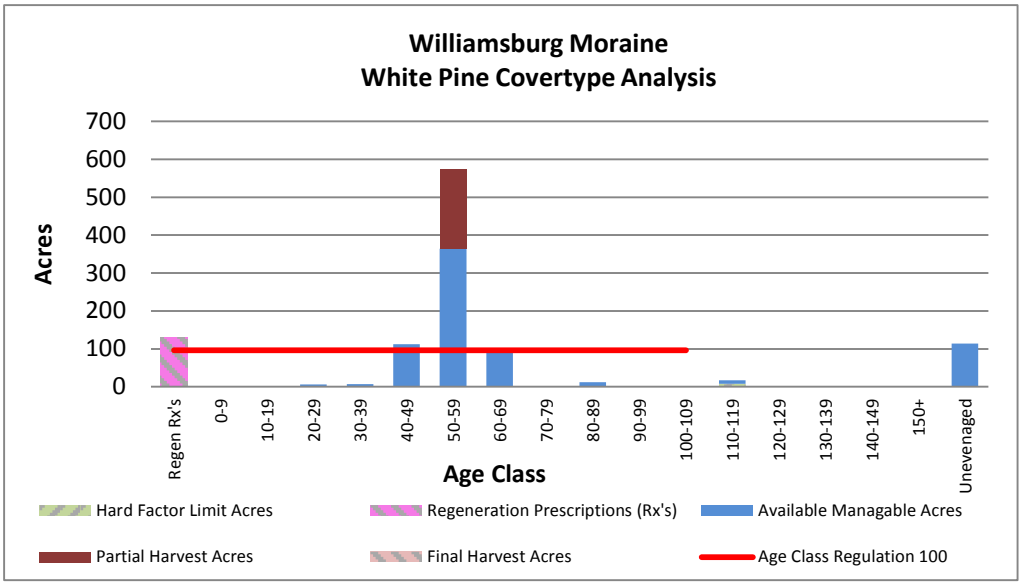

Figure 4.19.6. Age-class distribution for white pine in the Williamsburg Moraines management area (2012 Department of Natural Resources inventory data).

Long-Term Management Objectives

- Continue management of white pine in mixed stands through partial harvests at a projected desired future harvest level of 447 acres per 10-year period.
- Continue final harvests at a projected desired future harvest level of 96 acres per 10-year period to maintain white pine stands.

4.19.1.6 Forest Cover Type Management – Cedar and Lowland Conifer

Cedar acres total 961 or 5% of the management area (Table 4.19.1) and lowland conifers acres total 4,937 or 13% of the management area (Table 4.19.1), constituting a significant portion of the management area. There are 589 acres of lowland conifers (Figure 4.19.8) with a hard factor limit and all 961 acres of cedar are factor limited due to access and operability issues. There types may offer only limited opportunities for management.

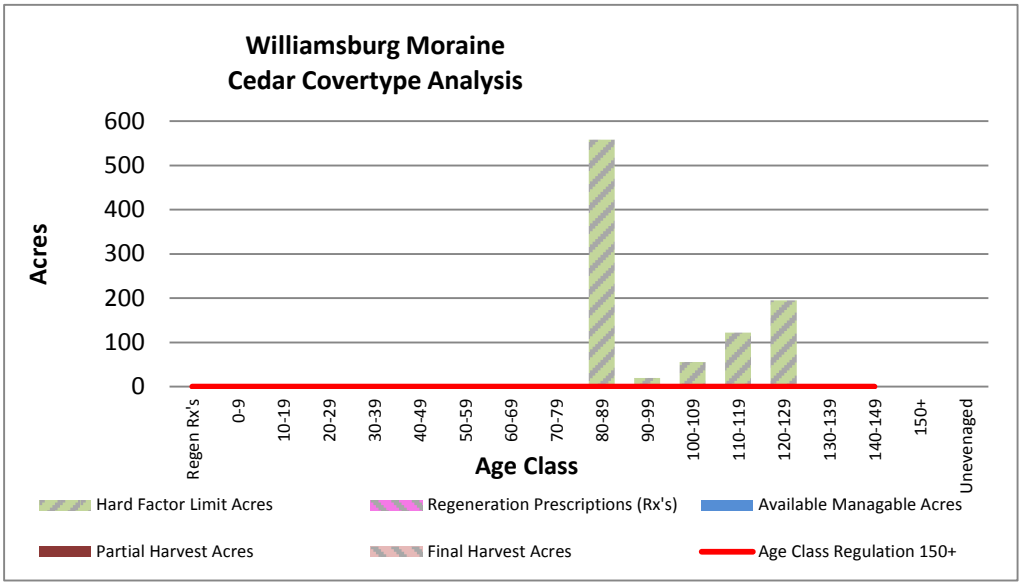

Figure 4.19.7. Age-class distribution for cedar in the Williamsburg Moraine management area (2012 Department of Natural Resources inventory data).

