United States Department of the Interior

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March 6, 2000

Peter Poolman, Chief
Environmental Compliance Section
Walla Walla District, Corps of Engineers
201 North 3rd.
Walla Walla, WA 99362-1876

RE: Highway 12 Planning Aid Report

Dear Mr. Poolman:

Enclosed please find the Planning Aid Report (report) prepared by the U.S. Fish and Wildlife Service (Service) for the Corps of Engineers (Corps) to assist with your planning for the proposed Highway 12 widening project. This report has been prepared by the Service under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). However, this report does not constitute the report of the Service and the Department of the Interior pursuant to section 2 (b) of the FWCA. If the Corps planning continues into the feasibility stage for this project, we would anticipate being contacted to provide a FWCA report which does satisfy section 2 (b) of the FWCA.

This report is based primarily on information gained through the Service's Habitat Evaluation Procedures (HEP) conducted in 1999 within the study area. Information in this report was also obtained from site visits and surveys; project files; various published and unpublished literature and other data; maps; aerial photos; and information obtained from personnel with the Corps and Washington Department of Fish and Wildlife.

If you have any questions, contact Don Haley of my staff at (509) 754-8580.

Sincerely,

Mark Miller
Project Leader

ENCLOSURE

CC: WDFW, Kennewick (La Riviere)
USFWS, Pasco (~~Franco~~ Chuck and Browers)
USFWS, Spokane

PLANNING AID REPORT
FOR
HIGHWAY 12 WIDENING PROJECT

PREPARED BY

U.S. FISH AND WILDLIFE SERVICE
UPPER COLUMBIA RIVER BASIN FIELD OFFICE
SPOKANE, WASHINGTON
MOSES LAKE, WASHINGTON

PREPARED FOR

U. S. ARMY, CORPS OF ENGINEERS
WALLA WALLA DISTRICT
WALLA WALLA, WASHINGTON

March, 2000

INTRODUCTION

This Planning Aid Report (PAR) concerns the quality of wildlife habitat on those portions of land owned by the Corps of Engineers (Corps) as part of the Lower Snake River Fish and Wildlife Compensation Plan lands and which may be impacted by the widening of US Highway 12. This land is leased to the U.S. Fish and Wildlife Service (Service) as part of the McNary National Wildlife Refuge in Walla Walla County, Washington. This report has been prepared under the authority of and in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 USC 661 et seq.), but does not fulfill our obligations under Section 2 (b) of the Act. This study was limited to study of a selected plan which has not yet been approved for construction.

The objectives of this study were to: 1) determine probable impacts of the project's proposed alternatives on fish and wildlife and their habitats and 2) recommend mitigation measures needed to reduce construction-caused adverse impacts to fish and wildlife habitat. In order to determine the probable impacts of construction on existing fish and wildlife resources, Habitat Evaluation Procedures (HEP) were used. These procedures are described in more detail in the Methods section.

STUDY AREA

The study area included the land owned by the Corps of Engineers along Highway 12 between Burbank, Washington and the intersection with Highway 730 at Wallula. This area includes the Two Rivers and Wallula Habitat Management Units (HMU). The entire project area is within the shrub-steppe big sagebrush (*Artemesia tridentata*) – bluebunch wheatgrass (*Agropyron spicatum*) habitat type. This habitat type consists of four well-defined vegetation layers. The most prominent layer consists of various shrub species, principally big sagebrush, which is intermixed with a second layer comprised of a variety of tall perennial grasses, principally bluebunch wheatgrass. The third layer consists of low-lying perennial and annual grasses and forbs, which are usually less than four inches tall. Finally, the fourth vegetative layer is made up of a thin, fragile crust, called the cryptogam, which occurs directly on the soil surface. Various lichen, moss, and liverwort species comprise this layer. Most of the shrub-steppe in the project area has been impacted by human influences such as livestock grazing, fire, and exotic species introductions. As a result, most of the project area has been significantly altered and now represents new plant associations. Cheatgrass (*Bromus tectorum*) has become very widespread in the project area and has replaced native grasses species in some areas. Big sagebrush has been replaced by gray rabbitbrush (*Chrysothamnus nauseosus*) as the dominant shrub in many places. Non-native forbs such as knapweed (*Centaurea ssp.*) and star thistle also dominate in many areas.

