Worksheet #1

Area of Interest:	**Stands within MA 8.1 of Interior HFRP, and having major component of overstory being mature or decadent jack pine**
Location:	**Silvicultural Cetification Stand/ Compartment 80, Stand 37: Scenic 1 Segment, Middle Branch of Ontonagon River, Watersmeet RD, Ottawa NF, Gogebic County, Michigan**

Forest Type(s)	Management Goals	Management Objectives	Time Frames
▪ 01 & 30, a couple 02 (focus of where RXs would be applicable) now near 80 years age or greater	▪ All MA 8.1: Water quality/free-flowing	▪ Maintain & protect streamside vegetation through riparian protection zones and activity buffers ▪ Establish long-lived conifers (LLC), white pine & hemlock, for shade	▪ Maintain & protect: Current & into future ▪ Establish white pine and hemlock now, provide shade in 60 – 80 years
▪ * WSR, Middle Branch of Ontonagon River, Scenic Segment 1 (MBOR)	▪ All MA 8.1: Recreation, motorized where appropriate ▪ Scenic 1 MBOR: Canoeing, kayaking & flyfishing	▪ Maintain and improve access ▪ Maintain and improve trout poulations	▪ Maintain: Now ▪ Improve: Some trout number increase soon through habitat/LWD
▪	▪ All MA 8.1: Geology - stable stream channels	▪ Maintain & protect streamside vegetation through riparian protection zones and activity buffers ▪ Prevent sediment from entering streams	▪ Riparian protections and Best Management Practices currently in effect.
▪	▪ All MA 8.1: Fish & wildlife habitat ▪ Scenic 1 MBOR: Brook & brown trout ▪ Scenic 1 MBOR: Wood turtle ▪ Scenic 1 MBOR: Browse for deer	▪ Improve trout habitat by reducing stream temperatures which are limiting populations ▪ Maintain sandy banks for nesting ▪ Provide aspen and maple seedlings for deer browse	▪ Reduce temperatures in 60 – 80 years through streamside planting ▪ Monitor wood turtle nesting ▪ Next 2 – 10 years adjacent timber harvesting of hardwoods & aspen
▪	▪ Ottawa Forest Plan: Maintain & expand white pine & hemlock (restore nearer to historic levels) ▪ All MA 8.1: Vegetation – diverse, dynamic & complex, various successional stages w/ climax communities being common, & streamside protection & shade ▪ Scenic 1 MBOR: Shade & input large woody debris (LWD) ▪ Scenic 1 MBOR: Hemlock, white pine & conifer ▪ Scenic 1 MBOR: Forest health maintained to minimize threats to outstanding remarkable values (ORVs)	▪ White pine & hemlock are infrequent or absent due logging to supply 1880s mill Interior townsite: Plant white pine and hemlock where absent, & provide for regeneration through shelterwood systems where located ▪ Maintain or establish streamside long-lived conifers ▪ Allow dying trees to fall into stream, or perform LWD/ tree placement ▪ Maintain health of jack and red pine plantations through thinning & salvage log	▪ Establish white pine & hemlock now through planting, but won't be serving ecological function or propagating more for 80 – 100 years ▪ Future: > LLC = > LWD ▪ Thin & salvage log over-stocked and over-mature next 2 – 10 years to prevent jack pine budworm and Ips spp.
▪	▪ Interior HFRP: Reduce hazardous fuels & restore healthy forests ▪ Stateline Community Wildlife Protection Plan: Reduce risk of fire to local communities	▪ Harvest insect-killed trees and maintain healthy forests. ▪ Remove wildland fire fuels ▪ Convert fire prone stands (jack pine) to resistant (quaking aspen, white pine, etc.)	▪ Next 2 –10 years, thin red pine stands, remove some or all of jack pine component (over-mature) ▪ Clearcut jack pine w/ aspen