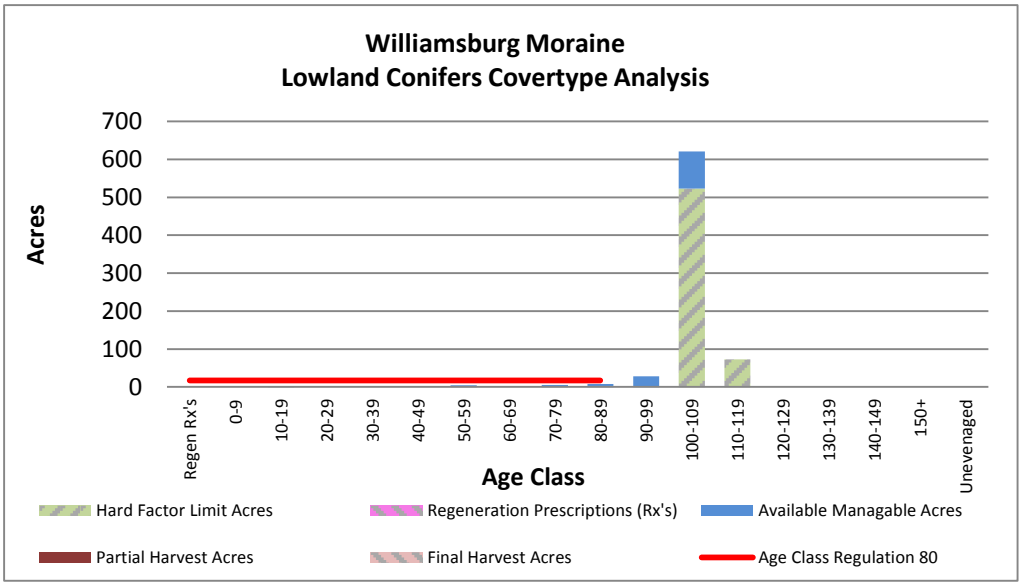

Figure 4.19.8. Age-class distribution for lowland conifers in the Williamsburg Moraine management area (2012 DNR inventory data).

Desired Future Condition

- These cover types will contribute to the compositional diversity of the landscape and wildlife habitat while providing forest products.

10-Year Management Objectives

- Conduct regeneration harvests on a projected 17 acres of lowland conifer;
- Additional opportunities to increase harvest prescriptions in lowland forest types will be assessed, both in and outside (due to forest health issues) of normal years-of-entry; and
- Consider methods to ensure adequate regeneration of cedar and lowland conifer.

Long-Term Management Objectives

- Continue harvests, where feasible, at the projected desired future harvest levels of 17 acres for lowland conifer per 10-year period to maintain habitat for species such as deer (a featured species in this management area) and to produce forest products.

4.19.1.7 Forest Cover Type Management – Mixed Upland Deciduous

Current Condition

Mixed upland deciduous (primarily aspen, oak and red maple) acres total 1,592 acres or 8% of the management area (Table 4.19.1). Due to the age classes of this type (Figure 4.19.9) it would appear that these stands are primarily oak stands mixed with smaller amounts of aspen and red maple. The community is distributed throughout the management area on habitat class PArVHa sites. Forest communities classed as mixed upland deciduous in this management area are valued ecologically as sources of habitat and mast for numerous species of wildlife including bear, white-tailed deer, squirrels and various birds and commercially for firewood and industrial lumber.

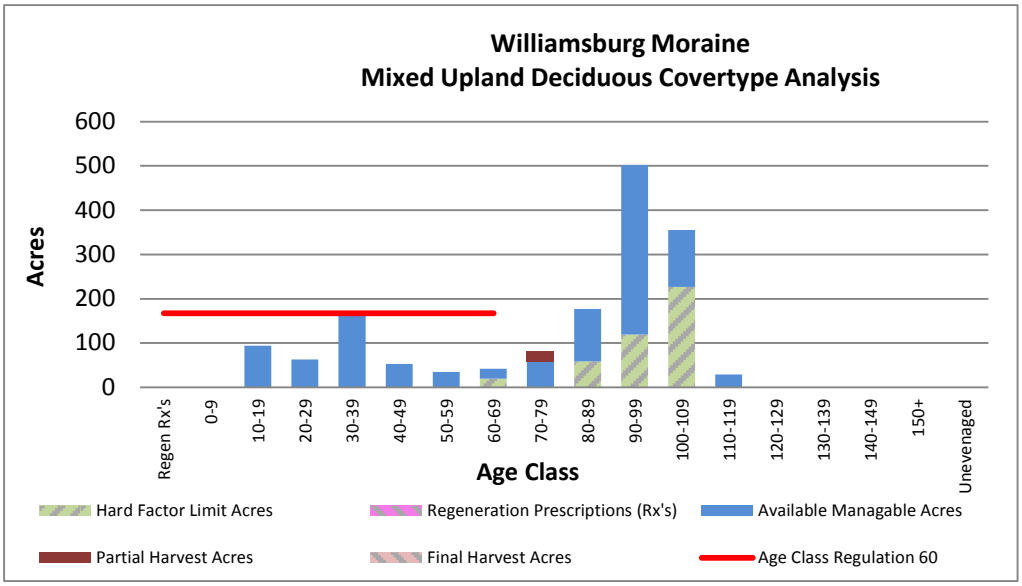

Figure 4.19.9. Age-class distribution for mixed upland deciduous in the Williamsburg Moraines management area (2012 Department of Natural Resources inventory data).

Desired Future Condition

- These communities will located on operable sites, contributing to the compositional diversity of the landscape while providing for continual harvest and to contribute to the preservation of regional biodiversity by providing habitat for a unique suite of plants and wide variety of animal species.

10-Year Management Objectives

- These areas will be managed primarily through selection harvests that may select an individual species for harvest;
- Conduct regeneration harvests on a projected 474 acres to regenerate those species which meet silvicultural criteria; and
- Conduct partial harvests on a projected 479 acres; primarily partial harvests on oak.

Long-Term Management Objectives

- A desired future harvest level for final harvest is projected at 167 acres per 10-year period;
- A desired future harvest level for partial harvest is projected at 479 acres per 10-year period; and
- Maintain these mixed types through continued management to provide a diverse cover type that provides habitat and forest products on a sustainable basis.

4.19.1.8 Forest Cover Type Management – Lowland Open/Semi-Open Lands

Current Condition

Lowland open/semi-open lands (lowland shrub, marsh, treed bog and bog) communities in this management area are valued ecologically as sources of habitat for numerous species of wildlife. Lowland open/semi-open acres total 284 acres or 1% of the management area (Table 4.19.1).

Desired Future Condition

- Lowland open/semi-open lands sites will be maintained at or above current levels to provide wildlife habitat.

10-Year Management Objectives

- Management in lowland open/semi-open lands will be minimal. What little maintenance that will be done will be to maintain the hydrology and open characteristics.

Long-Term Management Objectives

- Continue management to maintain upland open/semi-open lands at or above current levels;
- Continue to protect stands from illegal off-road vehicle use; and
- Where feasible and necessary, use control methods on invasive non-native species.