The habitat within this area was heavily influenced by the creation of the reservoir behind McNary Dam. The water table behind the dam created many wetlands within an arid landscape, while also destroying most of the existing wetlands by submerging them under the reservoir.

There are a number of palustrine wetlands within the project area including emergent, scrub-shrub, and forested types. Table 2 lists all the cover types in the project area and the dominant plant species in each cover type. Most wetlands are concentrated at either end of the project at Casey Pond near Burbank, or along the Walla Walla River at the other end. The wetlands range from small seeps to large marshy areas associated with deep water habitats.

The two crop circles in Burbank, owned by the Corps and managed by the U.S. Fish and Wildlife Service's McNary National Wildlife Refuge, were originally included within the study area, but were later dropped because these lands are being traded to the Port of Walla Walla in exchange for land outside the Highway 12 expansion corridor.

PROJECT DESCRIPTION

The Washington State Department of Transportation plans to expand a 13-mile section of US Highway 12 from two to four lanes. The project location extends from the Snake River Bridge near Pasco, Washington east to the US12/US730 intersection at Wallula Junction, 29 miles west of Walla Walla, Washington. The proposed expansion of Highway 12 from two to four lanes, as currently planned, would impact a total of 21.3 acres of federal land, including 6.7 acres of palustrine forested, scrub-shrub and emergent wetlands and open water. These impacts are primarily from the footprint of the expanded roadbed.

METHODS

The Service began fieldwork for the Highway12 HEP study on June 7, 1999, completed the majority of it in July and finished it on August 16, 1999. We field checked representative portions of each of the 12 cover types identified by the Corps on cover type overlays for each of the cover type polygons. Field visits revealed that due to cover-typing errors on aerial photo overlays, cover types were occasionally mislabeled. For example, some annual forbland was labeled grassland. We sampled each cover type, whether identified on overlays or not, and made corrections to the overlays as errors were identified. Appendix B identifies each of the HSI's by species and cover type polygon.

HEP was the primary method used to evaluate and quantify habitat values for the Compensation Plan. HEP is a species-based habitat analysis procedure. The procedure assesses the value of the habitat for certain select species over the life of the project. The species evaluated are selected either to represent entire groups of species (for example, mallards may be used to represent dabbling ducks) or because of some special value they have in the area (for example, popular game birds). For this project, criteria for species selection included economic/recreational importance, use of representative cover types, ecological importance, availability of adequate HSI models. Most of the species selected were also used in the Lower Snake River Fish and Wildlife Compensation Plan (USFWS 1991) since this project covered part of the same land area.

Table 1. List of selected evaluation species with justification

Species	Reason for Selection
Yellow warbler (*Dendroica petechia*)	Indicator species for scrub-shrub wetlands
Marsh wren (*Cistothorus palustris*)	Indicator species for emergent wetlands
Song sparrow (*Melospiza melodia*)	Indicator species for mesic shrubland and riparian forest understory
Western meadowlark (*Sturnella neglecta*)	Indicator species for grassland/shrubsteppe
Lesser scaup (*Aythya affinis*)	Indicator species for open water
Mallard (*Anas platyrhynchos*)	Indicator species for waterfowl habitat associated with backwater/ ponded areas
California quail (*Callipepla californica*)	Important upland game bird
Mule deer (*Odocoileus hemionus*)	Important big game species
Beaver (*Castor canadensis*)	Indicator species for riparian forest

Once species are selected, models which describe a range of habitat values for that species are written. Evaluation species models that were used were those that were agreed upon by the Service and WDFW, and in general are the species that were used in the HEP performed for the Lower Snake River Compensation Plan, which includes the area of this project. These models generally relate certain aspects of the habitat, such as percent ground cover or height of vegetation, to the value of the habitat for the species. The models rank the habitats on a scale from 0.0 to 1.0, with 0.0 being of no value and 1.0 being of highest value. These scores are known as habitat suitability indices (HSI) and may change over time as the habitat changes. In most models, once the HSI scores are determined for each species, they are multiplied by the

number of acres of habitat available to the species to derive a measure which takes into account both the habitat quality and quantity. This measure is called habitat units (HU). The HU scores are altered either by changes in the number of acres of habitat available to a species or by changes in the quality of the available habitat over the life of the project. The total HU's available over the entire life of the project are generally averaged over the project life to yield a value which is the average annual HU's available for each species. The results from the HEP can then be used to compare the future with and without the project conditions to provide an estimate of the project-related impacts to wildlife.

