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Tuzigoot National Monument
Yavapai County, AZ

Tavasci Marsh Wetland Assessment

Wetland Vegetation Communities, Condition, and Functions

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Introduction

Tavasci Marsh is a large, freshwater marsh within the Tuzigoot National Monument unit of the National Park Service. Tuzigoot National Monument is located in central Arizona south of the towns of Sedona and Flagstaff and directly north of the town of Cottonwood. The nearly hundred-acre marsh was acquired by the National Park Service in December 2005. It is the largest freshwater marsh in Arizona unconnected to the Colorado River and is designated as an Important Bird Area by the Audubon Society (Northern Arizona Audubon 2009).

Tavasci Marsh lies in half of an abandoned oxbow of the Verde River. Directly upstream, in the first half of the oxbow is the artificially impounded Peck's Lake. Peck's Lake, fed by the Verde River, is one of two primary sources of water into Tavasci Marsh. The other main source is a series of natural springs that seep from the canyon walls which surround the marsh. The marsh has had a long and complex history of human management, from being farmed by the Sinagua occupants of the adjacent Tuzigoot pueblo hundreds of years ago to more recent use as a dairy pasture. Throughout its history there have been numerous hydrologic modifications to both decrease and increase water levels in the marsh.

An expansion in cattails (*Typha* spp.) and die-off in fringing riparian habitat in recent years has generated concerns among land managers and local resource experts that the condition of the marsh may be deteriorating and that some of the important functions and values that led to the marsh being listed as an Important Bird Area might be lost. According to managers, land leveling and increased outflow from the adjacent Peck's Lake reservoir has resulted in topographic and hydrologic conditions that are extremely favorable for expansion of cattails that have usurped open water areas and natural transition zones to the adjacent dry mesquite (*Prosopis velutina*) bosque. Local wildlife biologists such as Roger Radd of Northern Arizona Audubon Society believe that the lack of open water and fringing riparian habitat could be having a large impact on bird use of Tavasci Marsh, leading to a decrease in riparian associates and waterfowl species.

In cooperation with other local and federal agencies, Tuzigoot National Monument is proposing to develop a wetland management plan for Tavasci Marsh to improve not only conditions, but functions and values provided by this unique freshwater system. Prior to developing a wetland management plan, the park decided to develop a better understanding of the current wetland communities present in the marsh and their condition, as well as a better understanding of their functions and values. To complete this assessment, Tuzigoot worked through the Water Resources Division of the

National Park Service (Park Service) to hire wetland biologists that have conducted similar wetland assessments in California.

These biologists identified and mapped wetland communities through direct field observation using GPS and interpretation of aerial imagery primarily during a site visit in April 2009. During this survey, information was collected to assess both condition and functionality of the marsh using several assessment methods, including the California Rapid Assessment Method (CRAM; Collins et al. 2008) and the Oregon Rapid Wetland Assessment Protocol (ORWAP; Adamus et al. 2009).

In addition, a delineation of wetlands potentially subject to jurisdiction by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act was also completed. Wetlands within national parks are also subject to oversight by the Park Service based on Director's Order #77-1, which pushes park units to avoid wetland loss and minimize wetland impacts. The extent of wetlands within Park Service oversight may or may not overlap precisely with that of the Corps, particularly with recent changes in jurisdictional guidance from U.S. Supreme Court rulings.

The following document summarizes results from these studies, which hopefully can be used to better inform future management efforts of this unique ecosystem.

Geologic Context

More than 10,000 years ago, Peck's Lake and the Tavasci Marsh area were once the active course of the Verde River (Northern Arizona Audubon 2009). With volcanic flows, this portion of the river's alignment or meander was disconnected, leaving a substantial and sinuous oxbow feature on the landscape that gave rise to the Tonto Apache name of "twisted water" (Lindsay 2000). The soils in the marsh are a mixture of both the underlying Verde Formation and fluvial deposits from the time when it was part of the river course. The Verde Formation is a relatively young soil formed from the deposits of a prehistoric lake which occupied the Verde Valley during the late Miocene, 5 million years ago,

Peck's Lake. 1887. Photograph by Mearns.

and local soils combine limestone, clastic, and evaporitic (or mudstone) facies (Lindsay 2000). Localized conglomerates composed of alluvial cobble and gravel are visible in several areas around the marsh. While the soils underlying the marsh are formed of deep deposits of alluvium, the soils of the adjacent upland are poorly formed and shallow (Lindsay 2000).

History and Change in Vegetation Communities

Prior to any management by either Native Americans or European settlers, the Peck's Lake/Tavasci Marsh area probably functioned in areas as an oxbow lake or lacustrine basin. A series of numerous, small springs emerge from the base of the Verde Formation on the eastern side of Tavasci Marsh and Peck's Lake, with one of the largest in the Tavasci Marsh area being just north of Shea Springs (URS 1999). These spring-fed areas or cienegas (small, shallow wetland features fed by springs or by a geologic formation that forces groundwater to the surface) probably promoted establishment of Wet Meadow, Freshwater Marsh, and Riparian Woodland wetland communities. Photographs from 1889 show Mearns, one of the first white settlers to the area, camped next to a shallow marshy "Peck's Lake" (Northern Arizona Audubon 2009). These wetter vegetation communities may have graded into drier vegetation communities – some of which was still "wetland" – such as alkali sacaton meadows or mesquite bosque.

Tavasci Marsh. 1883.

While information on historic vegetation conditions within the Peck's Lake/Tavasci Marsh area is scant, some background research has been developed on Bigham Cienega near Tucson. The 1879 General Land Office surveys for the Bigham Cienega and vicinity indicate that the historically moister areas near this cienega supported dense, shrubby willows, while sacaton grasslands, deciduous riparian forests, and mesquite bosques fringed the cienega (Baker undated). The Bigham Cienega system later grew to four times its size in the late 1800s (Fonseca 2000) and subsequently converted to a lotic system dominated by "extensive stands of cattails, bulrush, and other obligate wetland plants" (Baker undated).

A seed bank study showed that the most abundant germinants in the Bigham Cienega were tall emergents such as bulrush (*Schoenoplectus pungens/*

Tavasci Marsh area. 1937 during excavation of the pueblo.

americanus[1]) and cattail (*Typha domingensis*), as well as more low-growing plants such as spikerush (*Eleocharis macrostachya*; Titus and Titus 2008). Some of the other wetland species in the seed bank included other low- to mid-sized emergents such as sedge (*Cyperus odoratus*), spikerush (*Eleocharis acicularis*), toadrush (*Juncus bufonius*), watercress (*Nasturtium officinale*; non-native), *Polygonum punctatum*, rabbitfoot grass (*Polypogon monspeliensis*), and veronica (*Veronica americana*; Titus and Titus 2008). In addition, the endangered Huachuca water umbel (*Lilaeopsis schafferina* ssp. *recurva)* germinated, although it has not been found recently in the cienega (Titus and Titus 2008). Adjoining this freshwater marsh are communities of mesquite bosque, palustrine wooded swamp, and cottonwood-willow forest, while alkali sacaton persists only along riparian forest edges or in the understory (Baker undated). The conversion from Riparian Scrub-Shrub to Freshwater Marsh within the past 100 years may have resulted from a decrease in the frequency of burning with European settlement, which appears to have caused many southwest desert wetlands to shift to more wooded wetland types and increased the prevalence of bulrush (Davis et al. 2002). Further changes in this system have occurred since 2002, with prolonged drought and perhaps groundwater withdrawals drying up this wetland and converting it to a mix of bareground and monospecific stands of

[1] These authors treated *S. pungens* and *americanus* as synonymous, but, for our work, we followed the strategy of characterizing *S. americanus* as a medium- to large-sized emergent bulrush, while *S. pungens* is characterized as a small to medium-sized rush.

the upland sunflower by 2005-2006 (*Helianthus annus*; Titus and Titus 2008).

There may be some strong parallels between the wetland and vegetation communities present at Bigham Cienega and what once may have existed in the Tavasci Marsh area, particularly prior to European settlement. As with Bigham, the Tavasci Marsh area has probably been subject to a long history of manipulation for agricultural purposes. Some type of agricultural development of the Peck's Lake/Tavasci Marsh area may have been conducted by the Sinagua, an agricultural tribe that established the Tuzigoot pueblos before leaving the area in 1400 AD (Watchable Wildlife 2008). Management may have included burning and diversion of flows to improve conditions for crops.

Peck's Lake in the 1800s. Photo taken by Mearns

With European settlement, the former oxbow floodplain terrace at Peck's Lake and Tavasci Marsh began to be managed for livestock grazing, including hay production. The frequency of burns at Peck's Lake diminished at this point, as is attested to by the fact that there is an increase in woody species such as cottonwood (*Populus fremontii*) and willow (*Salix goodingii*) in the pollen records dating to 1915 coincident with the earliest appearance of exotic weeds, along with increases in other woody species such as mesquite (Davis and Turner 1987 *in* Davis et al. 2002). The settlers also artificially flooded the Peck's Lake basin, which also caused an "abrupt and extreme" increase in herbaceous wetland vegetation in the pollen records for this area (Davis and Turner 1987 *in* Davis et al. 2002). In 1914, the development of Peck's Lake increased with construction of a dam and a diversion tunnel ("Brewer's Tunnel") to funnel Verde River flows into the basin to create a recreational lake for the new city of Clarkdale, founded by William Clark (M. Castillo, Arizona State Parks, *pers. comm*.).

Tavasci Marsh was historically farmed for dairy and beef cattle from 1928 to 1991. The land was drained from the 1920's through 1991 to provide more land for grazing and farming and leveled to provide better pasture conditions. To improve forage quality in the Tavasci Marsh area, a series of ditches were apparently dug to bring additional waters from Peck's Lake to this spring-fed meadow. One of the ditches -- the Allen or Hawkins ditch -- conveyed waters into a former alfalfa field on the southwestern edge of Peck's Lake that was managed by Phelps Dodge and then carried the remaining waters

into the western side of the marsh, but this ditch was apparently abandoned at some point and filled in, although a portion of it remains and does receive some backwater inflow from the marsh (Ward 2008). Another more recently constructed ditch was dug on the western side of the marsh, with two more ditches located in the interior of the marsh. The westernmost ditch fed into several smaller lateral ditches constructed to convey flow into what was then pasturelands, but the ranchers apparently rarely used these lateral ditches because use made pasture conditions too wet (D. Casper, NPS, *pers. comm*.). The initial connection between the westernmost ditch and Peck's Lake was a 10-inch culvert designed to convey stormwater overflow downstream, but, in the 1990s, this was exchanged for an outfall structure designed to convey up to 24 acre-feet of water (R. Radd, Northern Arizona Aububon, *pers. comm*.).

The management regime intensified when Arizona Department of Game and Fish (ADGF) installed a set of weirs in 1990 downstream in the marsh to control outflow from the marsh into the Verde River (M. Castillo, Arizona State Parks, *pers. comm*.). In addition, further impoundment of waters in the marsh occurred when beavers began erecting dams downstream of the ADGF weirs near the Tavasci Marsh outlet in 1993 (URS 1999; M. Castillo, Arizona State Parks, *pers. comm*.). In 1993, an approximately 500-year flood event also backed up into Tavasci Marsh from the Verde River, introducing sediment into the marsh (M. Castillo, Arizona State Parks, *pers. comm*.). Also, instream mining in the Verde River caused the riverbed to degrade as much as 6 feet by this time, and this degradation propagated up into the Tavasci Marsh outlet channel, particularly following the flood event (M. Castillo, Arizona State Parks, *pers. comm*.). While this was an exceptionally large flood event, smaller magnitude flood events also back up into the marsh outlet channel and in the southernmost portions of the marsh (M. Castillo, Arizona State Parks, *pers. comm*.). In 1999, Phelps Dodge began to increase flow diversion rates from Peck's Lake into Tavasci Marsh apparently to decrease residency time within the lake and improve pH and dissolved oxygen conditions in response to the lake being declared impaired under Section 303(d) of the Clean Water Act and being required to meet Total Maximum Daily Limits (TMDL; NPS 2007).

Between 1928 and 1991, most of the Tavasci Marsh area was pasturelands, with a small Freshwater Marsh wetland area. In the late 1960s – early 1970s, the marsh portion of Tavasci Marsh was estimated at about 35 acres, with 10 of these acres being primarily cattails (Todd 1972). The water table fluctuated during the year, dropping in the summer and thereby allowing a "lush understory" of different grass species and buttercup (Ranunculaceae) to grow adjacent to and into the cattails (Todd 1972). There were also occasional patches of sedges such as *Cyperus* and *Carex* spp., bulrushes (*Schoenoplectus*), and spikerushes (*Eleocharis* spp.). Mudflats often

persisted along the shoreline of the marsh adjacent to open water areas (Todd 1972). At this time, burning was used to limit cattail expansion and increase area available for forage, as well as to improve visibility of "bogged cattle," but Todd noted that cattle grazed both the low-growing and cattail portions of the marsh pretty heavily, which appeared to actually reduce cattail extent by 10 percent during the period of his study (Todd 1972). A dense, but narrow, stand of mesquite and acacia bordered the east side of the marsh at the base of the steep limestone slopes, while pockets of a few mature willows (*Salix*) and "seepwillow" (*Baccharis*) occurred on the south end of the marsh and along the drainage ditch, respectively (Todd 1972).

Tavasci Marsh in the 1990s. Photo courtesy of Northern Arizona Audubon.

A review of aerial imagery from 1988 actually showed little change from previous decades, at least in the extent of cattails, with acreage of these tall emergents estimated from aerial imagery analysis at about 10 acres (Figure 1). Meadows in the southern end of the marsh largely consisted of the non-native wetland grass, bermudagrass (*Cynodon dactylon;* M. Castillo, Arizona State Parks, *pers. comm.*). However, with discontinuation in agricultural management and a decline in maintenance of the ditch along the west side of the marsh, conditions within the Tavasci Marsh began to change dramatically. Sedimentation from the unstable Verde Formation slopes apparently filled the ditches and caused outflow from Peck's Lake to sheetflow across the former agricultural pasturelands. In addition, installation of the weir and establishment of beaver dams also increased impoundment of Peck's Lake waters within the system.

With the extent of moderate to deep water conditions expanding greatly within the former oxbow, the acreage of Freshwater Marsh vegetation communities jumped, as well, particularly the extent of area dominated by tall freshwater emergents such as cattails (*Typha* spp.) and bulrush (*Schoenoplectus* spp.). In 1999, the southern two-thirds of the marsh was dominated by cattails, with establishment of the beaver dams apparently increasing water levels south of the road and promoting cattail expansion in southernmost portions of the marsh (URS 1999). The northern one-third of the marsh at this time remained dominated by grasses or sedges and was dry during summer or saturated to the surface (URS 1999). While acreages were not provided in the URS report, these proportions probably translate to 57 to 63 acres of the Tavasci Marsh area being dominated by cattails at that time. Cattail expansion accelerated greatly apparently around 1999, when

Phelps Dodge began to increase flow diversion rates from Peck's Lake into Tavasci Marsh to meet TMDLS (NPS 2007).

From approximately 10 acres in 1988 (Figure 1), tall-emergent-dominated Freshwater Marsh has increased to 75.2 acres of the 95.9-acre Tavasci Marsh area. Dense stands dominated by *Typha latifolia and dominengsis* represent the largest proportion of the Freshwater Marsh, followed by *Schoenoplectus americanus*. The dominance of *T. domingensis* and *Schoenoplectus americanus* is similar to conditions found in other altered cienega or southwestern depressional basin systems such as Bigham and Cienega de Santa Clara in Mexico (Titus and Titus 2008, Zengel et al. 1995).

The consistent – if not regular – inflows from Peck's Lake has not only increased surface water levels in the Tavasci Marsh area, but appears to have created a strong hydraulic pressure gradient in the groundwater table that may have expanded the extent of wetland along the perimeter of the marsh. These perimeter wetlands primarily support Wet Meadow and Grassland, Moist Meadow and Grassland, and Mesic Scrub (Mesquite Bosque) and some ruderal wetlands dominated by Mexican fireweed (*Kochia scoparia*). The natural groundwater table fed by the various spring complexes may also be altered not only by surface inflows from Peck's Lake, but also by the locally elevated groundwater table created by the lake itself.

The sandy nature of the parent soil material, which is sometimes intermixed with cobble and potentially even some coarse fill, increases lateral transmissivity of groundwater within surface soils, and duration of saturation is promoted in some areas by inclusions of clay-dominated horizons within soils. In some areas, these clays are referred to as "Cienega" clays (Martin 1963 *in* Davis et al. 2002). Most of these perimeter wetlands are probably seasonally or intermittently flooded or surface inundated during rain events, but, based on the characteristics of the soil surface, most of the hydrology for these areas derives from an elevated groundwater table that leaves surface soils saturated either permanently to semi-permanently (directly adjacent to marsh) or seasonally to intermittently (several weeks a year in upslope or more inland areas). This hydraulic pressure gradient on the groundwater table may also extend the zone of mixing between the two different hydrologic sources (Peck's Lake outflow, Shea-Dead Horse Springs Complex) further upslope than occurred historically, thereby diluting some of the potentially unique characteristics of the limestone-derived groundwater.

Methods

Field and Office Data Collection

Lorraine Parsons and Amelia Ryan, wetlands ecologists for Point Reyes National Seashore (Point Reyes Station, CA), conducted the field surveys for Tavasci Marsh. The marsh was assessed primarily during the initial site visit April 6-10, 2009. Some sites were revisited on May 5-6, 2009 to double check minor data gaps from the initial visit.

Field surveys were conducted by simultaneously gathering information on vegetation, hydrology and soils. Surveys began at the Shea Springs site and proceeded in an essentially counterclockwise fashion around the marsh. Most of the assessment was conducted along the marsh edge. The marsh center is primarily dense, monotypic stands of cattail, or sometime bulrush and is extremely difficult to access. The marsh interior was penetrated 50-100 meters from the perimeter at several points, however the majority of the interior was evaluated using binoculars and aerial photos. The data gathered in the field was used to allocate vegetation communities and association, to assess wetland conditions and functions, and to delineate the wetland boundary. A detailed description of the Vegetation Community and Association Mapping, and Conditions and Functional Assessments is contained below. A detailed description of the wetland delineation is located in Appendix E.

Field data was supplemented by the review of numerous papers and reports, websites such as the USDA's PLANTS site (http://plants.usda.gov/), aerial photos and maps, and other office-based data sources.

Vegetation Communities and Associations

Vegetation was initially mapped in patches or "polygons" according to species composition. Each polygon mapped represented an area of relatively uniform composition among dominant species. Dominant species were defined as any species comprising greater than 20% absolute cover. Within each polygon, all plant species present were noted, and the percent cover of each species was assigned to a cover class (Table 1). The minimum mapping unit was primarily 0.01 acres or $10m^2$, meaning that vegetation patches that smaller then this were lumped into the surrounding polygons and not distinguished separately. We also noted all strata (e.g., herb, shrub, and tree) in which the plant species occurred (Table 1).

All plant species observed during field surveys were identified to the level necessary to ensure that any special status species present would be detected: a list of all plant species observed is provided in Appendix D. While several taxonomic keys were used to identify plant species observed

(e.g., Hickman 1993, Kearney and Peebles 1960, McDougall 1973), scientific and common nomenclature followed The Jepson Manual (Hickman 1993).

Table 1. Cover class and strata designations used in vegetation mapping.

Cover Classes	1	<1%
	2	1-5%
	3	6-15%
	4	16-25%
	5	51-75%
	6	76-100%
Strata	Herb	<0.75m
	Shrub	0.75 – 5m
	Subcanopy Tree	5 – 15m
	Overstory Tree	>15m

Based on our field observations, the vegetation of each polygon was further classified according to two levels: Vegetation Community and Association. Vegetation Community classifications represent a modified version of Holland (1986) and includes designations such as Freshwater Marsh, Mesic Scrub, and Open Water (Table 2). Associations characterize polygons by the dominant and/or characteristic plant species within each polygon. Associations with slashes (*Salix lasiolepis/Rubus discolor*) between species' names refers to riparian polygons where the co-dominant species occurred in different strata, with the former typically in the overstory, whereas Associations with a hyphen in the species' names (*Salix lasiolepis-Rubus discolor*) represent areas where both co-dominant species occurred in the same strata. Polygons with no-clear dominance trends were incorporated into the Association "Mixed." Associations were determined by assessing which species or combination of species had the highest percent cover within the polygon.

Polygons were mapped onto 2001 multispectral images (1:12,000 or $1m^2$ pixel) either using heads-up digitizing or GPS field data in Arc Map 9.2 (ESRI). Information about the polygon, including Cowardin Wetlands Code, ID Number, CRAM unit name and classification in Vegetation Community and Association were entered into the ArcMap 9.2 attribute table. The attached datasheets (Appendix A) include the complete list of species observed for each polygon, along with surveyors, Cover Class, Strata, Wetland Indicator Status, and any comments.

Cowardin Wetlands Classification

In addition to being classified by vegetation, each wetland was further classified according to *The Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979). The wetland classification system was developed by the USFWS and is used by the National Wetlands Inventory to describe and classify wetlands. This classification method categorizes wetlands into several categories: System, Subsystem, Class, Water Regime, and Special modifiers.

Table 2. Applicable Cowardin Classes, Water Regime, and Special Modifiers.

NWI CODE	CLASS	NWI CODE	WATER REGIME	NWI CODE	SPECIAL MODIFIERS
RB	Rock Bottom	A	Temporarily Flooded	b	Beaver
UB	Unconsolidated Bottom	B1	Seasonally Saturated /Well Drained	d	Partially drained/Ditched
AB	Aquatic Bed	B2	Seasonally Saturated	f	Farmed
RF	Reef	B3	Permanently Saturated	g	Grazed
US	Unconsolidated Shore	C1	Seasonally Flooded/Well Drained	h	Diked/Impounded
RS	Rocky Shore	C2	Seasonally Flooded/Seas. Saturated	r	Artificial Substrate
SB	Streambed	C3	Seasonally Flooded/Perm. Saturated	s	Spoil
ML	Moss-Lichen Wetland	F	Semi-permanently Flooded	x	Excavated
EM	Emergent Wetland	G	Intermittently Exposed		
SS	Scrub-shrub Wetland	H	Permanently Flooded		
FO	Forested Wetland	J	Intermittently Flooded		
		K	Artificially Flooded		
		W	Intermittently Flooded/Temp		
		X	Phreatophytic		
		Y	Saturated/Semipermanently/ Seasonally Flooded		
		Z	Intermittently Exposed/Permanently Flooded		
		U	Unknown		

System is a complex of wetlands and deepwater habitats that share the influence of similar hydrologic, geomorphic, chemical or biological factors. At Tavasci Marsh, all wetlands are considered to be of the System "Palustrine" (code P) for which there are no subsystem. Riparian areas that were not wetlands were also mapped (System code = Rp for Riparian). *Class* describes the general appearance of the habitat in terms of the dominant life form of the vegetation or the physiography and composition of the substrate.

Water regime modifiers describe site hydrology in a way that can either be observed on site or inferred from vegetation or other indicators. *Special modifiers* describe human-made modifications to the environment that may significantly influence the character of the habitat.

Table 2 describes the classes and water regime and special modifiers used in the mapping efforts and provides their codes. Water regime modifiers were broken into more detailed categories than those used by the USFWS. For example. where B indicates saturation in USFWS codes, we have further separated water regimes into B1-3 to indicate the duration of saturation. Each category has several possible descriptors to choose from, and each descriptor has been assigned a code of one-two letters and numbers. So, for example, a wetland dominated by emergent rushes and that appeared to be seasonally saturated would be recorded at PEMB.

Conditions Assessment Protocol

The Conditions Assessment was carried out using the California Rapid Assessment Method for Wetlands (CRAM; Collins et al. 2009). Conditions Assessments are conducted on Assessment Areas (AAs) which are differentiated based on hydrogeomorphic class (i.e. landscape position and hydrology). CRAM recognizes seven hydrogeomorphic classes (Depressional, Riverine, Estuarine, Lacustrine, Playas, Seeps and Springs, or Vernal Pools) which differ slightly from each-other in their assessment metrics. Assessment metrics are common characteristics of wetlands such as landscape connectivity, water source, and structural patch richness. These metrics are grouped into three attributes: Buffer and Landscapes Context, Hydrology, and Structure (Physical and Biotic). Each metric has a set of narrative descriptions which represent a range of conditions for that particular metric. The descriptions are attached to a score, and the scores for particular metrics are used to determine the condition of the three wetland attributes and the marsh overall.

AAs may be made up of numerous vegetation polygons, for example, several wetland polygons classified as Depressional wetland class that are either physically contiguous and/or somehow hydrologically connected would comprise one Assessment Area, and this Assessment Area may border another such as a Riverine wetland that is comprised of several wetland polygons, as well.

Over the course of our field visits four Assessment Areas (AAs) were identified. Once Assessment Areas were identified, information was collected for those indicators that require field-based data. These included metrics such as the number of plant layers present in the AA and the number and kind of physical patches such as animal mounds and burrows, standing snags or pools, etc. Additional data was gathered in the office. For example, aerial

photos were used to determine buffer extent and reports and personal communication were the degree of alteration to the sites hydroperiod. The combination of both data sources was used to rate the Tavasci Marsh AAs for each metric outlined in CRAM and give the scores discussed in the Conditions Assessment section below.

Functional Assessment Protocol

A functional assessment was conducted using the Oregon Rapid Wetland Assessment Protocol (ORWAP; Adamus et al. 2009). This method is intended to assess functions and values, a need which has been identified in a number of laws and policies such as the December 2002 Regulatory Guidance Letter pertaining to Section 404 of the Federal Clean Water Act (Adamus et al. 2009). *Functions and values* are independent variables which are used to evaluate ecosystem services (Adamus et al. 2009). Functions describe the capability to carry out an ecosystem service and values relate opportunity to carry out that particular service.

ORWAP also identifies Assessment Areas (AAs) for the functional assessment, however they differ slightly from those described by CRAM. The entire Tavasci Marsh was assessed as one AA. ORWAP also identifies a Contributing Area (CA; Figure 6), which is roughly equivalent to the upstream watershed. For Tavasci Marsh this included Peck's Lake and immediate vicinity and the watersheds of two large washes that empty into Tavasci Marsh.

ORWAP uses 148 metrics to assess the wetland. These metrics are entered into an excel database where they are weighted differently and combined to assess different 16 functions and values of the AA. These are presented in an automatically generated score sheet that is calculated from the responses to the 148 metrics. A particular metric may be used to assess more than one function. For example the presence of fringing wetland is used to evaluate both the water storage and fish habitat functions.

The functions are combined into eight "grouped services" and the overall wetland function is summed by three overall attributes: wetland ecological condition, stressors, and sensitivity. Scores are not necessarily averaged: they combine additive scores, averaging and highest value of alternative metrics. The rational is that these metrics don't add up numerically in real life: a certain species may have two alternative habitats that support it, in which case the presence of either one may be equivalent for that species or metric. These were developed mainly based on the experience of Paul Adamus of Oregon State University, the principal author, who authored one of the first functional assessment models in 1983 and has specialized in this field since that time. The ORWAP manual (Adamus et al. 2009) contains a full description of the formulas used to scores the different functions and the rational behind each one.

The use of ORWAP to assess Tavasci Marsh was undertaken after the initial site visit based on field notes, personal communications, reports and aerial imagery. In some instances metrics that were specific to Oregon had to be adapted for their use for Tavasci Marsh. For example, though we used the fact that Tavasci Marsh is reported as the largest freshwater marsh in Arizona outside of the Colorado River to infer that it was the largest marsh in its HUC4, HUC5, and HUC6 watershed even though we did not know the exact extent of those divisions of the watershed. The scores for Tavasci Marsh were generated from the responses we entered into the excel database created for ORWAP. The scores are discussed in the conditions assessment section below and the full scores and responses are contained in Appendix C.

Vegetation Communities and Associations

Nine vegetation communities were identified within the 96-acre Tavasci Marsh Complex (Table 3; Figure 2). By far the most common was Freshwater Marsh, occupying over 78% of the mapped area. The next largest community type, Wet Meadow, covered less than one-tenth of the habitat of Freshwater Marsh, though meadows and grasslands together covered approximately 15 acres (~15%) of the wetland area. Open water, though not a vegetation type, was included as a community. Open water comprised just over 2% of the total study area. The nine communities and the vegetation associations for each community are described in detail below.

Table 3. Vegetation Communities

Community	Area (m^2)	Acres	% Total
Disturbed	3,476.8	0.86	0.90
Forested Riparian	7,335.2	1.81	1.89
Freshwater Marsh	304,443.6	75.23	78.43
Mesic Scrub	3,377.6	0.83	0.87
Moist Grassland	13,731.9	3.39	3.54
Moist Meadow	14,968.9	3.70	3.86
Open Water	8,768.4	2.17	2.26
Ruderal	1,589.6	0.39	0.41
Scrub-Shrub Riparian	413.2	0.10	0.11
Wet Grassland	1,969.7	0.49	0.51
Wet Meadow	28,112.2	6.95	7.24
Grand Total	**388187.0**	**95.92**	**100.00**

Forested and Scrub Shrub Riparian

The *Forested* and *Scrub-Shrub Riparian* vegetation communities covered 2% of the study area, the vast majority of this being Forested Riparian. These communities were dominated by Fremont's cottonwood (*Populus fremontii*) and Gooding's willow (*Salix goodingii*). Other tree species present in this community include Arizona Ash (*Fraxinus velutina*) and box elder (*Acer negundo* var. *interius*). Understory plants were very diverse, depending on the moisture regime beneath the overstory. In moister areas the understory was composed of rushes and sedges (*Carex praegracilis, Juncus balticus, Eleocharis parishii*), and even cattail (*Typha* sp.) in one instance. In mesic areas, native and non-native grasses (*Leymus triticoides*, *Hordeum murinum* and *Bromus madritensis* ssp. *rubens*) as well as shrubs such as golden current (*Ribes aureum*) and the non-native Mexican fireweed (*Kochia scoparia*) made up the understory.

Forested / Scrub-shrub Associations

Species	Area (m^2)	Acres	% Total
Fraxinus velutina-Salix goodingii	2904.9	0.72	0.75
Populus fremontii	1150.1	0.28	0.30
Populus fremontii-other	2632.6	0.65	0.68
Salix goodingii	589.7	0.15	0.15
Mixed	57.83	0.01	0.01

Many riparian trees are phreatophytes, meaning that they require moist to wet conditions at the time of establishment, but develop long taproots as they age which allow them to survive as adults in sites with relatively little inundation in the top 14 to 18 inches of the soil surface. Accordingly, the riparian habitat occurred at in a variety of moisture regimes ranging from seasonally flooded/permanently saturated to seasonally saturated. There were also large riparian trees outside of the wetland (in particular between the marsh and the Verde River) in areas that likely have comparatively low water tables most of the year. There were many dead trees in the marsh and around its fringes, which may result from an elevation in the local water table to an extent that these trees cannot tolerate.

Freshwater Marsh

Freshwater Marsh is characterized as areas dominated by more than 70 percent of persistent sedges, rushes, and other non-clover herbs that are inundated or saturated nearly year-round. This was by far the most common community at Tavasci Marsh, comprising nearly 80% of the total area of the marsh. Most of the freshwater marsh was dominated by one of two species of cattail (*Typha*

domingensis and *Typha latifolia*), which together comprised 67 acres or 69% of the total mapped area. The other species which occupied a significant percentage of the marsh was American three-square (*Schoenoplectus americanus*), covering just over 8 acres or 9% of the mapped area. Dotted smartweed (*Polygonum punctatum*) and softstem-bulrush (*Schoenoplectus tabernaemontani*) also dominated small areas, however these together accounted for only 0.1 acres of marsh. Other plant species that occurred in this community included rushes and sedges (*Carex praegracilis, Juncus balticus, Eleocharis parishii*), scratchgrass (*Muhlenbergia asperifolia*), stinging nettle (*Urtica dioica*), and curly dock (Rumex crispus). Cattail stands along perimeter of the marsh often had higher diversity of sub-dominant species, however, approximately 10m from the marsh edge other species generally ceased to occur, and *Typha spp* (or *Schoenoplectus americanus*) grew in monotypic stands that completely excluded other species.