4.19.1.9 Forest Cover Type Management – Upland Open/Semi-Open Lands

Current Condition

Upland open/semi-open acres total 1,478 acres or 8% of the management area. This category is a combination of the following non-forested land cover types: herbaceous open land, upland shrub, low-density trees and bare/sparsely vegetated. These non-forested areas are a result of natural processes of fire, frost or other disturbances which create openings in the forest canopy along with the past management practices to maintain these areas. These communities are valued ecologically as sources of open land habitat for numerous species of wildlife.

Desired Future Condition

- Maintain upland open/semi-open lands at or above the current level to provide habitat for species which use openings.

10-Year Management Objectives

- Continue using prescribed fire, woody brush removal, herbicide or grass plantings to maintain upland open/semi-open lands; and
- Protect stands from illegal off-road vehicle use and where feasible and necessary, use control methods on invasive non-native species.

Long-Term Management Objectives

- Upland open/semi-open lands will be maintained provide habitat for species that require open habitats.

4.19.1.10 Forest Cover Type Management – Other Types

Current Condition

Individual cover types which may cover less than 5% of the management area include: natural mixed pines, 659 acres (3% of the management area). Other forested and non-forested communities total 1,301 acres (7%) and are spread across the management area. All of the timbered and non-timbered communities have important ecological values and are important habitat for numerous wildlife species.

Desired Future Condition

- These cover types will contribute to the compositional diversity of the landscape in addition to providing wood products, wildlife habitat and recreational opportunities.

10-Year Management Objectives

- Seek opportunities to harvest, where appropriate, the scattered acreages of upland and lowland minor types where access and operability will not adversely impact sensitive areas;
- Conduct partial harvests on a projected 90 acres of natural mixed pines; and
- Conduct final harvests on a projected 29 acres of natural mixed pines and 145 acres of upland mixed forest.

Long-Term Management Objectives

- Continue efforts to regenerate lowland types where feasible.

4.19.2 Featured Wildlife Species

Each of the featured species outlined below includes recommended practices with regard to forest and/or wetland management.

The following have been identified as featured species for this management area during this cycle of state forest planning:

- American marten
- American woodcock (Skegemog Lake State Wildlife Management Area)
- Beaver (Skegemog Lake State Wildlife Management Area)
- Black bear
- Black-throated blue warbler
- Eastern massasauga (Skegemog Lake State Wildlife Management Area)
- Mallard (Skegemog Lake State Wildlife Management Area)
- Pileated woodpecker
- Wild turkey
- White-tailed deer
- Wood duck (Skegemog Lake State Wildlife Management Area)
- Wood thrush

The primary focus of wildlife habitat management in the Williamsburg Moraine management area will be to address the habitat requirements identified for the listed featured species. Based on the selected featured species, some of the most significant wildlife management issues in the management area are the maintenance of young forest, extensive mature forest, large open grassland complexes and marsh/grassland complexes; the retention of large, over-mature trees and snags; and the maintenance and expansion of hard mast, understory shrub and mesic conifer components. Additional detail on the featured species approach can be found in Section 3.

American Marten

The goal for American marten in the northern Lower Peninsula is to increase available habitat. American marten needs mature mixed forest stands or old conifer-dominated stands, with dead and down material for maintaining a stable and sufficient supply of small mammals as prey. American marten are rarely found outside the forest canopy. This species depends upon live-tree dens, snags and coarse woody debris for loafing (resting) and denning sites. State forest management should address the maintenance and improvement of extensive and mature forest tracts, corridors, dead wood and conifer components in priority landscapes.

Wildlife Habitat Specifications:

- Identify, maintain, develop or restore large forested tracts and forested corridors.
- In even-aged management systems, within-stand retention should focus on large diameter (greater than15 inches in diameter at breast-height) trees, known cavity trees and/or mesic conifers to maintain/increase denning and loafing sites.
- Where possible, increase both standing-dead and downed-dead wood by:
  - Applying at least the minimum level of within-stand retention to all stands in management area;
  - Writing harvest specifications to leave slash at the stump or to minimize the removal of slash; and
  - Limiting or prohibiting firewood permits at marten-occupied sites.

American Woodcock

The goal for woodcock in the northern Lower Peninsula is to maintain or increase available habitat. American woodcock use young aspen stands having stem densities ranging from 6,000-20,000 stems/acre for feeding, nesting and brood-rearing. State forest management should address the maintenance of adequate early successional habitat to provide feeding, nesting and brood-rearing habitat and opportunity for hunting.

Wildlife Habitat Specifications:

- Maintain the aspen cover type and the aspen component in mixed stands within the management area.
  - Implementation of 10-year management direction for aspen, lowland aspen and lowland deciduous will be sufficient to meet this woodcock habitat specification.
- Move to balance the age-class distribution of aspen and continue management to regenerate oak to maintain young forests across the management area.
  - Implementation of 10-year management direction for aspen, lowland aspen and lowland deciduous will be sufficient to meet this woodcock habitat specification.
- Identify commercial and non-commercial treatment opportunities in aspen and alder stands associated with non-high priority trout stream riparian zones or forested wetlands.

Beaver

The goal for beaver in the northern Lower Peninsula is to maintain available habitat. Consideration will be given to best management practices, trout stream management and trends in beaver nuisance permits issued. State forest management for the species should focus on providing favorable food within 100 feet of streams that are not designated high priority trout streams.

Wildlife Habitat Specifications:

- Maintain or promote alder, aspen, birch, maple or willow cover types within 100 feet of non-high priority trout streams with gradients of less than 15% and other inland bodies of water.
  - Implementation of the Dingman Marsh and French Farm Flooding master plans and the 10-year management direction for aspen, lowland aspen and lowland deciduous will be sufficient to meet this habitat specification.