In this case, while HSI's were determined for each habitat polygon within the project area, HU's were only calculated for the portion of those polygons which would be impacted by the proposed project. Also, it was decided to simply assume that current HU conditions approximate Future Without the Project conditions. It was further assumed that the Future with the Project conditions would simply reduce the HU's to zero since the impact would virtually cover that habitat.

Two techniques were employed which have been successfully used in the past to determine HSI values with significantly less effort than using detailed field measurements. Wakely and O'Neil (1988) describe these techniques in detail. The first technique involves measuring HSI model variables on a discrete scale rather than a continuous one. To do this, the suitability indices (SI) for each variable, which are graphically expressed as curves, are divided into three categories: zero where SI equals 0.0, low where SI is less than 0.5 and high where SI is greater than or equal to 0.5. For example, for canopy cover of shrubs for some evaluation species, 0.0 percent canopy cover would equal zero, less than 35 percent canopy cover may equal low, and greater than or equal to 35 percent canopy cover may equal high. Wakely and O'Neil (1988) recommended assigning the zero suitability rating a score of 0.0, low a score of 0.2, and high a score of 0.9. If it was reasonable to divide the SI curve into four discrete categories, based on a flatter slope, we added a medium category and assigned it a score of 0.5, based on Wakely and O'Neil (1988). Those habitat variables that were already in discrete units, for example, the growth form of emergents for the marsh wren model, would retain their units and corresponding SI scores.

The second technique used to reduce field effort involved the use of ocular estimates of habitat variables rather than precise measurements. Since the habitat variables were divided into only three or four discrete categories, ocular estimates were relatively simple and accurate. For example, for the song sparrow model, the percent canopy cover of shrubs would be either 0.0, less than 25 percent or greater than or equal to 25 percent (see Appendix A). For this model, the observer only needed to determine if: 1) shrub canopy coverage is present and 2) whether or not it is greater than, less than or approximately equal to 25 percent. In order to reduce variability in ocular estimates, the same observer made all estimations. Additionally, a limited number of habitat variable measurements were taken in the field to periodically "calibrate" the ocular estimates.

The entire study area was divided into cover type polygons (Table 2 and attached maps). An HSI was then calculated for each HEP species selected for that cover type (Appendix A) in each

Table 2. Cover types used in the Highway 12 habitat evaluation with representative features

Cover Type	Code	Representative Features
Agricultural cropland	AC	Various annual crops
Annual forbland	AF	Tumble mustard (*Brassica ssp.*) Knapweed Cheatgrass
Grassland	G	Cheatgrass Bluebunch wheatgrass
Shrubsteppe		
low canopy cover	SSL	Gray rabbitbrush
high canopy cover	SSH	Wyoming big sagebrush Cheatgrass
Mesic shrubland	MS	Smooth sumac (*Rhus glabra*) Douglas hawthorn (*Crataegus douglasii*)
Riparian forest	PFO	Black cottonwood (*Populus trichocarpa*) Russian olive (*Elaeagnus angustifolia*) Black locust (*Robinia pseudoacacia*)
Palustrine scrub-shrub	PSS	Willows (*Salix spp.*)
Palustrine emergent	PEM	Cattail (*Typha latifolia*) Sedges (*Carex ssp.*) Bulrushes (*Scirpus ssp.*)
Palustrine open water	POW	Ponds and backwater areas
Riverine	ROW	River channel
Residential/Industrial	RI	
Recreational	RE	
Railroads/Roads	RR/PR	

polygon. Since only one proposed highway alignment was provided to the Service, no comparison of impacts to fish and wildlife resources can be made for various highway alignments.