Freshwater Marsh Associations

Species	Area (m^2)	Acres	% Total
Polygonum punctatum	155.9	0.04	0.04
Schoenoplectus americanus	34377.8	8.49	8.86
Schoenoplectus tabernaemontani	253.5	0.06	0.07
Typha domingensis	126168.4	31.18	32.50
Typha latifolia	90452.4	22.35	23.30
Typha latifolia-other	12305.0	3.04	3.17
T. latifolia-T. domingensis	9695.1	2.40	2.50
T. latifolia-T. domingensis-S. americanus	31006.3	7.66	7.99

As has been discussed earlier, freshwater marsh is sustained in Tavasci Marsh by potentially both surface and groundwater outflows from Peck's Lake, as well as outflow from the natural springs that rim the eastern and western sides of the marsh.

Mesic Scrub

Mesic scrub represents a wetland-upland transition zone community. At Tavasci Marsh, this community was dominated by velvet mesquite (*Prosopis velutina*). This community covers less than 1% of the immediate vicinity of Tavasci Marsh. This is slightly misleading, however: Only areas thought to be functioning as wetland were mapped as part of this study, thus there are vast upland areas composed of this species that were not mapped. Velvet mesquite bosque (woodland) covers two alluvial fans from washes which adjoin Tavasci Marsh and much of the marsh perimeter. In mesic scrub areas, velvet mesquite was associated with two other species: the native grass beardless wildrye (*Leymus triticoides*) and the invasive Mexican fireweed (*Kochia scoparia*). Other species in this community include golden current (*Ribes aureum*), stinging nettle (*Urtica dioica*), mulefat (*Baccharis salicifolia*), red barberry

(*Berberis haematocarpa*), and non-native species brome (*Bromus sp.*) and London rocket (*Sisymbrium irio*). As with many of the fringing marsh communities, this community has probably developed or at least expanded in response to elevated groundwater tables created by outflows from Peck's Lake, as well as inflow from the complex of springs that occur in select areas on the east and west side of the marsh (Spring Complex).

Mesic Scrub Associations			
Species	**Area (m^2)**	**Acres**	**% Total**
Prosopis velutina-Kochia scoparia	695.0	0.17	0.18
Prosopis velutina-Leymus triticoides	2682.6	0.66	0.69

Velvet mesquite provides extremely important habitat to numerous bird species and is among the community types with highest species richness in desert areas (Brand et al. 2008). Interestingly, examination of the pollen record suggests that mesquite may be more common now than historically due to fire suppression (Davis et al. 2002).

Moist and Wet Grasslands

Wet Grassland is a community dominated (>50 percent) by grasses and herbs that are predominantly facultative or obligate hydrophytes or wetland species. The *Wet Grassland* community was composed of one association: beardless wildrye (*Leymus triticoides*), which comprises 0.49 acres (0.5%) of the total mapped area, approximately 1/3 of the total cover for the *Leymus triticoides* association.

Moist Grassland is defined as areas ecotonal to wet marsh or grassland that are dominated by more moderately to weakly hydrophytic wetland plant species, particularly grasses such as Bermudagrass (Cynodon dactylon), tall fescue (Festuca arundinacea), and scratchgrass (Muhlenbergia asperifolia). In some areas, sedges and rushes such as *Carex praegracilis, Juncus balticus*, and *Eleocharis parishii* co-occurred with these grasses, but they typically represented less than 30% cover. Moist grassland is distinguished from wet grassland by a drier moisture regime rather than by changes in plant community composition alone. In addition to the *Leymus triticoides* association (0.87 acres), one swale (0.72 acres) was dominated by big sacaton (*Sporobolus wrightii*). Non-native grasses such as tall fescue

Moist and Wet Grassland Associations			
Species	**Area (m^2)**	**Acres**	**% Total**
Cynodon dactylon	2613.3	0.65	0.67
Festuca arundinacea	2087.0	0.52	0.54
Leymus triticoides	5407.9	1.34	1.39
Leymus triticoides-Kochia scoparia	94.7	0.02	0.02
Sporobolus wrightii	2922.4	0.72	0.75

(*Festuca arundinacea*) and Bermudagrass (*Cynodon dactylon*) covered an additional 1.2 acres of the mapped area.

As with the mesquite bosque, many of these communities are maintained by the higher than normal groundwater tables created by surface and potentially groundwater outflow from Peck's Lake, as well as groundwater from the Spring Complex

Moist and Wet Meadows

Moist Meadow represents somewhat of an intermediate between some of the wetter and drier vegetation communities. This habitat supports at least 30 percent cover of sedge and rush species such as *Carex praegracilis, Juncus balticus*, and *Eleocharis parishii*. The hydroperiod is shorter than for Wet Meadow and may involve non-persistent inundation or saturation of soils following seasonal flooding.

Wet meadows support at least 30 percent cover of sedge, rush, or other non-clover herbs, as well as grasses. The hydroperiod for this community is drier than for the Freshwater Marsh, but saturation often extends year round. This community covered approximately 7 acres or 7% of the mapped area.

Moist and Wet Meadow Associations

Species	Area (m^2)	Acres	% Total
Carex praegracilis	1043.0	0.26	0.27
C. praegracilis-J. balticus	14678.4	3.63	3.78
Eleocharis parishii	722.3	0.18	0.19
E. parishii-C. praegracilis/ J. balticus	5131.3	1.27	1.32
E. parishii-Kochia scoparia	63.6	0.02	0.02
E. parishii-M.asperifolia	20122.1	4.97	5.18
Juncus balticus	16.6	0.00	0.00
Melilotus indica	143.1	0.04	0.04
Muhlenbergia asperifolia – J. balticus/C. praegracilis	2363.5	0.58	0.61
M. asperifolia-Rumex	892.5	0.22	0.23

Open Water

Open water was mapped as a part of the vegetation mapping effort, even though there is no vegetation necessarily associated with this habitat type. However, in areas that were accessible, often a significant cover of aquatic vegetation was observed. The species that were observed growing in open water habitat in the accessible areas were parrot's feather (*Myriophyllum aquaticum*) and curly pondweed (*Potamogeton crispus*). Neither of these species is native to Arizona, but both

Open Water Associations

Species	Area (m^2)	Acres	% Total
Algae	280.2	0.07	0.07
Myriophyllum aquaticum	103.7	0.03	0.03
Potamogeton crispus	119.3	0.03	0.03
none	7841.5	1.94	2.02

provide some food support to water bird species. Open water totaled 2.2 acres or less than 2.3 percent of the Tavasci Marsh area.

Ruderal / Disturbed

Ruderal and *Disturbed* communities represented a small portion of the Study Area (1.3 acres). *Ruderal* included areas supporting a mixture of herbs and forbs with often no clear or consistent dominance pattern. Disturbed were those area that appeared to have been significantly altered by non-natural processes in recent history. Most of those polygons for which associations were designated were dominated or partially dominated by Mexican fireweed (*Kochia scoparia*). The disturbances acting in these areas included paths, roads, grazing, and artificial fill.

Ruderal / Disturbed Associations

Species	Area (m^2)	Acres	% Total
Kochia scoparia	2884.2	0.71	0.74
K. scoparia-L. triticoides	129.1	0.03	0.03
K. scoparia-M.asperifolia	89.2	0.02	0.02
K. scoparia-Urtica dioica	1963.9	0.49	0.51

Invasive Species

Several invasive (or exotic) species were identified during the mapping efforts (Table 4). Invasive species are defined as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." (Executive Order 13112 of February 3, 1999). National Park Service Management Policies (2001) state that "exotic species will not be allowed to displace native species if displacement can be prevented" and that "high priority will be given to managing exotic species that have, or potentially could have, a substantial impact on park resources, and that can reasonably be expected to be successfully controllable."

The 2004 *Non-Native Plant Mapping at Montezuma Castle and Tuzigoot National Monuments* (Mau-Crimmins et al. 2004) identified and mapped several invasive species of concern within the Tuzigoot National Monument. The park boundary at that time did not include Tavasci Marsh, but many of the species they identified were encountered during mapping. Management of invasive species has been ongoing at Tuzigoot, and the extent of several other species such as Russian olive (*Elaeagnus angustifolia*) occurring in the marsh perimeter had already been reduced considerably at the time of mapping.

The Arizona Wildlands Invasive Plant Working Group (AWIPWG; 2006) has released a list of invasive plant species of concern grouped into three categories: low, medium, and high. Plants ranked high are those species which "have severe ecological impacts on ecosystems, plant and animal

Table 4. Invasive and Non-native Species. Invasive species identified by the Arizona Wildlands Invasive Plant Working Group are ranked as high, medium or low threat. Alert status is indicated by an exclamation point and identification of a species as a park service target species is indicated by "NPS".

Alert Status	Species	Common Name	Life form	Acres
	High: Severe Ecological Impacts			
	Acroptilon repens	Russian knapweed	H	
NPS	*Bromus madritensis ssp. rubens*	red brome	H	
	Elaeagnus angustifolia	Russian olive		
!	*Myriophyllum aquaticum*	parrot feather watermilfoil	H	0.03*
	Medium: Substantial and Apparent Ecological Impacts			
	Bromus diandrus	ripgut brome	H	
NPS	*Cynodon dactylon*	Bermuda grass	H	0.65
NPS	*Hordeum murinum*	mouse barley	H	
NPS	*Melilotus alba*	white sweetclover	H	
!	*Sonchus asper*	spiny sowthistle	H	
	Low: Minor Yet Detectable Ecological Impacts			
	Cirsium vulgare	bull thistle	H	
	Other Non-native Species			
	Agrostis stolonifera	creeping bent	H	
NPS?	*Descurainia sophia*	herb sophia	H	
	Festuca arundinacea	tall fescue	H	0.52
NPS	*Hordeum jubatum*	foxtail barley	H	
	Kochia scoparia	Mexican fireweed	S	1.42
NPS	*Marrubium vulgare*	horehound	H	
	Morus alba	White mulberry	T	
	Plantago lanceolata	English plantain	H	
NPS	*Polypogon monspeliensis*	annual rabbitsfoot grass	h	
	Potamogeton crispus	curly pondweed	h	0.03*
NPS	*Rumex crispus*	curly dock	h	
NPS	*Sisymbrium irio*	London rocket	h	

Source: *Arizona Wildlands Invasive Plant Working Group*

communities, and vegetational structure…" Those species that are ranked as medium have "substantial and apparent ecological impacts…" and those ranked low have "minor yet detectable ecological impacts…" In addition, they have identified species with either medium or high designations that have as yet limited distribution for "Alert" status in the hopes of early detection and prevention of further spread.

The status of those species identified at the time of mapping, their rank according to AWIPWG and their potential to impact wetland resources is discussed below.

Invasive Plants Ranked High

Red Brome (*Bromus madritensis* ssp. *rubens*), a species ranked high by AWIPWG and also of concern to the National Park service was present primarily in moist-dry grassland and mixed shrubland communities fringing the marsh. The dry grassland and mixed shrubland communities were not described in the vegetation communities section of this report because they were not a part of the wetland. Parrot Feather (*Myriophyllum aquaticum*), a species which is both ranked of high ecological impact and designated with alert status, was also present in the marsh. Though only 0.03 acres were mapped as supporting parrot feather, it may well have a significantly larger distribution in the open water habitats. Due to the difficulty of accessing the center of the marsh and the depth of the standing water these habitats were generally mapped from afar. This species was found downstream of the Peck's lake outlet and likely came in from the adjacent lake. Where it dominates open water habitat, this species has been known to enhance mosquito breeding habitat and shade out the algae species that form the base of much of the aquatic food web, thereby drastically reducing overall food availability (DiTomaso et al. 2003).

A population of another highly invasive species, Russian knapweed (*Acroptilon repens*) was found in a moist grassland area at the southern end of the marsh. This species becomes established when soils are disturbed and is known to crowd out other species through a combination of allelopathy and rhizomatous growth (Beck 2008).

Invasive Plants Ranked Medium

Of the five species encountered during the mapping efforts three were identified by Mau-Crimmins et al. (2004) as of concern to the park service: Bermuda grass (*Cynodon dactylon*), mouse barley (*Hordeum murinum*), and white sweet clover (*Melilotus alba*) and one species, spiny sow-thistle, is an alert species (*Sonchus asper*). Bermuda grass was frequently encountered during our mapping efforts and dominated four (4) polygons of the *Moist Grassland* community type. This species spreads stoloniferously, and it a

pernicious invader of grassland and pasture habitats. Unchecked, it has the potential to spread more widely into moist grassland habitats.

Invasive Plants Ranked Low, Other Non-native and Weedy Native Species

The only low-ranking species, bull thistle (*Cirsium vulgare*) was encountered only occasionally during mapping efforts. Of more concern are several other species that were encountered, in particular non-native "mustard" herbs such as Sophia and Londen rocket (*Descurainia sophia* and *Sisymbrium irio*), which were nearly co-dominant in the understory of some mesquite polygons, and Mexican fireweed, (*Kochia scoparia*). Mexican fireweed was the most commonly encountered non-native species, dominating 1.42 acres (12 polygons) and occurring as a sub-dominant in a number of others. This species grew at the exclusion of other species in many instances, usually in disturbed soil. It was around much of the perimeter communities of the wetland and may pose a significant threat of expansion. In addition, strains of Mexican fireweed have developed resistance to certain herbicides (sulfonylurea and imidazolinone herbicides such as Imazypyr; Primiani et al. 1990) and can be allelopathic (Karachi and Peiper 1987).

In addition to the presense of non-native invasive species, their also exists some potential impact from weedy native species. The marsh is currently dominated by large monospecific stands of native cattail species (Typha latifolia and T. domingoensis)– to the exclusion of other species. Recent research into the cattail pollen record east of the Mississippi River found an 80% increase in the abundance of *Typha* species over the last hundred years (Shih and Finkelstein 2008).

While the expansion of cattail may be in part related to the increase in water level at the marsh, the presence of annual sunflower (*Helianthus annuus*) at the southern end of the marsh may be of some concern in the event of drawdown in the marsh. Sunflower completely dominated Bigham Cienega in southern Arizona to the exclusion of other species when marsh water levels dropped (Titus and Titus 2008). While native to the southwest, the long cultivation of this species has introduced weedy escapes into the landscape (Burke et al. 2002), which may alter the way it functions in the surrounding ecosystem.

Cowardin Classification

The classification of the marsh according to USFWS Cowardin Classification system is depicted in Figure 4 and summarized in Table 5. Because the Vegetation Communities are covered in detail elsewhere, Cowardin classification data are categorized according to their water regime modifiers.

The most prevalent water regime *Permanently Flooded*, which covered 47 acres, or nearly half the 96 acre study area. *Semi-Permanently Flooded* was the second most common water regime, occupying nearly 29 acres. These two water regimes were the most widespread because they were associated with the areas dominated by cattails. The other water regimes were associated with the meadow, grassland, and riparian habitats, and to the ecotone between monospecific stands of cattails and drier edge habitats. Though special modifiers were applied in mapping where known human modifications had occured, they are not summarized here because they could not be evaluated for many areas.

Table 5. Cowardin Classification by Water Regime

Water Regime Modifier	NWI CODE	Acres
Seasonally Saturated /Well Drained	**Total**	**2.18**
	PEMB1	1.23
	PSSB1	0.95
Seasonally Saturated	**Total**	**4.10**
	PEMB2	3.47
	PSSB2	0.49
	PFOB2	0.15
Permanently Saturated	PEMC1	**1.08**
Seasonally Flooded/Seas. Saturated	**Total**	**4.80**
	PEMC2	4.27
	PSSC2	0.01
	PFOC2	0.52
Seasonally Flooded/Perm. Saturated	**Total**	**7.26**
	PEMC3	7.06
	PSSC3	0.08
	PFOC3	0.12
Semi-permanently Flooded	**Total**	**28.53**
	PABF	0.03
	PEMF	28.35
	PFOF	0.16
Permanently Flooded	**Total**	**47.21**
	PUBH	2.06
	PABH	0.08
	PEMH	45.05
	PFOH	0.02
Phreatophytic	RpFOX	**0.63**
Upland	**Total**	**1.56**

Conditions Assessment

Any assessment of condition in this system needs to take into account the historical context of management and the changes to what would have been the natural system, but it cannot factor these changes into the evaluation. Given the long history of management of this area from native American agricultural use to intensively managed irrigated pasture and, most recently, "treatment" marsh, assessing condition of the marsh from the perspective of its deviation from historic conditions is not a viable approach. With continued inflows from Peck's Lake likely into the near future, it is unlikely that management could completely return this system to historic conditions, even if a target endpoint could be determined.

For this reason, the condition assessment needs to focus on the quality of the system in its current state and determine how well the system functions relative to the potential for that particular type or class of wetland or other high- (or higher) quality wetlands of the same type. To assess conditions within the Tavasci Marsh area, the system was split into four Assessment Areas (AAs): Tavasci Marsh (Freshwater Marsh; Depressional AA), Perimeter Wetlands (Wet and Moist Meadows and Grassland, Mesic Scrub; Depressional AA); Shea – Dead Horse Springs Complex or Cienega (Forested Riparian, Wet Meadow; Seep/Spring AA); and the Tavasci Marsh Outlet Channel (Forested Riparian and Open Water; Riverine AA). The location of these AAs is shown in Figure 5.

As was described in the Methods section, conditions of these AAs were assessed using qualitative categorical ratings from CRAM (California Rapid Assessment Methodology), which is structured and has been calibrated to accommodate arid, as well as semi-arid, systems. Ratings for four principal attributes – buffer condition, hydrology, physical structure, and biotic structure – are individualized for each wetland class (e.g., Depressional, Seep/Spring, etc.) and scaled such that each class has the potential to score 100%.

The final attribute scores were as follows:

- Tavasci Marsh (Depressional AA): 69.9%
- Perimeter Wetlands (Depressional AA): 65.8%
- Shea – Dead Horse Springs Complex (Springs/Seep AA): 65.9%
- Tavasci Marsh Outlet Channel (Riverine AA): 61.7%

The AAs scored moderately high (60.4 – 90.3%) in buffer condition and extent largely because the areas directly adjacent to Tavasci Marsh area such as Tuzigoot National Monument, Dead Horse State Park, and Peck's Lake are lightly developed, although the Phelps Dodge Company does operate a large

commercial mining operation nearby. The AA that rated lowest for buffers was Perimeter Wetlands, as some of these are directly adjacent to former tailings ponds and other disturbed commercial mining areas. While the extent of buffer is high, the condition or quality of buffer has been degraded by the presence of non-native and sometimes invasive species such as Mexican fireweed (*Kochia scoparia*) and Russian knapweed (*Acroptilon repens*), although soils are mostly undisturbed (except by grazing), and the area is subject to little or no human visitation.

Not surprisingly, given the highly altered hydrologic management of this area, the AAs rated only fair (47.2 to 55.6%) in terms of hydrologic condition due to the fact that 81% - 87% of the current sources of water for the former oxbow floodplain comes from diversions from Peck's Lake, with the remaining 13% to 19% coming from natural groundwater inflow from the Spring Complex (Ward 2008). The regulated system of inflow from Peck's Lake and the ADGF weirs also create unnatural cycles of inundation and drawdown that are not characteristic of natural southwestern wetland systems. The culverted road separating Peck's Lake from Tavasci Marsh area and other small berms and fill areas place some constraint on rising waters within the AA having unrestricted access to floodplain areas, but, in general, the Tavasci Marsh area is naturally constrained by the steep slopes of the Verde Formation and surrounding hills. The AA that rated lowest for hydrologic management was the Outlet Channel, which is an entrenched (apparently from excavation) and lacking in any sinuosity.

The three larger AAs have similar ratings for physical structure, which might be considered moderately high in terms of condition (62.5 - 75%). These AAs ranked moderately high for structural patch richness. The evident die-off of riparian trees along the perimeter of the Freshwater Marsh, Perimeter Wetlands, and Spring Complex has led to abundant and sizeable standing snags (as well as large woody debris) that has increased physical structure complexity in a system now largely dominated by rush and sedges. However, the amount of pools or open water areas and other non-vegetated areas is fairly low. There is also moderate variation in topography within the Perimeter Wetlands and Spring Complex, but topographic complexity is lower within the Freshwater Marsh itself, possibly due to its management and heavy use formerly as a pasture. The small artificial outlet channel ranked much lower then the rest of the AAs (45.8%) due to the lack of topographic complexity of the artificial channel.

The ratings for biotic structure were actually moderately high for the Tavasci Marsh and Perimeter Wetland AAs (72.2 – 83.3%), but the Springs Complex and Outlet Channel were rated lower (57.5% and 62.8%). The die-off of riparian trees and shrubs has decreased the number of plant layers within many of the AAs, leading to a fairly uniform plant cover within most of the

Tavasci Marsh area, although some trees have persisted in the Springs Complex. In general, the number of non-natives in the AAs is relatively low, with Mexican fireweed present along the perimeters of the Tavasci Marsh area and therefore much more prevalent in the Perimeter Wetland and Spring Complex AAs. In terms of plant diversity, the Springs Complex supported a larger number of co-dominant plant species (approximately 9) than either the Perimeter Wetlands (6-8 co-dominants) or Tavasci Marsh (3 co-dominants). While diversity was low, Tavasci Marsh actually ranked very well in terms of vertical biotic structure, because of the degree of canopy closure within the dense cattail-bulrush stands. Indeed, the canopy closure is strong enough that, during field surveys for this assessment, a strong temperature differential of perhaps 10 degrees Fahrenheit was noted between the air above and within the cattail-bulrush stands. Also, there was a fair amount of horizontal interspersion or zonation of habitats within Tavasci Marsh and Perimeter Wetland AAs due to some variation spatially (and probably temporally) in water levels and some micro-topographic complexity, although from a macro-topographic perspective, these areas are pretty uniform. The Outlet Channel had poor horizontal interspersion, though it ranked moderately well in the other metrics.

While attribute scores would suggest that conditions within the Tavasci Marsh area are not optimal, with optimal being a score of 100%, these numbers need to be weighed against what might be expected from high- (or higher) quality wetlands of the same class in Arizona and the southwest region. Because of the high degree of habitat alteration and urban and agricultural development, reference wetlands within this region are difficult to find. More than 95% of the cienegas in Arizona have been lost within the last 150 years due to development and groundwater withdrawal (Baker undated). Natural Freshwater Marshes are almost non-existent.

To gain some perspective on conditions within less altered spring systems, we also evaluated a spring-fed wetland along Beaver Creek near Montezuma Castle, which is called Expansion Springs (D. Casper, NPS, *pers. comm*.). This spring differs somewhat from the springs in the Tavasci Marsh and Peck's Lake areas in that it abuts an active stream channel: flow emerges from the steep sides of the canyon in which the creek is located and perches on the floodplain terrace, eventually flowing into the creek. While this area is adjacent to a residential development and does receive at least moderate use by visitors, the development is sufficiently distant that the extent and quality of buffer is very high, although there are few other wetlands nearby. The hydrology of the springs -- if not the creek -- has not been directly altered, resulting in a very high hydrology rating, and the physical and biotic structure attributes also ranked pretty high, as well. The final attribute score for Expansion Springs was 82.3%, which is 25% higher than the score for the Shea-Dead Horse Springs Complex (65.9%). Unfortunately, there were

no Depressional Wetlands (Freshwater Marsh) available at the time of the field study to evaluate, and while CRAM does list some scores compiled for other wetlands in southern and northern California, currently, all of the listed scores listed are for Estuarine or Riverine systems.

Full scores and the complete datasheets used to calculate the Conditions Assessment scores are located in Appendix B.

Functional Assessment

CRAM specifically evaluates condition of wetlands. It does not evaluate how well these wetlands function in terms of the "services" provided to plants, wildlife, and humans. The U.S. Army Corps of Engineers and some academic institutions have been involved with development of a Hydrogeomorphic Assessment (HGM) approach for assessing functionality of wetlands within certain classes and regions. The HGM approach, in a sense, is intended to replace or augment earlier assessment methods such as WET (Wetland Evaluation Technique) and HEP (Habitat Evaluation Procedure) that attempted to qualitatively evaluate the functions performed by particular wetlands. The HGM approach is more quantitative in nature, although it still represents an estimate of wetland functionality as it relies on directly measurable indicators of functionality. The assessment provides a measure of functionality by comparing scorings on these indicators to reference wetlands and Reference Standard wetlands, the latter of which are considered the highest performing wetlands of that class.

Because of the variation in functions played by specific classes or types of wetlands and by wetlands in certain regions of the U.S., the HGM approach is based on development of standardized regional approaches for each class or type of wetland, with the categories being similar to that of CRAM (e.g., Depressional, Riverine, Tidal Fringe, etc.) Adoption of the HGM approach has lagged somewhat because regional development of HGM is further advanced in some areas than others and because many resource managers and practitioners have instead adopted use of more rapid assessment methodologies such as ORAM (Ohio Rapid Assessment Methodology) and CRAM (California Rapid Assessment Methodology). The only HGM system available for Arizona wetlands targets Riverine systems and was developed specifically for the Tres Rios del Norte Ecosystem Restoration Project in Pima County (Burks-Copes and Webb 2003).

While a HGM assessment could not be formally conducted, some evaluation of the functions played by these AAs within the Tavasci Marsh area can be undertaken, using the Oregon Rapid Assessment Protocol (ORWAP; http://www.oregon.gov/DSL/WETLAND/or_wet_prot.shtml). This method

was developed by Paul Adamus, who was involved in development of some of the early functional assessment methods, for the Department of State Lands of Oregon as a rapid assessment method applicable to all wetlands within the state of Oregon. While many wetlands in Oregon may differ substantially from Tavasci Marsh, this model was developed to encompass wetlands throughout Oregon, which, from an east to west direction, does have an extremely variable climate in which regional precipitation averages range between 8 and 200 inches and temperatures range between -54 and 119 ºF (Western Regional Climate Center:_http://www.wrcc.dri.edu/narratives/OREGON.htm).

While ORWAP is a "rapid" assessment method, unlike CRAM, ORWAP was developed specifically to assess the *functions and values* of wetlands provide to ecosystems, not just condition. *Functions and values* are independent variables which make up ecosystem services (Adamus et al. 2009). A wetland may have a high ability to carry out a particular function such as sediment retention, but the value of that wetland for that function is only high if there is a source or likely source of sediment to that wetland (Adamus et al. 2009).

The ORWAP method rates 148 indicators and uses them to calculate 16 specific functions the wetland may carryout and its likely value in doing so. These functions include services such as sediment retention, carbon sequestration, and waterbird feeding habitat. These specific functions are further combined into 8 "grouped services" that are broader functions such as water quality support and fish support. These scores are then reduced to three overall attributes: wetland ecological condition, stressors, and sensitivity. *Ecological Condition* is meant to indicate overall ecosystem "integrity or health," but mainly reflects the vegetation community of the site. The *Stressor* score represents the degree of risk of alteration or disturbance to a wetland from natural or anthropogenic sources, and *Sensitivity* measures the predicted ability of the wetland to recover from stressors.

ORWAP was developed to evaluate the contiguous wetlands within project areas as single entities, so the functional assessment was carried out for the entire wetland (Figure 6). In addition to the assessment Area, ORWAP also identifies the Contributing Area, essentially the upstream watershed (Figure 6). A complete set of the data sheets used to evaluate Tavasci Marsh and calculate its scores is contained in Appendix C. Table 3, below, summarizes the grouped services and attribute scores calculated for Tavasci Marsh.

Overall, Tavasci Marsh rated relatively high in ecological condition. The score of 6.69 was near the 75-percentile mark, meaning it ranked higher than just under 75% of wetlands evaluated during the field-testing process. However,

it ranked far above the 75-percentile mark in wetland stressors, which indicates it is subject to numerous sources of potential impact to wetland function. At 6.36, Tavasci Marsh was still significantly below the maximum encountered stressor score of 7.70, but ranks firmly on the high end of the spectrum. On the other hand, wetland sensitivity was ranked low, below the 25th percentile, meaning this wetland was not particularly sensitive to the stressors acting on it.

Tavasci Marsh scored below the 75th percentile of field tested wetlands in all of the grouped services metrics (Table 3). Most services were ranked on the higher end of 25th-75th percentile range. The high score of Tavasci marsh in water quality support primarily reflects the high thermoregulation in the marsh. Because Tavasci marsh provides abundant plant cover and has deep water areas, it contains the cool water conditions many species require. Indeed, as noted elsewhere, the cattail cover was observed to lower water temperatures considerably. Tavasci Marsh also ranked relatively high in the Aquatic Support Group in function and received the maximum value score for this metric. The Aquatic Support score reflects the high function the habitat at Tavasci is judged to provide for amphibians and reptiles and the high value of the habitat it provides for waterbird feeding. Tavasci also received a maximum score for it value in the Terrestrial Support Group. Here its high ranking reflects the habitat value of Tavasci marsh to songbirds, raptors, and mammals.

Table 3. Summary of Overall Functions and Values of Tavasci Marsh as assessed by ORWAP, as compared to the 25-75 percentile of 221 field-tested wetlands in Oregon.

GROUPED SERVICES:	Function Scores	25-75 Percentile	Values Scores	25-75 Percentile
Hydrologic Function	**2.88**	1.73 - 4.61	**2.83**	2.50 - 4.50
Water Quality Support Group	**9.33**	5.35 - 10.00	**5.53**	5.32 - 6.74
Carbon Sequestration Function	**2.43**	2.05 - 2.69		
Fish Support Group	**4.10**	0.80 - 4.75	**6.41**	5.71 - 10.00
Aquatic Support Group	**7.70**	5.89 - 7.74	**10.00**	8.00 - 10.00
Terrestrial Support Group	**6.72**	4.89 - 6.96	**10.00**	7.00 - 9.00
Public Use & Recognition			**0.48**	2.92 - 10.00
Provisioning Services			**2.00**	0.00 - 2.00
OTHER ATTRIBUTES:				
Wetland Ecological Condition			**6.69**	4.46 - 6.80
Wetland Stressors			**6.36**	2.41 - 4.97
Wetland Sensitivity			**2.72**	3.75 - 5.50

Wildlife Use

Both the rapid condition and HGM assessments do not evaluate wildlife use specifically, although they do attempt to evaluate the potential for the wetland to serve as wildlife habitat as a function of vertical and biotic structure. The ORWAP method does specifically attempt to assess the potential support for fish and aquatic and terrestrial wildlife species, however, all of these methods only provide information on potential for use by wildlife, because wildlife use cannot really be assessed adequately within one field visit or within the timeframes employed by these "rapid" assessment methodologies.

Because of Tavasci Marsh's value to wildlife, surveys have been conducted sporadically within the area, with most recent one being a thorough inventory of fish, amphibians, reptiles, birds and mammals conducted by the USGS between 2002 and 2004 (Schmidt et al. 2005). Most of these surveys included the adjacent reach of the Verde River and upland areas of Tuzigoot National Monument in addition to Tavasci Marsh proper. With most of the surveys being either checklists or anecdotal information on species observations, formal analyses of changes in wildlife use with changes in the structure and character of the marsh is difficult, if not impossible, although some hypotheses on the degree and direction of change may be possible.

Birds

Vermillion flycatcher

Birds represent the most well-studied wildlife group using the Tavasci Marsh, as one might expect considering that it has been nominated as an Arizona Important Bird Area. In the late 1960s-early 1970s, Tavasci Marsh was characterized as "one of the richest bird life areas in Arizona" (Todd 1972). Todd noted that the only remaining population of summering soras and Virginia rails in the region at that time occurred at Tavasci Marsh, with soras and rails being "closely associated with cattails" (Todd 1972). Since then, the federally endangered Yuma clapper rail has also been observed in Tavasci Marsh at least once (D. Van Gausig *pers. comm. in* Schmidt et al. 2005). Hundreds of ducks (mostly teals) were observed feeding in inundated meadows, with sedges and rushes both being important foods for waterfowl (Todd 1972). The cattails, which represented only 10 acres of the marsh at that time, represented refugia for waterfowl, as well. Migrant shorebirds often utilized the muddy shorelines of the marsh (Todd 1972).

Through inventory efforts by other groups (Zarki and Zarki 1981, Johnson and Sogge 1995, and Von Gausig and Radd 2001), the number of bird species recorded at Tavasci Marsh and adjacent areas reached 248 (Schmidt et al. 2005). According to Schmidt et al. (2005), "the diversity of birds in the monument and the surrounding area is extraordinary for a natural area of its size, and Tavasci Marsh and the Verde River are the resources that account for this high bird diversity." Approximately 65 of the species recorded are closely associated with open water and marshes (Schmidt et al. 2005). Of these, 22 were ducks and geese; 3, grebes; 9; herons and egrets; 3, rails; 16, shorebirds; and 7, gulls (Schmidt et al. 2005). Of these 248 species, 176 species are probably directed associated with Tavasci Marsh (R. Radd, Northern Arizona Audubon, *pers. comm*.).