Black Bear

The goal for black bear in the northern Lower Peninsula is to maintain or improve habitat. Black bears have large home ranges and require large contiguous tracts of diverse forests with a mixture of cover types. They tend to use forested riparian corridors in their movements (which can be extensive). Hard mast is critical in the fall for bears to achieve adequate weight gains before denning. State forest management for the species should focus on improving existing habitat by minimizing forest fragmentation and maintaining oak to offset potential population declines due to changes in land-use.

Wildlife Habitat Specifications:

- Identify, maintain, develop or restore forested corridors that connect larger forested tracts, paying particular attention to riparian zones.
  - Implementation of riparian guidance (best management practices) will be sufficient to meet the black bear habitat specifications related to preventing fragmentation and maintaining corridors.
- Conduct silvicultural practices that maintain or increase oak-dominated stands and the oak component of mixed stands.
  - Implementation of the 10-year management direction for oak will be sufficient to meet black bear habitat specifications.

Black-throated Blue Warbler

The goal for black-throated blue warbler in the northern Lower Peninsula is to maintain available habitat. Black-throated blue warbler is an area-sensitive species (e.g., densities increase exponentially with increasing patch size) mainly occurring in mesic deciduous forest tracts >50 years in age and >250 acres in size, with a dense understory layer for nesting and foraging. State forest management for the species should focus on maintaining mature, large (>50 years old and >250 acres) mesic deciduous forest tracts with a dense understory layer for nesting and foraging.

Wildlife Habitat Specifications:

- Identify, maintain, develop or restore mesic-deciduous tracts >50 years old and >250 acres in size;
- Maximize forest interior (of northern hardwood stands) within the management area by increasing the portion of forest over 250 acres, minimizing edges (concentrating openings, oil and gas development, roads and pipelines along the forest or stand edge) and providing canopy gaps through single tree and group selection harvest practices; and
- Conduct silvicultural practices to maintain or promote a well-developed shrub understory.

Eastern Massasauga Rattlesnake

The goal for eastern massasauga rattlesnake in the management area is to maintain available habitat and provide for the long-term persistence of the rattlesnake population. Eastern massasauga rattlesnakes inhabit open wetlands for over-wintering as well as adjacent upland open cover types that support gestation and parturition. Populations in northern Michigan will often use lowland coniferous forests, such as cedar swamps, as well as open wetlands. Upland sites may range from forest openings to old fields, agricultural lands and prairies. State forest management for the species should focus on maintaining suitable habitat on dedicated managed lands in accordance with the approved Candidate Conservation Agreement with Assurances. As of August 2013, the Candidate Conservation Agreement is in the initial stages of approval and as a result is subject to change. Refer to approved Candidate Conservation Agreement for final managed land boundaries and habitat management guidelines. Approximately 6,300 acres of state forest land in the Rattlesnake Hills management area are proposed for designated as eastern massasauga rattlesnake managed lands per the raft Candidate Conservation Agreement.

Wildlife Habitat Specifications:

- At occupied sites maintain ≤50% canopy from trees and shrubs in wetland and upland vegetation types, maintain patches of suitable habitat at greater than 250 acres, restrict mowing and burning to November to March when eastern massasauga rattlesnake are in hibernation, and refrain from manipulating water levels between November and March at sites where eastern massasauga rattlesnake are known to occur.
    - Implementation of eastern massasauga rattlesnake Candidate Conservation Agreement in appropriate management areas will be sufficient to meet eastern massasauga rattlesnake wildlife habitat specifications in this management area.

Mallard

Mallards prefer complexes of grassland and shallow seasonal or semi-permanent marshes in association with permanent hemi-marshes for pair bonding, nesting and brood rearing. Mallard pair-bonding wetlands are typically 0.25-20 acres in size and brood rearing wetlands are typically 1.2-30 acres in size. Optimal hemi-marsh sites are >2.5 acres with open water portions having extensive portions less than three feet deep and 4:1 area of adjacent grasslands to hemi-marsh. Mallards nest on upland sites, normally within about 200 yards from water.

Wildlife Habitat Specifications:

- Maintain priority wetlands in hemi-marsh condition, with 50/50 open water to emergent marsh, for both breeding and non-breeding habitat.
    - Implementation of the Wildlife Management Area Master Plans for Dingman Marsh, French Farm Flooding, and O'Neil Lake state wildlife management areas and application of the beaver wildlife habitat specifications will be sufficient to meet this mallard habitat specification.
- Maintain stable water levels at managed floodings from April through August.

Pileated Woodpecker

The goal for pileated woodpecker in the northern Lower Peninsula is to maintain available habitat. Pileated woodpeckers prefer stands greater than 40 years old for foraging and greater than 70 years old for nesting and roosting and abundance is positively related to the density of trees greater than 12 inches in diameter at breast-height. State forest management should focus on the maintenance of a component of large diameter trees (>12 inches in diameter at breast height) at the landscape scale.

Wildlife Habitat Specifications:

- Maintain a component of large diameter trees greater than 12 inches in diameter at breast height.
  - Implementation of Within-Stand Retention Guidance, factor-limited acres, uneven-aged management in the northern hardwoods type, special conservation areas with objectives for big tree management and continued mortality from insect and disease will be sufficient to meet the pileated woodpecker habitat specifications for large trees in this management area.

Wild Turkey

The goal for turkey in the northern Lower Peninsula is maintain available habitat. In northern Lower Peninsula, snow depth is the primary limiting factor that restricts turkey population expansion as deep snow limits access to winter food. The availability of acorns can help mediate the impacts of deep snow. A secondary limiting factor throughout their range is good brood cover. Openings with grasses and forbs and little or no overstory trees are preferred. State forest management should focus on providing natural winter food, maintaining and regenerating oak and maintaining brood-rearing openings to improve brood-production and winter survival.