Worksheet #2

Broad-scale Impacts and Vulnerabilities	Climate Change Impacts and Vulnerabilities for the Area of Interest	Vulnerability Determination
▪ **Warmer temperatures, longer summer season with high temperatures, altered precipitation regimes, & possibly drier soils in summers due to increased transpiration**	▪ W/O harvests (or wildfire), stands will develop through succession into tolerant species such as balsam fir, red maple and sugar maple which would not be well adapted to the soil type if it became drier ▪ Stream temperatures within Scenic 1 Segment MBOR are currently marginal, non-trout stream with any temperature increase ▪ Water stress of red pine and existing jack pine likely to lead to outbreak of jack pine budworm or Ips spp. ▪ Higher winter temperatures will increase frequency and severity of spruce budworm outbreaks ▪ With less severe winter temperatures, hemlock wooley adelgid likely to spread into Great Lakes and eliminate hemlock where it currently exists ▪ Warmer summer temperatures, and possibly still heavy snowfall in winter could allow balsam wooley adelgid to spread into Great Lakes and diminish role of balsam fir to non-commercial and less ecological function (wildlife habitat) ▪ Although white spruce are now mostly dead in riparian areas due to decline, further mortality of younger spruce and spruce further from riparian area if further stressed by low soil moisture ▪ Earlier low water conditions (stream impassable w/ watercraft) and loss of trout will eliminate recreational interest ▪ Might be plenty of LWD in streams, but only due to increased tree mortality ▪ Abnormal flood-stage, stream flows could remove streamside vegetation, increasing erosion, stream sediment load, and meandering of stream coarse due to surrounding soils of outwash sand.	**<u>High Risk</u>** • High stream temperatures • Non-trout stream • More budworm and Ips outbreaks • Hemlock wooley adelgid spread to Great lakes • Balsam Fir wooley adelgid spreads to Great Lakes • More loss spruce to decline • Likely loss of recreational use due to no trout & low water • Likely plenty of LWD due to tree mortality **<u>Moderate Risk</u>** • Maples will find soils unsuitable, maples grow on wide range of soils, but growth likely reduced • Difficult to predict if spring flows will be high enough to de-stabilize streambanks
▪ **Decline of associated rare species & species of interest**	▪ Habitat may not support wood turtles ▪ Deer populations affected by drought and warmer temperatures	**<u>Low Risk</u>** • Wood turtle populations doing well on “sister stream”, Cisco Branch of Ontonagon River, which is warmer & more prone to low, drought flows • Deer likely to thrive with shorter winters
▪ **Increased risk of wildfire occurrence & severity putting local communities at risk**	▪ Increased likelihood of wildfire occurrence & severity caused by drier fuels, warmer/drier temperatures during burn periods, & increased fuel loadings caused by mortality due to insect outbreaks & drought stress	**<u>High Risk</u>** • Currently rate of decomposition of downed woody debris & duff is surprisingly fast, possibly due to fog from stream. Would change w/ climate.