American coot on a cattail raft.

Federally listed species observed during the USGS surveys included the bald eagle (FT) and the yellow-billed cuckoo (FC), the latter of which was observed along the Verde River (Schmidt et al. 2005). In terms of non-native species of concern, brown-headed cowbirds that predate on the nests of native species were also observed and were more abundant than recorded numbers would suggest (Schmidt et al. 2005). As with many areas, the diversity of birds is directly attributable not necessarily to one particular habitat, but to the diverse mix of habitats present in the monument, including large cottonwood-willow riparian forests along the Verde River, mesquite forests along the perimeter, and freshwater marsh in Tavasci Marsh (Schmidt et al. 2005). While riparian habitat is one of the most important habitats for breeding birds in the area (Strong and Bock 1990, Brand et al. 2008), several nests were observed in the cattails during our field study, and the cooler temperatures below the cattail thatch may provide refugia during the hotter spring and summer months. While grassland habitats tend to support fewer species, those that do occur are often unique to that habitat (Brand et al. 2008).

While the checklist for this area included 248 species, during surveys conducted between 2002 and 2004, only 127 bird species were recorded by the USGS (Schmidt et al. 2005). Most of those that were not observed were associated with water (ducks, grebes, herons, shorebirds, and gulls; Schmidt et al. 2005). The USGS researchers ascribed the lower species count to the ephemeral nature of the marsh's use by some of these water-associated species pointing to the fact that species accumulation curve continue to climb even after 3,000 bird observations (Schmidt et al. 2005). Also, the total of

248 species was probably generated by continual additions to previous lists, so, therefore, inventories did not necessarily record 248 species during any one period (Schmidt et al. 2005). According to Roger Radd of Northern Arizona Audubon Society, bird counts conducted by Radd and other Audubon members suggest that the number of bird species using Tavasci Marsh may have dropped since dieback of the riparian habitat along the marsh's perimeter and expansion of the cattails. Riparian habitats support the highest diversity of bird species in southwestern desert ecosystems.

A list of some of the birds observed during our field study in April 2009 can be found in Figure 7.

Fish

In terms of fish use of Tavasci Marsh and the adjacent Verde River, the USGS survey documented 11 species and 885 individuals, all of which were non-native (Schmidt et al. 2005). Even in the late 1960s-early 1970s, most of the fish observed were non-native species such as carp, sunfish, and mosquitofish (Todd 1972). Cienegas in other areas of Arizona have been documented to support native fish such as the desert pupfish, Gila topminnow, Gila chub, and the Quitobaquito pupfish (endemic to the Quitobaquito Springs in Organ Pipe National Monument; AFG undated), but most of the native species with the most potential to occur in the Tuzigoot National Monument area are ones associated with rivers such as the desert sucker, Sonora sucker, roundtail chub, and Colorado pikeminnow (Bonar 2004 *in* Schmidt et al. 2005). None of the native species listed with potential to occur were associated with cienegas. The species with most potential to occur in the cienega would be Gila topminnows and juvenile Razorback suckers, a riverine fish that could use this area as a nursery (S. Hedwall, USFWS, *pers. comm*.). The duration and degree of habitat alteration in the Peck's Lake and Tavasci Marsh areas – including introduction of game fish into Peck's Lake -- may have long ago caused any population of native non-riverine fish species to become extirpated. Fish numbers and species diversity in Tavasci Marsh appeared relatively low, with only four species found (western mosquitofish, green sunfish, yellow bullhead, and bluegill), although the USGS researchers noted that surveying the marsh adequately given the dense vegetation may have precluded an accurate inventory and count (Schmidt et al. 2005). During our study, mosquitofish were observed near the weir structure (Figure 7).

Amphibians and Reptiles

Some native amphibians and reptiles were documented in Tavasci Marsh by Todd in 1972, including the Sonoran mud turtle and "leopard frog," as well as the non-native American bullfrog introduced from the eastern U.S. The leopard frog observed was probably the lowland leopard frog based on historical records from the marsh (Schmidt et al. 2005). However, during

Adult Sonoran mud turtle.

USGS surveys, no native amphibians were observed, with most of the amphibians counted being the American bullfrog, which is a predator of native species (Schmidt et al. 2005). In terms of reptiles, species of concern such as the Sonoran mud turtle has continued to persist at Tavasci Marsh, and the Mexican gartersnake was documented at the marsh in 2002 (Rosen and Schwalbe 2002 *in* Schmidt et al. 2005). Another reptilian species with potential to occur in this area includes the Narrow-headed gartersnake (S. Hedwall, USFWS, *pers. comm*.). During our study, a turtle was observed on the eastern perimeter of the marsh near Shea Springs (Figure 7).

In general, amphibian and reptile diversity at Tuzigoot National Monument is high, with 28 species and 939 observations recorded (Schmidt et al. 2005). Lizards comprised more than 73% of these observations, with snakes being another 10% (Schmidt et al. 2005). However, "the low number of amphibians and aquatic reptiles is cause for concern given the diversity and spatial extent of aquatic environments in Tavasci Marsh and the adjacent Verde River" (Schmidt et al. 2005). In comparison, 38 species of amphibians and reptiles were documented at the Las Cienegas National Conservation Area, with this area still supporting at least one species of leopard frog (although it was in decline), Sonoran mud turtle, Mexican gartersnake, and low numbers of bullfrog (Rosen and Caldwell 2004). The paucity of native amphibians and aquatic reptiles may be due to heavy predation by non-native predators such as the American bullfrog, crayfish, and game fish (Schmidt et al. 2005). Bullfrogs often thrive in areas with permanent or year-round inundation.

Mammals

The diversity of habitats at Tuzigoot National Monument also attracts mammals. During the USGS survey, approximately 25 species of mammals were recorded in the area (Schmidt et al. 2005). Most of these were upland species, but river otter and American beaver frequented Tavasci Marsh (Schmidt et al. 2005). In the early 1900s, the American beaver population had declined, and the southwestern subspecies of river other (*Lontra canadensis sonora*) had been hunted or trapped almost to extinction (Schmidt et al. 2005). In the 1980s, river otters were reintroduced using a subspecies of river otters from Louisiana (ssp. *laxatina*): the USGS could not verify which subspecies (or mixture) it caught, although it noted that there

are no currently verified populations of the southwestern subspecies (Melquist et al. 2003 *in* Scmidt et al. 2005). During our study, river otters were observed several times, and scat from otters was commonly found along the wetland perimeter in Wet and Moist Meadows and Grassland (Figure 7). In addition, a beaver dam was observed at the southern end of the marsh (Figure 7). Additional mammals or nests sighted during our study included wood rat nests, raccoons, rabbit (dead), and tracks of javelina.

Beaver dam and pond, Tavasci Marsh

With sixteen recorded species, bats make up one of the largest groups of mammals at Tuzigoot (Schmidt et al. 2005). Like birds, bats diversity has also been tied to the availability of a diversity of habitats. In a survey of mesquite bosque, riparian, and freshwater marsh habitats, Williams et al. (2006) found riparian habitat supported the greatest number of bat species, but that each of the habitats was preferentially used by certain species.

Invertebrates

One other species with potential to occur in the Tavasci Marsh is the Page springsnail (*Pyrgulopsis morrisoni*), a candidate species for federal listing. The Page springsnail occurs in spring-fed wetlands and cienegas, with its current distribution limited to the vicinity of the upper Verde River within a complex of eight (8) springs along Oak Creek near Page Springs in Yavapai County (USFWS 2007). Historically, a population was found in Tavasci Marsh, but this population is believed to have been extirpated (USFWS 2007). A number of factors have impacted this species, including flow restrictions and impoundments, reductions in primary productivity, chemicals, and groundwater withdrawals in the region (USFWS 2007).

Summary and Conclusions

Tavasci Marsh is a large and complex wetland system that reflects a long history of human management. Changes in management over the last hundred years have greatly affected the hydrology and the vegetation of the site, yet based on the assessment methods, marsh would appear to be functioning moderately to very well. The condition and functions may not be equivalent to those of less disturbed systems such as the Expansion Springs Complex, but Tavasci Marsh represents a unique ecosystem in this arid region and vital resource for wildlife, evident from the fact that it was one of the first areas listed under Arizona's Important Bird Areas designation.

While the marsh has probably changed in structure and character a number of times since the late 1800s, the most recent changes appear to coincide with an increase in water release from Peck's Lake into Tavasci Marsh to enable Peck's Lake to meet TMDL requirements. Based on analysis of historical reports and aerial photographs, cattails have increased 650% since 1988, replacing what were potentially mesic grasslands or pasturelands and Wet Meadow. Conversely, riparian habitat has decreased on the marsh perimeter during the past 20 years, as apparent from the high number of drowned snags. Overall, the extent of wetlands is probably greater now than historically due to high groundwater table along the perimeter that is promoted by Peck's Lake water releases. This high water table has promoted expansion of Wet Meadow, Moist and Wet Grassland, and even mesic ruderal and shrubland habitat into what might have been formerly upland areas.

Within Tavasci Marsh, the current mix or diversity of habitats may be roughly equivalent to that prior to increased Peck's Lake releases, with losses of riparian habitat somewhat offset by the expansion of mesic shrubland. However, evenness – or the amount of area represented by different habitats – may have been altered greatly in recent decades, with a large percentage of the marsh complex appearing to have converted from pastureland (Moist or Wet Grassland), Wet Meadow, and, to a lesser extent, riparian habitat into Freshwater Marsh.

Despite intensive hydrologic and moderate topographic manipulation, condition and function assessments suggest that Tavasci Marsh functions relatively well, scoring near the 75% percentile in wetland quality according to the ORWAP protocol. While the system appeared to be subject to a high number of stressors, the ORWAP assessment suggests that the marsh was not appear particularly sensitive to them. CRAM scores were similar, ranging between 61.7% to 69.9%, with 100% being the optimal score. While few wetlands could achieve that rating, a better comparison – at least for the spring wetlands – comes from another Park Service wetland, Expansion,

which had a score of 82.3%, 25% higher than the score for the Shea-Dead Horse Springs Complex (65.9%). Under CRAM, some of the highest condition scores for Tavasci Marsh came from the the extent and quality of the adjacent lands, which act as a buffer for the wetland, and biotic and physical structure, while under ORWAP, support for aquatic and terrestrial wildlife, if not fish, ranked at or above the 75% percentile. Hydrologic function and water quality support scored closer to the 25% percentile.

In desert ecosystems, riparian habitats support the highest diversity of birds (Brand et al. 2008, Strong and Bock 1990) and bats (Williams et al. 2006), and support the greatest number of threatened and endangered vertebrate species in the southwest (Johnson 2009 *in* Zaimes et al. 2007). What makes Tavasci Marsh and its Freshwater Marsh and Wet Meadow habitats particularly valuable for wildlife species is its proximity to the high value riparian systems along the Verde River and the adjacent, only lightly to moderately disturbed upland habitats. This factor undoubtedly influenced the marsh's relatively high ranking under ORWAP for support of aquatic and terrestrial wildlife.

In general, field surveys and monitoring support this high wildlife function ranking. As befitting a designated Important Bird Area, "the diversity of birds in the monument and the surrounding area is extraordinary for a natural area of its size, and Tavasci Marsh and the Verde River are the resources that account for this high bird diversity" (Schmidt et al. 2005). In addition to high diversity, the marsh may also support federally listed species such as the Yuma clapper rail, which has been observed at least once (D. Van Gausig *in* Schmidt et al. 2005). Two native reptiles have been recorded as present – the Sonoran mud turtle and the Mexican gartersnake (Rosen and Schwalbe 2002 *in* Schmidt et al. 2005). River otters have recolonized this area after being reintroduced from a Louisiana subspecies, and beavers have also moved into the marsh, establishing dams at its southern end.

Still, while the wetland assessment and even surveys suggest that the habitat and potential for wildlife within this system is high, what is unclear is how much actual wildlife use of the marsh and adjacent areas may have changed relative to what occurred historically or even what occurred within recent decades. According to Roger Radd of Northern Arizona Audubon Society, bird counts conducted by Audubon suggest that the number of bird species using Tavasci Marsh may have dropped since dieback of the riparian habitat along the marsh's perimeter and expansion of the cattails. During surveys from 2002-2004, the USGS recorded only 127 of the 248 bird species on the marsh checklist, however, researchers ascribed the disparity between totals to the ephemeral nature of the marsh's use by water-associated species and the cumulative nature of the checklist itself (Schmidt et al. 2005). All of the fish and amphibians observed during USGS surveys

were non-native species, with the lowland leopard frog, which was observed during the 1972 surveys by Todd, not found (Schmidt et al. 2005). Evaluating and characterizing changes in wildlife use over time, however, is almost impossible due to the scant number of surveys that were conducted historically or differences between sampling approaches between surveys.

Ultimately, Tavasci Marsh appears to be a marsh system which provides many important functions. However, the changes this system has undergone since the increase in release of Peck's Lake waters into the marsh may have altered the functionality of the system to some degree or even decreased some functions. Whether or not the overall changes to this system are viewed as beneficial or detrimental may depend largely on the value placed on different functions.

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Personal Communications

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Figures

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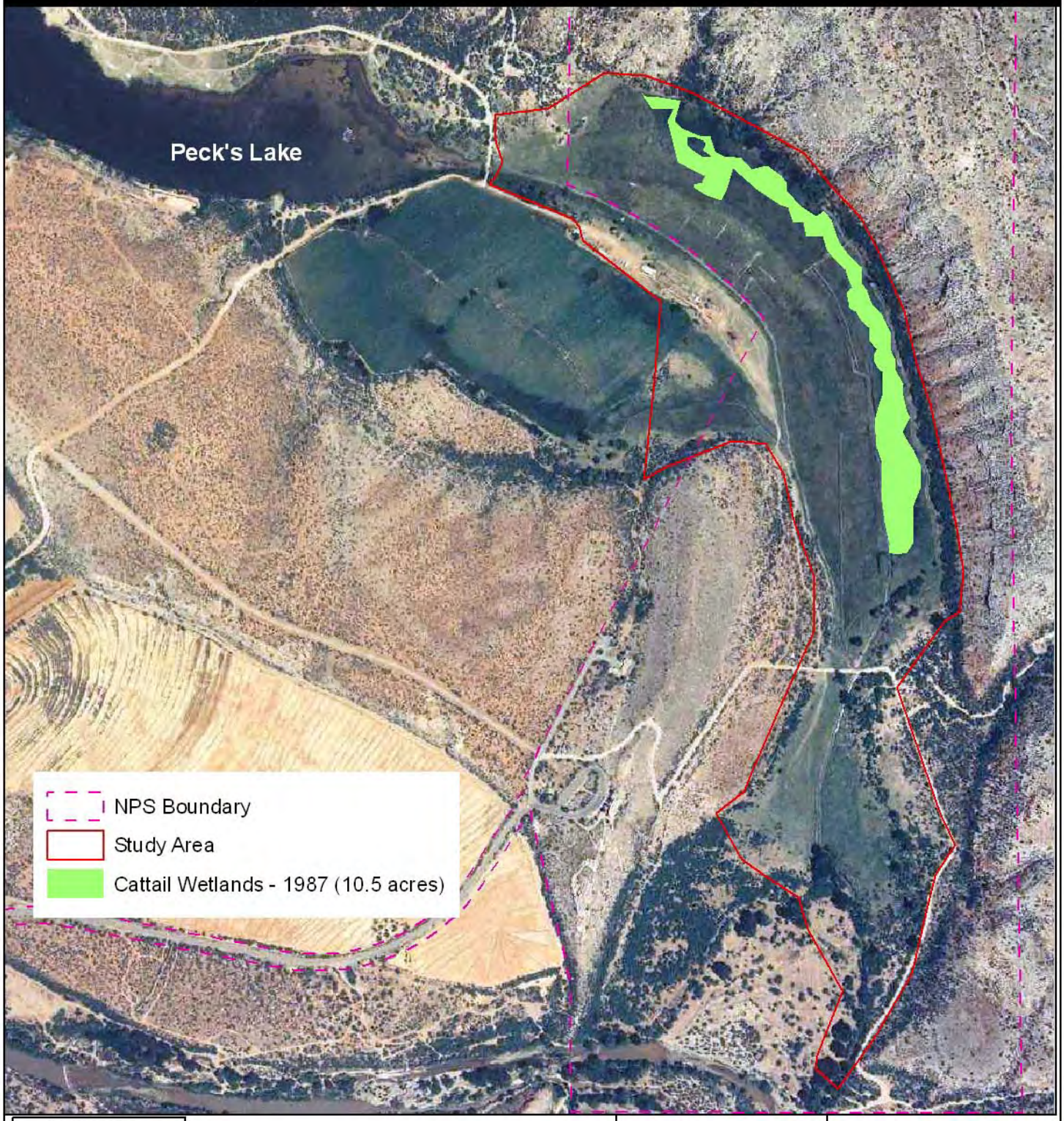
Tavasci Wetland Assessment
Cattail/Standing Water Marsh c. 1987



Vicinity Map

National Park Service
Tuzigoot National Monument
Yavapai County, AZ

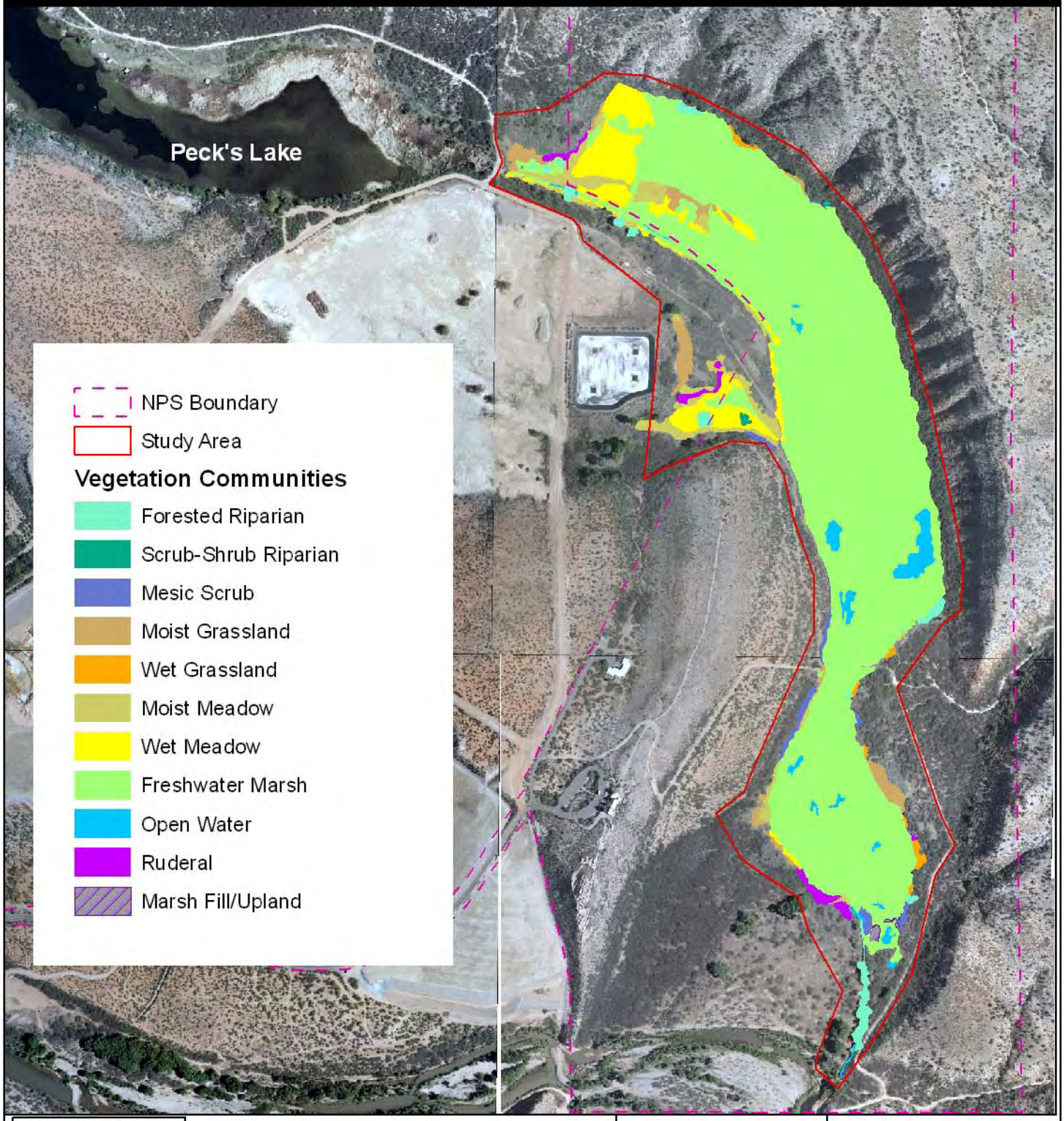
0 500 1,000 1,500 2,000 Feet

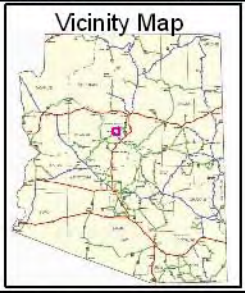
N
W E
S

Figure 1

Plot date: April 2009

Tavasci Wetland Assessment
Vegetation Communities





National Park Service
Tuzigoot National Monument
Yavapai County, AZ

0 0.1 0.2 0.3 Miles

N
W E
S

Figure 2

Plot date: April 2009

Tavasci Wetland Assessment
Vegetation Map

NPS Boundary Study Area

Vegetation Associations

Freshwater Marsh
- 1 Polygonum punctatum
- 2 Schoenoplectus americanus
- 3 Schoenoplectus tabernaemontani
- 4 Typha domingensis
- 5 Typha latifolia
- 6 Typha latifolia-Typha domingensis
- 7 Typha latifolia-T. domingensis-Schoenoplectus americanus
- 8 Typha latifolia-other

Forested/Scrub-Shrub Riparian
- 9 Fraxinus velutina-Salix goodingii
- 10 Populus fremontii
- 11 Populus fremontii-other
- 12 Salix goodingii

Mesic Scrub
- 13 Prosopis velutina-Kochia scoparia
- 14 Prosopis velutina-Leymus triticoides

Wet/Moist Grassland
- 15 Cynodon dactylon
- 16 Festuca arundinacea
- 17 Leymus triticoides
- 18 Leymus triticoides-Kochia scoparia
- 19 Sporobolus wrightii

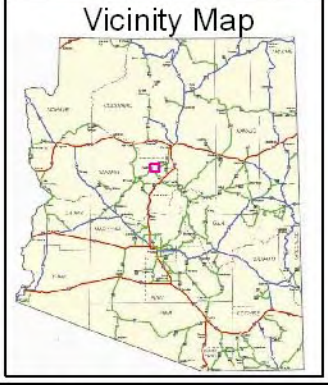
Wet/Moist Meadow
- 20 Carex praegracilis
- 21 Carex praegracilis-Juncus balticus
- 22 Eleocharis parishii
- 23 Eleocharis parishii-Carex praegracilis/Juncus balticus
- 24 Eleocharis parishii-Kochia scoparia
- 25 Eleocharis parishii-Mulhenberia asperifolia
- 26 Juncus balticus
- 27 Muhlenbergia asperifolia -Juncus balticus/Carex praegracilis
- 28 Muhlenbergia asperifolia-Rumex
- 29 Melilotus indica

Open Water
- 30 Algae
- 31 Myriophyllum aquaticum
- 32 Potamogeton crispus
- 33 Open Water - unknown vegetation

Ruderal/Disturbed
- 34 Kochia scoparia
- 35 Kochia scoparia-Leymus triticoides
- 36 Kochia scoparia-Muehlenbergia asperifolia
- 37 Kochia scoparia-Urtica dioica

Other
- 38 Mixed
- 39 Unknown

Vicinity Map



National Park Service
Tuzigoot National Monument
Yavapai County, AZ

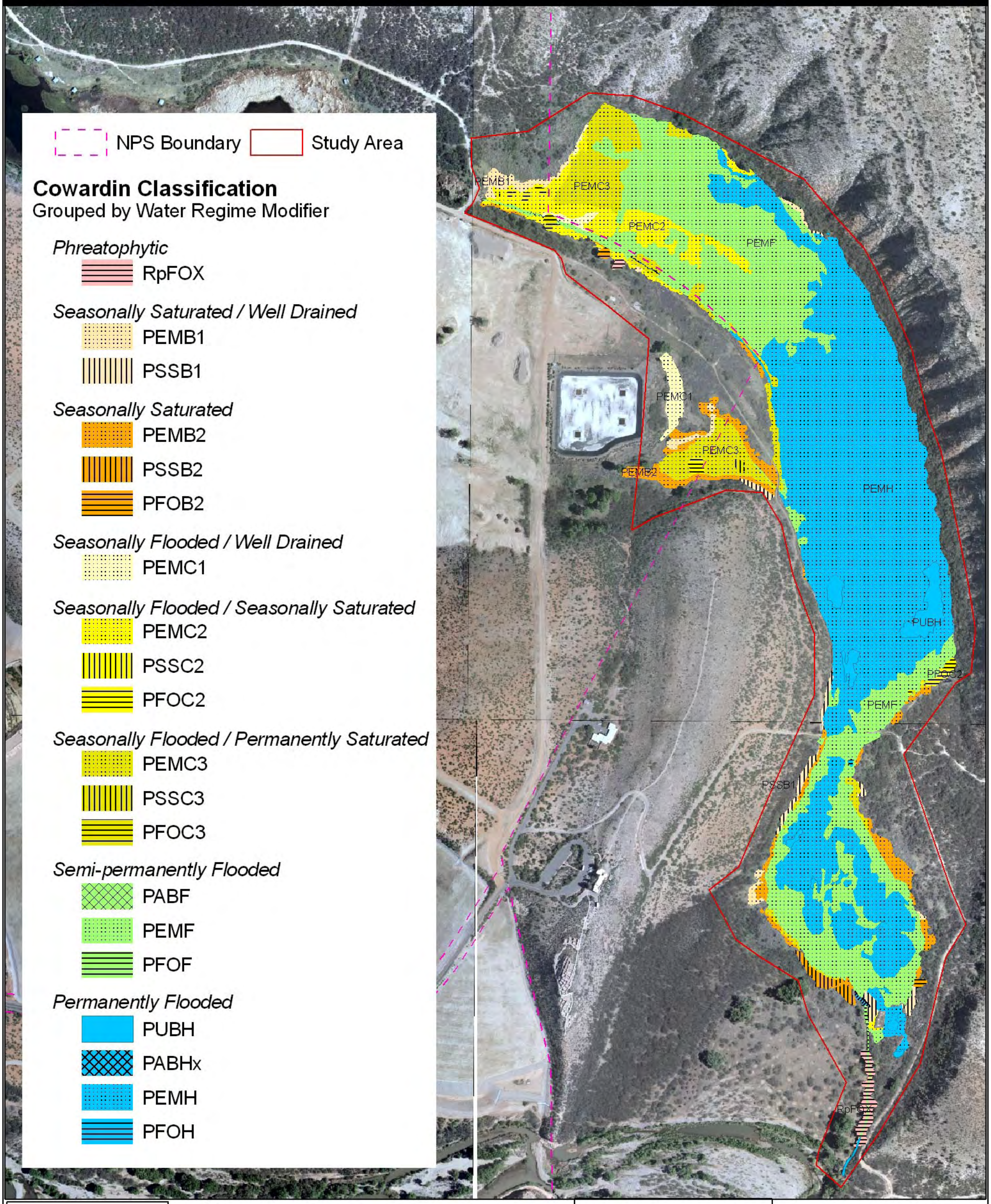
0 0.1 0.2 0.3 Miles

N
W E
S

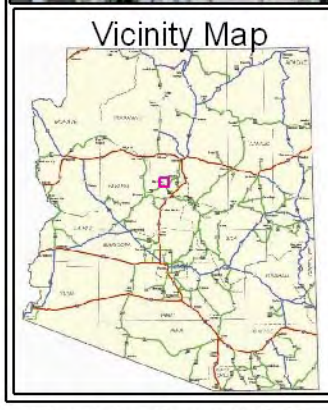
Figure 3

Plot date: April 2009

Tavasci Wetland Assessment
Cowardin Classification Map



Vicinity Map



National Park Service
Tuzigoot National Monument
Yavapai County, AZ

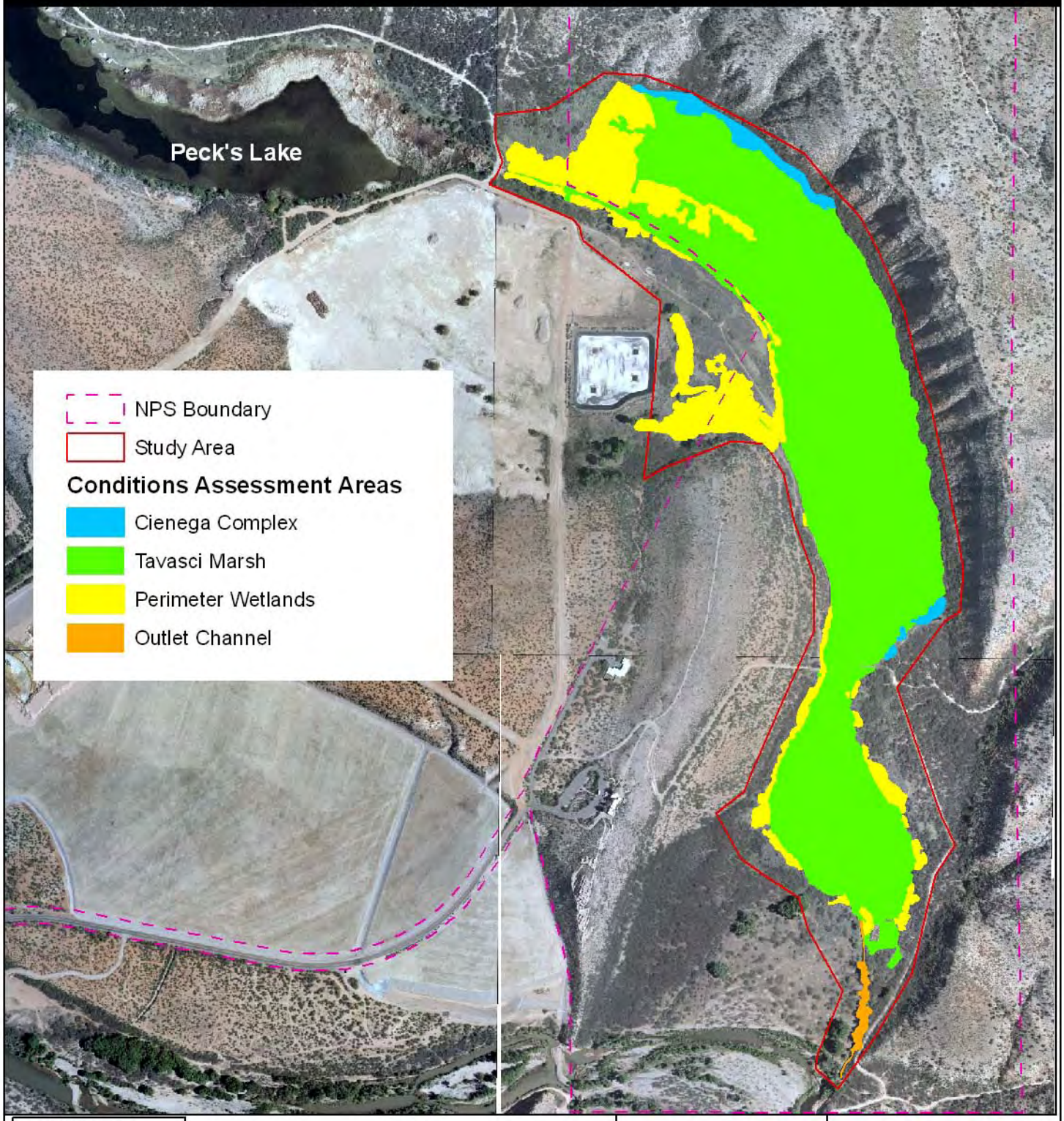
0 0.1 0.2 0.3 Miles

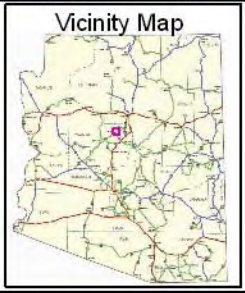
N
W E
S

Figure 4

Plot date: August 2009

Tavasci Wetland Assessment
CRAM Conditions Assessment Areas





National Park Service
Tuzigoot National Monument
Yavapai County, AZ

0 500 1,000 1,500 2,000 Feet

N
W E
S

Figure 5

Plot date: April 2009

Tavasci Wetland Assessment
ORWAP Functional Assessment Areas

Vicinity Map

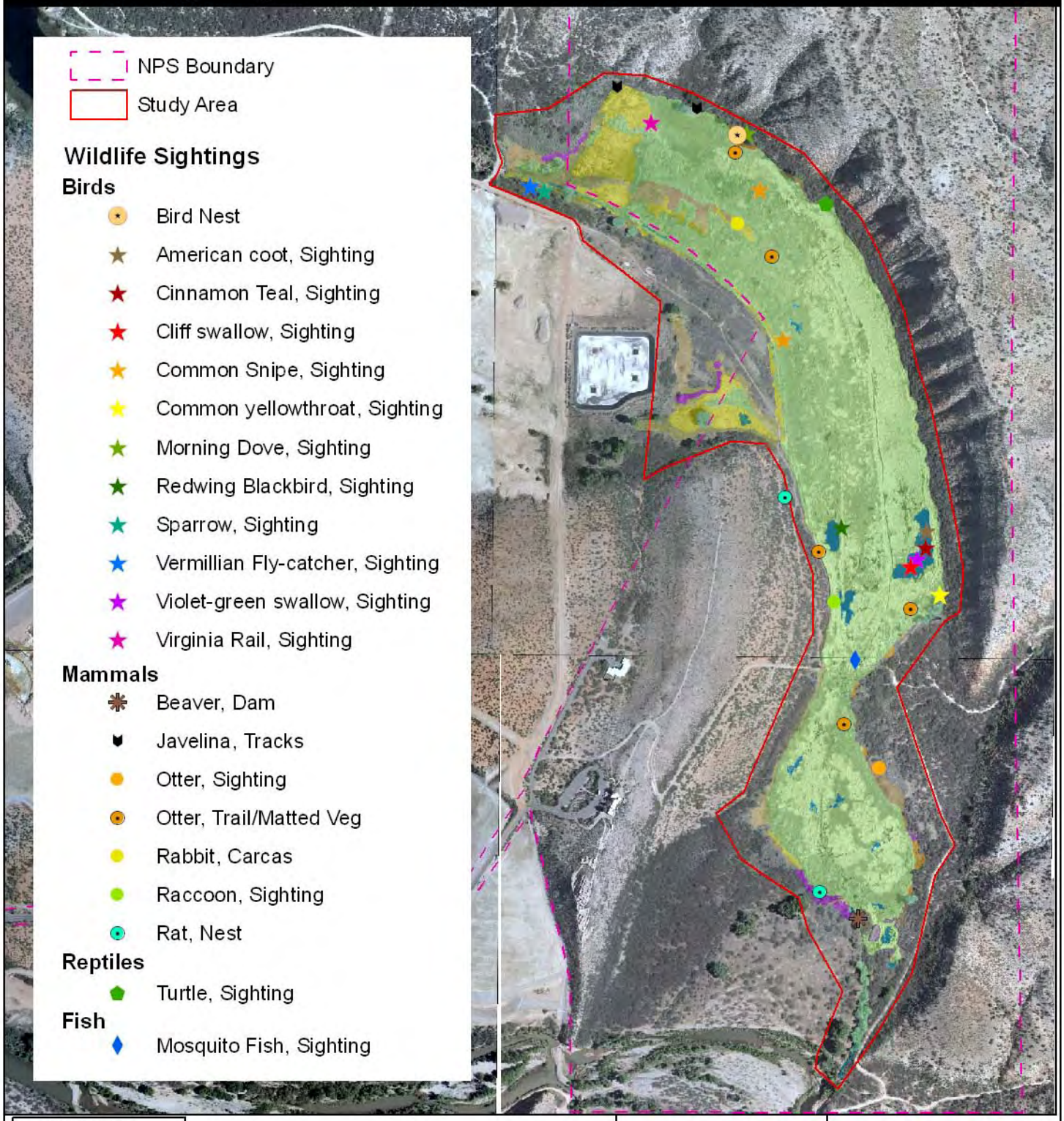
National Park Service
Tuzigoot National Monument
Yavapai County, AZ