Wildlife Habitat Specifications:

- Maintain and increase the number of brood-rearing openings (forest openings, savannas, barrens, hayfields, etc.).
  - Implementation of 10-year management direction for upland open land will be sufficient to meet this turkey habitat specification.
- Through opening maintenance, planting and pruning, provide sources of winter food that are accessible above the snow (food plots, annual grains, fruit-bearing trees or shrubs).
  - Implementation of 10-year management direction for upland open land will be sufficient to meet this turkey habitat specification.
- Conduct silvicultural practices that conserve the oak component in forest stands and promote oak regeneration.
  - Implementation of 10-year management direction for oak will be sufficient to meet this turkey habitat specification.

White-tailed Deer

The goals for white-tailed deer habitat in the northern Lower Peninsula are to: 1) Maintain spring and summer forage and improve recreational access through openings management; 2) Maintain the overall proportion of potential woody browse such as aspen; 3) Maintain or increase the oak component in forest stands and promote oak regeneration; and 4) Maintain and promote functional shelter in wintering complexes.

Wildlife Habitat Specifications:

- Annual manage at least 3,000 acres of forest openings across the ecoregion to provide spring and summer forage and recreational opportunities.
  - Implementation of 10-year management direction for upland open land and upland shrub will be sufficient to meet this deer habitat specification.
- Maintain the aspen cover type and the aspen component in mixed stands within the management area.
  - Implementation of 10-year management direction for aspen, lowland aspen and lowland deciduous will be sufficient to meet this deer habitat specification.
- Move to balance the age-class distribution of aspen and continue management to regenerate oak to maintain young forests across the management area.
  - Implementation of 10-year management direction for aspen, lowland aspen, lowland deciduous and oak will be sufficient to meet this deer habitat specification.
- Conduct silvicultural practices that conserve the oak component in forest stands and promote oak regeneration.
  - Implementation of 10-year management direction for oak will be sufficient to meet this deer habitat specification.
- Manage cedar and hemlock with the main objectives of regeneration and providing future functional cover.
  - Implementation of 10-year management direction for cedar and lowland conifer will be sufficient to meet this deer habitat specification.
- Promote hemlock on appropriate sites using silviculture to increase within-stand hemlock components.

Wood Duck

The goal for wood duck in the northern Lower Peninsula is to maintain or increase available habitat. Wood duck are most limited by available nesting and brood rearing habitat. Wood duck nest in tree cavities near rivers, streams, swamps, beaver ponds and marshes. Nests require mature hardwood trees with 10 inches or larger in diameter at breast height. Brood-rearing habitat is composed of wetland areas such as forested wetlands, shrub-scrub wetlands and emergent marshes that maintain adequate water through the brood rearing period. Hemi-marshes with nearby shrub-scrub or forest are important, where marshes are typically within 100 yards of woody cover. Optimal breeding habitat includes 1.25 acres or larger hemi-marsh and/or swamp (forested and shrub-scrub wetlands) located within 1,100 yards of mature hardwood forest. State forest management should focus on the protection of forest wetlands and adjacent snags and the management of priority state wildlife management areas with suitable habitat.

Wildlife Habitat Specifications:

- Maintain priority wetlands in hemi-marsh condition, with 50/50 open water to emergent marsh, for both breeding and non-breeding habitat.
    - Implementation of the wildlife management area master plans for Dingman Marsh, French Farm Flooding, and O'Neil Lake state wildlife management areas and application of the beaver wildlife habitat specifications will be sufficient to meet this wood duck habitat specification.
- Maintain stable water levels at managed floodings from April through August.

Wood Thrush

The goal for wood thrush in the northern Lower Peninsula is to maintain available habitat. Wood thrush occur primarily in upland, mesic deciduous and mixed forests with large trees, diverse tree communities, moderate undergrowth and a well-developed litter layer. Wood thrush is highly susceptible to nest predation and brood parasitism, which increases with forest fragmentation. State forest management for the species should focus on maintaining large (>250 acres) forest tracts, minimizing edge and promoting a dense understory layer for nesting and foraging.

Wildlife Habitat Specifications:

- Identify, maintain, develop or restore mesic-deciduous tracts >50 years old and >250 acres in size;
- Maximize forest interior (of northern hardwood stands) within the management area by increasing the portion of forest over 250 acres, minimizing edges (concentrating openings, oil and gas development, roads and pipelines along the forest or stand edge) and providing canopy gaps through single tree and group selection harvest practices; and
- Conduct silvicultural practices to maintain or promote a well-developed shrub understory.

4.19.3 Rare Species and Special Resource Area Management

All forest operations must be reviewed for potential conflicts between rare species and proposed forest operations following the guidance in "DNR's *Approach to the Protection of Rare Species on State Forest Lands*" (IC4172). This is especially important when listed species are present or past surveys have indicated a possibility of their presence.

Past surveys have noted and confirmed twelve listed species as well as four natural communities of note occurring in the management area as listed in Table 4.9.2. Any established management guidelines will be followed. Further surveys for special species and natural communities will be carried out as a matter of course during the inventory process and opportunistically for special more focused surveys.

As shown in Figure 4.19.10, the Skegemog Swamp is the only special conservation area in the Williamsburg Moraines management area.

Also shown in Figure 4.19.10 is the Skegemog Lake wildlife area, a high conservation value area.

There is also one ecological reference area (Figure 4.19.10) that is mostly on state land. The ecological reference area represents the northern fen natural community type and is 47.26 acres in area. This ecological reference area will be managed to enhance and protect the natural vegetative and associated wildlife communities as directed by an ecological reference area-specific management plan. These individual management plans will be developed over the life of this planning period.

Management goals during this planning period:

- Document occurrences of rare, threatened, endangered and special concern species and natural communities for the management area through the inventory process or with occasional focused surveys.
- Evaluate all potential Type 1, potential Type 2 and potential old growth areas to determine their status as a special resource area.
- Develop and maintain management and monitoring plans for ecological reference areas on state forest land.

Table 4.19.2. Occurrence information for special concern, rare, threatened and endangered communities and species for the Williamsburg Moraines management area.