Future without the Project-

The following table shows acreages and HU's which were for the habitat that would be otherwise impacted by the proposed project. For those habitats with more than one species represented, the HU represents a total of the HU's for each of the species. For example, for palustrine forest the HU's for beaver, mule deer, and song sparrow were each .25 for a total of .75 HU's. For habitats unaffected by the proposed project (for example, agricultural cropland) the HU's would total "0".

Table 3. Habitat units by cover type without the project

Cover Type	Acres	Habitat Units	Species
palustrine forest	0.5	0.75	beaver, mule deer, song sparrow
palustrine emergent	1.4	0.65	marsh wren
palustrine scrub-shrub	2.7	5.06	yellow warbler, beaver, mule deer
mesic shrubland	0.2	0.22	song sparrow
shrub-steppe low	6.2	3.68	mule deer, western meadowlark
shrub-steppe high	0.0	0.0	mule deer, western meadowlark
grassland	0.2	0.04	mule deer western meadowlark
annual forbland	7.9	3.84	mule deer, western meadowlark
agricultural cropland	0.0	0.0	California quail
recreational	0.1	0.02	beaver, song sparrow, mule deer
palustrine open water	2.1	0.68	lesser scaup, mallard

Future with the Project-

As mentioned above, only the HU's for habitat that would otherwise be directly impacted by the proposed project were calculated for the Future without Project conditions. Therefore, all of those HU's would be eliminated with the project as currently planned and HU totals would become zero. At this time, there are no definitive plans for mitigation actions to minimize or compensate for adverse impacts and so we did not calculate corresponding HU's for replacement. However, we do discuss some mitigation options in a later section of this report.

Palustrine Forest
All palustrine forest habitat losses are in the Casey Pond area and are about equally divided among the three species modeled for this cover type.

Palustrine Emergent
The proposed highway alignment would impact only 1.4 acres of this cover type for a total loss of only 0.65 HUs for the marsh wren. Losses are mostly within the wetland at Wallula Town, with two additional small wetland losses in the Casey Pond area.

Palustrine Scrub-shrub
The greatest loss of HUs would be within this cover type. Almost all of the losses are in the Wallula HMU in the area of the highway bridge crossing over the Walla Walla River. Both sides of the existing bridge have dense stands of hydrophytic shrubs that provide habitat for all three species modeled for this cover type. The proposed location for the new bridge (upstream side of the existing bridge) is the preferred location since this area has already been degraded through creation of "volunteer" roads by people accessing the river from the rest stop. The habitat downstream of the existing bridge is undisturbed and is connected in an unbroken block to the mouth of the Walla Walla River and therefore provides additional habitat value that may not be reflected in the HEP analysis. There are additional small losses of palustrine scrub-shrub in both the Casey Pond and Wallula Town areas.

Shrub-steppe Low
The low-density shrub-steppe habitat in the project area is generally of low quality for both mule deer (HSI range 0.2 - 0.5) and western meadowlark (HSI range 0 - 0.4 and one 0.7)(see Appendix B). This cover type is of low value for mule deer because the shrub component is dominated by rabbitbrush, which is not a preferred forage species. Although rabbitbrush is a native species, it tends to dominate in areas that have been disturbed through fire, over grazing, or land clearing. Habitat value is limited for the western meadowlark because the understory is dominated by invasive non-native forbs such as knapweed and mustard, and the grass component is dominated by cheatgrass.

Shrub-steppe High
There was no loss of shrub-steppe high habitat because the proposed highway alignment does not cross this habitat type.

Grassland
The only area of grassland habitat that would be impacted by the proposed project is of very low value to mule deer (HSI 0.2) and of no value to western meadowlark. This small grassland patch is sandwiched between an agricultural crop circle and the current Highway 12 alignment. The patch is dominated by weedy species and has no shrub component for mule deer foraging or western meadowlark perching.

Mesic Shrubland
This cover type is very limited within the project area and is only found in the Wallula HMU near the Highway 12 bridge over the Walla Walla River.

Annual Forbland
Annual forbland habitat is extensive in the project area and is generally of very low habitat quality for native species. HSI values range from 0.2 to 0.3 (see appendix B). Cheatgrass, knapweed, star thistle, and other non-native species dominate the annual forbland cover type.