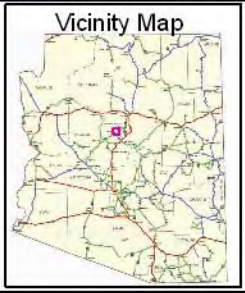
N
W E
S

Figure 6

Plot date: April 2009

Tavasci Wetland Assessment
Wildlife Sightings





National Park Service
Tuzigoot National Monument
Yavapai County, AZ

0 500 1,000 1,500 2,000 Feet

N
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S

Figure 7

Plot date: April 2009

Appendix A: Wetland Assessment Forms

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Appendix B: Conditions Assessment Forms (CRAM)

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Scoring Sheet: Perennial Depressional Wetlands

AA Name: Tavasci Marsh				(m/d/y) 04 10 09
Attributes and Metrics		**Scores**		**Comments**
Buffer and Landscape Context				
Landscape Connectivity (D)		B [9]		
Buffer submetric A: *Percent of AA with Buffer*	A [12]			Grazing, Soil excavation, non-native plants
Buffer submetric B: *Average Buffer Width*	A [12]			
Buffer submetric C: *Buffer Condition*	B [8]			
D + [C x (A x B)$^{1/2}$] $^{1/2}$ = **Attribute Score**		Raw 18.8	Final 78%	Final Attribute Score = (Raw Score/24)100
Hydrology				
Water Source		C-		
Hydroperiod or Channel Stability		D		
Hydrologic Connectivity		A		
Attribute Score		Raw 20	Final 56%	Final Attribute Score = (Raw Score/36)100
Physical Structure				
Structural Patch Richness		B		10/13
Topographic Complexity		C		
Attribute Score		Raw 15	Final 63%	Final Attribute Score = (Raw Score/24)100
Biotic Structure				
Plant Community submetric A: *Number of Plant Layers*	B [9]			aquatic, medium, tall
Plant Community submetric B: *Number of Co-dominant species*	D [3]			
Plant Community submetric C: *Percent Invasion*	A [12]			Assuming Typha sp are native T. domingensis not T. angustifolia
Plant Community Metric (*average of submetrics A-C*)		B+ [8]		
Horizontal Interspersion and Zonation		B+ [10]		
Vertical Biotic Structure		A [12]		
Attribute Score		Raw 30	Final 83%	Final Attribute Score = (Raw Score/36)100
Overall AA Score		69.9%		**Average of Final Attribute Scores**

Structural Patch Type Worksheet for All Wetland Types, Except Vernal Pool Systems

Circle each type of patch that is observed in the AA and enter the total number of observed patches in Table 4.16 below. In the case of riverine wetlands, their status as confined or non-confined must first be determined (see section 3.2.2.1).

STRUCTURAL PATCH TYPE (check for presence)	Riverine (Non-confined)	Riverine (Confined)	All Estuarine	**Depressional**	Slope Wetlands	Lacustrine	Individual Vernal Pools	Playas
Minimum Patch Size	3 m^2	3 m^2	3 m^2	**3 m^2**	1 m^2	3 m^2	1 m^2	3 m^2
Secondary channels on floodplains or along shorelines	1	0	1	**0**	1	1	0	1
Swales on floodplain or along shoreline	1	0	0	**(1)**	1	1	1	1
Pannes or pools on floodplain	1	0	1	**0**	1	1	1	1
Vegetated islands (mostly above high-water)	1	0	0	**(1)**	0	0	1	1
Pools or depressions in channels (wet or dry channels)	1	1	1	**0**	0	0	0	0
Riffles or rapids (wet channel) or planar bed (dry channel)	1	1	0	**0**	0	0	0	0
Non-vegetated flats or bare ground (sandflats, mudflats, gravel flats, etc.)	0	0	1	**1**	1	1	1	1
Point bars and in-channel bars	1	1	1	**0**	0	0	0	0
Debris jams	1	1	1	**0**	0	1	0	0
Abundant wrackline or organic debris in channel, on floodplain, or across depressional wetland plain	1	1	1	**(1)**	0	1	0	0
Plant hummocks and/or sediment mounds	1	1	1	**(1)**	1	1	1	1
Bank slumps or undercut banks in channels or along shoreline	1	1	1	**1**	0	1	0	0
Variegated, convoluted, or crenulated foreshore (instead of broadly arcuate or mostly straight)	1	1	0	**(1)**	0	1	0	0
Animal mounds and burrows	0	0	1	**(1)**	1	0	1	1
Standing snags (at least 3 m tall)	1	1	1	**(1)**	1	1	0	0
Filamentous macroalgae or algal mats	1	1	1	**(1)**	1	1	1	1
Shellfish beds	0	0	1	**0**	0	1	0	0
Concentric or parallel high water marks	0	0	0	**(1)**	1	1	1	1
Soil cracks	0	0	1	**1**	0	1	1	1
Cobble and/or Boulders	1	1	0	**0**	1	1	1	0
Submerged vegetation	1	0	1	**(1)**	0	1	0	0
Total Possible	16	11	15	**13**	10	16	10	10
No. Observed Patch Types (enter here and use in Table 4.16 below)				**10**				

Stressor Checklist Worksheet

Tavasci Marsh

HYDROLOGY ATTRIBUTE (WITHIN 50 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Point Source (PS) discharges (POTW, other non-stormwater discharge)		X
Non-point Source (Non-PS) discharges (urban runoff, farm drainage)	X	
Flow diversions or unnatural inflows		X
Dams (reservoirs, detention basins, recharge basins)		X
Flow obstructions (culverts, paved stream crossings)		
Weir/drop structure, tide gates		X
Dredged inlet/channel		
Engineered channel (riprap, armored channel bank, bed)		
Dike/levees		
Groundwater extraction		
Ditches (borrow, agricultural drainage, mosquito control, etc.)		X
Actively managed hydrology		X
Comments		

PHYSICAL STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Filling or dumping of sediment or soils **(N/A for restoration areas)**	X (minor)	
Grading/ compaction **(N/A for restoration areas)**		
Plowing/Discing **(N/A for restoration areas)**		
Resource extraction (sediment, gravel, oil and/or gas)		
Vegetation management		
Excessive sediment or organic debris from watershed		
Excessive runoff from watershed		
Nutrient impaired (PS or Non-PS pollution)		X
Heavy metal impaired (PS or Non-PS pollution)	X	
Pesticides or trace organics impaired (PS or Non-PS pollution)	?	
Bacteria and pathogens impaired (PS or Non-PS pollution)	?	
Trash or refuse		
Comments		

Tavasci Marsh

BIOTIC STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Mowing, grazing, excessive herbivory (within AA)		
Excessive human visitation		
Predation and habitat destruction by non-native vertebrates (e.g., *Virginia opossum* and domestic predators, such as feral pets)	X (Fish)	
Tree cutting/sapling removal		
Removal of woody debris		
Treatment of non-native and nuisance plant species		
Pesticide application or vector control		
Biological resource extraction or stocking (fisheries, aquaculture)		
Excessive organic debris in matrix (for vernal pools)		
Lack of vegetation management to conserve natural resources		
Lack of treatment of invasive plants adjacent to AA or buffer	X	
Comments		

BUFFER AND LANDSCAPE CONTEXT ATTRIBUTE (WITHIN 500 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Urban residential		
Industrial/commercial		
Military training/Air traffic		✓
Dams (or other major flow regulation or disruption)		X
Dryland farming		
Intensive row-crop agriculture		
Orchards/nurseries		
Commercial feedlots		
Dairies		
Ranching (enclosed livestock grazing or horse paddock or feedlot)		
Transportation corridor		
Rangeland (livestock rangeland also managed for native vegetation)	X	
Sports fields and urban parklands (golf courses, soccer fields, etc.)		
Passive recreation (bird-watching, hiking, etc.)		
Active recreation (off-road vehicles, mountain biking, hunting, fishing)		
Physical resource extraction (rock, sediment, oil/gas)		X
Biological resource extraction (aquaculture, commercial fisheries)		
Comments		

Scoring Sheet: Perennial Depressional Wetlands

AA Name: Tavasci Perimeter Wetlands				(m/d/y) 04 10 09
Attributes and Metrics		**Scores**		**Comments**
Buffer and Landscape Context				
Landscape Connectivity (D)		C [6]		~40%
Buffer submetric A: Percent of AA with Buffer	A [12]			-
Buffer submetric B: Average Buffer Width	A [12]			
Buffer submetric C: Buffer Condition	C [6]			
D + [C x (A x B)$^{1/2}$]$^{1/2}$ = **Attribute Score**		Raw	Final	Final Attribute Score = (Raw Score/24)100
Hydrology				
Water Source		C [6]		
Hydroperiod or Channel Stability		D [3]		
Hydrologic Connectivity		A- [11]		
Attribute Score		Raw	Final	Final Attribute Score = (Raw Score/36)100
		20	55.6	
Physical Structure				
Structural Patch Richness		C [6]		
Topographic Complexity		B [9]		
Attribute Score		Raw	Final	Final Attribute Score = (Raw Score/24)100
		15	62.5	
Biotic Structure				
Plant Community submetric A: Number of Plant Layers	C [6]			
Plant Community submetric B: Number of Co-dominant species	C [6]			
Plant Community submetric C: Percent Invasion	B [9]			
Plant Community Metric (*average of submetrics A-C*)		C+ [7]		
Horizontal Interspersion and Zonation		B [8]		
Vertical Biotic Structure		A- [11]		
Attribute Score		Raw	Final	Final Attribute Score = (Raw Score/36)100
		26	72.2	
Overall AA Score		65.8%		**Average of Final Attribute Scores**

Structural Patch Type Worksheet for All Wetland Types, Except Vernal Pool Systems

Circle each type of patch that is observed in the AA and enter the total number of observed patches in Table 4.16 below. In the case of riverine wetlands, their status as confined or non-confined must first be determined (see section 3.2.2.1).

STRUCTURAL PATCH TYPE (check for presence)	Riverine (Non-confined)	Riverine (Confined)	All Estuarine	**Depressional**	Slope Wetlands	Lacustrine	Individual Vernal Pools	Playas
Minimum Patch Size	3 m^2	3 m^2	3 m^2	**3 m^2**	1 m^2	3 m^2	1 m^2	3 m^2
Secondary channels on floodplains or along shorelines	1	0	1	**0**	1	1	0	1
Swales on floodplain or along shoreline	1	0	0	**1**	1	1	1	1
Pannes or pools on floodplain	1	0	1	**0**	1	1	1	1
Vegetated islands (mostly above high-water)	1	0	0	**(1)**	0	0	1	1
Pools or depressions in channels (wet or dry channels)	1	1	1	**0**	0	0	0	0
Riffles or rapids (wet channel) or planar bed (dry channel)	1	1	0	**0**	0	0	0	0
Non-vegetated flats or bare ground (sandflats, mudflats, gravel flats, etc.)	0	0	1	**1**	1	1	1	1
Point bars and in-channel bars	1	1	1	**0**	0	0	0	0
Debris jams	1	1	1	**0**	0	1	0	0
Abundant wrackline or organic debris in channel, on floodplain, or across depressional wetland plain	1	1	1	**(1)**	0	1	0	0
Plant hummocks and/or sediment mounds	1	1	1	**(1)**	1	1	1	1
Bank slumps or undercut banks in channels or along shoreline	1	1	1	**1**	0	1	0	0
Variegated, convoluted, or crenulated foreshore (instead of broadly arcuate or mostly straight)	1	1	0	**1**	0	1	0	0
Animal mounds and burrows	0	0	1	**(1)**	1	0	1	1
Standing snags (at least 3 m tall)	1	1	1	**(1)**	1	1	0	0
Filamentous macroalgae or algal mats	1	1	1	**1**	1	1	1	1
Shellfish beds	0	0	1	**0**	0	1	0	0
Concentric or parallel high water marks	0	0	0	**(1)**	1	1	1	1
Soil cracks	0	0	1	**1**	0	1	1	1
Cobble and/or Boulders	1	1	0	**0**	1	1	1	0
Submerged vegetation	1	0	1	**1**	0	1	0	0
Total Possible	16	11	15	**13**	10	16	10	10
No. Observed Patch Types (enter here and use in Table 4.16 below)				**6**				

Stressor Checklist Worksheet

HYDROLOGY ATTRIBUTE (WITHIN 50 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Point Source (PS) discharges (POTW, other non-stormwater discharge)	X	
Non-point Source (Non-PS) discharges (urban runoff, farm drainage)		
Flow diversions or unnatural inflows		
Dams (reservoirs, detention basins, recharge basins)		
Flow obstructions (culverts, paved stream crossings)	X?	
Weir/drop structure, tide gates		
Dredged inlet/channel		
Engineered channel (riprap, armored channel bank, bed)		
Dike/levees	X?	
Groundwater extraction		
Ditches (borrow, agricultural drainage, mosquito control, etc.)	X	
Actively managed hydrology	? positive	
Comments		

present beneficial

PHYSICAL STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Filling or dumping of sediment or soils **(N/A for restoration areas)**	X	
Grading/ compaction **(N/A for restoration areas)**	X	
Plowing/Discing **(N/A for restoration areas)**		
Resource extraction (sediment, gravel, oil and/or gas)		
Vegetation management - yes positive		
Excessive sediment or organic debris from watershed		
Excessive runoff from watershed		
Nutrient impaired (PS or Non-PS pollution)	X	
Heavy metal impaired (PS or Non-PS pollution)	?	
Pesticides or trace organics impaired (PS or Non-PS pollution)	?	
Bacteria and pathogens impaired (PS or Non-PS pollution)	X	
Trash or refuse	X	
Comments		

BIOTIC STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Mowing, grazing, excessive herbivory (within AA)	X	
Excessive human visitation		
Predation and habitat destruction by non-native vertebrates (e.g., *Virginia opossum* and domestic predators, such as feral pets)		
Tree cutting/sapling removal		
Removal of woody debris		
Treatment of non-native and nuisance plant species possible		
Pesticide application or vector control possible		
Biological resource extraction or stocking (fisheries, aquaculture)		
Excessive organic debris in matrix (for vernal pools)		
Lack of vegetation management to conserve natural resources	X	
Lack of treatment of invasive plants adjacent to AA or buffer	X	
Comments		
Are managing but need more resources to treat invasives		
Restoration/riparian planting		

BUFFER AND LANDSCAPE CONTEXT ATTRIBUTE (WITHIN 500 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Urban residential		
Industrial/commercial		
Military training/Air traffic		
Dams (or other major flow regulation or disruption)	X	
Dryland farming		
Intensive row-crop agriculture		
Orchards/nurseries		
Commercial feedlots		
Dairies		
Ranching (enclosed livestock grazing or horse paddock or feedlot)		
Transportation corridor		
Rangeland (livestock rangeland also managed for native vegetation)	X	
Sports fields and urban parklands (golf courses, soccer fields, etc.)		
Passive recreation (bird-watching, hiking, etc.)		
Active recreation (off-road vehicles, mountain biking, hunting, fishing)		
Physical resource extraction (rock, sediment, oil/gas)	X	
Biological resource extraction (aquaculture, commercial fisheries)		
Comments		

Scoring Sheet: Perennial Depressional Wetlands / Shea Springs Wetlands Complex

AA Name: Shea Springs/Cienega Complex				(m/d/y)	04	06	09
Attributes and Metrics		**Scores**		**Comments**			
Buffer and Landscape Context							
Landscape Connectivity (D)		B					
Buffer submetric A: Percent of AA with Buffer	A						
Buffer submetric B: Average Buffer Width	A						
Buffer submetric C: Buffer Condition	B						
D + [C x (A x B)$^{1/3}$]$^{1/3}$ = **Attribute Score**		Raw 19.4	Final 81	Final Attribute Score = (Raw Score/24)100			
Hydrology							
Water Source		C+					
Hydroperiod or Channel Stability		C					
Hydrologic Connectivity		B					
Attribute Score		Raw 18	Final 50	Final Attribute Score = (Raw Score/36)100			
Physical Structure							
Structural Patch Richness		C					
Topographic Complexity		B					
Attribute Score		Raw 15	Final 62.5	Final Attribute Score = (Raw Score/24)100			
Biotic Structure							
Plant Community submetric A: Number of Plant Layers	A/B						
Plant Community submetric B: Number of Co-dominant species	B(-)						
Plant Community submetric C: Percent Invasion	B						
Plant Community Metric (*average of submetrics A-C*)							
Horizontal Interspersion and Zonation		C					
Vertical Biotic Structure		D					
Attribute Score		Raw	Final	Final Attribute Score = (Raw Score/36)100			
Overall AA Score		65.9%		**Average of Final Attribute Scores**			

ABC

FAR

Structural Patch Type Worksheet for All Wetland Types, Except Vernal Pool Systems

Circle each type of patch that is observed in the AA and enter the total number of observed patches in Table 4.16 below. In the case of riverine wetlands, their status as confined or non-confined must first be determined (see section 3.2.2.1).

STRUCTURAL PATCH TYPE (check for presence)	Riverine (Non-confined)	Riverine (Confined)	All Estuarine	**Depressional**	Slope Wetlands	Lacustrine	Individual Vernal Pools	Playas
Minimum Patch Size	3 m^2	3 m^2	3 m^2	**3 m^2**	1 m^2	3 m^2	1 m^2	3 m^2
Secondary channels on floodplains or along shorelines	1	0	1	**0**	1	1	0	1
Swales on floodplain or along shoreline	1	0	0	**1**	(1)	1	1	1
Pannes or pools on floodplain	1	0	1	**0**	1	1	1	1
Vegetated islands (mostly above high-water)	1	0	0	**1**	0	0	1	1
Pools or depressions in channels (wet or dry channels)	1	1	1	**0**	0	0	0	0
Riffles or rapids (wet channel) or planar bed (dry channel)	1	1	0	**0**	0	0	0	0
Non-vegetated flats or bare ground (sandflats, mudflats, gravel flats, etc.)	0	0	1	**1**	1	1	1	1
Point bars and in-channel bars	1	1	1	**0**	0	0	0	0
Debris jams	1	1	1	**0**	0	1	0	0
Abundant wrackline or organic debris in channel, on floodplain, or across depressional wetland plain	1	1	1	(**1**)	0	1	0	0
Plant hummocks and/or sediment mounds	1	1	1	**1**	(1)	1	1	1
Bank slumps or undercut banks in channels or along shoreline	1	1	1	**1**	0	1	0	0
Variegated, convoluted, or crenulated foreshore (instead of broadly arcuate or mostly straight)	1	1	0	**1**	0	1	0	0
Animal mounds and burrows	0	0	1	**1**	(1)	0	1	1
Standing snags (at least 3 m tall)	1	1	1	**1**	(1)	1	0	0
Filamentous macroalgae or algal mats	1	1	1	**1**	1	1	1	1
Shellfish beds	0	0	1	**0**	0	1	0	0
Concentric or parallel high water marks	0	0	0	**1**	1	1	1	1
Soil cracks	0	0	1	**1**	0	1	1	1
Cobble and/or Boulders	1	1	0	**0**	1	1	1	0
Submerged vegetation	1	0	1	**1**	0	1	0	0
Total Possible	16	11	15	**13**	10	16	10	10
No. Observed Patch Types (enter here and use in Table 4.16 below)					5			

Shea Spring Wetlands Complex

Stressor Checklist Worksheet

HYDROLOGY ATTRIBUTE (WITHIN 50 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Point Source (PS) discharges (POTW, other non-stormwater discharge)		
Non-point Source (Non-PS) discharges (urban runoff, farm drainage)		X
Flow diversions or unnatural inflows		X
Dams (reservoirs, detention basins, recharge basins)		
Flow obstructions (culverts, paved stream crossings)		
Weir/drop structure, tide gates		
Dredged inlet/channel		
Engineered channel (riprap, armored channel bank, bed)		
Dike/levees		
Groundwater extraction		
Ditches (borrow, agricultural drainage, mosquito control, etc.)		
Actively managed hydrology		X
Comments		

PHYSICAL STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Filling or dumping of sediment or soils **(N/A for restoration areas)**		
Grading/ compaction **(N/A for restoration areas)**	X (Cows)	
Plowing/Discing **(N/A for restoration areas)**		
Resource extraction (sediment, gravel, oil and/or gas)		
Vegetation management		
Excessive sediment or organic debris from watershed		
Excessive runoff from watershed		
Nutrient impaired (PS or Non-PS pollution)	?	
Heavy metal impaired (PS or Non-PS pollution)		
Pesticides or trace organics impaired (PS or Non-PS pollution)		
Bacteria and pathogens impaired (PS or Non-PS pollution)		
Trash or refuse		
Comments		

Shea Springs Wetland Complex

BIOTIC STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Mowing, grazing, excessive herbivory (within AA)	X	
Excessive human visitation		
Predation and habitat destruction by non-native vertebrates (e.g., *Virginia opossum* and domestic predators, such as feral pets)		
Tree cutting/sapling removal		
Removal of woody debris		
Treatment of non-native and nuisance plant species	present, but positive?	
Pesticide application or vector control		
Biological resource extraction or stocking (fisheries, aquaculture)		
Excessive organic debris in matrix (for vernal pools)		
Lack of vegetation management to conserve natural resources		
Lack of treatment of invasive plants adjacent to AA or buffer		
Comments		

BUFFER AND LANDSCAPE CONTEXT ATTRIBUTE (WITHIN 500 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Urban residential		
Industrial/commercial		
Military training/Air traffic		
Dams (or other major flow regulation or disruption)		
Dryland farming		
Intensive row-crop agriculture		
Orchards/nurseries		
Commercial feedlots		
Dairies		
Ranching (enclosed livestock grazing or horse paddock or feedlot)		
Transportation corridor		
Rangeland (livestock rangeland also managed for native vegetation)		
Sports fields and urban parklands (golf courses, soccer fields, etc.)		
Passive recreation (bird-watching, hiking, etc.)		
Active recreation (off-road vehicles, mountain biking, hunting, fishing)		
Physical resource extraction (rock, sediment, oil/gas)		
Biological resource extraction (aquaculture, commercial fisheries)		
Comments		

Scoring Sheet: Riverine Wetlands

AA Name: Tavasci Marsh Outlet Channel			(m/d/y) 04 10 09
Attributes and Metrics		**Scores**	**Comments**
Buffer and Landscape Context			
Landscape Connectivity (D)		A (12)	
Buffer submetric A: Percent of AA with Buffer	A		
Buffer submetric B: Average Buffer Width	A		
Buffer submetric C: Buffer Condition	(B-) C+		
D + [C x (A x B)$^{1/2}$] $^{1/2}$ = **Attribute Score** (12)	Raw: 21.80	Final: 90.8	Final Attribute Score = (Raw Score/24)100
Hydrology			
Water Source		C – (5)	
Hydroperiod or Channel Stability		C+ (7)	
Hydrologic Connectivity		C- (5)	L - check in A2?
Attribute Score	Raw: 17	Final: 47.2	Final Attribute Score = (Raw Score/36)100
Physical Structure			
Structural Patch Richness		B- (8)	
Topographic Complexity		D (3)	
Attribute Score	Raw: 11	Final: 45.8	Final Attribute Score = (Raw Score/24)100
Biotic Structure			
Plant Community submetric A: Number of Plant Layers	B 9		
Plant Community submetric B: Number of Co-dominant species	B- 5		
Plant Community submetric C: Percent Invasion	B 9		
Plant Community Metric (*average of submetrics A-C*)	8.6		
Horizontal Interspersion and Zonation	C- 5		
Vertical Biotic Structure	B 9		
Attribute Score	Raw: 22.6	Final: 62.9	Final Attribute Score = (Raw Score/36)100
Overall AA Score	61.65		**Average of Final Attribute Scores**

Structural Patch Type Worksheet for All Wetland Types, Except Vernal Pool Systems

Circle each type of patch that is observed in the AA and enter the total number of observed patches in Table 4.16 below. In the case of riverine wetlands, their status as confined or non-confined must first be determined (see section 3.2.2.1).

STRUCTURAL PATCH TYPE (check for presence)	Riverine (Non-confined)	Riverine (Confined)	All Estuarine	**Depressional**	Slope Wetlands	Lacustrine	Individual Vernal Pools	Playas
Minimum Patch Size	3 m^2	3 m^2	3 m^2	**3 m^2**	1 m^2	3 m^2	1 m^2	3 m^2
Secondary channels on floodplains or along shorelines	1	0	1	**0**	1	1	0	1
Swales on floodplain or along shoreline	1	0	0	**1**	1	1	1	1
Pannes or pools on floodplain	1	0	1	**0**	1	1	1	1
Vegetated islands (mostly above high-water)	1	0	0	**1**	0	0	1	1
Pools or depressions in channels (wet or dry channels)	(1)	1	1	**0**	0	0	0	0
Riffles or rapids (wet channel) or planar bed (dry channel)	(1)	1	0	**0**	0	0	0	0
Non-vegetated flats or bare ground (sandflats, mudflats, gravel flats, etc.)	0	0	1	**1**	1	1	1	1
Point bars and in-channel bars	1	1	1	**0**	0	0	0	0
Debris jams	(1)	1	1	**0**	0	1	0	0
Abundant wrackline or organic debris in channel, on floodplain, or across depressional wetland plain	(1)	1	1	**1**	0	1	0	0
Plant hummocks and/or sediment mounds	(1)	1	1	**1**	1	1	1	1
Bank slumps or undercut banks in channels or along shoreline	1	1	1	**1**	0	1	0	0
Variegated, convoluted, or crenulated foreshore (instead of broadly arcuate or mostly straight)	1	1	0	**1**	0	1	0	0
Animal mounds and burrows	0	0	1	**1**	1	0	1	1
Standing snags (at least 3 m tall)	(1)	1	1	**1**	1	1	0	0
Filamentous macroalgae or algal mats	(1)	1	1	**1**	1	1	1	1
Shellfish beds	0	0	1	**0**	0	1	0	0
Concentric or parallel high water marks	0	0	0	**1**	1	1	1	1
Soil cracks	0	0	1	**1**	0	1	1	1
Cobble and/or Boulders	1	1	0	**0**	1	1	1	0
Submerged vegetation	(1)	0	1	**1**	0	1	0	0
Total Possible	16	11	15	**13**	10	16	10	10
No. Observed Patch Types (enter here and use in Table 4.16 below)	8							

Stressor Checklist Worksheet

HYDROLOGY ATTRIBUTE (WITHIN 50 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Point Source (PS) discharges (POTW, other non-stormwater discharge)		
Non-point Source (Non-PS) discharges (urban runoff, farm drainage)	X (marsh)	X ?
Flow diversions or unnatural inflows		X
Dams (reservoirs, detention basins, recharge basins)		
Flow obstructions (culverts, paved stream crossings) Beaver		
Weir/drop structure, tide gates		
Dredged inlet/channel		
Engineered channel (riprap, armored channel bank, bed)		X
Dike/levees		
Groundwater extraction		
Ditches (borrow, agricultural drainage, mosquito control, etc.)		
Actively managed hydrology		X
Comments		

PHYSICAL STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Filling or dumping of sediment or soils **(N/A for restoration areas)**		
Grading/ compaction **(N/A for restoration areas)**		
Plowing/Discing **(N/A for restoration areas)**		
Resource extraction (sediment, gravel, oil and/or gas)		
Vegetation management		
Excessive sediment or organic debris from watershed		
Excessive runoff from watershed		
Nutrient impaired (PS or Non-PS pollution)	X ?	
Heavy metal impaired (PS or Non-PS pollution)	X ?	
Pesticides or trace organics impaired (PS or Non-PS pollution)		
Bacteria and pathogens impaired (PS or Non-PS pollution)		
Trash or refuse		
Comments		

BIOTIC STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Mowing, grazing, excessive herbivory (within AA)		
Excessive human visitation		
Predation and habitat destruction by non-native vertebrates (e.g., *Virginia opossum* and domestic predators, such as feral pets)		
Tree cutting/sapling removal		
Removal of woody debris		
Treatment of non-native and nuisance plant species		
Pesticide application or vector control		
Biological resource extraction or stocking (fisheries, aquaculture)		
Excessive organic debris in matrix (for vernal pools)		
Lack of vegetation management to conserve natural resources		
Lack of treatment of invasive plants adjacent to AA or buffer	X	
Comments		

BUFFER AND LANDSCAPE CONTEXT ATTRIBUTE (WITHIN 500 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Urban residential		
Industrial/commercial		
Military training/Air traffic		
Dams (or other major flow regulation or disruption)		
Dryland farming		
Intensive row-crop agriculture		
Orchards/nurseries		
Commercial feedlots		
Dairies		
Ranching (enclosed livestock grazing or horse paddock or feedlot)		
Transportation corridor		
Rangeland (livestock rangeland also managed for native vegetation)	X	
Sports fields and urban parklands (golf courses, soccer fields, etc.)		
Passive recreation (bird-watching, hiking, etc.)		
Active recreation (off-road vehicles, mountain biking, hunting, fishing)	X ?	
Physical resource extraction (rock, sediment, oil/gas)		
Biological resource extraction (aquaculture, commercial fisheries)		
Comments		

Scoring Sheet: Perennial Depressional Wetlands

Expansion Springs Wetlands along Benton Creek

AA Name: Expansion Springs				(m/d/y) 04 07 09
Attributes and Metrics		**Scores**		**Comments**
Buffer and Landscape Context				
Landscape Connectivity (D)		C		
Buffer submetric A: Percent of AA with Buffer	A			
Buffer submetric B: Average Buffer Width	A			
Buffer submetric C: Buffer Condition	B			
D + [C x (A x B)$^{1/2}$] $^{1/2}$ = **Attribute Score**		Raw 16.4	Final 68	Final Attribute Score = (Raw Score/24)100
Hydrology				
Water Source		A- (10.5)		some effects of altered hydrology from river on some edges
Hydroperiod or Channel Stability		A- (10.5)		
Hydrologic Connectivity		A (12)		
Attribute Score		Raw 33	Final 92	Final Attribute Score = (Raw Score/36)100
Physical Structure				
Structural Patch Richness		B		
Topographic Complexity		A		
Attribute Score		Raw 21	Final 88	Final Attribute Score = (Raw Score/24)100
Biotic Structure				
Plant Community submetric A: Number of Plant Layers	B			Medium, Tall, Very Tall
Plant Community submetric B: Number of Co-dominant species	C			FEAR, CAR SP#1, RUDI, SAGO, FRYE, CAR SP#2
Plant Community submetric C: Percent Invasion	B			FEAR, RUDI - 2/6 = 33%
Plant Community Metric (*average of submetrics A-C*)		8		
Horizontal Interspersion and Zonation		A		
Vertical Biotic Structure		B		
Attribute Score		Raw 29	Final 81	Final Attribute Score = (Raw Score/36)100
Overall AA Score		82.25		**Average of Final Attribute Scores**

12
+ 9
2

Structural Patch Type Worksheet for All Wetland Types, Except Vernal Pool Systems

Circle each type of patch that is observed in the AA and enter the total number of observed patches in Table 4.16 below. In the case of riverine wetlands, their status as confined or non-confined must first be determined (see section 3.2.2.1).