Worksheet #3, Page 1

Management Objective (From Worksheet #1)	Challenges to Meeting Management Objective with Climate Change	Opportunities for Meeting Management Objective with Climate Change	Feasibility of Meeting Objective under Current Management	Other Considerations
▪ **Maintain & protect streamside vegetation through riparian protection zones & BMPs & prevent sediment**	▪ Mortality of streamside trees will increase "tip-overs" and exposed soil, & likely drier soils will have less dense vegetation	▪ If winter snowpack diminishes, normal spring flooding will be less, resulting in less erosive forces	▪ Short & long-term protection of water quality good w/ existing practices	▪ Lower flows & warmer temperatures are in themselves reduced water quality
▪ **Establish white pine, hemlock & other long –lived conifers as streamside shade & to meet restoration goals**	▪ Milder winters = more deer, whose browsing reduces planting success & seedling survival of white pine & hemlock ▪ Hemlock not viable if hemlock wooley adelgid established w/o biological controls ▪ Increase spruce budworm impacts or shorter cycles would lifespan & height of white spruce	▪ Somewhat drier conditions could favor white pine on this & similar sites over competing species (red & sugar maple)	▪ Silviculturist & soil scientist on northern tier of forest have had success with low density planting of white pine & hemlock, but low deer numbers in north portion of forest ▪ More aggressive mgmt. through shelterwoods & higher density planting has proven success w/ white pine, even w/ deer	▪ Past leadership on the Ottawa NF has interpreted directives concerning scenic WSR segments w/ less of a "preserve" prospective. Current leadership opposes treatments of other than red pine plantations & a few other exceptions as not meeting DFCs
▪ **Improve trout habitat by reducing stream temperatures & increasing LWD**	▪ Warmer & lower flows of stream will convert to a warm-water fishery	▪ More tree mortality will produce more large woody debris in stream ▪ Warmer temperatures could increase growth & reduce time until effective of replacement shade trees, if soil moisture is adequate	▪ As noted above, some success in planting riparian canopy gaps ▪ Planned LWD placement will supplement natural inputs ▪ Replacement shade trees will take 60 – 80 years to develop	▪ Current loss of streamside spruce & balsam fir to budworm & decline, & time frame before replacing trees are effective, make other than sparse trout populations unlikely
▪ **Provide aspen & maple seedlings as browse for deer**	▪ Winter survival is limiting factor for deer populations in U.P. of Michigan due to DNR mgmt. policies. Higher populations will increase browsing & net effect will be less available forage	▪ Warmer temperatures will increase seedling growth & browse production & more oak species could be present ▪ Unpalatable species, such as balsam fir & spruce will decline w/ climate change	▪ Winter harvest on adjacent hardwoods & conversion of aspen through clearcutting of others will provide browse ▪ Non-harvest of these stands will, in short term, provide denser canopies & better thermal cover for wintering deer	▪ Succession of stands to hardwoods, w/o regeneration of conifers due to lack of soil disturbance & shade will ultimately reduce snow interception & thermal cover for wintering deer. May be offset by milder winters.

Slow down to consider…

Worksheet #3, Page 2

Management Objective (From Worksheet #1)	Challenges to Meeting Management Objective with Climate Change	Opportunities for Meeting Management Objective with Climate Change	Feasibility of Meeting Objective under Current Management	Other Considerations
▪ **Maintain forest health of jack, red & mixed pine stands, & prevent insect outbreaks in these & other forest types**	▪ Greater water stress on trees will reduce their resistance to insects which reproduce in pine cambium ▪ Reduced tree vigor will reduce tree survival after partial defoliation ▪ W/O cold winter temperatures to cause winter mortality of forest pests, outbreaks will be more frequent & severe	▪ The range of balsam fir & black spruce are forecasted to shift north of this area under some climate change models, with more southerly species of oaks & pines predicted to find changed climate suitable	▪ Red pine plantations are proposed for group selection treatments which will reduce basal area & maintain tree health ▪ Periodic outbreak of spruce budworm is at peak, or past, & historically will abate for 25 – 30 years ▪ Untreated stands w/ mature & decadent jack pine, & are frequently over-stocked, pose risk for jack pine budworm or Ips spp. outbreak. Being cumulatively < 300 acres total, unknown whether could affect forest as a whole	▪ Past leadership on the Ottawa NF has interpreted directives concerning scenic WSR segments w/ less of a "preserve" prospective. Current leadership opposes treatments of other than red pine plantations & a few other exceptions as not meeting DFCs
▪ **Reduce wildland fuels & convert fire prone species to less fire prone species**	▪ Tree mortality caused as result of climate change will increase wildland fuels ▪ Fire prone types would stay static or increase, because wetter forest types might convert to more fire prone types due to drier conditions & increased fire activity	▪ If rainfall & soil moisture increase proportionate with temperature under climate change, decomposition rates of wildland fuels will increase due to increased microbial activity ▪ Balsam fir and black spruce are highly flammable and provide ladder fuels to initiate crown fires, but their presence may diminish as their range shifts north	▪ In general, acres of jack pine are being reduced through efforts to meet forest plan objectives of aspen acres. Widespread acres of wet & riparian conifer types on the forest offset this reduction of short-lived conifer acres lost ▪ Non-harvest of jack & mixed pine stands in non-"wild" WSR will temporarily increase for the next 50 years or so, until they convert through succession to hardwood types	▪ Past leadership on the Ottawa NF has interpreted directives concerning scenic WSR segments w/ less of a "preserve" prospective. Current leadership opposes treatments of other than red pine plantations & a few other exceptions as not meeting DFCs