Agricultural Cropland
There would be no loss of agricultural cropland habitat because the proposed highway alignment does not cross this habitat type within the area of this evaluation (see attached maps).

Recreational
The only recreational land the proposed highway alignment would cross is at the rest area in the Wallula HMU. The site is an irrigated area of grass and trees and was evaluated in the same manner as a palustrine forest. The site provides no habitat for beaver because it is too far from water, it provides no habitat for song sparrow because there is no shrub understory. There is some habitat for mule deer, but it is limited (HSI 0.2) due to the lack of shrubs.

Palustrine Open Water
All losses of this cover type are in the Casey Pond area and are mostly losses to mallard habitat. Habitat for lesser scaup is very limited in the project area since the project impacts will be in the near shore area, which is not heavily utilized by wintering lesser scaup, but is used by mallards.

MITIGATION RECOMMENDATIONS

The following mitigation recommendations are fairly general. More detailed measures would need to be developed as project plans and alternatives are finalized. The Service would be available to help with the development of a refined mitigation plan.

Palustrine Forest
This is a valuable cover type for a wide variety of wildlife including the federally listed threatened bald eagle. All losses in this cover type should be mitigated on-site and in-kind by either improving the quality of existing habitat or creating additional habitat. There are several potential mitigation areas near the project corridor where existing palustrine forest habitat could be improved, including polygons PF 8 and PF 9 (see attached maps). These sites have little to no

shrub understory or young cottonwood regeneration, both important habitat components for song sparrow, beaver, and mule deer, the three indicator species used in this study for this cover type. Mitigation in this cover type should include planting native black cottonwood, willow, red-osier dogwood, and other native hydrophytic shrubs.

Palustrine Emergent

Palustrine emergent wetlands provide valuable habitat for many wildlife species including neotropical migratory birds such as marsh wren, many waterfowl species, furbearers, and others. The HU losses should also be replaced on-site and in-kind. There would likely be several opportunities to alter hydrology and topography slightly in such a way as to create or enhance this wetland type.

Palustrine Scrub-shrub

This is a very valuable cover type for a wide variety of wildlife including many neotropical migratory birds. All losses in this cover type should also be mitigated on-site and in-kind by either improving the quality of existing habitat or creating additional habitat. Some potential areas where existing palustrine scrub-shrub habitat could be improved, include polygons PSS 1 in the Wallula HMU and PSS 7 & 8 in the Casey Pond area (see attached maps). These sites all have a low percent shrub canopy cover and could be improved for all three indicator species (yellow warbler, beaver, and mule deer) by increasing the canopy coverage of hydrophytic shrubs. Additionally, PSS 1 has a number of "volunteer" access roads that could be closed and revegetated for additional habitat connectivity and security. Revegetation should include native willows, red-osier dogwood, and other native hydrophytic shrubs.

Shrub-steppe Low

This cover type is abundant in the project area and generally of low quality to native wildlife species, creating ample opportunities for mitigation through restoration in-kind and on-site. Conversion of shrub-steppe areas from rabbitbrush to a sagebrush overstory, control of noxious weeds and restoration of a native grass and forb understory would provide high quality habitat for both mule deer and western meadowlark (the indicator species used for this cover type) as well as other native wildlife. In addition, shrub-steppe habitat could be established on other cover types such as low quality annual forbland, cheatgrass dominated grassland and agricultural cropland.

Grassland

Very little grassland habitat would be impacted by the proposed highway expansion and likely exists in the project area due to fire disturbance removing the shrub overstory. Therefore, losses to this cover type should be compensated for by mitigating additional shrub-steppe low habitat.

Mesic Shrubland

There is only one small patch of mesic shrubland in the project area; it is in the Wallula HMU near the Walla Walla River. This site provides high quality song sparrow habitat with nearly optimal percent shrub canopy cover, shrub height and distance to water. There are opportunities to mitigate for losses to this cover type within the same cover type polygon (MS 1). For

example, there is a dead end dirt road that could be closed and revegetated with mesic shrubs such as chokecherry, hawthorn, hackberry, and blackberry.