STRUCTURAL PATCH TYPE (check for presence)	Riverine (Non-confined)	Riverine (Confined)	All Estuarine	**Depressional**	Slope Wetlands	Lacustrine	Individual Vernal Pools	Playas
Minimum Patch Size	3 m^2	3 m^2	3 m^2	**3 m^2**	1 m^2	3 m^2	1 m^2	3 m^2
Secondary channels on floodplains or along shorelines	1	0	1	**0**	1	1	0	1
Swales on floodplain or along shoreline	1	0	0	**1**	(1)	1	1	1
Pannes or pools on floodplain	1	0	1	**0**	1	1	1	1
Vegetated islands (mostly above high-water)	1	0	0	**1**	0	0	1	1
Pools or depressions in channels (wet or dry channels)	1	1	1	**0**	0	0	0	0
Riffles or rapids (wet channel) or planar bed (dry channel)	1	1	0	**0**	0	0	0	0
Non-vegetated flats or bare ground (sandflats, mudflats, gravel flats, etc.)	0	0	1	**1**	(1)	1	1	1
Point bars and in-channel bars	1	1	1	**0**	0	0	0	0
Debris jams	1	1	1	**0**	0	1	0	0
Abundant wrackline or organic debris in channel, on floodplain, or across depressional wetland plain	1	1	1	**1**	0	1	0	0
Plant hummocks and/or sediment mounds	1	1	1	**1**	(1)	1	1	1
Bank slumps or undercut banks in channels or along shoreline	1	1	1	**1**	0	1	0	0
Variegated, convoluted, or crenulated foreshore (instead of broadly arcuate or mostly straight)	1	1	0	**1**	0	1	0	0
Animal mounds and burrows	0	0	1	**1**	(1)	0	1	1
Standing snags (at least 3 m tall)	1	1	1	**1**	1	1	0	0
Filamentous macroalgae or algal mats	1	1	1	**1**	(1)	1	1	1
Shellfish beds	0	0	1	**0**	0	1	0	0
Concentric or parallel high water marks	0	0	0	**1**	1	1	1	1
Soil cracks	0	0	1	**1**	0	1	1	1
Cobble and/or Boulders	1	1	0	**0**	(1)	1	1	0
Submerged vegetation	1	0	1	**1**	0	1	0	0
Total Possible	16	11	15	**13**	10	16	10	10
No. Observed Patch Types (enter here and use in Table 4.16 below)					6			

Stressor Checklist Worksheet

HYDROLOGY ATTRIBUTE (WITHIN 50 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Point Source (PS) discharges (POTW, other non-stormwater discharge)		
Non-point Source (Non-PS) discharges (urban runoff, farm drainage)	X	
Flow diversions or unnatural inflows	X	
Dams (reservoirs, detention basins, recharge basins)		
Flow obstructions (culverts, paved stream crossings)		
Weir/drop structure, tide gates		
Dredged inlet/channel		
Engineered channel (riprap, armored channel bank, bed)		
Dike/levees		
Groundwater extraction		
Ditches (borrow, agricultural drainage, mosquito control, etc.)		
Actively managed hydrology		
Comments		

PHYSICAL STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Filling or dumping of sediment or soils **(N/A for restoration areas)**		
Grading/ compaction **(N/A for restoration areas)**		
Plowing/Discing **(N/A for restoration areas)**		
Resource extraction (sediment, gravel, oil and/or gas)		
Vegetation management		
Excessive sediment or organic debris from watershed		
Excessive runoff from watershed		
Nutrient impaired (PS or Non-PS pollution)	?	
Heavy metal impaired (PS or Non-PS pollution)		
Pesticides or trace organics impaired (PS or Non-PS pollution)	?	
Bacteria and pathogens impaired (PS or Non-PS pollution)	?	
Trash or refuse	X	
Comments		

BIOTIC STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Mowing, grazing, excessive herbivory (within AA)		
Excessive human visitation		
Predation and habitat destruction by non-native vertebrates (e.g., *Virginia opossum* and domestic predators, such as feral pets)		
Tree cutting/sapling removal		
Removal of woody debris		
Treatment of non-native and nuisance plant species		
Pesticide application or vector control		
Biological resource extraction or stocking (fisheries, aquaculture)		
Excessive organic debris in matrix (for vernal pools)		
Lack of vegetation management to conserve natural resources		
Lack of treatment of invasive plants adjacent to AA or buffer	X	
Comments		

BUFFER AND LANDSCAPE CONTEXT ATTRIBUTE (WITHIN 500 M OF AA)	Present and likely to have negative effect on AA	Significant negative effect on AA
Urban residential		
Industrial/commercial		
Military training/Air traffic		
Dams (or other major flow regulation or disruption)		
Dryland farming		
Intensive row-crop agriculture		
Orchards/nurseries		
Commercial feedlots		
Dairies		
Ranching (enclosed livestock grazing or horse paddock or feedlot)		
Transportation corridor		
Rangeland (livestock rangeland also managed for native vegetation)		
Sports fields and urban parklands (golf courses, soccer fields, etc.)		
Passive recreation (bird-watching, hiking, etc.)		
Active recreation (off-road vehicles, mountain biking, hunting, fishing)		
Physical resource extraction (rock, sediment, oil/gas)		
Biological resource extraction (aquaculture, commercial fisheries)		
Comments		

Appendix C: Functional Assessment Forms (ORWAP)

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CoverPg: Basic Description of Assessment

Site Name:	Tavasci Marsh
Investigator Name:	A. Ryan and L. Parsons
Date of Field Assessment:	4/6/09-4/10/09 and 5/2/09
County:	Yavapai County
Nearest Town:	Clarkdale, AZ
Latitude (decimal degrees):	112.02200
Longitude (decimal degrees):	37.77700
TRS, quarter/quarter section and tax lot(s)	
Approximate size of the Assessment Area (AA, in acres)	95
AA as percent of entire wetland (approx.)	100
If delineated, DSL file number (WD #) if known	
Soil Map Units within the AA(list these in approx. rank order by area, from WSS web site or published county survey; see manual)	not mapped
Soil Map Units surrounding and contiguous to the AA(list all present in approx. rank order by area; see manual)	Verde Fomation
Cowardin Systems & Classes (indicate all present, based on field visit and/or aerial imagery): Systems: Palustrine =P, Riverine =R, Lacustrine =L, Estuarine =E Classes: Emergent =EM, Scrub-Shrub =SS, Forested =FO, Aquatic Bed (incl. SAV) =AB, Open Water =OW, Unconsolidated Bottom =UB, Unconsolidated Shore =US	
HGM Class (Scores worksheet will suggest a class; see manual section 2.4.2)	Depressional
If tidal, the tidal phase during most of visit:	
What percent (approx.) of the **wetland** were you able to visit?	20%
What percent (approx.) of the **AA** were you able to visit?	20%
Have you attended an ORWAP training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using ORWAP (approx.)?	None
Comments about the site or this ORWAP assessment (attach extra page if desired):	

ORWAP SCORES SHEET. Version 2.0.

Site Name:	Tavasci Marsh		
Investigator Name:	A. Ryan and L. Parsons		
Date of Field Assessment:	4/6/09-4/10/09 and 5/2/09		
Latitude (decimal degrees):	112.02200	Longitude (decimal degrees):	37.77700

Note: It is normal for some cells below to have non-zero values even when no data have been entered. This does not imply hidden weighting of those functions or values.

Please cite this method as: Adamus, P., J. Morlan, and K. Verble. 2009. Oregon Rapid Wetland Assessment Protocol (ORWAP): calculator spreadsheet, databases, and data forms. Oregon Dept. of State Lands, Salem, OR.

SPECIFIC FUNCTIONS:	Relative Effectiveness of the Function	Relative Values of the Function	(click on cells in this column to see definitions of the wetland functions)
Water Storage & Delay (WS)	2.88	2.83	
Sediment Retention & Stabilization (SR)	5.51	4.47	
Phosphorus Retention (PR)	8.43	5.53	
Nitrate Removal & Retention (NR)	5.16	3.98	
Thermoregulation (T)	9.33	3.33	
Carbon Sequestration (CS)	2.43		
Organic Matter Export (OE)	4.72		
Aquatic Invertebrate Habitat (INV)	6.03	7.70	
Anadromous Fish Habitat (FA)	0.00	6.41	
Non-anadromous Fish Habitat (FR)	4.10	3.21	
Amphibian & Reptile Habitat (AM)	7.70	8.33	
Waterbird Feeding Habitat (WBF)	6.41	10.00	
Waterbird Nesting Habitat (WBN)	7.03	8.75	
Songbird, Raptor, & Mammal Habitat (SBM)	6.72	10.00	
Pollinator Habitat (POL)	6.52	5.00	
Native Plant Diversity (PD)	5.27	7.50	

GROUPED SERVICES:	**Group Scores (functions)**	**Group Scores (values)**	
Hydrologic Function (WS)	2.88	2.83	(identical to Water Storage and Delay function and value scores)
Water Quality Support Group (WQ)	9.33	5.53	(maximum of scores for SR, PR, NR, and T)
Carbon Sequestration Function (CS)	2.43		(identical to Carbon Sequestration score above)
Fish Support Group (FISH)	4.10	6.41	(maximum of scores for FA and FR)
Aquatic Support Group (AQ)	7.70	10.00	(maximum of scores for OE, AM, INV, WBF, and WBN)
Terrestrial Support Group (TERR)	6.72	10.00	(maximum of scores for PD, POL, and SBM)
Public Use & Recognition (PU)		0.48	
Provisioning Services (PS)		2.00	

OTHER ATTRIBUTES:

Wetland Ecological Condition		6.69	(click on this cell to see this attribute defined)
Wetland Stressors		6.36	(click on this cell to see this attribute defined)
Wetland Sensitivity		2.72	(click on this cell to see this attribute defined)

HGM Class - Relative Probabilities	
Estuarine	0.00
Riverine	2.70
Slope	10.00
Flat	0.00
Depressional	0.00
Lacustrine	0.00

	A	B	C	D	E	F
1		Date:	Site Name:		Investigator:	
2	Office Data Form (OF). ORWAP version 2.0. Answering many of the following questions requires viewing aerial imagery and maps, covering an area up to within 2 miles of the AA. In the unshaded boxes of the Data column, change the blank or 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Do not write in any shaded parts of this data form. Questions whose cells in column D have a "W" MUST be answered only for the ENTIRE wetland. Italicized indicators pertain only to wetland values. Although some land cover types (e.g., crops) can vary greatly from year to year, report only the conditions known to prevail during the majority of the past 5 years, or if unknown, then the conditions found in the available aerial imagery. Please do not attempt to fill out this data form until you're familiar with the accompanying manual.					
3	#	Indicator	Conditions	Data	Explanations, Definitions	Chek
4	D1	*Mitigation Investment*	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere (0= no, 1= yes)	0	[PUv+]	
5			(no information)	0		
6	D2	*Conservation Investment*	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance habitat mainly as part of a voluntary effort not used explicitly to offset impacts elsewhere (0= no, 1= yes)	0	voluntary= WRP, CRP, land trust easements with partial public funding, etc. Locations of OWEB-funded projects are mapped at http://www.oregonexplorer.info/owri_vistool/Intro.aspx [PUv+]	
7			(no information)	0		
8	D3	Normal Land Cover	This AA (a) is not along (or in the biennial floodplain of) a large stream or river where riparian woodlands would be typical and (b) had a Presettlement vegetation class not dominated by trees as indicated by the Wetlands Explorer web site: www.oregonexplorer.info/wetlands/ORWAP . Enter 1 if both are true, 0= if not.	0	If the openness of the surrounding landscape is due almost entirely to agriculture and other human activities occurring within the past century, do not answer affirmatively. This question is used as a classification variable mainly to set appropriate expectations for the extent of surrounding forest cover. [INVc,FAc,FRc,SBMc,PD,CQc,SENSc]	
9	D4	Enclosed by Roads	Draw a circle of radius of 2 miles centered on the AA. Within that circle, do paved public roads completely encircle the AA? (0= no, 1= yes)	0	See illustration in Appendix A of the ORWAP manual. Consider only paved roads, not other potential barriers to wildlife movement (e.g., large rivers, fields). Ignore roads not visible in aerial imagery due to overlapping tree canopy. [AM-,SBM-,Stress+]	
10	D5	Distance to Nearest Busy Road	The distance from the center of the AA to the nearest road with an average daytime traffic rate of at least 1 vehicle/ minute is:		Estimate the traffic rate using your judgment and considering the road width, local population, alternate routes, and other factors. [AM-,WBN-,SBM-, PD-,STR+]	1
11			>1 mile	1		
12			0.5- 1 mile	0		
13			1000-2600 ft	0		
14			500-1000 ft	0		
15			100-500 ft	0		
16			<100 ft	0		
17	D6	Forest Landscape Extent	Draw a circle of radius of 2 miles centered on the AA. Including the AA itself, the cumulative amount of forest (regardless of patch sizes) is:		Forested= woody vegetation currently taller than 20 ft, and with >70% canopy closure. [SBM+]	1
18			<5% of the circle	1		
19			5 to 20%	0		
20			20 to 50%	0		
21			50 to 80%	0		
22			>80%	0		
23	D7	Forest Tract Proximity	The minimum distance from the AA edge to the closest forested tract or corridor larger than 100 acres is:		forested tract= a land cover patch that has >70% tree cover. A corridor is simply an elongated forested patch that is not narrower than 150 ft at any point. "Not separated" from the AA means not separated by roads or other features that create a tree canopy gap wider than 150 ft. [SBM+]	1
24			<100 ft, or contiguous and not separated from the AA by impervious surface, open water, bare dirt, or lawn	0		
25			100-300 ft; or <100 ft but separated by impervious surface, open water, bare dirt, or lawn	0		
26			300-1000 ft	0		
27			>1000 ft	1		
28	D8	Size of Nearby Forest	The largest patch or corridor within 0.5 mile of the AA edge that is forested (and not separated from the AA by roads, fields, etc. that create a gap wider than 150 ft), occupies:		The patch or corridor may either be entirely or only partially within the 0.5 mile distance. Disqualify any patch or corridor of forest where canopy thins to <75% cover, or where the forested patch becomes separated from the AA by a tree canopy gap of >150 ft or where the forested corridor narrows to less than 150 ft width. See illustrations in Appendix A of the ORWAP manual. [SBM+]	1
29			<1 acre of forest	1	1 acre is about: 200 ft on a side (if square)	
30			1-10 acres	0	10 acres is about: 660 ft on a side	
31			10-100 acres	0	100 acres is about: 0.5 mile on a side	
32			100-1000 acres	0	1000 acres is about: 1 mile on a side	
33			>1000 acres	0		

	A	B	C	D	E	F
34	D9	Natural Land Cover Extent	Within a 2-mile radius measured from the center of the AA, the percent of the land that has *natural land cover* (see definition on right) is:		Natural land cover includes wooded areas, native prairies, sagebrush, vegetated wetlands as well as relatively unmanaged commercial lands such as ryegrass fields, hayfields, lightly grazed pastures, timber harvest areas, and rangeland. It does not include water, row crops (vegetable, orchards, Christmas tree farms), residential areas, golf courses, recreational fields, pavement, bare soil, rock, bare sand, or gravel or dirt roads. Natural land cover is not the same as native vegetation. It frequently includes a dominance of non-native plants (e.g., cheat grass, Himalayan blackberry). Although some land cover types (e.g., crops) can vary greatly from year to year, report only the conditions known to prevail during the majority of the past 5 years, or if unknown, then the conditions found in the available aerial imagery. [AM+,SBM+)	1
35			<5% of the land	0		
36			5 to 20% of the land	0		
37			20 to 60% of the land	0		
38			60 to 90% of the land	1		
39			>90% of the land	0		
40	D10	Type of Land Cover Alteration	Within a 2-mile radius measured from the center of the AA, the percent of the area that is not "natural land cover" or water is mostly:		[POLv-,AM+,SBM+]	1
41			impervious surface, e.g., paved road, parking lot, building, exposed rock	0		
42			bare pervious surface, e.g., dirt or gravel road, plowed fields, dunes, recent clearcut or landslide	1		
43			cultivated row crops, orchards, vineyards, tree plantations	0		
44			artificially landscaped areas or lawn	0		
45			grassland grazed or mowed to a height usually shorter than 4 inches	0		
46			other	0		
47			(none of above; land cover is >90% natural land cover)	0		
48	D11	Proximity to Natural Land Cover	The minimum distance from the AA edge to the edge of the closest tract or corridor of natural (not necessarily native) land cover larger than 100 acres and not separated from the AA by roads or other gaps of intensely altered land wider than 150 ft, is:		Natural land cover includes wooded areas, native prairies, sagebrush, vegetated wetlands, as well as relatively unmanaged commercial lands such as ryegrass fields, hayfields, lightly grazed pastures, timber harvest areas, and rangeland. It does not include water, row crops (vegetable, orchards, Christmas tree farms), residential areas, golf courses, recreational fields, pavement, bare soil, rock, bare sand, or gravel or dirt roads. Include this wetland AA in the estimate. Natural land cover is not the same as native vegetation. It frequently includes a dominance of non-native plants (e.g., cheatgrass, Himalayan blackberry). [POL+,INV+,AM+,SBM+,Sens-]	1
49			<100 ft, or the AA contains >100 acres of vegetation, or >100 acres of natural land cover is contiguous to the AA (not separated by impervious surface or wide (>50 ft) stretches of open water, bare ground, or lawn)	1		
50			<100 ft, but separated from the wetland by impervious surface or wide (>50 ft) stretches of open water, bare ground, or lawn	0		
51			100-300 ft; and not separated from the wetland by impervious surface or wide (>50 ft) stretches of open water, bare ground, or lawn	0		
52			100-300 ft, but separated from the wetland by impervious surface or wide (>50 ft) stretches of open water, bare ground, or lawn	0		
53			> 300 ft	0		
54	D12	Size of Largest Nearby Tract or Corridor of Natural Land Cover	The largest patch or corridor that is natural land cover and is within 0.5 mile of the AA edge, and not separated from the AA by roads etc. that create gaps wider than 150 ft, occupies:		The patch or corridor may either be entirely or only partially within the 0.5 mile distance. Disqualify any patch or corridor of natural land cover where it becomes separated from the AA by a gap of >150 ft, if the gap is comprised of impervious surface, bare dirt, or lawn, or if the natural land corridor narrows to less than 150 ft. [POL+,AM+,WBN+,SBM+, Sens-] 1 acre is about: 200 ft on a side (if square) 10 acres is about: 660 ft on a side 100 acres is about: 0.5 mile on a side 1000 acres is about: 1 mile on a side	1
55			<1 acre	0		
56			1-10 acres	0		
57			10-100 acres	0		
58			100-1000 acres	0		
59			>1000 acres	1		
60	D13	Local Wetland Uniqueness	Within 0.5 mile of the center of the AA, the AA and vegetation of the same form that is contiguous to the AA together provide (select all that apply):		This question will require field verification. In all cases, the patch may be entirely within the wetland, or may cover only part of the wetland but extend into contiguous upland. Likewise the patches to which it is being compared may be entirely or only partially within the 0.5 mile radius. There is no minimum size limit. [POLv+,AMv+,WBNv+,SBMv+,PDv+]	1
61			the largest patch of currently ungrazed, unmowed, and unshaded herbaceous vegetation	1		
62			the largest patch of unshaded shrubland (excluding plantations)	0		
63			the largest patch of deciduous or evergreen trees (excluding plantations)	0		
64			NONE of above	0		
65	D14	Open Land & Wetland in Landscape	Draw a circle of radius of 2 miles centered on the AA. The amount of cropland, grassed airport, golf course, herbaceous wetland (including this one), or other open lands in flat terrain is:		Open land as assessed here can include pasture, ryegrass fields, plowed land, or hayfields but only if known to be in flat terrain (almost no noticeable slope). It does not include woody crops (orchards, vineyards, tree plantations). In dry parts of the state, open lands in flat areas are often irrigated as recognized by distinctly greener coloration in aerial images. Do not include lakes, ponds, or rivers as wetlands in this question. See photo illustrations in Appendix A of the ORWAP manual. [POLv+,WBF+]	1
66			<5% of the land	0		
67			5 to 20%	1		
68			20 to 50%	0		
69			50 to 80%	0		

	A	B	C	D	E	F
70			>80%	0		
71	D15	Proximity to Open Land	The distance from the AA edge to the closest tract of cropland, grassed airport, golf course, herbaceous wetland (including this one), or other open lands in flat terrain and larger than 1 acre is:		A "tract" is a patch consisting entirely of one or more of the named land cover types. [POLv+,WBF+]	1
72			<100 ft, or the AA contains >1 acre of such cover, or is contiguous to >1 acre of such cover	1		
73			100 to 300 ft	0		
74			300 to 1000 ft	0		
75			>1000 ft	0		
76	D16	Ponded Water in Landscape	Draw a circle of radius of 2 miles centered on the AA. Including water ponded in the AA itself or in a fringing water body, the amount of non-tidal water that is ponded during most of the year is:		Ponded water = any surface water that is not obviously part of a river, stream, or tidal system. Include herbaceous (emergent) wetlands larger than 1 acre if they are inundated and water is ponded at least seasonally. [AM+,WBF+,WBN+,SBM+,Sens-]	1
77			<5% of the circle, located in 5 or fewer ponds or lakes	1		
78			<5% of the circle, located in >5 ponds or lakes	0		
79			5 to 30%, located in 10 or fewer ponds or lakes	0		
80			5 to 30%, located in >10 ponds or lakes	0		
81			>30%, located in 15 or fewer ponds or lakes	0		
82			>30%, located in >15 ponds or lakes	0		
83	D17	Ponded Water Proximity	The minimum distance from the AA edge to the closest non-tidal wetland, pond, or lake that is larger than 1 acre, is ponded most of the year, and is not part of the same associated wetland, pond, or lake, is:		If multiple smaller water bodies are separated by <150 ft they may be combined when evaluating acreage. "Uninterrupted" means no impervious surfaces wider than 150 ft interrupt the corridor. "Natural" land corridor means a corridor comprised of natural land cover as defined in D9 above. If able to consult NWI maps, consider only those polygons whose water regime is labeled as "permanent," "intermittently exposed," or "semipermanent" (codes F, G, or H on NWI maps). These codes are not shown on Oregon Explorer wetlands layer. [AM+,WBF+,WBN+,SBM+,Sens-]	1
84			<300 ft, and connected with a natural land corridor	1		
85			<300 ft, but no uninterrupted natural land corridor	0		
86			300-1000 ft, and connected with a natural land corridor	0		
87			300-1000 ft, but no uninterrupted natural land corridor	0		
88			>1000 ft, and connected with a natural land corridor	0		
89			>1000 ft, but no uninterrupted natural land corridor	0		
90	D18	Large Ponded Water Proximity	The distance from the AA edge to the closest (but separate) non-tidal body of water that is ponded during most of the year and is larger than 20 acres (about 1000 ft on a side) is:		If multiple smaller water bodies are separated by <150 ft they may be combined when evaluating acreage. Consult wetland maps, considering only those polygons whose water regime may be "permanent," "intermittently exposed," or "semipermanent" (codes F, G, H on NWI maps). [WBF+,WBN+,Sens-]	1
91			<1 mile	1		
92			1-5 miles	0		
93			>5 miles	0		
94	D19	Tidal Proximity	The distance from the AA edge to the closest tidal body of water is:		[CS+,WBF+]	1
95			<1 mile	0		
96			1-5 miles	0		
97			>5 miles	1		
98	D20	*Upslope Soil Erodibility Risk*	Using the Web Soil Survey procedure described in the ORWAP manual, the rating of the soil map unit which occupies the largest percentage of the zone 200 ft uphill from the AA is:		See the ORWAP manual for instructions on how to obtain this information online. [SRv+, Sens+]	1
99			very severe	0		
100			severe	0		
101			moderate	1		
102			slight	0		
103			(could not determine)	0		
104	D21	Extent of Dominant Vegetation Class in Wetland	Using the Web Soil Survey AOI tool to measure it, what is the area of the largest patch of emergent, shrub, or forest vegetation within the entire wetland of which the AA is a part? Use just the dominant class. See instructions in last column.	W	When drawing the polygon around the patch, exclude vegetation of the same patch type if separated by a gap created by open water, road, dike, or upland that is wider than 150 ft. [WBF+, WBN+, SBM+, POL+, Sens-]	1
105			<0.1 acre	0		
106			0.1 - 1 acre	0		
107			1 to 10 acres	0		
108			10 to 100 acres	1		
109			100 to 1000 acres	0		
110			>1000 acres	0		

	A	B	C	D	E	F
111	D22	*Wetland Size Uniqueness in Watershed*	From the Wetlands Explorer web site (see Manual), note the 12-digit code number for this wetland's HUC6 (Hydrologic Unit Code, i.e., watershed). Then turn to the HUC4, HUC5, and HUC6 worksheets in the ORWAP_SuppInfo file and compare the extent of the wetland's dominant vegetation form (from above) with that of the largest wetlands of the same class in the same HUC4 (first 8 digits), the same HUC5 (first 10 digits), and the same HUC6 (12 digits). Enter "1" for all that apply below:	W	"of its type" means Cowardin system and class. First determine size importance in HUC6 and if criteria met, then also screen for importance in HUC5 and if met then in HUC4. Note that data are lacking for some HUCs. [WBFv+, WBNv+, SBMv+]	3
112			the vegetated part of this wetland is as large or larger than any of its class mapped in its HUC4 watershed	1		
113			the vegetated part of this wetland is as large or larger than any of its class mapped in its HUC5 watershed	1		
114			the vegetated part of this wetland is as large or larger than any of its class mapped in its HUC6 watershed	1		
115			none of above			
116			data are inadequate (NWI mapping not >90% completed in HUC)	0		
117	D23	*Wetland Number & Diversity Uniqueness*	Turn to the HUCbest worksheet in the ORWAP_SuppInfo file. Using the HUC code noted from the web site, is this AA located in one of the HUCs that are listed as having a large diversity of wetland types relative to area of wetlands, or a large number or area of wetlands relative to area of the HUC? Enter "1" for all that apply below:		"type diversity" was based on Cowardin system and class (e.g., Palustrine emergent). Note that data are lacking for some HUCs. The criteria used to define "large" diversity of types, large number of wetlands, and large proportional area were based on the residuals of regression of those variables against wetland area or numbers in the associated HUC. The top 5% of the residuals were used to identify the most outstanding wetlands in each category. [AM+, WBF+, WBN,+ SBM]+	2
118			yes, for the HUC4 watershed	0		
119			yes, for the HUC5 watershed	1		
120			yes, for the HUC6 watershed	1		
121			none of above	0		
122			data are inadequate (NWI mapping not completed in HUC)	0		
123	To answer most of the following questions, you must obtain specific information from web sites or agencies as indicated in the Manual or in the last column (E). In a few cases you may need to also examine aerial imagery. In the Data column (D), change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated.					
124	D24	Historical Hydrologic Connectivity	Compared to extent of wetland that may have been originally present at this location (just prior to settlement in 1851), the current wetland is:	W	"Originally present" means immediately prior to widespread settlement of the region by western cultures (generally, about 1850). See ORWAP manual (section 2.2.6) for instructions on how to see hydric soils in the vicinity. If the hydric soil map units that intersect the wetland are together much larger than the wetland, assume fragmentation has occurred. If possible, also see maps of pr settlement vegetation (available from ORNHIC for parts of Oregon), and topography. [CQ+]	1
125			same size and boundaries, approximately. For example, wetland boundary may be nearly identical to hydric soil boundary	0		
126			smaller (50-99% of the original size) and/or severed (by roads, dikes, drained soils, etc) from a few historically connected wetlands that may no longer exist. Soil map may show hydric soil extending somewhat beyond current wetland boundary.	0		
127			much smaller (<50% of the original size) and/or extensively severed (by roads, dikes, drained soils) from many historically connected wetlands that may no longer exist. Soil map may show hydric soil extending far beyond current wetland boundary.	0		
128			larger (due to damming of stream or runoff, excavation, removal of obstructions, irrigation, etc that floods soils not mapped as hydric) or has been connected to wetlands from which it existed in isolation just prior to settlement.	1		
129			no wetland is known to have been present at this location originally (no hydric soil is mapped and presettlement vegetation was not wetland; the entire wetland may have resulted from impoundment, excavation, or regrading of upland soils)	0		
130	D25	*Special Conservation Designations of the Wetland or Local Area*	According to the Oregon Wetlands Explorer web site or other sources noted below:		See section 2.2.8 of the ORWAP manual.	1
131			a) the AA is within or is connected to (at least seasonally) a stream or other water body within 0.5 mile that has been designated as Essential Indigenous Anadromous Salmonid Habitat (ESH)	0		
132			b) the AA is within or contiguous to a Special Protected Area managed by a conservation group or designated as specially protected for conservation by a state or federal resource agency,	0	This includes BLM Area of Critical Environmental Concern (ACEC) or Outstanding Natural Area (ONA), Federal Research Natural Area (RNA) or Special Interest Area (SIA), or Natural Heritage Conservation (NHCA), Land Trust and Nature Conservancy Preserves, and others.	