Worksheet #4, Page 1

Adaptation Approach	Tactic	Time Frames	Benefits	Drawbacks & Barriers	Practicability of Tactic	Recommend Tactic?
▪ **Sustain Ecological Function/ Reduce Impact Existing Biological Stressor/ Protect from Severe Fire** – Existing red pine as surrogate	▪ Maintain health & promote growth of existing red pine to provide shade & stabilize banks	▪ Short term (2 – 10 years)	▪ If implemented, does achieve some objectives ▪ Salvage harvest also generates timber volumes & revenue, & reduces wildfire fuels	▪ Long – term, red pine is not sustainable on landscape w/o treatments (cc or seed tree) which are unacceptable considering scenic WSR designation	▪ High – with approval from deciding official through project decision, would be economical & implementable	▪ Yes
▪ **Sustain Ecological Function/ Facilitate Community Adjustment through Species Change** – Plant brown trout	▪ Replace native species with introduced, but naturalized species that is more tolerant to changed environment	▪ Immediate	▪ Provides similar recreational experience ▪ Brown trout are widely popular & frequently preferred by some flyfisher-persons	▪ Not native to North America. Brook trout are more ubiquitous for inexperienced fisher-persons ▪ Could progress brook trout toward "threatened" listing	▪ High – requires funding, but likely collaborators, such as state DNR & sportsman organizations	▪ Yes
▪ **Sustain Ecological Function/ Species & Structural Diversity/ Ecosystem Redundancy/ Reduce Impact Existing Biological Stressor/ Protect from Severe Fire** – Shelterwood harvest & underplant white pine	▪ Re-establish ecosystem component which with wide ecological amplitude & will persist in predicted changed climate ▪ Shelterwood system, especially to lower residual basal areas will reduce deer winter use & their browsing	▪ Short term/ establish (2 – 10 years) ▪ Long-term (60 – 80 years & beyond) effective in role shade, long-lived conifer, etc.	▪ Meets multiple objectives (shade, diversity, restoration goals, less fire-prone), and is self-sustaining through regeneration following small scale disturbance	▪ Requires harvest entries & temporary visual and vegetation modification, which has been interpreted as unacceptable within "scenic" WSR ▪ Requires post-harvest tending to insure success. Multiple harvests more successful, but multiple temporary impacts	▪ High – with approval from deciding official through project decision, would be economical & implementable	▪ Yes

Slow down to consider…

Worksheet #4, Page 2

Adaptation Approach	Tactic	Time Frames	Benefits	Drawbacks & Barriers	Practicability of Tactic	Recommend Tactic?
▪ **Reduce Impact Existing Biological Stressor** – Control deer numbers through harvest, especially issuing doe tags	▪ Control deer numbers, even if milder winters allow greater survival.	▪ Immediate	▪ Less deer numbers allows browse to be adequate for remaining deer	▪ Lower numbers will limit recreational hunting & tourism economy ▪ Michigan DNR has long history of opposing widespread harvest of does as means to manage deer numbers	▪ High – only requires cooperation of one state agency, if local sportsman clubs can be convinced of need & benefits	▪ Yes
▪ **Promote Landscape Connectivity** – Restore white pine & hemlock within entire length of MBOR	▪ Implement shelterwood or other underplanting RX at multiple locations throughout WSR	▪ Short term (2 – 10 years) segments within Interior HFRP ▪ Long term – other segments & ownerships	▪ Allows northward movement of related species during predicted warming & change of climate	▪ "Preservation" interpretation of "scenic" designation ▪ Some segments w/ wilderness designation may prohibit activity	▪ High - North/ south orientation of branches of Ontonagon watershed suited for species movement during climate change ▪ Moderate – limitations on management activities due to directives & interpretation of others	▪ Yes
▪ **Refugia** – Underplant hemlock in river corridor stands	▪ Plant eastern hemlock in understory of existing stands, then protect from browsing through wire cages or exclosures	▪ Short term/ establish (2 – 10 years) ▪ Long-term (60 – 80 years & beyond) to establish as overstory component	▪ Meets multiple objectives, including restoration goals ▪ Isolation/ sparse distribution may shield from spread of wooley adelgid	▪ Slow seedling growth & vulnerability to deer browsing ▪ Cages & exclosures are expensive & require maintenance	▪ Low – linear riparian features are natural habitat to wintering deer ▪ Low – predicted range of hemlock under climate change will preclude survival	▪ No
▪ **Reduce Impact Existing Biological Stressor** – Modify MBOR above to cool water	▪ Accelerate rate movement of cooler water through Sherman Pond/ rice bed area	▪ Mid-term – (10 to 20 years) & beyond	▪ Cooler water in summer will improve trout survival in marginal habitat downstream	▪ Although not historically existing, rice beds now provide LVD tribe source for traditional harvest	▪ Low – modifying channel would require extensive environmental analysis & face tribal opposition	▪ No