Annual Forbland

The annual forbland cover type is, dominated by non-native and noxious weeds, therefore losses to this cover type should not be mitigated in-kind. This cover type does provide habitat for the two HEP indicator species (mule deer and western meadowlark) and thus the conversion of annual forbland habitat to paved highway results in a real loss of habitat for these species. Therefore, we recommend that project impacts to this cover type be improving plant species composition (eliminate noxious weeds and increase native species) on adjacent annual forbland. Another option would be to improve habitat conditions for mule deer and western meadowlark at other cover types (grassland, shrub-steppe, riparian forest, and palustrine scrub-shrub).

Recreational

The small area of recreational land that will be impacted by the proposed highway alignment provides very little wildlife habitat and losses within this cover type need not be mitigated in-kind or on-site. Adding these minimal habitat losses (0.02 HU) for beaver, mule deer, and song sparrow to palustrine forest mitigation areas would provide greater overall habitat value.

Palustrine Open Water

Loss of near shore habitat in this cover type can best be minimized and mitigated through design of the highway alignment as it crosses Casey Pond. Impacts to mallards and other species which use the near shore habitat could be further minimized by adding some areas of sloped fill to allow establishment of emergent wetland vegetation such as bulrush, cattail, and rushes.

Highway Design

Of the two median design options provided to the Service for review, impacts to upland cover types would be minimized by using Design B. Design A appears to have a much wider right-of-way and therefore a larger impact area. However, by compressing the lanes and using a crowned median, as in Design B, the right-of-way, and thus the impact area, would be minimized. However, we recognize that this would likely result in loss of more animals from vehicle collisions. Incorporating adequate passage under the highway in certain locations (overpasses, bottomless culverts, etc.) would allow more animals to move past the highway without the threat of collision.

Impacts to wetland cover types (palustrine forest, scrub-shrub, and emergent) could be minimized by use of Casey Pond Design Option 2. This design, of the three options provided to the Service, minimizes fill into the wetlands. Design Options 3 and 4 would extend disturbance and construction farther out into the wetlands.

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APPENDIX A

Species Model Descriptions and Discrete Habitat Variables

Beaver: This model evaluates palustrine forested (PF) and scrub/shrub habitat. The model measures the quality of year-round habitat. Optimum habitat conditions occur with 45 - 60% tree canopy cover with 100% of the trees between 2.5 and 15.2 cm dbh, 40- 60% shrub canopy cover at least 2m tall, > 50% of woody vegetation comprised of aspen, willow, cottonwood, or alder, and no more than small annual water fluctuations that don't affect lodges or burrow entrances.

V1 % tree canopy closure

- Zero = 0
- < 10% = .2
- between 10% and 30% or > 60% = .6
- > 30% and < 60% = 1.0

V2 % of trees 2.5 to 15.2 cm dbh

- zero to 25% = .2
- > 25% and <75% = .5
- > 75% = .9

V3 % shrub canopy cover

- zero = 0
- < 10% =.2
- > 10% and < 35% = .5
- > 35% = .9

V4 average height of shrub canopy

- zero = 0
- < 1 meter =.3
- between 1 and 2 meters =.7
- > 2 meters = 1.0

V5 species composition of woody vegetation (trees and/or shrubs)

- > 50% aspen, willow cottonwood, or alder = 1.0
- > 50% other deciduous species = .6
- > 50% coniferous species = .2

V8 average annual water fluctuation

- small fluctuations that have no effect on burrow entrances = 1.0
- moderate fluctuations that affect burrow entrances =.5
- extreme fluctuations or water absent part of year = 0

HSI food = $[(V1 * V2)^{1/2} * V5]^{1/2} + [(V3 * V4)^{1/2} * V5]^{1/2}$

HSI water = V8

TOTAL HSI = lower of food or water HSI

Yellow warbler: Scrub/shrub wetland (PSS) comprises the primary habitat for this species. The model measures reproductive habitat suitability, which is assumed to meet all habitat needs. Optimum habitat conditions occur with moderate to high shrub densities (60 - 80%) which

average at least 7 feet tall. Hyrdophytic shrubs (willow, cottonwood, elderberry, and olive) increase the value of PSS for yellow warblers with 100% cover optimal.