	A	B	C	D	E	F
133			c) the AA is within or contiguous to a Wetland Priority Area	0	As recognized by the ODFW's Oregon Wildlife Conservation Strategy or the Oregon Natural Heritage Program	
134			d) the AA is within an IBA (Important Bird Area), as officially designated and listed in the IBA worksheet in the ORWAP_SuppInfo file	1		
135			NONE of above	0		
136	D26	*Non-anadromous Fish Species of Conservation Concern*	According to the Wetlands Explorer web site, the score for occurrences of rare non-anadromous fish species in the vicinity of this AA is:		Species include Pit-Klamath brook lamprey (S3), Miller Lake lamprey (S1), Klamath lamprey (S3), Malheur mottled sculpin (S3), Margined sculpin (S3), Slender sculpin (S3), Alvord chub (S2), Tui chub (S), Borax Lake chub (S1), Speckled dace (SS), Oregon chub (S2), Umpqua chub (S2), Modoc sucker (S1), Klamath smallscale sucker (SS), Warner sucker (S1), Shortnose sucker (S1), Pit Sculpin (S1), Klamath Lake Sculpin (S3), Bull Trout (S3), Blue Chub (S3), Umpqua Dace (S3), Lahontan Redside (S2), Klamath Largescale Sucker (S3), Tahoe Sucker (S1), Lost River Sucker (S1), Sacramento Perch (S3). Note that for some of these species, only specific geographic populations are designated. S1 is the most imperiled, S3 less so, according to ratings by the Oregon Natural Heritage Information Center. [FRv+]	1
137			high (≥ 0.75 for maximum score, or ≥ 0.90 for score sum), or there is a recent (within 5 yrs) onsite observation of any of these species by a qualified observer under conditions similar to what now occur	0		
138			intermediate (i.e., not as described above or below)	0		
139			low (≤ 0.33 for both the maximum score this group's score sum, but not 0 for both)	0		
140			zero for both this group's maximum and its sum score, and no recent onsite observation of these species by a qualified observer under conditions similar to what now occur	1		
141	D27	*Invertebrate Species of Conservation Concern*	According to the Wetlands Explorer web site, the score for occurrences of rare invertebrate species in the vicinity of this AA is:		See InvertsRare worksheet in ORWAP_SuppInfo file.	1
142			high (≥ 0.75 for maximum score, or for this group's score sum), or there is a recent onsite observation of any of these species by a qualified observer under conditions similar to what now occur	0		
143			low (< 0.75 for maximum score AND for this group's score sum, but not 0 for both)	0		
144			zero for both this group's maximum and its sum score, and no recent onsite observation of these species by a qualified observer under conditions similar to what now occur	1		
145	D28	*Amphibian or Reptile of Conservation Concern*	According to the Wetlands Explorer web site, the score for occurrences of rare amphibian or reptile species in the vicinity of this AA is:		Species include: Painted Turtle (S2), Northwestern Pond Turtle (S2), Clouded Salamander (S3), Oregon Slender Salamander (S2), Larch Mountain Salamander (S2), Siskiyou Mountains Salamander (S2), Cope's Giant Salamander (S2), Cascade Torrent Salamander (S3), Columbia Torrent Salamander (S3), Coastal Tailed Frog (S3), Inland Tailed Frog (S2), Northern Red-legged Frog (S3), Foothill Yellow-legged Frog (S2), Cascades Frog (S3), Northern Leopard Frog (S1), Oregon Spotted Frog (S2), Columbia Spotted Frog (S2), Great Basin Back-collared Lizard (S3), Desert Horned Lizard (S3), Night Snake (S3), Common Kingsnake (S3), Ground Snake (S3). [AMv+]	1
146			high (≥ 0.60 for maximum score, or >0.90 for score sum), or there is a recent onsite observation of any of these species by a qualified observer under conditions similar to what now occur	0		
147			intermediate (i.e., not as described above or below)	0		
148			low (≤ 0.21 for maximum score AND <0.15 for score sum, but not 0 for both)	1		
149			zero for both this group's maximum and its sum score, and no recent onsite observation of these species by a qualified observer under conditions similar to what now occur	0		
150	D29	*Nesting Waterbird Species of Conservation Concern*	According to the Wetlands Explorer web site, the score for occurrences of rare nesting waterbird species i the vicinity of this AA is:		Species include: Red-necked Grebe (S1), Am. White Pelican (S2), Snowy Egret (S2), Barrow's Goldeneye (S3), Bufflehead (S2), Yellow Rail (S1), Sandhill Crane (S3), Snowy Plover (S2), Black-necked Stilt (SS), Long-billed Curlew (S3), Franklin's Gull (S2), Caspian Tern (SS). [WBNv+]	1
151			high (≥ 0.60 for maximum score, or ≥1.00 for this group's score sum), or there is a recent onsite observation of any of these species by a qualified observer under conditions similar to what now occur	0		
152			intermediate (i.e., not as described above or below)	0		
153			low (≤ 0.09 for maximum score and for score sum, but not 0 for both)	1		
154			zero for both this group's maximum and its sum score, and no recent onsite observation of these species by a qualified observer under conditions similar to what now occur	0		
155	D30	*Feeding (Non-breeding) Waterbird Species of Conservation Concern*	According to the Wetlands Explorer web site, the score for occurrences of rare non-breeding (feeding) waterbird species in the vicinity of this AA is:		"Non-breeding" mainly refers to waterbird feeding during migration and winter. [WBFv+]	1
156			high (≥ 0.33 for maximum score, or there is a recent onsite observation of any of these species by a qualified observer under conditions similar to what now occur	1		
157			low (< 0.33 for maximum score and for score sum, but not 0 for both)	0		
158			zero for both this group's maximum and its sum score, and no recent onsite observation of these species by a qualified observer under conditions similar to what now occur	0		
159	D31	*Songbird, Raptor, Mammal Species of Conservation Concern*	According to the Wetlands Explorer web site, the score for occurrences of rare songbird, raptor, or mammal species in the vicinity of this AA is:		Species include: Bald Eagle (SS), Northern Goshawk (S3), Swainson's Hawk (S3), Ferruginous Hawk (S3), Peregrine Falcon (S1), Band-tailed Pigeon (S3), Flammulated Owl (S3), Burrowing Owl (S3), Spotted Owl (S3), Great Gray Owl (S3), Short-Eared Owl (SS), Common Nighthawk (SS), Lewis's Woodpecker (S3), White-Headed Woodpecker (S2), Black-Backed Woodpecker (S3), American Three-toed Woodpecker (S3), Pileated Woodpecker (SS), Olive-sided Flycatcher (S3), Willow Flycatcher (SS), Horned Lark (SS), Purple Martin (S2), White-breasted (Slender-billed) Nuthatch (SS), Blue-gray Gnatcatcher (S3), Varied Thrush (SS), Loggerhead Shrik (S3), Yellow-breasted Chat (SS), Chipping Sparrow (SS), Brewer's Sparrow (SS), Vesper Sparrow (SS), Sage Sparrow (SS), Grasshopper Sparrow (S2), Western Meadowlark (SS), Fringed Myotis (S2), Long-Legged Myotis (S3), California Myotis (S3), Silver-haired Bat (S3), Hoary Bat (S3), Spotted Bat (S2), Townsend's Big-eared Bat (S2), Pallid Bat (S2), Red Tree Vole (S3), Kit Fox (S1), Ringtail (S3), American Marten (S3), Fisher (S2), Columbian White-Tailed Deer (SS). [SBMv+	1
160			high (≥ 0.60 for maximum score, or >1.13 for score sum), or there is a recent onsite observation of any of these species by a qualified observer under conditions similar to what now occur	1		
161			intermediate (i.e., not as described above or below)	0		
162			low (≤ 0.09 for maximum score AND <0.13 for score sum, but not 0 for both)	0		

	A	B	C	D	E	F
163			zero for both this group's maximum and its sum score, and no recent onsite observation of these species by a qualified observer under conditions similar to what now occur	0		
164	D32	*Plant Species of Conservation Concern*	According to the Wetlands Explorer web site, the score for occurrences of rare plant species in the vicinity of this AA is:		[PDv+]	1
165			high (≥ 0.75 for maximum score, or > 4.00 for score sum), or there is a recent onsite observation of any of these species by a qualified observer under conditions similar to what now occur	0		
166			intermediate (i.e., not as described above or below)	0		
167			low (≤ 0.12 for maximum score AND < 0.20 for score sum, but not 0 for both)	1		
168			zero for both this group's maximum and its sum score, and no recent onsite observation of these species by a qualified observer under conditions similar to what now occur	0		
169	D33	*Floodable Property*	According to the Wetlands Explorer web site:		Do not consider pasture or hayfields to be "cropland." See the ORWAP manual for instructions on how to obtain this information online at http://www.oregonexplorer.info/wetlands/ORWAP [WSv+]	1
170			The AA is tidal, or is either (a) **not** within a 100-yr floodplain of a river, or (b) there are **no** inhabited buildings or cropland within 2 miles downslope that are within the 100-yr floodplain. Mark "1" then **SKIP** TO D35.	0		
171			**Inhabited buildings** within 1 mile downslope from the AA also are within the 100-yr floodplain	0		
172			**Croplands** but no inhabited buildings are within 1 mile downslope from the AA, and that cropland is also within the 100-yr floodplain	0		
173			Inhabited buildings within **1-2 miles** downslope from the AA are also are within the 100-yr floodplain	0		
174			Croplands but no inhabited buildings are within 1-2 miles downslope from the AA, and that cropland is also within the 100-yr floodplain	0		
175			No floodplain data are available, and damage from river floods has not been known to have occurred within 2 miles downgradient. Mark "1" then **SKIP** to D35.	1		
176	D34	*Downslope Storage*	Between the AA and any floodable buildings or cropland located within 2 miles downslope:		[WSv-]	
177			river flow is regulated **and** there are many detention ponds and wetlands capable of storing water.	0		
178			river flow is regulated **or** there are many detention ponds and wetlands capable of storing water.	0		
179			NONE of the above	0		
180	D35	*Relative Elevation in Watershed*	According to Wetlands Explorer map showing this AA's position within its HUC4 watershed, the AA is [see Manual for specific guidance]:		1) Which end of the HUC4 is the bottom? Where streams join, the "V" that they form on the map points towards bottom of the HUC. 2) If the AA is close to the river or large stream that exits at the bottom of the HUC4, check "lower 1/3" unless its distance from the HUC outlet is more than half the length of the HUC, in which case consider AA to be in the "middle 1/3." If neither, proceed to 3. 3) If AA is closer to the boundary (margin) of the HUC than to its center, and is more than half the length of the HUC from the HUC's outlet, consider it to be in the "upper 1/3." If not, in most cases consider it to be in the "middle 1/3." However, if AA is far from any mapped stream, a determination of "upper 1/3" may fit the best.	1
181			in the upper one-third of its watershed	0		
182			in the middle one-third of its watershed	0		
183			in the lower one-third of its watershed, or is included in a 100-yr floodplain, or is closer than about 2 miles from a channel known to be wider than 50 ft (stream order 4 or larger),	1		
184	D36	Contributing Area (CA) Percent	**Based on the definition and protocol in the ORWAP manual**, the area of the **wetland** (and of any lake or pond of which this AA is a part), relative to its **contributing** area (CA) is:	W	The CA is basically the upslope area that has the potential to deliver water to the wetland. The CA boundary typically does not cross any streams or ditches except the one at the wetland outlet (if any). If the wetland is on the fringe of a pond or lake, compare the area of that water body to its contributing area -- not the area of the wetland compared to the wetland's contributing area. For most wetlands and especially ones containing tributaries, the first choice will be the most appropriate. [WSv+,SRv+,PRv+,NRv+, Sens+]	1
185			<1% of its CA (true if wetland is tidal, or along major river, or has many tributaries, or gets substantial water drawn from other surface water bodies, e.g., flood irrigation)	0		
186			1 to 10% of its CA	1		
187			10 to 100% of its CA	0		
188			Larger than the area of its CA (wetland has essentially no CA, e.g., isolated by dikes with no input channels, or is in terrain so flat that a CA can't be delineated). SKIP TO D40.	0		

	A	B	C	D	E	F
189	D37	Unvegetated Surface in the Contributing Area	The proportion of the CA comprised of buildings, roads, parking lots, other pavement, exposed bedrock, and other impervious surface is about :	W	[WSv-,SRv-,PRv-,NRv-]	1
190			>25%	0		
191			10 to 25%	0		
192			<10%, or wetland is tidal	1		
193	D38	Upslope Storage	The cumulative area of other wetlands, detention ponds, and reservoirs in the same CA is:	W	[WSv-,SRv-,PRv-,NRv-]	1
194			Much (>10x) greater than the area of this wetland (plus any contiguous pond or lake) or inflow is strongly regulated by dams etc.	0		
195			Somewhat greater than the area of this wetland (plus any contiguous pond or lake) and flows to wetland are not strongly regulated	1		
196			Less than the area of this wetland (plus any contiguous pond or lake), or wetland is tidal, or no upslope wetlands/ ponds and no inflow regulation	0		
197	D39	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) CA slopes are steep, (c) input channels have been straightened, (d) upslope wetlands have been ditched extensively, (e) land cover is mostly non-forest, and/or (f) most CA soils are shallow and/or have high runoff coefficients). This statement is:	W	[WSv+,SRv+,PRv+,NRv+]	1
198			Mostly true	1		
199			Somewhat true	0		
200			Mostly untrue, or wetland is tidal	0		
201	D40	Known Water Quality Issues in the Input Water	Within 1 mile upstream from the wetland, at least one of the major sources of surface water to this wetland (at least seasonally) has been designated as Water Quality Limited (303d) for at least one of the parameters below. Obtain from web site only -- do not guess. Select all that apply.	W	See the ORWAP manual (section 2.2.7) for instructions on how to obtain this information online at http://deq12.deq.state.or.us/lasar2/default.aspx [SRv+,PRv+,NRv+,TRv+,INV-,WBF-,WBN-,STR+]	1
202			total suspended solids (TSS), sedimentation, or turbidity	0		
203			phosphorus	0		
204			nitrate or ammonia	0		
205			toxics, dioxin, heavy metals (iron, manganese, lead, zinc, etc.)	1		
206			temperature	0		
207			None of above, or degraded water cannot reach wetland, or no data.	0		
208	D41	Known Water Quality Issues Below the Wetland	Within 1 mile downstream or downslope from this wetland, there is at least one stream or other water body that has been designated as Water Quality Limited (303d) for at least one of the parameters below. Obtain from web site only -- do not guess. Select all that apply.	W	See the ORWAP manual (section 2.2.7) for instructions on how to obtain this information online at http://deq12.deq.state.or.us/lasar2/default.aspx [SRv+,PRv+,NRv+,TRv+,INV-,WBF-,WBN-,STR+]	1
209			total suspended solids (TSS), sedimentation, or turbidity	0		
210			phosphorus	0		
211			nitrate or ammonia	0		
212			toxics, dioxin, heavy metals (iron, manganese, lead, zinc, etc.)	0		
213			temperature	0		
214			None of above, or no data.	1		
215	D42	Type of Outflow Connection to 303d	At least part of the AA is connected to the downstream 303d water mentioned in D41 above:		persistent water= flows for more than 9 months during most years. [SRv+,PRv+,NRv+,TRv+,INV-,WBF-,WBN-,STR+]	1
216			for 9 or more continuous months annually persistent water in a stream, ditch, lake, or other water body)	0		
217			intermittently (at least once annually, but for less than 9 months continually)	0		
218			Not connected, or connected less than annually	1		
219	D43	Drinking Water Source (DEQ)	According to the ODEQ LASAR database, the AA is within:		See the ORWAP manual (section 2.2.7) for instructions on obtaining this online from http://deq12.deq.state.or.us/lasar2/default.aspx	1
220			the source area for a surface-water drinking water source (DW source - Surface)	0	[NRv+]	
221			the source area for a groundwater drinking water source (DW source - Ground)	0		
222			Neither of above	1		

	A	B	C	D	E	F
223	D44	Groundwater Risk Designations	The AA is (select all that apply):		[NRv+]	1
224			within a designated Groundwater Management Area (ODEQ), see maps in Appendix A of ORWAP manual.	0		
225			within a designated Sole Source Aquifer area (EPA): the North Florence Dunal Aquifer	0		
226			NONE of above	1		
227	D45	Mean Annual Precipitation	According to the PRISM Data Explorer (see ORWAP manual for instructions), annual precipitation in the vicinity of the wetland has normally been:		Obtain online as explained in Manual from: http://gisdev.nacse.org/prism/nn/index.phtml These categories reflect the 10th, 25th, 50th, 75th, and 90th percentiles of all points in a comprehensive spatial grid of annual precipitation points in Oregon, for the years 1971-200 [INVv+,AMv+,WBFv+,WBNv+,SBMv+,PDv+,Sens-]	1
228			<10 inches per year	1		
229			10-12 inches per year	0		
230			13-19 inches per year	0		
231			20-47 inches per year	0		
232			48-77 inches per year	0		
233			>77 inches per year	0		
234	D46	County Rank for Phosphorus Loading	The phosphorus loading rank of the county in which the AA is located is: (select one); see WQprob worksheet in ORWAP SuppInfo file.		If you don't know it, determine which county the wetland is in from the ODEQ web site ttp://deq12.deq.state.or.us/lasar2/default.aspx as explained in Manual. Data used for these rankings are from a national survey by USGS and represent the combined inputs (kg of P per sq. km.) from fertilizer (2001) and livestock (average of the years 1982, 1987, 1992, and 1997). [PRv+]	1
235			top 4 in Oregon (Marion, Malheur, Umatilla, Linn)	0		
236			top 18 (see Table 6 in WQprob worksheet in file ORWAP_SuppInfo)	0		
237			bottom 18 (see Table 6 in WQprob worksheet)	1		
238			bottom 4 (Josephine, Hood River, Lincoln, Clatsop)	0		
239	D47	County Rank for Nitrogen Loading	The nitrogen loading rank of the county in which the AA is located is: (select one); see WQprob worksheet in ORWAP SuppInfo file.		Data used for these rankings are from a national survey by USGS and represent the combined inputs (kg of N per sq. km.) from fertilizer, livestock, and atmospheric deposition of N during 2001. [NRv+]	1
240			top 4 in Oregon (Marion, Malheur, Umatilla, Linn)	0		
241			top 18 (see Table 7 in WQprob worksheet)	0		
242			bottom 18 (see Table 7 in WQprob worksheet)	1		
243			bottom 4 (Curry, Josephine, Lincoln, Clatsop)	0		
244	Answer these final two questions only if the AA is tidal.					
245	D48	Estuarine Position	The AA's relative position in the estuary is (SKIP if nontidal):		[WSv+,PR+,PD+]	
246			lower 1/3 (often on a bay and distant from the head-of-tide of a major river; includes most saline tidal wetlands)	0		
247			mid 1/3	0		
248			upper 1/3 (near the head-of-tide of a major river; includes most brackish and fresh tidal wetlands)	0		
249	D49	Salinity	The usual maximum water-surface salinity during high tide in summer in the main channel or bay closest t the AA is (SKIP if nontidal):		Refer to maps in ORWAP section of DSL Web Site (http://www.oregonstatelands.us/DSL/WETLAND/technical_resources.shtml) or (preferably) determine this from field measurement or from data at the ODEQ LASAR web site (see ORWAP manual for instructions on accessing those data). [SR-,PR-,CS+,OE+,FA-,PD-]	
250			>30 parts per thousand (undiluted seawater)	0		
251			5-30 ppt (mesohaline, polyhaline)	0		
252			0.5 - 5 ppt (oligohaline)	0		
253			<0.5 ppt (fresh)	0		
254			no data for nearby locations found at the ODEQ LASAR web site or from other sources	0		

	A	B	C	D	E	F
1		Date:	Site Name:		Investigator:	
2		Field F data form. ORWAP version 2.0. In the unshaded boxes of the Data column, change the blank or 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in any shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgeable persons, and/or reviewing aerial imagery. Although accuracy will be greater if questions are answered for the entire wetland (not limiting only to the part potentially affected by a project), most questions may be answered for just part of a wetland-- the assessment area (AA). HOWEVER, questions with a W in the gray box in column D must be answered for the ENTIRE wetland of which the AA is a part.				
3	#	Indicator	Conditions	Data	Explanations, Definitions	Chek
4	F1	Presence of Specific Wetland Types	Does the AA contain, or is it part of, any of these wetland types? Mark "1" next to all that apply.	W		1
5			Tidal wetland: receives tidal water at least once during a normal year, regardless of salinity, and dominated by emergent or woody vegetation.	0	tidal = level of surface water fluctuates every ~6 hours on a daily basis in response to tides. [All functions, as classifier]	
6			Lacustrine wetland: an undiked non-tidal wetland bordering a body of standing open water that is >20 acres.	0	open water = surface water that contains no vegetation (except perhaps floating-leaved or completely submersed species). [WBN+]	
7			Fringe wetland: an undiked "shoreline" wetland bordering persistent open water that is >3 times wider than the wetland (includes most tidal, lacustrine, large riverine, some others).	0	1	
8			NONE of above	1		
9	F2	Wetland Type of Conservation Concern	Does the AA contain, or is it part of, any of these wetland types? Mark "1" next to all that apply. Consult the "Rare Wetland Type" reported for the general vicinity by the Oregon Explorer web site, but be aware that those may not apply to the exact AA you have delimited.	W		1
10			Bog or Fen: contains a sponge-like organic soil layer which covers most of the AA AND often has extensive cover of sedges and/or broad-leaved evergreen shrubs (e.g., Ledum). Often lacks tributaries, being fed mainly by groundwater and/or direct precipitation.	0	[CS+,Sens+]	
11			Playa, Salt Flat, or Alkaline Lake: a non-tidal ponded water body usually having saline (salinity >1 ppt or conductivity >1000 µS) or alkaline (conductivity >2000 µS and pH >9) conditions and large seasonal water level fluctuations (if inputs-outputs unregulated). If a playa or salt flat, vegetation cover is sparse and native plants typical of saline or alkaline conditions (e.g., *Distichlis* , *Atriplex*) are common.	0	See file ORWAP_SuppInfo, worksheet P_Salt for species typically occurring in tidal or saline conditions. [PR+,CS+,INV+,FA-,FR-,AM-,WBF+]	
12			Hot spring (anywhere in Oregon): a wetland where discharging groundwater in summer is >10 degrees (F) warmer than the expected water temperature.	0		
13			Native wet prairie (west of the Cascade crest): a seasonally inundated wetland, usually without a naturally-occurring inlet or outlet, and dominated primarily by native graminoids. May have species in column E.	0	Deschampsia caespitosa, Danthonia californica, Camassia quamash, Triteleia hyacinthina, Carex densa, C. aperta, C. unilateralis, and others. [PDv,CQc]	
14			Vernal pool (Willamette Valley): a seasonally inundated wetland, underlain by hardpan or claypan, with hummocky micro-relief, usually without a naturally-occurring inlet or outlet, and with native plant species distinctly different from those in slightly higher areas. May have species in column E.	0	Downingia elegans, Isoetes nuttallii, Triteleia hyacinthina, Eleocharis spp., Eryngium petiolatum, Plagiobothrys figuratus, Plagiobothrys scouleri, Grindelia nana, Veronica peregrina, Lasthenia glaberrima , Cicendia quadrangularis, Kickxia elatine, Gnaphalium palustre, Callitriche spp., and others. [PDv]	
15			Vernal pool (Medford area): a seasonally inundated acidic wetland, underlain by hardpan, with hummocky micro-relief, usually without a naturally-occurring inlet or outlet, and often having concentric rings of native vegetation. May have species in column E.	0	Downingia vina, Isoetes nuttalli, Pilularia americana, Triteleia hyacinthina, Eleocharis spp., Eryngium petiolatum, Plagiobothrys brachteatus, Plagiobothrys scouleri, Grindelia nana, Veronica peregrina, Alopecurus saccatus, Lasthenia californica, Deschampsia danthonioides, Callitriche spp. , and others. [PDv]	
16			Vernal pool (Columbia Plateau): a seasonally inundated wetland, usually without a naturally-occurring inlet or outlet, located on shallow basalt bedrock. May have species in column E.	0	Camassia quamash, Epilobium densiflorum, Callitriche marginata, and others. [PDv]	

	A	B	C	D	E	F
17			Interdunal wetland (Coastal ecoregion): a seasonally inundated wetland, usually without a naturally-occurring inlet or outlet, located between sand dunes where wind has scoured the sand down to the water table (deflation plain), and often with significant cover of species in column E.	0	Carex obnupta, Argentina egedii, Juncus lesueurii, J. nevadensis, J. falcatus, Sisyrinchium californicum, Salix hookeriana , and others. [PDv]	
18			Mature forested wetland (anywhere): a wetland in which mean diameter of trees (d.b.h., FACW and FAC species only) exceeds 18 inches, and/or the average age of trees exceeds 80 years, or there are >5 trees/acre with diameter >32 inches.	0	To qualify, the diameter of >18 inches must be the mean measured from at least 10 trees. [PDv]	
19			Ultramafic soil wetland (mainly southwestern Oregon): a low-elevation wetland, usually with a sponge-like organic soil layer, occurring in an area with exposed serpentine or peridotite rock, and/or in soils with very low Ca:Mg ratios.	0	[PDv]	
20			Wooded tidal wetlands with >30% cover of trees and shrubs. A wetland inundated at least once annually by tides and often dominated by woody plant species.	0	The plant species may include Sitka spruce, crabapple, and/or others [PDv]	
21			Undiked tidal *freshwater* wetland: an emergent or wooded wetland inundated at least once annually by tides and with surface salinity <0.5 ppt during most of spring and summer, and which has never been diked.	0	[PDv]	
22			NONE of above	1		
23	Is part of the site tidal? If yes, answer next 2 questions. If no, SKIP TO # F5.					
24	F3	Low Marsh	The percent of the vegetated part of the AA that is "low marsh" (covered by tidal water for part of almost every day) is:		Include any natural channels within the marsh that are inundated at least once daily by tide. See file ORWAP_SuppInfo, worksheet P_LowTidal. [WS-,OE+,POL-,INV+,FA+,FR+,WBF+,WBN-,SBM-,PD-]	
25			>95% of the AA	0		
26			50-95% of the AA	0		
27			25-50% of the AA	0		
28			1-25% of the AA	0		
29			<1% or none of the AA (high marsh only)	0		
30	F4	Tidal-Nontidal Hydroconnectivity	This tidal wetland is (select one):	W	contiguous= abutting, with no major physical separation that prohibits free exchange or flow of surface water, if any is present. See illustrations in Appendix A of the ORWAP manual. [FA+,WBF+,WBN+,PD+]	
31			*contiguous* to a non-tidal palustrine wetland that contains surface water at least seasonally, and mostly not separated by a dike or other barrier, allowing fish access to both wetlands during spring.	0		
32			contiguous to a non-tidal palustrine wetland that contains surface water at least seasonally, but mostly separated by a dike or other barrier, yet still allowing fish access to both wetlands during spring.	0		
33			not contiguous to a non-tidal palustrine wetland that contains surface water, but has an inflowing stream that allows fish during the springtime to access a non-tidal wetland < 1 mile upstream.	0		
34			not contiguous to a non-tidal palustrine wetland that contains surface water, but has an inflowing stream that allows fish during the springtime to access a non-tidal wetland > 1 mile upstream.	0		
35			not contiguous to a non-tidal palustrine wetland, and lacks an inflowing non-tidal stream that provides fish access to an upstream wetland that contains surface water at least seasonally.	0		
36	F5	Interannual Water Dynamics	Select one:		[PR-,NR-,CS-,OE+,INV+,FR-,WBF+,WBN+,PD+]	1
37			throughout the last 5 years most of the AA has been constantly covered with surface water, except for only once or twice (for a period of <6 continuous months) when most of the AA went dry (lacked surface water, due to drawdown, drought, etc.).	0		

	A	B	C	D	E	F
38			throughout the last 5 years most of the AA has **constantly lacked** surface water, except for only **once or twice** period (for a period of <6 continuous months) when most of the AA was **inundated** (had surface water).	0		
39			neither of above	1		
40			unknown	0		
41	F6	Surface Water Occurrence	No part of the AA is ever inundated (contains at least 1 inch of water above the land surface) for more than 14 consecutive days during a normal year. That is, it is a **saturated-only** wetland. If true, mark "1" here, then **SKIP TO F39** (Herbaceous Extent)	0	[classifier for all functions]	
42	F7	Seasonal Water Extent	During normal years, the percent of the AA that is inundated **only seasonally** (more than 14 consecutive days but no more than 9 months, or in tidal wetlands is "high marsh" that is inundated by tides fewer than half the days in any month) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. Vegetation may be patterned in concentric or parallel zones, as one moves outward & away from the deepest part of the wetland or channel. Although useful only as a general guide, the NRCS county soil survey descriptions of the predominant soil types usually includes information on flooding frequency and saturation persistence. [WS+,SR+,NR+,CS+,OE+,INV-,FA+, AM-, Sens+]	1
43			>75% of the AA	0		
44			50-75% of the AA	0		
45			25-50% of the AA	1		
46			5-25% of the AA	0		
47			<5% of the AA, or none	0		
48	F8	Extent of Persistent Surface Water (**Dry** Season)	When the AA's surface water is at its **lowest** annual level, the percent of the AA still containing surface water (whether obscured by vegetation or not) is:		For tidal sites, consider the condition that would exist at annual lowest tide. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. In the county soil survey, the NRCS descriptions of the predominant soil types may include information on saturation persistence in those types. [WS-,PR-,NR-,CS-,POL-,INV+,FR+,AM+,WBF+,WBN+,SB-]	1
49			>95% of the AA	0		
50			50-95% of the AA	0		
51			25-50% of the AA	1		
52			1-25% of the AA	0		
53			None of the above, and the AA contains or is part of a fringe wetland, **SKIP to F10**	0		
54			None of the above, and not a fringe wetland, **SKIP to F10**	0		
55	F9	Onsite Surface Water Isolation (**Dry** Season)	When the AA's surface water is at its **lowest annual level** (for tidal wetlands = annual lowest tide), the percent of the surface water that is in or connected to flowing channels that exit the AA, compared to surface water that is outside of channels and their floodplains (e.g., in small depressions that do not connect annually to the channel if any), is:		For tidal sites, consider the condition that would exist at annual lowest tide. See illustration in Appendix A of ORWAP manual. [WS+, SR+,PR+,NR+,OE-,T-, INV+,FA-,FR+,AM+,WBF+,WBN+,Sens+]	1
56			all (100%) located in channels, swales, or with a contiguous surface water connection to a lake or estuary at all times of year	0		
57			75-99% in or connected to channels, swales, or contiguous lake/ estuary, 1-25% in isolated pools	0		
58			50-75% in or connected to channels, swales, or contiguous lake/ estuary, 25-50% in isolated pools	1		
59			25-50% in or connected to channels, swales, or contiguous lake/ estuary, 50-75% in isolated pools	0		
60			1-25% in or connected to channels, swales, or contiguous lake/ estuary, 75-99% in isolated pools	0		
61			all located in isolated pools or a single isolated pond from which no surface water exits when levels are lowest	0		
62	F10	Onsite Surface Water Isolation (**Wet** Season)	During **most of the wettest time of a normal year**, the percent of the surface water that is in or connected to ditches, swales, or flowing channels that exit the AA, compared to surface water that is in isolated pools that do not connect annually to channels or swales (if any), is:		For tidal sites, consider the condition at mean high tide. See Appendix A of ORWAP manual. **Swales** are sloping areas that contain >1 inch of surface water for at least 2 consecutive days per year, and are less distinct (broader and flatter in cross-section) than channels. Sites fed by unregulated streams that descend on north-facing slopes tend to remain wet longer into the summer, especially in montane snow-fed areas.[WS+, SR+,PR+,NR+,CS+,OE-,INV+,FA-,FR+,AM+,WBF+]	1
63			all (100%) located in channels, *swales* , or in other areas with a wet-season surface connection to channels or to a contiguous lake or estuary	0		
64			75-99% in or connected to channels, swales, or contiguous lake/ estuary, 1-25% in isolated pools	1		