Worksheet #5

Monitoring Items	Monitoring Metric(s)	Criteria for Evaluation	Monitoring Implementation
▪ Evaluate current forest health & fuel loadings of 01 & 30 stands in Scenic 1 of WSR, & project fuel loadings post-harvest if treatments are implemented	▪ Use fuel loading data & projection of fuel loading in future to predict fire behavior, w/ & w/o treatment	▪ Will treatment significantly reduce fire behavior in short term & long term?	▪ If implemented, evaluate fuels reduction & supervise tree planting of less fire prone species
▪ Perform stand exam of subject stands & evaluate stand composition, habitat type & other factors for suitability to implement shelterwood/ underplant RX, or similar RX	▪ Have specialists evaluate treatment alternatives for environmental compliance ▪ Evaluate predicted stand development using FVS, economics & silviculture to choose alternative RX which best meets objectives	▪ Are the treatments environmentally sound? ▪ Do directives authorize treatment? ▪ Will treatment meet objectives & DFCs? ▪ Will the treatment results change under a climate change scenario?	▪ Perform post-harvest review ▪ Inspect tree planting ▪ Perform regeneration surveys ▪ Review tending activities to assure seedling survival ▪ Monitor stand & target species health throughout stand development
▪ Monitor long-term survival & proliferation of white pine (& hemlock) throughout the river corridor, along its streambanks, & throughout the landscape	▪ Trees per acre, basal area, or other stand composition metric ▪ Health & growth of white pine (& hemlock) ▪ Regeneration of subsequent cohorts of white pine (& hemlock)	▪ Is the species' representation within stands meeting target metric? ▪ Is the species healthy & regenerating, or does it need tending or other activities? ▪ Is it providing effective shade?	▪ Perform stand exams ▪ Have specialists measure effective shade or other parameter to measure species contribution to reducing stream temperatures
▪ Evaluate effectiveness of treatments in maintaining landscape level ecological function and forest health	▪ Monitor species composition within stands & across the landscape for effects of climate change on species composition ▪ Along with specialists, monitor effectiveness of adaptive strategies on maintaining ecological functions, facilitating species survival & migration, & species transition/ replacement	▪ What basal area is represented by a species within stands, or how many acres are occupied by forest types containing the subject species? ▪ Is a species, or its surrogate, performing the critical ecological function? ▪ What is the health of the subject species, or are there threats to its future health?	▪ Review stand and forest inventory data ▪ Consult with specialists ▪ Perform inspections on stands for insects & disease, or other sources of mortality ▪ Stay educated by reviewing research literature and correspondence on issues of forest health
▪ Evaluate effectiveness of non-timber/ non-silviculture activities on achieving the other objectives of stand & management area	▪ Deer per square mile & browsing intensity ▪ Trout per river mile & trout recruitment ▪ Visitor days of recreationists	▪ Are deer populations within goals & is browse adequate to support their health? ▪ Are trout numbers supporting recreation & are they reproducing? ▪ Has visitor use maintained/ increased?	▪ Survey deer populations ▪ Do stream shocking or creel surveys to determine trout densities & age distribution ▪ Measure visitor use