V1 live deciduous shrub canopy cover <20' tall

- no shrubs = 0
- < 20% = .2
- > 20% and < 50% = .5
- > 50% = .9

V2 shrub height

- no shrubs = 0
- < 2' = .2
- > 2' and < 4' = .5
- > 4' = .9

V3 % shrub canopy that is hydrophytic

- < 25% = .2
- > 25% and < 75% = .5
- > 75% = .9

$HSI = (V1 * V2 * V3)^{1/2}$

Marsh wren: This is the representative species using emergent wetlands (PEM). The cover and reproductive requirements of the bird are addressed with this model and assumes other habitat needs are met if these are satisfied. Optimum vegetation types are cattail or bulrush dominated wetlands with a closed canopy (>80%) of herbaceous cover (except Equisetum), water depth >5 inches and no woody canopy cover.

V1 growth form of dominant (30%) emergents

- cattail, cordgrass, bulrush = 1.0
- bluejoint, reed canarygrass = .5
- buttonbush = .1
- other = 0

V2 canopy cover of persistent and nonpersistent emergent species

- zero = 0
- < 50% = .1
- > 50% and < 75% = .5
- > 75% = .9

V3 mean water depth

- zero = 0
- < 3" = .2
- > 3" = .9

V4 woody canopy cover

- 100% = 0
- > 65% = .2
- > 35% and < 65% = .5
- < 35% = .9

$HSI = (V1 * V2 * V3)^{1/3} * V4$

Song Sparrow: Song sparrows are found primarily in mesic shrubland (MS) and shrub understory of riparian forests (PF). MS consists of hackberry, hawthorn, chokecherry, and blackberry. Optimum habitat conditions occur with a moderate to high shrub canopy (40 - 80%) with averages between 4½ to 11 feet tall and less than 1/4 mile from water or PF.

V1 shrub canopy cover (all woody < 20' tall)

- zero = 0
- < 20% = .2
- > 20% = .9

V2 shrub height

- no shrubs = 0
- < 3' = .2
- > 3' = .9

V3 distance to water

- > ½ mile = 0
- > ¼ mile and < ½ mile = .2
- < ¼ mile = .9

HSI = minimum of $(V1 * V2)^{1/2}$ OR V3

Mallard: This model evaluates brood-rearing habitat of palustrine open water (POW) with shoreline consisting of wetland/riparian cover types (PEM, PSS, PF), mesic shrubland (MS), and forblands (AF). Optimum conditions occur with 100% shoreline cover of these cover types. Those areas accessible only by walking or boat were assumed to be optimal, from a disturbance standpoint.

V1 % shoreline cover by PEM, PSS, PF, MS, or AF

- zero = 0
- > 0 and < 30% = .2
- > 30% and < 70% = .5
- > 70% = .9

V2 human disturbance level

- continuous (park) = .1
- frequent (easy walk from major road or high maintenance HMU) = .3
- occasional (near a secondary road) = .6
- accessible by walking or boat only = .9

HSI = V1 x V2

Western meadowlark: Habitat for this common species was considered to include all nonagricultural upland cover types (G, SSH, SSL, AF). Optimum conditions occur with at least 70% herbaceous cover (with at least 60% grass) with an average plant height of between 8 and 16 inches. Optimum shrub canopy is <5% and average distance to perch sites (tall plant, post, or wire at least 20 inches tall) is < 100 feet.

V1 % herbaceous canopy cover

- zero = 0

- < 50% = .2
- > 50% = .9

V2 % herbaceous canopy cover that is grass

- zero = 0
- < 50% = .2
- > 50% = .9

V3 mean herbaceous plant height

- zero or >30" = 0
- < 4" or between 24 and 30" = .2
- between 4" and 24" = .9

V4 distance to perch site

- > 150' = .2
- < 150' = .9

V5 % shrub canopy cover

- > 40% = 0
- < 40% and > 25% = .2
- < 25% = .9

$HSI = (V1 * V2 * V3 * V4)^{1/2} * V5$

Lesser scaup: This model evaluates lesser scaup wintering habitat in open water (POW). Optimum habitat conditions occur when at least 40% of the area supports pelecypods, less than 5% of the area supports emergent vegetation, the average winter water depth is between one and three meters and there is little to no human disturbance to feeding areas.