Common Name	Scientific Name	Status	Status in Management Area	Climate Change Vulnerability Index (CCVI)	Confidence	Natural Community Association	Probable Cover Types	Successional Stage
Natural Community								
Northern fen		S3/G3	Confirmed				Lowland open/semi-open	N/A
Birds								
Northern goshawk	*Accipiter gentilis*	SC/G5/S3	Confirmed	PS	Very High	Mesic northern Forest	Northern Hardwood	Late
						Hardwood-conifer swamp	Lowland Mixed	Mid
						Northern hardwood swamp	Black Ash	Late
						Floodplain forest	Lowland mixed	Mid
						Dry northern forest	Jack Pine, Red Pine	Late
						Dry-mesic northern forest	White Pine	Late
						Boreal forest	Upland & Lowland Sp/F	Mid
Red-shouldered hawk	*Buteo lineatus*	T/G5/S3-4	Confirmed	PS	Very High	Floodplain forest	Lowland mixed	Mid
						Dry-mesic northern forest	White Pine	Late
						Mesic northern Forest	Northern Hardwood	Late
Common loon	*Gavia immer*	T/G5/S3-4	Confirmed	HV	Very High	Emergent Marsh	Lowland open/semi-open	N/A
						Bog	Lowland open/semi-open	N/A
Bald eagle	*Haliaeetus leucocephalus*	SC/G5/S4	Confirmed	IL	Moderate	Bog	Lowland open/semi-open	N/A
						Hardwood-conifer swamp	Lowland Mixed	Mid
						Northern hardwood swamp	Black Ash	Late
						Poor conifer swamp	Tamarack	Late
						Floodplain forest	Lowland mixed	Mid
						Dry northern forest	Jack Pine, Red Pine	Early
						Dry-mesic northern forest	White Pine	Late
						Mesic northern Forest	Northern Hardwood	Late
Osprey	*Pandion haliaetus*	SC/G5/S2-3	Confirmed	PS	Low	Coastal fen	Lowland open/semi-open	N/A
						Northern hardwood swamp	Black Ash	Late
						Floodplain forest	Lowland Mixed	Mid
						Hardwood-conifer swamp	Lowland Mixed	Mid
Insect								
Red-legged spittlebug	*Prosapia ignipectus*	SC/G4/S2S3	Confirmed	EV	Moderate	Alvar	Upland open/semi-open	N/A
						Prairie fen	Upland open/semi-open	N/A
						Pine barrens	Jack Pine	Early
						Mesic sand prairie	Upland open/semi-open	N/A
Reptile								
Spotted trutle	*Clemmys guttata*	T/G5/S2	Confirmed	HV	Low	Prairie fen	Lowland open/semi-open	N/A
						Emergent marsh	Lowland open/semi-open	N/A
						Great Lakes marsh	Lowland open/semi-open	N/A
						Interdunal wetland	Lowland open/semi-open	N/A
						Coastal plain marsh	Lowland open/semi-open	N/A
						Lakeplain wet prairie	Lowland open/semi-open	N/A
						Wet prairie	Lowland open/semi-open	N/A
						Wet-mesic sand prairie	Lowland open/semi-open	N/A
						Inundated shrub swamp	Lowland open/semi-open	N/A
						Northern fen	Lowland open/semi-open	N/A
						Northern wet meadow	Lowland open/semi-open	N/A
						Mesic prairie	Upland open/semi-open	N/A
						Dry-mesic prairie	Upland open/semi-open	N/A
						Open dunes	Upland open/semi-open	N/A
						Bog	Lowland open/semi-open	N/A
Eastern Massassauga rattlesnake	*Sistrurus catenatus catenatus*	C/SC/G3G4T3T4Q/S3S4	Confirmed	HV	High	Coastal fen	Lowland open/semi-open	N/A
						Dry-mesic prairie	Upland open/semi-open	N/A
						Dry sand prairie	Upland open/semi-open	N/A
						Poor conifer swamp	Tamarack	Late
						Bog	Lowland open/semi-open	N/A
						Emergent marsh	Lowland open/semi-open	N/A
						Northern wet meadow	Lowland open/semi-open	N/A
						Intermittent wetland	Lowland open/semi-open	N/A
						Coastal plain marsh	Lowland open/semi-open	N/A
						Wet-mesic sand prairie	Lowland open/semi-open	N/A
						Wet prairie	Lowland open/semi-open	N/A
						Prairie fen	Lowland open/semi-open	N/A
						Northern fen	Lowland open/semi-open	N/A
						Rich conifer swamp	Tamarack	Late
						Northern hardwood swamp	Black Ash	Late
						Floodplain forest	Lowland mixed	Mid
						Northern shrub thicket	Upland open/semi-open	N/A
						Mesic northern forest	Northern Hardwood	Late
						Dry northern forest	Jack Pine, Red Pine	Early
						Oak-pine barrens	Oak	Mid
						Pine barrens	Jack Pine	Early
						Mesic prairie	Upland open/semi-open	N/A
						Mesic sand prairie	Upland open/semi-open	N/A
						Hardwood-conifer swamp	Lowland Mixed	Mid

Climate Change Vulnerability Index: EV – Extremely Vulnerable; HV – Highly Vulnerable; MV – Moderately Vulnerable; PS – Presumed Stable; and IL – Increase Likely.