	A	B	C	D	E	F
65			50-75% in or connected to channels, swales, or contiguous lake/ estuary, 25-50% in isolated pools	0		
66			25-50% in or connected to channels, swales, or contiguous lake/ estuary, 50-75% in isolated pools	0		
67			1-25% in or connected to channels, swales, or contiguous lake/ estuary, 75-99% in isolated pools	0		
68			all located in isolated pools or a single isolated pond from which no surface water exits	0		
69	F11	Predominant Water Fluctuation Range	During most years, the difference in surface water level in most of the vegetated area between the driest and wettest time of year is:		In farmed wetlands that have different crops from year to year, consider vegetation condition as it probably existed during most of the past 5 years. See photo illustrations in Appendix A of the ORWAP manual. [WS+,PR-,NR+,CS-,OE+,INV-, AM-,WBN-]	1
70			>6 ft change	0		
71			3-6 ft change	0		
72			1-3 ft change	1		
73			0.5 - 1 ft change	0		
74			<0.5 ft or no change (stable)	0		
75	F12	Predominant Depth Class	During most of the time surface water is present, its depth in most of the inundated part of the AA is:		This question is asking about the spatial median depth that occurs during most of the period while the AA is inundated, even if inundation is only seasonal or temporary. Include surface water in channels and ditches as well as ponded areas. For tidal sites, assess the condition as it exists at mean high tide. See illustration in Appendix A of the ORWAP manual. [SR+,PR+,CS-,OE-,T+,INV-,FA+,FR+,WBF-,WBN-,PD-,Sens-]	1
76			>6 ft deep	1		
77			2-6 ft deep	0		
78			1-2 ft deep	0		
79			0.5 - 1 ft deep	0		
80			<0.5 ft deep	0		
81	F13	Depth Class Distribution	During most of the time when surface water is present (select one):		If the only persistent water on site is in a channel, the first choice is usually most appropriate. Estimate these proportions by considering the gradient and microtopography of the site. See illustration in Appendix A of the ORWAP manual. [INV+,FR+,WBF+,WBN+]	1
82			One depth class (use the classes in F12) comprises >90% of the AA's inundated area	0		
83			One depth class comprises >50% of the AA's inundated area	0		
84			Neither of above	1		
85	F14	Deep Spots	Ponded nontidal water deeper than 3 ft covers at least 1 acre or >5% of the AA during (check all that apply):			2
86			most of the period November-April	1		
87			most of the period May-October	1		
88			neither of above (no ponded water >3 ft deep is that extensive)	0		
89			impossible to tell	0		
90	F15	Open Water Interspersion With Partly Inundated Vegetation	Visualize the extent and distribution of ponded open water within the AA, relative to the distribution of the most dominant form of partly-inundated vegetation (herbaceous or woody, with stems and leaves >4" above the water surface). Visualize this as it occurs during May of most years. In the table to the right, first estimate the percent open water (left column) in the AA, then its distribution (top row). Select the highest applicable number and enter it in column D. If the AA has no ponded water during May, score it "1." If this is a fringe wetland, assume Open Water is >70%.	5	[NR+,OE+,INV+,FA+,FR+,WBF+,WBN+] See illustrations in Appendix A.	5
91			Note: Ponded open water is surface water that is not visibly flowing and contains no vegetation (except perhaps floating-leaved or completely submersed species) and is not beneath a canopy of trees or shrubs. For tidal sites, consider the condition at average mid-tide.			
92	F16	Inflow	When surface water enters the AA, it enters as (select all applicable choices):		[HGM, Sens]	3
93			flow moving in streams, ditches, other channels	1		
94			surface water exchanged broadly as overflow with contiguous waters such as an estuary, lake, or river	0		
95			water pumped into or intentionally diverted to the AA, e.g., as part of a stormwater dispersion system, irrigation practice, or drainage tile outlet	1		
96			groundwater, runoff, and direct precipitation	1		

	Woody, cat-tail, or bulrush			Other vegetation		
open water as % of AA	water in many small patches	inter-mediate	water in one/ few larger patches	water in many small patches	inter-mediate	water in one/ few larger patches
>70	19	15	6	12	9	3
30-70	20	16	7	14	10	4
1-30	18	14	5	11	8	2
<1	1	1	1	1	1	1

	A	B	C	D	E	F
97	F17	Groundwater	Select one:	W	If discharging groundwater in summer is warmer than ambient air temperature, answer "None of the above." [NR+,CS+,T+,POL+,INV+,FA+,AM+,HGM]	1
98			Part of the wetland contains **strong** evidence of groundwater discharges at the wetland surface during summer: (a) Springs are observed or are shown on Wetlands Explorer map, or (b) water is cooler in summer and warmer in winter than in other local wetlands, or (c) measurements from shallow wells indicate groundwater is discharging to the wetland.	1		
99			Part of the wetland has **less definitive** evidence of discharging groundwater during summer. That is, wetland has **no perennial tributary** and is on **organic, sandy, or gravelly soil** (as determined in F58) **AND** has one or more: (a) outflow is present and persists during most of the summer or (b) on a natural slope of >5%, or (c) very close to the base of a natural slope steeper than 15%, or (d) located at a geologic fault, or (e) has rust deposits, colored precipitates, or dispersible natural oil sheen, or (f) within a mile of the top of a HUC4 watershed (see Wetlands Explorer for boundaries).	0		
100			Neither of above is true, although some groundwater may discharge to or flow through the wetland, and wetland is in a region of **eastern Oregon** with mean annual precipitation of less than 20 inches.	0		
101			None of the above, although some groundwater may discharge to or flow through the wetland	0		
102	F18	Outflow Duration	The **most durable** surface water connection between the **wetland** and the closest contiguous and/or downslope surface waters is:	W	The connection may be via a ditch, pipe, tidegate, or culvert as well as through a natural channel, floodplain, or overflow area. Do not rely only on topographic or NWI maps to show this; inspect while in field. The frequencies given are only approximate and are for a "normal" year. The inundation need not occur during the "growing season." [WS-,SR+,PR+,NR+,CS-,OE+,T+,FA+,FR+,Sens-]	1
103			persistent (>9 months/yr), or daily tidal exchange	1		
104			seasonal (14 days to 9 months/yr, not necessarily consecutive)	0		
105			temporary (<14 days, not necessarily consecutive)	0		
106			none -- the wetland lacks an outlet. If so, mark "1" here and **SKIP TO F25** (Sheltering of Water).	0		
107	F19	Outflow Confinement	During major runoff events, in the places where surface water exits the wetland it is:	W	"Impeded" means causing a delay or reduction in water velocity or volume. "Major runoff events" would include biennial high water causes by storms and/or rapid snowmelt. [WS-,SR+,PR+,NR+,CS-,OE+,FA+,FR+,Sens-]	1
108			impeded by a pipe, culvert, tidegate, narrowly breached dike, berm, beaver dam, or other obstruction (other than natural topography), or water is pumped out of the wetland (e.g., for irrigation)	1		
109			not impeded by anything other than (possibly) natural topography	0		
110	F20	Inlet+Outlet	Either the wetland has **BOTH an inlet and outlet** with seasonal or persistent surface flow, or the wetland is **tidal or lacustrine**. If so, enter "1" here and continue. **If neither condition met**, enter "0" here and then **SKIP to F25** (Sheltering of Water).	1	The inflow and outflow from the wetland may be via a shallow ditch, pipe, or culvert. Do not rely only on topographic or NWI maps to show this; inspect while visiting the site.	
111				W		
112	F21	Throughflow Complexity	During peak annual flow, the surface water that flows through the AA's channel or floodplain:		This mainly refers to surface water that moves between the inlet and outlet. Some judgment is required in assessing straight vs. indirect flow path. See diagram in Appendix A of the ORWAP manual. [WS+,SR+,PR+,NR+,CS+,INV+,FA+,FR+,WBF+,WBN+]	1
113			encounters little or no vegetation, boulders, or other sources of friction.	0		
114			mostly encounters herbaceous vegetation that offers little resistance, and water follows a fairly **straight** path from entrance to exit (few internal channels, only slight meandering)	0		
115			mostly encounters herbaceous vegetation that offers little resistance and follows a fairly **indirect** path from entrance to exit (non-channelized flow or many internal channels, or very braided or tightly meandering)	0		

	A	B	C	D	E	F
116			encounters measurable resistance from fairly-rigid vegetation (e.g., cattail, bulrush, woody plants) or channel-clogging debris, and follows a fairly straight path from entrance to exit.	0		
117			encounters measurable resistance from fairly-rigid vegetation (e.g., cattail, bulrush, woody species) or channel-clogging debris, and follows a fairly indirect path from entrance to exit.	1		
118	F22	Vegetated Zone Relative Width	During most of the time open water is present in the AA, vegetated areas within the AA, where they are contiguous to open water, are:		open water = surface water that contains no vegetation (except perhaps floating-leaved or completely submersed species) when viewed from above. May include channels, ditches, ponded areas, regardless if seasonal, persistent, or temporary. [SRv+,PRv+,NRv+, CS+,OE-,Sens-]	1
119			wider than the contiguous open water	1		
120			narrower than the contiguous open water	0		
121	F23	Vegetated Zone Absolute Width	The average width of vegetated area in the AA that separates adjoining uplands (if any) from contiguous open waters (if any) is:		Note: For most sites larger than 10 acres and with persistent water, measure the width using aerial imagery rather than estimate in the field. [SR+,PR+,NR+, CS+,OE-,WBN+,Sens-]	1
122			>300 ft, or no contiguous upland or open waters (not even temporary)	0		
123			100-300 ft	1		
124			25-100 ft	0		
125			5-25 ft	0		
126			<5 ft	0		
127	F24	Undercut Banks	The percent of the AA's water edge, if any, that has undercut banks that are partially visible above the water is:		water edge= streambank (both sides) or other edge between open water and soil. undercut= indented such that surface water flows beneath a canopy layer of soil, tree roots, or sod. At tidal sites, assess this at mid-tide. [FA+,FR+,AM+]	1
128			>75%	0		
129			50-75%	0		
130			25-50%	0		
131			1-25%	0		
132			<1%, or no definable water edge is present	0		
133			cannot estimate	1		
134	F25	Sheltering of Water	At mid-day in summer, the area of surface water within the AA that is shaded by herbaceous or woody vegetation, incised channels, streambanks, or other features also present within the AA is:		For tidal sites, consider the condition at mean low tide. For all sites, consider the aspect and surrounding topographic relief as well as vegetation height and density. [T+,FA+]	1
135			>75% of the water	1		
136			50-75% of the water	0		
137			25-50% of the water	0		
138			5-25% of the water	0		
139			<5% of the water	0		
140			(surface water is typically absent in summer or during low tide)	0		
141	F26	Abovewater Wood	The number of downed wood pieces thicker than 4 inches that remain only partly underwater during most of the spring or early summer, thus potentially serving as basking sites for turtles, birds, or frogs, is:		For tidal sites, consider the condition at mean high tide. Only the wood that is at or above the water surface is assessed because of the impracticality of assessing underwater wood accurately when using a rapid assessment method. [FA+,FR+,AM+,WBF+,SBM+]	1
142			Several	1		
143			Few or none, or AA never has any surface water at that time	0		
144	F27	Islands	Select all that apply:	W	island = terrestrial or wetland area larger than 400 sq.ft, and smaller than 1 sq. mi, and separated from "mainland" by water deeper than 3 ft over a distance of >50 ft during early summer. [AM+,WBF+,WBN+]	1
145			During early summer the wetland contains a floating vegetation mat suitable for nesting birds and isolated from the shore by water depths >3 ft. Or AA is an island with similar isolation and a gently-sloping water edge that is mostly vegetated.	1		
146			During early summer the wetland contains (or is) an island with a gently-sloping water edge, that is mostly bare and is isolated from the shore by water depths >3 ft.	0		
147			Neither of above	0		
148	F28	Shorebird Feeding Habitats	The extent of mudflats or unwooded shortgrass areas within the AA during April or August (or for tidal AAs, during mean low tide) is usually:		These areas must have (a) no vegetation (bare/ fallow), or herbaceous cover comprised mainly of grasses shorter than 4 inches during April and/or August, and (b) soils that either are saturated or covered with <1" of water during April and/or August, and (c) no detectable surrounding slope (e.g., not the bottom of an incised dry channel), and (d) no substantial areas of shrubs or trees. This addresses needs of most migratory sandpipers, plovers, stilts, avocets, curlews, and godwits. [WBF+]	1
149			none, or <100 sq. ft, and there are none that cover >10,000 sq. ft anywhere within 300 ft of the AA	1		

	A	B	C	D	E	F
150			none, or <100 sq. ft, but some that cover >10,000 are within 300 ft of the AA	0		
151			100-1000 sq. ft. within AA	0		
152			1000 – 10,000 sq. ft. within AA	0		
153			>10,000 sq. ft within AA	0		
154	F29	Waves	Which of the following is most true:		Erosive wave conditions often occur where adjoining open water has a fetch (uninterrupted distance) of greater than approximately 1 mile in the direction of the strongest and most frequent wind. [SRv+, PD-, STR+]	1
155			Wind or boats frequently generate waves of >1 ft near the AA, those waves are intercepted by the wetland, and structures behind the AA are protected from wave erosion	0		
156			Wind or boats frequently generate waves of >1 ft near the AA, those waves are intercepted by the wetland, but there are no structures behind the wetland	0		
157			Neither wind nor boats frequently generate waves of >1 ft near the AA	1		
158	F30	Vectors for Waterborne Pests	Select all that apply:		[SRv+, FA-,FR-,AM-,PD-,STR+]	1
159			a regularly-used boat dock is present within or contiguous to the AA	0		
160			a regularly-used boat dock is **not within the AA**, but there is one within 300 ft of the AA and there is a persistent or tidal surface connection between the dock and the AA	0		
161			large ships that empty ballast water are regularly present in nearby contiguous waters	0		
162			the AA has a **persistent surface water connection** (>9 mos./yr, via ditch, pipe, channel, tidegate, or floodplain) to a nearby perennial stream, river, lake, or estuary	1		
163			none of the above	0		
164	F31	Non-native Aquatic Animals	The following are known or likely to have reproducing populations in this AA, its wetland, or in water bodies within 300 ft that **connect to the AA at least seasonally**. Select all that apply:		**Assume non-native fish** to be present if wetland is associated with a nearby reservoir, fish pond, or perennial stream flowing through an agricultural or residential area. **Assume bullfrog, nutria, and/or carp** to be present if (a) the AA contains persistent water or is flooded seasonally by an adjoining body of permanent water, and (b) not a forested wetland, and (c) in western Oregon, elevation is lower than about 3000 ft. In the **ORWAP_SuppInfo** file, see **InvertsExo** worksheet for more complete list of non-native invertebrates or Oregon, and **WetVerts** worksheet for more complete list of fish that are not native to Oregon. You may also consult: http://www.dfw.state.or.us/conservationstrategy/invasive_species.asp [INV-,FA-,FR-,AM-,CQ-]	4
165			non-native amphibians (e.g., bullfrog) or reptiles (e.g., red-ear slider)	1		
166			carp	1		
167			other non-native fish (e.g., bass, gambusia, walleye, crappie, brook trout)	1		
168			non-native invertebrates (e.g., New Zealand mudsnail, mitten crab, rusty crayfish)	1		
169			nutria	0		
170			none of above, or unknown	0		
171		For the following (F32 to 34), if the statement is true, enter a "1" in column D. Otherwise that should be a "0"				
172	F32	Ice-free	During most years, most of the AA's surface water does **not** freeze, or freezes for fewer than 4 continuous weeks, or surface water is absent most winters.	1	[WS+,PR+,NR+,CS+,OE+,FR+,WBF+,Sens-]	
173	F33	Ponded Threshold	During **most of the summer**, the AA contains more than 0.25 acre of ponded non-tidal surface water that is deeper than 1 ft, or is within 300 ft of such an area and the intervening habitat is not developed (roads, etc.). Or nesting within the AA by ducks, geese, or swans has been proven.	1	[WBN+]	
174						
175	F34	No Scum	During most summers, **less than** 80% of the AA's water surface is covered by floating algae, duckweed, and other non-rooted aquatic plants, AND no major fish kills occur. **If no surface water is present in summer, mark "1"** in column D.	1	If wetland can be visited only during winter, it may not be possible to answer this question with much certainty unless local sources are contacted or indicators (e.g., dried remains of algae) are found. [PR+,FA+,PD+,CQ+]	
176	F35	Submerged & Floating-leaved Aquatic Vegetation (SAV)	*SAV* (submerged & floating-leaved aquatic vegetation) occupies an annual maximum of:		SAV = herbaceous plants that characteristically grow at or below the water surface, i.e., whose leaves are primarily and characteristically under or on the water surface during most of the part of the growing season when surface water is present. Some species are rooted in the sediment whereas others are not. If pond lily (*Nuphar*) is the predominant species, consider its maximum extent only during the period when surface water is present beneath the leaves. For tidal sites, consider the condition during mean high tide.	1
177			>95% of the surface water area	0		
178			50-95% of the surface water area	0		
179			25-50% of the surface water area	0		
180			5-25% of the surface water area	1	[INV+,FA+,FR+,AM+,WBF+,PDc,CQc,SENSc]	

	A	B	C	D	E	F
181			<5% of the surface water area. Mark "1" here and SKIP TO F39 (Herbaceous Extent).	0		
182	F36	SAV Invasive vs. Non-invasive Cover	The areal cover of SAV at mid-summer is comprised of:		Invasive SAV species include: *Egeria densa* (Brazilian elodea), *Hydrilla verticillata* , *Myriophyllum aquaticum* (parrotfeather watermilfoil), *Cabomba caroliniana* (fanwort), *Nymphaea odorata* (white pondlily). For known distributions of these in your county, see: http://www.weedmapper.org/maps.html [PD-,CQ-,Sens-]	1
183			mostly invasive SAV species (see list in column E). Mark "1" here and SKIP to F39.	0		
184			mostly non-invasive species	1		
185			impossible to tell	0		
186	F37	SAV Native Species Dominance	Considering just the SAV species that are native:		[PD-, CQ-, Sens-]	1
187			one or two of those species together comprise >50% of the SAV cover	0		
188			no two of the native SAV species together comprise >50% of the SAV cover	1		
189			impossible to tell	0		
190	F38	SAV Species Ubiquity	Of all the SAV species in this AA:		[PD-, CQ-, Sens-]	1
191			all are species that are common among Oregon's wetlands and lakes.	1		
192			at least one species is a SAV plant that is not common among Oregon's wetlands and lakes, and it covers >1% of the SAV area or >100 sq. ft. See file ORWAP_SuppInfo, worksheet P_UnCom.	0		
193			impossible to tell	0		
194		Note: In the next 4 questions, "herbaceous" does not include SAV or herbaceous plants growing under a woody canopy, unless that canopy covers >80% of the vegetated part of the AA. If the AA is farmed, estimate herbaceous cover (including crops) as it would exist under maximum cover conditions during the majority of the last 5 years.				
195	F39	Herbaceous Extent	The areal cover of herbaceous plants during mid-summer is:		herbaceous = forbs, graminoids, ferns, liverworts, moss. Can include crops. Do not include submersed and floating-leaved aquatics (SAV) in the category of "herbaceous", or when defining the "vegetated part" of the site. *Note: For sites larger than 10 acres, this should be determined from aerial imagery rather than estimated in the field.* [POLc,INV+,WBF+,WBN+,PDc, CQc,SENSc]	1
196			>95% of the vegetated part of the AA	1		
197			50-95% of the vegetated part of the AA	0		
198			25-50% of the vegetated part of the AA	0		
199			5-25% of the vegetated part of the AA	0		
200			<5% of the vegetated part of the AA. Mark "1" here and SKIP TO F44 (Woody Extent).	0		
201	F40	Graminoid vs. Forb Cover	When the areal cover of herbaceous plants is at an annual maximum, those plants are:		graminoids= grasses, sedges, rushes, reeds, burreed, cat-tail, and other grasslike plants . Remember to focus only on plants not beneath a woody canopy, unless that canopy occupies >80% of the AA. If possible this should be assessed during mid-summer. [POLL-]	1
202			overwhelmingly graminoids (>80% cover of grasslike plants)	1		
203			mostly graminoids (50-80% cover)	0		
204			mostly non-graminoids (e.g., forbs, ferns) (50-80%)	0		
205			overwhelmingly (>80%) non-graminoids	0		
206	F41	Herbaceous Native vs. Non-native Cover	The maximum annual areal cover of herbaceous plants is:		In the file ORWAP_SuppInfo, see P_Invas worksheet for list of invasives and P_Exo for non-native species list. For known distributions of invasive plants in your county, see: http://www.weedmapper.org/maps.html Remember to focus only on plants that are not beneath a woody canopy. [POL-,PD-,CQ-,Sens-]	1
207			overwhelmingly (>80% cover) non-native species, of which >10% are species considered invasive (see column E). Mark "1" and SKIP to F44.	1		
208			overwhelmingly (>80% cover) non-native species, but <10% are considered invasive (see column E). Mark "1" and SKIP to F44.	0		
209			mostly (50-80%) non-native species, regardless of invasiveness	0		
210			mostly (50-80%) native species	0		
211			overwhelmingly (>80%) native species	0		
212	F42	Herbaceous Species Dominance	Of just the herbaceous (forb and graminoid) species:		Remember to focus only on plants that are not beneath a woody canopy. [POL-,PD-,CQ-,Sens-]	
213			one or two native species together comprise >50% of the areal cover of herbaceous plants at any time during the year, or no species are native	1		
214			no two of the native species together comprise >50% of the areal cover of herbaceous plants	0		
215	F43	Herbaceous Plant Species Ubiquity	Of all the herbaceous species in this AA:		This question and several others (F37, 38, 42, 48, 49) are used as "placeholders" until a Floristic Quality Assessment index can be developed for Oregon. Much information on distribution and frequencies of plant species	
216			all are species that are common among Oregon's wetlands.	1		

	A	B	C	D	E	F
217			at least one species is **not common** among Oregon's wetlands and it covers >1% of the AA's herbaceous area or >100 sq. ft (either contiguous or scattered). See file ORWAP_SuppInfo, worksheet P_UnCom.	0	is available from the Oregon Flora Project: www.oregonflora.org/ An interim assumption has been made that wetlands dominated by just one or a few widespread plant species tend to be in a more ecologically degraded condition -- but there are many exceptions. [POL-,PD-,CQ-,Sens-]	
218	F44	Woody Extent Within the AA	Within the AA, woody vegetation (shrubs, trees, woody vines) occupies:		*Note: For sites larger than 10 acres, this should be determined from aerial imagery rather than estimated only in the field.* Vines are twining or climbing plants with relatively long stems, and can be either woody or herbaceous. Include Himalayan blackberry. [CS+,POLc,SBM+,PDc,CQc,SENSc]	1
219			>95% of the vegetated part of the AA	0		
220			50-95% of the vegetated AA	0		
221			25-50% of the vegetated AA	0		
222			5-25% of the vegetated AA	0		
223			<5% of the vegetated AA	1		
224	F45	Woody Extent Along Water Edge	Where surface water is present **during the wettest time of year**, the AA's woody vegetation occupies:		open water = surface water that contains no vegetation (except perhaps floating-leaved or completely submersed species). [SBM+]	1
225			>95% of the area **within 100 ft of open water**, or, nearly all of the woody vegetation is inundated during annual high water	0		
226			50-95% of the area within 100 ft of open water, or most of the woody vegetation is inundated during annual high water	0		
227			25-50% of the area within 100 ft of open water	0		
228			5-25% of the area within 100 ft of open water	0		
229			<5% of the area within 100 ft of water; mark "1" here and **SKIP TO F50** (Woody Diameter Classes).	1		
230	F46	Woody Distribution	The woody vegetation (if any) within the AA is:		"contiguous to" means separated by less than one tree height. The separation may be caused by herbaceous vegetation, persistent water, roads, buildings, or bare soil, but not by shrubs. "Individually much smaller" means most small patches are <30% of the area of most of the individual large clumps. [SBM+, CQ+, Sens+]	
231			**clumped** in fairly distinct bands or patches mostly separate from herbaceous vegetation. **More than 90%** of the AA's shrub or tree area is in one or a few patches or bands; <10% is scattered in fragments that are individually much smaller than the clumps. Or, the vegetated part of the AA is **entirely** shrub or trees.	0		
232			**clumped** in bands or patches mostly separate from herbaceous vegetation. 60-90% is in clumps; 10-40% is scattered in much smaller fragments,	0		
233			**dispersed** quite evenly amid the herbaceous vegetation, in many small patches, that together comprise >40% of the AA's total shrub and tree area.	0		
234	F47	Cover of Woody Invasives	Within parts of the AA having **shrubs** or woody **vines**, the areal cover is:		In the file **ORWAP_SuppInfo**, see **P_Invas** worksheet for list of invasives and **P_Exo** for non-native species list. Woody invasives include: Hedera helix, Ailanthus altissima, Buddleja spp., Cytisus spp., Rubus armeniacus (discolor), Rubus laciniatus, Tamarix spp., Umbellularia californica, Robinia pseudoacacia. For known distribution of some invasives in your county see: http://www.weedmapper.org/maps.html [POL-,PD-,CQ-,Sens-]	
235			overwhelmingly (>80%) non-natives that are categorized as **invasive** (see column E).	0		
236			overwhelmingly **other non-natives**	0		
237			mostly (50-80%) non-natives	0		
238			mostly (50-80%) **natives**	0		
239			overwhelmingly (>80%) natives	0		
240	F48	Shrub & Vine Species Dominance	Of just the shrub & woody vine species:		[POL-,PD-,CQ-,Sens-]	
241			one or two of the **native** species together comprise **>80% of the shrub & vine** cover, or no shrub-vine species are native	0		
242			**no two** of the native species together comprise >80% of the shrub & vine cover	0		
243	F49	Shrub & Vine Species Ubiquity	Of all the shrub & woody vine species in this AA:		[POL-,PD-,CQ-,Sens-]	
244			all are species that are **common** among Oregon's wetlands.	0		
245			at least one species is **not common** among Oregon's wetlands and it covers >1% of the AA or >100 sq. ft See file ORWAP_SuppInfo, worksheet P_UnCom.	0		
246	F50	Woody Diameter Classes	Select all the types occupying >5% **of the wooded part** of the AA **or >5% of its upland edge** if that is wooded.		**upland edge**= plants located within one tree-height of the wetland-upland boundary. Measurements are the d.b.h., which is the tree diameter at 4.5 ft above the ground. If visited only in winter, consider "dead standing trees" to be those that are mainly without bark. Include woody vines such as Himalayan blackberry. [CS+,POL+,INV+,AM+,WBN+,SBM+,Sens+]	5
247			deciduous 1-4" diameter and >3 ft tall	0		
248			evergreen 1-4" diameter and >3 ft tall	0		
249			deciduous 4-9" diameter	1		

	A	B	C	D	E	F
250			evergreen 4-9" diameter	0		
251			dead standing 4-9" diameter	0		
252			deciduous 9-21" diameter	1		
253			evergreen 9-21" diameter	0		
254			dead standing 9-21" diameter	1		
255			deciduous >21" diameter	1		
256			evergreen >21" diameter	0		
257			dead standing >21" diameter	1		
258			Lacks woody vegetation, or none of above occupy >5% of the wooded part of the AA or 5% of the length of the upland edge.	0		
259	F51	N Fixers	Within the vegetated part of the AA, the cover of nitrogen-fixing plants (e.g., alder, sweetgale, legumes) is:		For a more complete list see file ORWAP_SuppInfo, worksheet NFIX. Do not include algae.	1
260			<1% or none	0		
261			1-25%	1		
262			25-50%	0		
263			50-75%	0		
264			>75%	0		
265	F52	Waterfowl Food Plants	The percent of the vegetated part of the AA, excluding areas that are never inundated, which contains one or more of these plants: Alisma spp., Beckmannia spp., Polygonum spp. (natives only), Potomogeton (Stuckenia) spp., Ruppia spp., Sagittaria spp., Sparganium spp., Zostera spp., is:		[WBF+,WBN+]	1
266			<1% or none, and none are known to occur commonly within the same wetland or within 300 ft of this AA	0		
267			<1% or none, but some are known to occur commonly within the same wetland or within 300 ft of this AA	0		
268			1-10%	1		
269			10-50%	0		
270			>50%	0		
271	F53	History of Fire or Vegetation Removal	The last time that >5% of the AA's vegetation cover was burned or harvested for hay or timber was:		[PR-,NR-,CS-,OE+,POL-,WBF+,PD+]	1
272			0-12 months ago, and this occurs almost annually within part of the AA	0		
273			0-12 months ago, but was not an annual (or near-annual) event	0		
274			1-5 years ago	0		
275			>5 years ago, or never	1		
276			unknown	0		
277	F54	Height Uniformity of Dominant Stratum	Within the stratum (herbaceous, shrub, or tree) that covers the most onsite area, the wetland plants during maximum annual cover condition are mostly:		e.g., If dominantly herbaceous, then "diverse heights" might include both short and tall forbs, some non-woody vines, and mid-height graminoids. See illustration in Appendix A of the ORWAP manual. [POL+,INV+,WBN+,SBM+,PD+]	1
278			of nearly uniform height (+ or - 20% of average)	1		
279			of very diverse heights (e.g., short & tall forbs, short & mid-height grasses)	0		
280	F55	Bare Ground & Accumulated Plant Litter	During minimum annual cover conditions, in a typical 1 x 1 m plot that is not under water, there is:		"Plant litter" does not include material still attached to a dead rooted plant, or detached material that is overtopped by rooted vegetation, or recently-mowed grass. Emphasis should be on plant litter from prior years ("thatch") that has not totally decayed or been consumed or washed away. "Bare ground" that is present under a tree or shrub canopy should be counted. It includes unvegetated soil, rock, sand, or mud between stems if any. Wetlands that are dominated by annual plant species tend to have more extensive areas that are bare or covered only by plant litter, during minimum annual cover conditions. See photo illustrations in Appendix A of the ORWAP manual. [SR-,PR-,NR-,CS-,OE-,POL-,INV-.AM-,SBM-,Sens+]	1
281			little or no (<5%) *bare ground* or accumulated plant litter (thatch) is visible between stems or under canopy. Herbaceous ground cover is dense. May be mostly perennial grasses, moss, or others with high stem or root density.	0		
282			some (5-20%) bare ground or litter is visible. Herbaceous ground cover is moderately dense. May be mostly perennial forbs, creeping vines, fairly sparse grasses.	0		
283			much (20-50%) bare ground or plant litter is visible. Low stem density. May be mostly woody plants, cattail, bulrush, sparse annuals.	1		
284			mostly (>50%) bare ground or accumulated plant litter	0		
285	F56	Upland Edge Shape Complexity	Most of the edge between the wetland and upland is (select one):	W	See illustrations in Appendix A of the ORWAP manual . [NR+,SBM+]	1