V1 % of area supporting pelecypods

- zero = 0
- < 20% = .2
- > 20% and < 40% = .5
- > 40% = .9

V2 % of area supporting emergent vegetation

- > 10% = 0
- > 5% and < 10% = .5
- < 5% = 1.0

V3 water depth at average winter water conditions

- > 10 meters = 0
- > 4 meters & < 10 meters = .5
- > 0 and < 4 meters = .9

V4 human disturbance to feeding area

- none to light = 1.0
- moderate = .7
- heavy = .3
- limiting = 0

$HSI = ((V1)^2 \times V2 \times V3 \times V4)^{1/5}$

OR V1 whichever is smaller

Mule deer: Mule deer use all vegetated non agricultural cover types in the area including G, MS, PF, PSS, SSH, SSL, and AF. The model evaluates winter food requirements. Optimum cover of shrubs < 5 feet tall is between 50 and 60% with between 40 and 60% preferred shrub (rabbitbrush, sagebrush, willow, rose, and bitterbrush) canopy cover. Herbaceous canopy is optimum when greater than 30%.

V1 % canopy cover of shrubs <5' tall

- zero = 0
- < 30% = .2
- > 30% = .9

V2 % canopy cover of preferred shrubs < 5' tall

- zero = 0
- < 20% = .2
- > 20% = .9

V3 % herbaceous canopy

- zero = 0
- < 20% = .2
- > 20% = .9

$$HSI = \frac{3(V1 * V2)^{1/2} + V3}{4}$$

APPENDIX B

HSI Calculations for Each Cover Type Polygon

Cover Type	Beaver	Yellow Warbler	Marsh Wren	Song Sparrow	Mallard	Lesser Scaup	Western Meadowlark	Mule Deer	Quail
PFO 8	.5			.4				.5	
PFO 9	.5			.9				.5	
PFO 11	.5			.4				.5	
PE 1			.5						
PE 2			.33						
PE 4			.8						
PE 5			0						
PE 6			.4						
PE 7			.8						
PE 9			.8						
PE 10			.7						
PE 11			.5						
PSS 1	.5	.5						.4	
PSS 2	.5	.5						.5	
PSS 3	.5	.9						.9	
PSS 4	.5	.9						.7	
PSS 5	.5	.9						.9	
PSS 6	.5	.9						.7	
PSS 7	.5	.5						.9	
PSS 8	.5	.6						.7	
PSS 9	.5	.9						.4	
PSS 10	0	.5						.9	
SSL 1							.3	.5	
SSL 2							.3	.5	

	Beaver	Yellow Warbler	Marsh Wren	Song Sparrow	Mallard	Lesser Scaup	Western Meadowlark	Mule Deer	Quail
SSL3							.2	.5	
SSL 4							.3	.4	
SSL 5							.2	.5	
SSL 7							.7	.4	
SSL 8							.3	.4	
SSL 12							.1	.5	
SSL 14							.4	.4	
SSL 15							.2	.4	
SSL 16							0	.2	
SSH 1							0	.5	
SSH 2							.1	.9	
SSH 3							0	.9	
SSH 5							0	.9	
SSH 6							0	.9	
SSH 7							0	.9	
SSH 9							0	.7	
SSH 11							0	.9	
SSH 15							0	.9	
G 2							.7	.9	
G 6							0	.2	
G 7							.1	.2	
G 9							0	.2	
M 1				.9				.2	

	Beaver	Yellow Warbler	Marsh Wren	Song Sparrow	Mallard	Lesser Scaup	Western Meadowlark	Mule Deer	Quail
AF 1							.3	.2	
AF 2							.3	.2	
AF 3							0	.2	
AF 4							.2	0	
AF 5							.2	.2	
AF 7							.2	.3	
REC 1	0			0				.2	
REC 2							0	0	
AC 2									0
AC 5									0
POW 1					.5	0			
POW 2					.3	0			
POW 3					.3	0			
POW 4					.3	0			
POW 5					.3	0			
POW 6					.5	0			
POW 7					.5	.2			
POW 8					.2	0			
POW 9					.5	0			
POW 10					.3	.5			