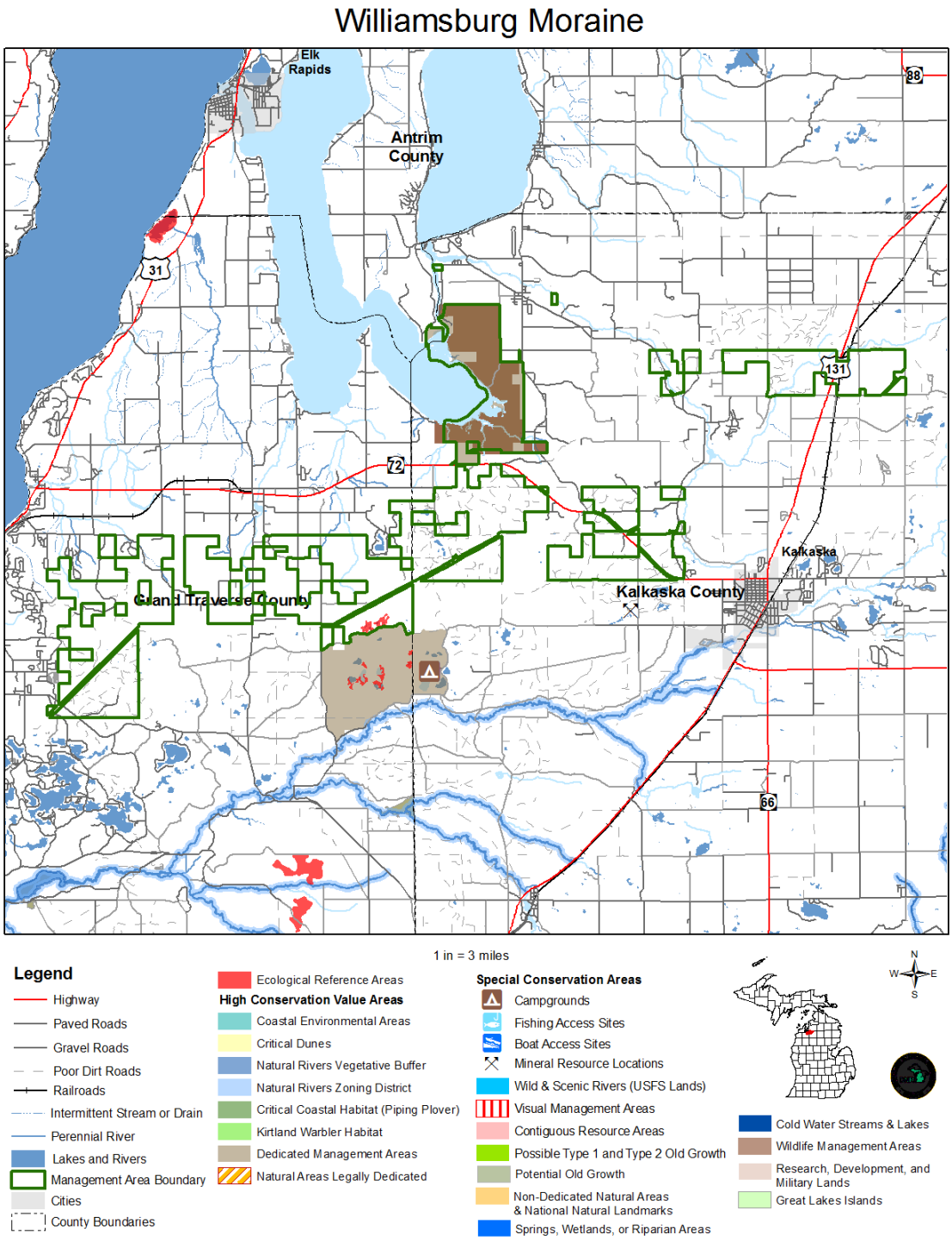

Figure 4.19.10. A map of the Williamsburg Moraines management area showing the special resource areas.

4.19.4 Forest Health Management

Although forest health issues span the entire landscape, some specific threats are more important in this management area due to the species composition, site quality or other factors. Some of the more important forest health pests in this management area include emerald ash borer, beech bark disease and oak decline and management should be adapted as follows:

- Full site use (e.g., stocking, desired species and low species diversity) on high-quality northern hardwood sites heavily impacted by beech bark disease and/or emerald ash borer is important;
- Consider planting red or white oaks, white or red pines, black cherry, white spruce, etc. as site conditions and quality allow;

- Herbicides may be needed to control competing vegetation and/or to reduce density of ash and beech regeneration; and
- While oak and other hardwood species growing on higher quality sites can occasionally suffer decline-associated mortality, it is primarily associated with frost-prone, well-drained soils.

Invasive Species

Invasive species pose a major threat to forest resources. They impact timber production, wildlife habitat and recreational access. Locations of invasive species mapped in and within a five-mile buffer of the management area are summarized in Table 4.19.3 below. This information was compiled from the Midwest Invasive Species Information Network database, but it should not be considered complete. This information and other sources that show the extent and location of invasives should be used to inform of the potential for additional sightings that should be documented. Invasives that merit eradication efforts are those species that threaten sensitive sites due to their location or growth characteristics and have population levels that may be successfully controlled.

Table 4.19.3. Locations of invasive species mapped in and within a five-mile buffer of the management area (Midwest Invasive Species Information Network database).

Williamsburg Moraine - FMD MA	Cases within FMD Areas	Cases within 5-Mile Buffer	Total number of cases	Total number of different Invasive Species
	0	9	9	2

Invasive Species within FMD Areas	Occurrences	Invasive Species within 5-Mile Buffer	Occurrences
-	-	Japanese Knotweed *Fallopia japonica*	1
-	-	Phragmites (Common Reed) *Phragmites australis*	8

4.19.5 Aquatic Resources

Fisheries Division management unit biologists will review proposed forest management activities using the compartment review process, and will consider the potential impact of proposed prescriptions upon riparian and aquatic values. Management prescriptions will be modified to account for riparian and aquatic values by applying the standards and guidance documents listed in the introduction to this plan section to the unique conditions specific to any given forest stand.

Prescription of riparian management zone widths greater than the minimum widths provided in IC4011 (*Sustainable Soil and Water Quality Practices on Forest Land*) must be justified and documented during the compartment review process.

Forested stands adjacent to designated high priority trout streams will specifically be managed to discourage beaver use in accordance with both DNR Policy and Procedure 39.21-20 Beaver Management and IC 4011. Designated high priority trout streams for this management area are shown in Figure 4.19.1 and listed in Appendix F.

4.19.6 Fire Management

Disturbance through fire has played an important role in the initial propagation and maintenance of oak and natural oak/pine types and small inclusions of aspen or herbaceous openland/upland brush types. Wildfire risk and fuel loading is increased in young dense conifer plantations.