	A	B	C	D	E	F
286			*Linear:* a significant proportion of the wetland's upland edge is straight, as in wetlands bounded by partly or wholly by dikes or roads	1		
287			*Convoluted:* Wetland perimeter is many times longer than maximum width of the wetland, with many alcoves and indentations ("fingers")	0		
288			*Intermediate:* Wetland's perimeter either (a) is only mildly convoluted, or (b) mixed -- contains about lengths of linear and convoluted segments.	0		
289	F57	Upland Inclusions	The extent of inclusions of upland within the AA (as indicated by their topography, plants, and/or soils) is:		[NR+,AM+,SBM+]	1
290			Many (e.g., wetland-upland "mosaic"), or >30% of the AA when combined	0		
291			Few or none	1		
292	F58	Soil Composition in the Soil Pit	The composition of the soil in the soil pit at the ground surface (uppermost soil layer and excluding the *duff layer,* see protocol in ORWAP Manual, section 2.3.2) is:		duff layer= leaves, woody material, and live or dead roots, moss that has undergone partial decomposition. See flow chart for estimating soil composition in Appendix A of the ORWAP manual. [PR,NR,CS,OE, PD, Sen]	1
293			*Loamy* : includes silt, silt loam, loam, sandy loam	0		
294			*Clayey* : includes clay, clay loam, silty clay, silty clay loam, sandy clay, sandy clay loam	1		
295			*Organic* : includes muck, mucky peat, peat, and mucky mineral	0		
296			*Coarse* : includes sand, loamy sand, gravel, cobble, stones, boulders, fluvents, fluvaquents, riverwash	0		
297	F59	Downed Wood	The number of downed wood pieces longer than 6 ft and with diameter >6", and not submerged by water when water is present, is:		include driftwood. [POL+,INV+,AM+,SBM+]	1
298			Several (>5 if AA is >10 acres, or >2 for smaller AAs)	1		
299			Few or none	0		
300	F60	Ground Irregularity	The number of animal burrows, mounds, hummocks, boulders, upturned trees, islands, natural levees, dry channels, pits, wide soil cracks, and microdepressions (in parts of the AA that lack persistent water) is:		"microtopography" refers mainly to vertical relief of <1 m and is represented only by inorganic features, except where plants have created depressions or mounds of soil. See photo illustrations in Appendix A of the ORWAP manual. [WS+,SR+,PR+,NR+,CS+,POL+,INV+,AM+,SBM+,PD+]	1
301			Several (extensive micro-topography)	1		
302			Few or none (minimal microtopography; <1% of the area that isn't persistently inundated); e.g., many flat sites having a single hydroperiod	0		
303			Intermediate	0		
304	F61	Internal Gradient	The gradient along most of the AA's water flow paths (both sheet and channel flow) is:		Except in isolated wetlands (no outlets), this is not the same as the shoreline slope. It is the elevational difference between highest and lowest points within the site, divided by the flow-distance between them and converted to percent. If most of the surface water is impounded within the site, the gradient is the gradient of the water surface, not the gradient of the submerged substrate. See diagram in Appendix A of the ORWAP manual. If available, use a clinometer to measure this. [WS-,SR-,PR-,NR-,CS-,OE+,AM-,WBF-,WBN-]	1
305			>10%	0		
306			6-10%	0		
307			2-5%	1		
308			Flat (<2%, no slope or flow is ever apparent. Includes most depressional sites	0		
309	F62	Fish Access From Offsite	Small fish (e.g., stickleback, minnow) from elsewhere in the watershed can access part of this AA for at least 2 days during most years or are known to already be present onsite.	1	Although incomplete, the species maps may be helpful at: http://map.streamnet.org/ or http://query.streamnet.org/ [INV-,FA+,FR+,AM-,WBF+]	
310	F63	Nesting or Roosting Structures	Within the AA or within its wetland or within 300 ft of AA, there are bridges, buildings, caves, or ledges with openings/ crevices, well-maintained bird or bat boxes, elevated platforms, or other artificial structures suitable for nesting by some native bird or bat species.	1	e.g., open buildings for barn swallows, bridges for cliff swallows, wood duck boxes, goose nesting platforms, sheltered places for bees and wasps [POL+,SBM+]	
311	F64	Cliffs, Banks, or Beaver	In the AA or within its wetland or within 100 ft of the AA, there are elevated terrestrial features such as cliffs, stream banks, excavated pits, or pumice walls (but not riprap) that extend at least 6 ft nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Or there is evidence that beaver have used this AA (e.g., gnawed limbs).	1	[POL+,SBM+]	

	A	B	C	D	E	F
312	F65	*Visibility*	The maximum percent of the AA that is visible from the best vantage point on public roads, public parking lots, public buildings, or public paved paths that adjoin or are within 300 ft of the AA (select one) is:		[PU+]	1
313			>50%	0		
314			25-50%	0		
315			<25%	1		
316	F66	*Ownership*	Most of the AA is (select one):		[PU+]	1
317			in public ownership	1		
318			in private ownership	0		
319	F67	*Public Access*	For most of the AA, permission for access is normally given or allowed:		In all cases, this question assumes that permission for access may be limited to certain activities. [PU+]	1
320			to anyone, on any date, no prior arrangements required	1		
321			to anyone, but only on particular dates, no prior arrangements required	0		
322			only on a case-by-case basis or only by prior arrangement, on any date	0		
323			only on a case-by-case basis or by prior arrangement, only on particular dates	0		
324			seldom or never	0		
325			(do not know)	0		
326	F68	*Non-consumptive Uses - Actual or Potential*	Assuming access permission was granted, select **all** statements that are true of this AA as it currently exists:		[PU+]	1
327			Walking is physically possible in >5% of the AA during most of year, e.g., free of deep water and dense shrub thickets	0		
328			All or part of the AA (or an area within sight of the AA and within 100 ft) would be physically accessible to people in wheelchairs, e.g., paved and flat	0		
329			Maintained roads, parking areas, or foot-trails are within 30 ft of the AA, or the AA can be accessed most of the year by boat	1		
330	F69	*Sustained Scientific Use*	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area.	0	[PU+]	0
331			(do not know)	0		
332	F70	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select all that apply.		"Low impact" means adherence to Best Management Practices such as those defined by NRCS and other agencies. Evidence may consist of direct observation, or presence of physical evidence (e.g., recently cut stumps, fishing lures, shell cases), or communication with the land owner or manager. [PS+]	1
333			low-impact commercial timber harvest	0		
334			low-impact grazing	1		
335			commercial harvesting of hay or mushrooms	0		
336			waterfowl hunting or furbearer trapping	0		
337			fishing (including shellfish harvest)	0		
338			None of the above	0		
339	F71	Domestic Wells	Wells that currently provide drinking water are:		If unknown, assume this is true if there is an inhabited structure within the specified distance and the neighborhood is known to not be connected to a municipal drinking water system (e.g., is outside an Urban Growth Boundary), or if crops are irrigated annually and the site is distant from a major water body. [NRv+]	1
340			Within 500 ft and downslope from the AA or at same elevation	0		
341			500-1000 ft and downslope or at same elevation	0		
342			>1000 ft downslope, or none downslope, or AA is tidal, or no information	1		
343	F72	Sediment Removal	Excessive accumulation of sediment has caused problems for large boats, with shoaling in some cases necessitating frequent dredging, in waters that are located:		[SRv+]	1
344			contiguous to the AA, or <1 mile downslope from the AA	0		
345			1-5 miles downslope	0		
346			>5 miles downslope, or no accumulation problems, or no information	1		
347	F73	Devegetation	The percent of the AA's vegetation cover that normally grows taller than 4 inches but which has been persistently reduced to less than that height by mowing and/or grazing by domestic or wild animals is:		[OE-,INV-,AM-,WBN-,SBM-,PD-,CQ-]	1
348			>95%	0		
349			50-90%	0		
350			5-50%	1		

	A	B	C	D	E	F
351			<5%, or grazing/ mowing does not cause the described condition	0		
352	F74	Core Area 1	The part of the AA **almost never** visited by humans during an average year probably comprises:		Judge this based on proximity to population centers, roads, trails, accessibility of the AA to the public, wetland size, usual water depth, and physical evidence of human visitation. Exclude visits that are not likely to continue and/or that are not an annual occurrence, e.g., by construction or monitoring crews. See illustration in Appendix A of the ORWAP manual. [AM+,WBF+,WBN+,SBM+,PD+,STR-]	1
353			>95% of the AA	0		
354			50-95%	1		
355			5-50%, or <5% but inhabited building is within 300 ft of the AA	0		
356			<5%, and no inhabited building within 300 ft of the AA	0		
357	F75	Core Area 2	The part of the AA visited by humans **almost daily for several weeks** during an average year probably comprises:		Exclude visits that are not likely to continue and/or that are not an annual occurrence, e.g., by construction or monitoring crews. [AM-,WBF-,WBN-,SBM-,PD-,STR+]	1
358			>95% of the AA	0		
359			50-95%	0		
360			5-50%	1		
361			<5%	0		
362	F76	Weed Source Along Upland Edge	Along the AA's boundary with upland, the percent of the **upland** edge (within 10 ft of AA) that is occupied by species that are marked as **invasive** in the P_Invas **worksheet** of the ORWAP_SuppInfo file is:		Some of the most common invaders along upland edges of Oregon wetlands are Himalayan blackberry, knotweed, sweetbrier rose, Russian olive, English ivy, nightshade, pepperweed, medusahead, white clover, ryegrass, quackgrass, false brome, bentgrass, dandelion, oxeye daisy, pennyroyal, bull and creeping thistles, tansy ragwort, poison hemlock, and teasel. See file **ORWAP_SuppInfo**, worksheet **P_Invas**. If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an invasive species, assume the unidentified plant to also be invasive. If vegetation is so senesced that apparently dominant edge species cannot be identified even to genus, answer "none". [PD-,STR+]	1
363			most (>50%) of the upland edge	1		
364			much (5-50%) of the upland edge	0		
365			some (1-5%) of the upland edge	0		
366			none of the upland edge (invasives apparently absent), or AA is an island with no upland	0		
367	F77	Natural Land Cover in Buffer	Within **100 ft upslope** of the AA's wetland-upland boundary, the percent of the upland that contains *natural* (**not necessarily native**) land cover is:		**Natural land cover** includes wooded areas, sagebrush, vegetated wetlands, prairies, **as well as** relatively unmanaged commercial lands such as hayfields, lightly grazed pastures, and most rangeland. It **does not include water**, row crops (vegetable, orchards, Christmas tree farms), residential areas, lawn, pavement, bare soil, gravel or dirt roads. Natural land cover is not the same as native vegetation or undisturbed soil. It frequently includes a dominance of non-native plants (e.g., ryegrass, Himalayan blackberry). If the entire site is an island without an upland edge, select the last choice. [POL+,INV+,FA+,FR+,AM+,WBN+,SBM+,PD+,Sens-]	1
368			>90%, or there is no upland boundary	1		
369			60 to 90%	0		
370			30 to 60%	0		
371			5 to 30%	0		
372			<5%	0		
373	F78	Type of Land Cover Alteration in Buffer	Within **100 ft upslope** of the AA's wetland-upland boundary, the upland land cover that is not natural (as defined above) is mostly:		[INV-,FA-,AM-,WBN-,SBM-,PD-,STR+]	1
374			impervious surface, e.g., paved road, parking lot, building, exposed rock	0		
375			bare pervious surface, e.g., dirt road, dike, dunes, recent clearcut, landslide	1		
376			cultivated row crops or orchard	0		
377			artificially landscaped areas or lawn	0		
378			grain fields, or grassland grazed or mowed to a height usually shorter than 4 inches	0		
379			other	0		
380			(buffer is >90% natural land cover or AA occupies all of an island)	0		
381	F79	*Buffer Slope*	Along the AA's **wetland-upland boundary and extending 100 ft uphill**, the average slope of the land is mostly:		NOTE: If the described area contains a disturbance feature, estimate instead the slope between the wetland-upland boundary and the most extensive such feature. **Disturbance feature** = building, paved area, recently cleared area, dirt road, lawn, intensely grazed pasture, orchard, vineyard, annually-harvested row crops. See illustration in Appendix A of the ORWAP manual. [Sens+]	1
382			<1% (flat -- almost no noticeable slope, or there is no upland boundary)	0		
383			2-5%	0		
384			5-30%	1		
385			>30%	0		
386	F80	Edge Slope	Within 10 ft **of ponded surface water** (if any) in early summer, the percent of the vegetated area (wetland or upland) that has a gentle or moderate slope (less than 5% slope) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. See illustration in Appendix A of the ORWAP manual. [AM-,WBN-]	1
387			>75%	1		
388			50-75%	0		
389			25-50%	0		
390			1-25%	0		

	A	B	C	D	E	F
391			<1%,	0		
392			(ponded surface water in early summer covers <1% of AA, or AA is tidal)	0		
393	F81	Independently Sustainable Hydrology	How likely is it that any or all of this AA will persist as a wetland (not necessarily of the same type) if an existing dike or berm, water control structure (e.g., dam, weir), or pumping/ diversion system that now helps sustain it -- and is within 1 mile of the AA -- was removed or became inoperable?		If all such human activities and structures disappeared, would the site still be a wetland? [WSv,SRv,PRv,NRv,INVv,AMv,WBFv,WBNv,SBMv,PDv+]	1
394			Very likely, or no such feature is present (greater sustainability potential)	0		
395			Somewhat likely -- part but not all of the AA would remain a wetland	1		
396			Unlikely or not at all (lower sustainability potential)	0		

Site Name:	Investigator:	Date:

Field S data form. ORWAP version 2.0.

S1 **Wetter Water Regime - *Internal* Causes**

In the last column, place an X next to any item that is likely to have caused a part of the AA to be inundated more extensively, more frequently, more deeply, and/or for longer duration than it would be without that item or activity. (The items you check are not used automatically by ORWAP. They are included simply so they may be considered when evaluating the factors in the table beneath them).

an impounding dam, dike, levee, weir, berm, road fill, or tidegate -- within or downgradient from the AA, or raising of outlet culvert elevation.	x
excavation within the AA, e.g., artificial pond, dead-end ditch	x
excavation or reflooding of upland soils that adjoined the AA, thus expanding the area of the AA	x
plugging of ditches or drain tile that otherwise would drain the AA (as part of intentional restoration, or due to lack of maintenance, sedimentation, etc.)	x
vegetation removal (e.g., logging) within the AA	
compaction (e.g., ruts) and/or subsidence of the AA's substrate as a result of machinery, livestock, or off road vehicles	
changes not related directly to humans, e.g., beaver	x

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1) in the last column that describe the combined maximum effect of those items in creating a wetter water regime that still persists in the AA. To estimate that, contrast it with the condition if checked items never occurred or were no longer present. The sum and final score will compute automatically.

	Severe (3 pts)	Medium (2 pts)	Mild (1 pt)	Pts
Spatial extent of increased wetness in the AA or its upland edge	>95% of AA or >95% of its upland edge (if any)	5-95% of AA or 5-95% of its upland edge (if any)	<5% of AA and <5% of its upland edge (if any)	2
When wetter condition began	<3 yrs ago	3-9 yrs ago	10-100 yrs ago	3
Score the following 2 rows only if the wetter conditions began within past 10 years, and only for the part of the AA that got wetter.				
Inundation now vs. previously	persistent vs. seldom	persistent vs. seasonal	slightly longer or more often	2
Average water level increase from previous condition	>1 ft	6-12"	<6 inches	2
			sum=	9
0 if Sum= 0, (1 pt) if Sum= 1-4. (2 pt) if 5-6. (3 pt) if 7-8. (4 pt) if 9-10. (5 pt) if >10.			final score=	4

S2 **Wetter Water Regime - *External* Causes**

In the last column, place an X next to any item occurring in the CA (including channels flowing into the AA) that is likely to have caused a part of the AA to be inundated more extensively, more frequently, more deeply, and/or for longer duration than it would be without that item or activity.

subsidies from stormwater, wastewater effluent, septic system leakage, or irrigation water (direct or via seepage)	
pavement, ditches, or drain tile in the CA that incidentally increase the transport of water into the AA	
removal of timber or phreatophytes in the CA or along the AA's tributaries	
removal of a water control structure or blockage in tributary upstream from the AA	
changes in the CA that are not related directly to humans, e.g., channel migration, landslides, insects, seismic activity	

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1) in the last column that describe the combined maximum effect of those items in creating a wetter water regime that still persists in the AA. To estimate that, contrast it with the condition if checked items never occurred or were no longer present.

	Severe (3 pts)	Medium (2 pts)	Mild (1 pt)	Pts
Spatial extent of activity in the CA	>20% of the CA	5-20% of the CA	<5% of the CA	3
When wetter condition began in the AA	<3 yrs ago	3-9 yrs ago	10-100 yrs ago	1
Score the following 2 rows only if the wetter conditions began within past 10 years, and only for the part of the AA that got wetter.				
Inundation now vs. previously	seldom vs. persistent	seasonal vs. persistent	slightly shorter or less often	2
Average water level increase from previous condition	>1 ft	6-12"	<6 inches	2
			sum=	8
0 if Sum= 0, (1 pt) if Sum= 1-4. (2 pt) if 5-6. (3 pt) if 7-8. (4 pt) if 9-10. (5 pt) if >10.			final score=	3

S3 **Drier Water Regime - Internal Causes**

In the last column, place an X next to any item located within or immediately adjacent to the AA, that is likely to have caused a part of the AA to be inundated less extensively, less deeply, less frequently, and/or for shorter duration that it would be without that item.

ditches or drain tile in the AA or along its edge that accelerate outflow from the AA	
lowering or enlargement of a surface water exit point (e.g., culvert) or modification of a water level control structure, resulting in quicker drainage	
accelerated downcutting or channelization of an adjacent or internal channel (cut below the historical water table level)	
deep ripping (e.g., with plows) that severs an underlying hydrologically-confining soil layer	
placement of fill material	
withdrawals (e.g., pumping) of natural surface or ground water directly out of the AA (not its tributaries)	

If any items were checked above, then for each row of the table below assign points (3, 2, or 1) in the last column that describe the combined maximum effect of those items in creating a drier water regime that still persists in the AA. To estimate that, contrast it with the condition if checked items never occurred or were no longer present.

	Severe (3 pts)	Medium (2 pt)	Mild (1 pt)	
Spatial extent of increased dryness in the AA	>95% of AA or >95% of its upland edge (if any)	5-95% of AA or 5-95% of its upland edge (if any)	<5% of AA and <5% of its upland edge (if any)	0
When drier condition began	<3 yrs ago	3-9 yrs ago	10-100 yrs ago	0
Score the following 2 rows only if the drier conditions began within past 10 years, and only for the part of the AA that got drier.				
Inundation now vs. previously	seldom vs. persistent	seasonal vs. persistent	slightly shorter or less often	0
Average water level decrease from previous condition	>1 ft	6-12"	<6 inches	0
			sum=	0
0 if Sum= 0, (1 pt) if Sum= 1-4. (2 pt) if 5-6. (3 pt) if 7-8. (4 pt) if 9-10. (5 pt) if >10.			final score=	0

S4 **Drier Water Regime - External Causes**

In the last column, place an X next to any item within the CA (including channels flowing into the AA) that is likely to have caused a part of the AA to be inundated less extensively, less deeply, less frequently, and/or for shorter duration that it would be without those.

a dam, dike, levee, weir, berm, or tidegate that interferes with natural inflow to the AA	
relocation of natural tributaries whose water would otherwise reach the AA	
instream water withdrawals from tributaries whose water would otherwise reach the AA	
groundwater withdrawals that divert water that would otherwise reach the AA	
proliferation of phreatophytes (woody plants with deep roots and high transpiration, e.g., juniper, autumn olive) or crops with high transpiration rates that are near the AA	
changes not related directly to humans	

If any items were checked above, then for each row of the table below assign points (3, 2, or 1) in the last column that describe the combined maximum effect of those items in creating a drier water regime that still persists in the AA. To estimate that, contrast it with the condition if checked items never occurred or were no longer present.

	Severe (3 pts)	Medium (2 pts)	Mild (1 pt)	
Spatial extent of activity in the CA	>20% of the CA	5-20% of the CA	<5% of the CA	0
When drier condition began in the AA	<3 yrs ago	3-9 yrs ago	10-100 yrs ago	0
Score the following 2 rows only if the drier conditions began within past 10 years, and only for the part of the AA that got drier.				
Inundation now vs. previously	seldom vs. persistent	seasonal vs. persistent	slightly shorter or less often	0
Average water level decrease from previous condition	>1 ft	1-12"	<1 inch	0
			sum=	0
0 if Sum= 0, (1 pt) if Sum= 1-4. (2 pt) if 5-6. (3 pt) if 7-8. (4 pt) if 9-10. (5 pt) if >10.			final score=	0

S5 **Altered Timing of Water Inputs**

In the last column, place an X next to any item that is likely to have caused the **timing** of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either **more muted** (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) **or more flashy** (larger or more frequent spikes but over shorter times).

flow regulation in tributaries or water level regulation in adjoining water body, or tidegate or other control structure at water entry points that regulates inflow to the AA	
increased pavement and other impervious surface in the CA	x
straightening, ditching, dredging, and/or lining of tributary channels in the CA	
discharges of irrigation water to the AA, applied at times when natural runoff typically is not significant	x
other	

If any items were checked above, then for each row of the table below assign points (3, 2, or 1) in the last column that describe the combined maximum effect of those items on the timing of water inputs to the AA. To estimate that, contrast it with the condition if checked items never occurred or were no longer present.

	Severe (3 pts)	Medium (2 pts)	Mild (1 pt)	
Spatial extent within the AA where timing shifted	>95% of AA	5-95% of AA	<5% of AA	3
When altered inputs began	<3 yrs ago	3-9 yrs ago	10-100 yrs ago	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the AA that experiences those.				
Input timing now vs. previously	shift of weeks	shift of days	shift of hours	3
Flashiness or muting	became very flashy or controlled	intermediate	became mildly flashy or controlled	3
			sum=	10
0 if Sum= 0, (1 pt) if Sum= 1-4. (2 pt) if 5-6. (3 pt) if 7-8. (4 pt) if 9-10. (5 pt) if >10.			final score=	4

S6 **Accelerated Inputs of Nutrients, Contaminants, and/or Salts**

In the last column, place an X next to any item -- occurring in **either the AA or its CA** -- that is likely to have accelerated the inputs of nutrients, contaminants, or salts to the AA

stormwater or wastewater effluent (including failing septic systems), landfills	
irrigation water discharges into the AA, including saline seeps	
livestock, dogs	
fertilizers applied to lawns, ag lands, or other areas in the CA	
pesticides applied to lawns, ag lands, roadsides, or other areas in the CA, but excluding spot applications for weed control in the AA	
dumping of large amounts of wood, leaves, grass clippings, trash into the AA or its tributaries	
artificial drainage of upslope lands	
reflooding of soils that had been dry for many years	
fire retardants from aerial firefighting	
oil or chemical spills (not just chronic inputs) from nearby roads	
erosion of nutrient-rich or contaminated soils	
chemical wastes from mining, oil/ gas extraction	
other human-related disturbances within the CA	x
sources not related directly to humans, e.g., fire, extensive cover of nitrogen-fixing plants (e.g., alder), concentrations of waterbirds or other wildlife, erosion of nutrient-rich soils	

If any items were checked above, then for each row of the table below assign points (3, 2, or 1) in the last column that describe the combined maximum effect of those items in generating loads of nutrients, contaminants, or salts reaching the AA. To estimate that, contrast it with the condition if checked items never occurred or were no longer present.

	Severe (3 pts)	Medium (2 pts)	Mild (1 pt)	
Usual toxicity of most toxic contaminants	industrial effluent or 303d listed* for toxics	cropland, dense residential, or 303d listed for nutrients	mildly impacting (livestock, pets, low density residential)	3
Frequency & duration of input	frequent and year-round	frequent but mostly seasonal	infrequent & during high runoff events mainly	1
AA proximity to main sources (actual or potential)	0-50 ft	50-300 ft or in groundwater	in other part of contributing area	2
* categorized by ODEQ as Water Quality Limited (303d) and toxic substances are listed by ODEQ as one reason. See item D40 in data form OF.			sum=	6
0 if Sum= 0, (1 pt) if Sum= 1-3. (2 pt) if 4-5. (3 pt) if 6-7. (4 pt) if 8. (5 pt) if 9.			final score=	3

S7 **Excessive Sediment Loading *from Contributing Area***

In the last column, place an X next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the AA from its CA.

erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires	
erosion from construction, in-channel machinery in the CA	
erosion from off-road vehicles in the CA	
erosion from livestock or foot traffic in the CA	
stormwater or wastewater effluent	
sediment from gravel mining, other mining, oil/ gas extraction	
accelerated channel downcutting or headcutting of tributaries due to altered land use	
other human-related disturbances within the CA	
natural processes within the CA, e.g., streambank erosion, landslides, erosion of erosion-prone soils especially following fire, floods	1

If any items were checked above, then for each row of the table below assign points (3, 2, or 1) in the last column that describe the combined maximum effect of those items in increasing the amount or transport of sediment into the AA. To estimate that, contrast it with the condition if checked items never occurred or were no longer present.

	Severe (3 pts)	Medium (2 pts)	Mild (1 pt)	
Erosion in CA	extensive evidence, high intensity*	potentially (based on high-intensity* land use) or scattered evidence	potentially (based on low-intensity* land use) w. little/ no direct evidence	1
Recentness of significant soil disturbance in the CA	current & ongoing	1-12 months ago	>1 yr ago	1
Duration of sediment inputs to the AA	frequent and year-round	frequent but mostly seasonal	infrequent & during high runoff events mainly	1
AA proximity to actual or potential sources	0-50 ft, or farther but on steep erodible slopes	50-300 ft	in other part of contributing area	2
			sum=	5

* high-intensity= plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment

0 if Sum= 0, (1 pt) if Sum= 1-4. (2 pt) if 5-6. (3 pt) if 7-8. (4 pt) if 9-10. (5 pt) if >10. final score= **2**

S8 **Soil or Sediment Alteration *Within the Assessment Area***

In the last column, place an X next to any item present in the AA that is likely to have compacted, eroded, or otherwise altered the AA's soil.

compaction from machinery, off-road vehicles, or mountain bikes, especially during wetter periods	x
leveling or other grading not to the natural contour	
tillage, plowing (but excluding disking for enhancement of native plants)	
fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland	
livestock and other sediment- or soil-disturbing animals, e.g., carp, nutria, wild boar, people on foot	x
excavation	
dredging in or adjacent to the AA	
boat traffic in or adjacent to the AA and sufficient to cause shore erosion or stir bottom sediments	
artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments	
natural processes within the AA, e.g., trampling by concentrated wildlife, shore or streambank erosion, landslides, normal erosion of erosion-prone soils especially following fire, floods.	

If any items were checked above, then for each row of the table below assign points (3, 2, or 1) in the last column that describe the combined maximum effect of those items in altering the AA's soils. To estimate that, contrast it with the soil condition if checked items never occurred or were no longer present.

	Severe (3 pts)	Medium (2 pts)	Mild (1 pt)	
Spatial extent of altered soil	>95% of AA or >95% of its upland edge (if any)	5-95% of AA or 5-95% of its upland edge (if any)	<5% of AA and <5% of its upland edge (if any)	2
Recentness of significant soil alteration in AA	current & ongoing	1-12 months ago	>1 yr ago	3
Duration of effects from last soil disturbance	long-lasting, minimal veg recovery	long-lasting but mostly revegetated	short-term, revegetated, not intense	1
Timing of soil alteration	frequent and year-round	frequent but mostly seasonal	infrequent & mainly during scattered events	2
			sum=	8

0 if Sum= 0, (1 pt) if Sum= 1-4. (2 pt) if 5-6. (3 pt) if 7-8. (4 pt) if 9-10. (5 pt) if >10. final score= **3**

S9

Vegetated Cover Removal Within the Assessment Area

In the last column, place an X next to any item present in the AA that is likely to have caused less canopy or ground cover, or less vegetation biomass, or less wood generally. If only the species composition (not total cover or biomass) changed, do not check any of these items.

clearing, logging, excepting removal of woody vegetation from native prairies	
grazing by livestock	x
mowing	x
herbicides, excepting spot applications for controlling non-native plants in the AA	
plowing, regrading	
removal of woody debris	
shading from large artificial structure, e.g., bridge, boardwalk, dock	
other human-related disturbances within the AA	x
natural processes concentrated within the AA, e.g., wind & wave scouring, windthrow, insect or disease infestations, fires, beaver damage, natural erosion, intensive grazing by deer, elk, geese.	

If any items were checked above, then for each row of the table below assign points (3, 2, or 1) in the last column that describe the combined maximum effect of those items on the amount of vegetation cover in the AA.

	Severe (3 pts)	Medium (2 pts)	Mild (1 pt)	
Spatial extent of veg removal in the AA	>95% of AA or >95% of its water edge (if any)	5-95% of AA or 5-95% of its water edge (if any)	<5% of AA and <5% of its water edge (if any)	2
Frequency of significant veg removal	regularly during most of the year	a few times a year	annual or less	2
Biomass recovery after each removal	> 20 yrs	2-20 yrs	<2 yrs	1
			sum=	5
0 if Sum= 0, (1 pt) if Sum= 1-3. (2 pt) if 4-5. (3 pt) if 6-7. (4 pt) if 8. (5 pt) if 9.			final score=	2

Appendix D: Plant Species List

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Tavasci Marsh Plant Species List – Tuzigoot National Monument

Family	PLANT Code	Species	Common Name	Life form	Wetland Indicator Status	Non-native?
Aceraceae	ACNE2	*Acer negundo var. interius*	box elder	t	FACW-	n
Apiaceae	HYVE2	*Hydrocotyle verticillata*	whorled marsh pennywort	h	OBL	y
Asteraceae	ACRE3	*Acroptilon repens*	Russian knapweed	h	NI	y
	CIVU	*Cirsium vulgare*	bull thistle	h	FACU	y
	BASA4	*Baccharis salicifolia*	Mule Fat	s	FACW	n
	HEAN3	*Helianthus annuus*	annual sunflower	h	FAC-	n
	SOAS	*Sonchus asper*	spiny sowthistle	h	FACW	y
	XAST	*Xanthium strumarium*	Rouch cocklebur	h	NI	n
Berberidaceae	BEHA	*Berberis haematocarpa*	Red barberry	s	NI	n
Brassicaceae	DESO2	*Descurainia sophia*	herb sophia	h	NA	y
	RONA2	*Rorippa nasturtium-aquaticum*	watercress	h	OBL	n
	SIIR	*Sisymbrium irio*	London rocket	h	NI	y
Chenopodiaceae	KOSC	*Kochia scoparia*	Mexican fireweed	s	FAC	y
Cupressaceae	JUOS	*Juniperus osteosperma*	Utah juniper	t	NA	n
Cyperaceae	CAPR5	*Carex praegracilis*	clustered field sedge	h	FACW+	n
	ELPA4	*Eleocharis parishii*	Parish's spikerush	h	FACW	n
	SCAM6	*Schoenoplectus americanus*	American threesquare	h	OBL	n
	SCTA2	*Schoenoplectus tabernaemontani*	softstem bullrush	h	OBL	n
Equisetaceae	EQLA	*Equisetum laevigatum*	Smooth horsetail	H	FACW	n
Fabaceae	MEAL2	*Melilotus alba*	white sweetclover	h	FACU+	y
	MEIN2	*Melilotus indica*	annual yellow sweetclover	h	FACU+	y
	PRVE	*Prosopis velutina*	velvet ash	s	NI	n
Grossulariaceae	RIAU	*Ribes aureum*	golgen current	s	FACW	n
Haloragaceae	MYAQ2	*Myriophyllum aquaticum*	parrot feather watermilfoil	h	OBL	y
Juncaceae	JUBA	*Juncus balticus*	Baltic rush	h	OBL	n
Lamiaceae	MAVU	*Marrubium vulgare*	horehound	h	FAC+	y
Lemnaceae	LEMI2	*Lemna minima*	common duckweed	h	OBL	n
Moraceae	MOAL	*Morus alba*	White mulberry	T	NO	y
Oleacece	FRVE2	*Fraxinus velutina*	Arizona ash	t	FAC+	n

Family	PLANT Code	Species	Common Name	Life form	Wetland Indicator Status	Non-native?
Onagraceae	EPCIC	*Epilobium ciliatum ssp. ciliatum*	fringed willowherb	h	FACW	n
Plantaginaceae	PLLA	*Plantago lanceolata*	English plantain	H	FAC	y
Poaceae	AGST2	*Agrostis stolonifera*	creeping bent	h	NI	y
	BRDI3	*Bromus diandrus*	ripgut brome	h	NI	y
	BRMAR	*Bromus madritensis ssp. rubens*	red brome	h	NI	y
	CYDA	*Cynodon dactylon*	Bermudagrass	h	FACU	y
	DISP	*Distichlis spicata*	inland saltgrass	h	FACW	n
	FEAR3	*Festuca arundinacea*	tall fescue	h	NA	y
	HOJU	*Hordeum jubatum*	foxtail barley	h	FACW-	y
	HOMU	*Hordeum murinum*	mouse barley	h	NI	y
	LETR5	*Leymus triticoides*	beardless wildrye	h	FACU	n
	POMO5	*Polypogon monspeliensis*	annual rabbitsfoot grass	h	FACW+	y
	MUAS	*Muhlenbergia asperifolia*	scratchgrass	h	FACW	n
	SPWR2	*Sporobolus wrightii*	big sacaton	h	NI	n
Polygonaceae	POPU5	*Polygonum punctatum*	dotted smartweed	h	OBL	n
	RUCR	*Rumex crispus*	curly dock	h	FACW	y
Potamogetonaceae	POCR3	*Potamogeton crispus*	curly pondweed	h	OBL	y
Salicaeae	SAGO	*Salix gooddingii*	Goodding's willow	t	OBL	n
	POFR2	*Populus fremontii*	Fremont Cottonwood	t	FACW	n
Schrophulariaceae	VEAM2	*Veronica americana*	American speedwell	h	OBL	n
Solonaceae	SOEL	*Solanum elaeagnifolium*	white horsenettle	h	NI	n
Typhaceae	TYDO	*Typha domingensis*	southern cattail	h	OBL	n
	TYLA	*Typha latifolia*	broadleaf cattail	h	OBL	n
Urticaceae	URDI	*Urtica dioica*	stinging nettle	h	NI	n

Appendix E: U.S.A.C.E. Wetland Delineation

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