The Michigan DNR has a prescribed fire program and maintains a well-trained staff to conduct prescribed burns for silviculture, habitat maintenance or habitat restoration. Each year, all burns prescribed on state forests, parks and wildlife game lands are evaluated and ranked, with funding allocated to the highest priority burns. The ability to fund prescribed burns is based on available funding, the total acres prescribed for burning and the prioritized ranking of individual burns. The demand for prescribed burning money frequently exceeds the amount of funding and some recommended burns may not be funded for that fiscal year. Once funded, the ability to implement a burn is dependent on suitable prescribed burning weather, a suitable fuel (vegetation) condition, local staffing and other resources.

The following fire management concepts should be applied in the management area:

- Seek opportunities to re-introduce fire in the oak/pine areas to encourage pine and oak regeneration and to discourage competition;
- Seek opportunities to use fire as a tool to restore or maintain managed openings; and
- Recognize that increased urbanization in close proximity and within the management area will present more wildland/urban interface challenges to wildfire suppression.

4.19.7 Public Access and Recreation

Where access is limited on state forest land, the department will continue to seek access across adjacent private property. In accordance with the department's *Sustainable Soil and Water Quality Practices of Forest Land*, upon completion of harvesting, temporary spur and seasonal roads will be closed and stabilized.

Existing recreational opportunities within this management area include off-road vehicle trails, snowmobile trails and non-motorized trails as shown in Figure 4.19.1. The popular Vasa cross country ski trail, which recently held the prestigious National Masters Championship race with participants from all over the country is in this management area. A section of the North Country Trail, which is America's longest national scenic trail, transects this management area and a critical portion of the equestrian Shore-to-Shore Trail, which runs from Lake Huron to Lake Michigan dissects this management area. Motorized recreational enthusiasts can enjoy scenic trails through northern Michigan forests dominated by white pine. Due to its proximity to populated areas coupled with favorable soil conditions, current and projected future recreation opportunities will continue to be an important aspect of this management area. Recreation facilities within this management area are shown below:

Campgrounds—N/A

Boating Access Sites—N/A

Off-Road Vehicle Trails
- Grand Traverse to Leetsville North Missaukee and Michigan Cycle Conservation Club Trail
- Leetsville Trail

Snowmobile Trails
- Various

Non-Motorized Trails
- Vasa Trail
- North Country Trail
- Shore-to-Shore Trail

Although managing recreational opportunities is the primary responsibility of Parks and Recreation Division, timber management activities may impact the quality of recreational opportunities and management modifications will be considered to minimize these impacts.

Management modifications that may minimize possible recreational trail and other infrastructure impacts are agreed upon by recreation staff in Parks and Recreation Division, and Forest Resources Division staff through the compartment review process. Public input received through meetings, including the compartment review process and other forums, will also be considered. Trail protection specifications can be applied through the vegetative management system in the design and administration of timber management activities. Guidance for within stand retention may also be used along trails to minimize impacts which may include modifications to management such as maintaining conifers to shade winter snow trails or retaining trees along single track off-road vehicle trails to maintain the integrity of narrow trails. Where modifications to management may not be compatible with timber management objectives, opportunities to educate the public on the department's timber management policies may be considered. Specifications and guidance for management around trails may include, but is not limited to: vegetative management system Sections 5.2.39, 5.2.40, 5.2.41 and 5.2.42 and the Department of Natural Resources Within Stand Retention Guidance.

4.19.8 Oil and Gas Development

Surface sediments consist of an end moraine of coarse-textured till, coarse-textured till, glacial outwash sand and gravel and postglacial alluvium and lacustrine (lake) sand and gravel. The glacial drift thickness varies between 200 and 800 feet. Sand and gravel pits are located in this management area and there is very good potential.

The Mississippian Coldwater and Sunbury Shales and Devonian Berea Sandstone, and Bedford and Antrim Shales subcrop below the glacial drift. The Antrim is quarried for cement products elsewhere in the state.

Most of this management area has been developed for oil and gas production from Antrim Shale or the Guelph (former Niagaran) reefs. Well spacing for both formations is currently 80 acres and most of the area of production is still under lease. Some additional state lands in the management area have been lease recently, most likely for the Collingwood Formation. The Collingwood Formation probably will have a well spacing of 320-640 acres per well (or possibly larger). The areas drilled for the Antrim and Guelph are also where the Collingwood could be developed, possibly using existing well sites and facilities.

Metallic mineral production is not supported by the geology given the depth to known metallic bearing formations.

Administration of oil and gas development on state forest land is provided by both the DNR and Department of Environmental Quality to ensure that minerals shall be developed in an orderly manner to optimize revenue consistent with other public interest and natural resource values.

Lease classification of state lands is guided by DNR Oil and Gas Lease Classification Procedure No. 27.23-15. Contained within each DNR Oil and Gas Lease Agreement are environmental terms which detail requirements for permits to drill issued by the Department of Environmental Quality, supervisor of wells pursuant to Part 615 of 1994 PA 451, as amended. No operations are to take place in a wetland (as defined in Part 303 of 1994 PA 451, as amended), habitat critical to the survival of an endangered species and designated under provisions of Part 365 of 1994 PA 451, as amended or a site designated by the secretary of state to be of historical or archeological significance, unless a plan to eliminate negative impacts to archeological or historical resources is agreed upon. Areas identified as having special wildlife, environmental, recreational significance and/or state surface require a development plan which will minimize negative impacts and will minimize surface waste while remaining consistent with the spacing requirements established by the supervisor of wells. All pipelines from the well site are required to follow existing well roads or utility corridors and all pipelines are to be buried below plow depth. Forest operations (including harvest and planting trees, prescribed fire and wildfire response) in the management area may require modification to accommodate the presence of pre-existing oil and gas pipelines located at or near the ground surface. Abandoned well sites should be incorporated back into state forest stands as either forest openings or re-forested areas, as determined by the vegetation plan contained in the lease agreement or as subsequently decided in compartment review.