EAST ENTRANCE TO SYLVAN PASS WETLAND DELINEATIONS

WETLANDS 001-103
August-October 2000

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WETLAND DELINEATIONS

ABSTRACT

The data gathered during the course of these wetland delineations found 103 jurisdictional wetlands within 200 feet of either side of the pavement edge along the 11.59km (7.2 miles) of highway from East Entrance to Sylvan Pass. The wetlands exhibited two Cowardin classes of wetlands: Palustrine (P) and Riverine/Upper Perennial/Streambed (R3SB), with some variation in water regime within these types. The P wetlands occured in two areas: One area was along the Middle Creek floodplain and was representative of abandoned river channels or seeps along the river terraces. The other area was along the south facing slopes that run between Cody Peak and Hoyt Peak. These were seeps that exited from the andesite talus or bedrock. The R3SB wetlands were along small creeks that feed the Middle Creek. Many sites in both wetland systems were human influenced wetlands such as ditches and wetlands altered by the imposition of road culverts and roadfill during earlier road construction. One new rare plant site was discovered within the wetlands. One new exotic plant species was discovered within the wetlands. The wetlands covered a total of 10.098 acres. Of these, wetlands in the form of man-made ditches numbered nine and covered a total of 0.099 acres. Due to inaccessibility, thirty-nine wetlands were not delineated but were indicated by a point or a line. The wetland acreage that they contained is unknown. All wetlands, being within the 200 foot wide survey areas are at risk of alteration by road building activities. Alternatives and mitigation sites are do exist and are being explored.

PROJECT INFORMATION

It has been proposed that the road from East Entrance to Sylvan Pass in Yellowstone National Park, Wyoming be reconstructed to meet the demands of increased traffic and safety concerns. This reconstruction would involve widening or relocating the road. This work has the potential to impact wetlands along the roadside.

The Federal Clean Water Act, Section 404, authorizes the Army Corps of Engineers, specifically the Chief of Engineers, to issue permits for the discharge of dredged or fill materials into waters of the United States. This permitting process is overseen by the Environmental Protection Agency and is reviewed by the Fish and Wildlife Service and the National Marine Fisheries Service. This permit requires that if a wetland is to be impacted by discharge, then its limits must be identified and delineated. This process is called *wetland delineation* or *wetland determination.* The resulting wetlands are referred to as *jurisdictional wetlands* and are regulated under Section 404 of the Federal Clean Water Act.

Thus, wetlands were identified, delineated, and mapped along the 11.59km (7.2 miles) of roadway between East Entrance and Sylvan Pass from August 1 through October 11, 2000. These were performed by Cole Irvin and David Schmoller, biological technicians with Yellowstone National Park.

METHODS

Wetland Determinations were performed as outlined in the January 1987 *Corps of Engineers Wetlands Delineation Manual* and with reference to the 1989 *Federal Manual for Identifying and Delineating Jurisdictional Wetlands*.

The survey site was the area along the roadway within 200 feet of either side of the pavement edge. Most wetlands were surveyed up to this 200 feet boundary. Exceptions to this were when the terrain was dangerously steep or where surveys would require crossing Middle Creek. These areas were observed from a distance. Evidence of disturbance or the existence of abnormal circumstances was documented. The routine wetland determination method was selected for all wetlands along the roadway. Survey lines were established through the project area according to the Intuitive Controlled survey method.

The three criteria that identify a jurisdictional wetland were determined in the following manner:

Soils: A soil pit was dug at a wetland representative of the palustrine wetland class common along this roadway and inspected for hydric soil characteristics. The data from this soil pit appears in Table 2, "Soil Pit Data." A consideration the publication *Soils of Yellowstone National Park* identified soils in the area according to soil family. (Rodman and others, 1996)

Hydrology: The road corridor was traversed its entire length with an eye for hydrologic characteristics. Hydrologic characters include water marks, water stained leaves, drift lines, sediment deposits, drainage patterns, inundation, and saturation of the soil in the root zone. When these appeared the hydrologic characters were recorded.

Vegetation: Vegetation was sampled throughout the site and in vicinity of the soil pits. An attempt was made to identify all species. Each species was assigned a modified cover-abundance value as shown in Table 1, “Modified Cover-Abundance Values”. Dominant species were those that comprised greater than 20 percent of the aerial cover. A wetland indicator status for each species was determined using the National List of Plant Species that Occur in Wetlands (Reed, 1996). This Wetland Indicator Status is listed for plant species encountered in this survey in Appendix 1, “Plant Names and Wetland Indicator Status”. Where dominant plants were primarily FAC species, the “FAC Neutral” test was used. Rare plants and noxious weeds were documented.

Table 1. ***Modified Cover-Abundance Values***

VALUE	T	1	2	3	4	5	6
% COVER	Trace	1-5%	5-25%	25-50%	50-75%	75-95%	95-100%

Each wetland community was classified according to the U. S. Fish and Wildlife Service manual *Classification of Wetlands and Deepwater Habitats of the United States*, commonly referred to as the “Cowardin Classification System”. (Cowardin, 1979) Since close observation of some wetlands found in steep areas was considered too dangerous, their classification was somewhat speculative. National Wetland Inventory maps were consulted to confirm classification. Wherever a wetland lay within the *ditch* created by the roadfill material or by excavation, the special modifier “x” was added to the classification designation. All wetlands delineated in this survey are listed according to wetland classification in Appendix 2, ”Wetland Classifications of Delineated Wetlands”.

A field copy of the "Routine Wetland Determination Data Form" was completed for wetland community. This form recorded vegetation, soil, and hydrologic measurements and observations. Latin plant names were used throughout. A list relating Latin names to common names appears in Appendix 1, “Plant Names and Wetland Indicator Status.” The field copy was then entered into WetForm™ Delineation Dataform Software. When filling out the computerized data form, all plants with a t rating were noted as *Trace*, all plants with a 1 rating were noted as *Present*, and all plants with a 2 to 6 rating were listed in the *Dominant Plant Species* section. All plants were listed from most dominant to least dominant. Data forms were printed for the project and stored in a project folder. Based on the information recorded in the Data Form and Table 2, each plant community that met all three wetland criteria was established as a jurisdictional wetland. Ditches that met all three criteria were considered jurisdictional wetlands.

The wetland sites were assigned an identification number from EESP001 to EESP103. Wetlands that were the result of the impoundment of water due to road construction or other human activity were assigned a number and the suffix “d”, for *ditch*. This numbering sequence was not always in geographic order because crews moved around the road corridor for logistical purposes.

The wetlands were then mapped using a Trimble ProXL GPS unit with a maximum PDOP set at 10.0. The PDOP was raised to this number due to the steepness of the terrain that blocked the signal paths to satellites. Similarly, although the data collection rates were from 1 to 5 seconds, often the actual collection rate was less frequent due to blocked signal paths. Mapping was often referenced to control points established along the roadway by land surveyors. All accessible streams were mapped as lines and non-streams were mapped as polygons. Where steepness of terrain prevented foot travel around the wetland, a line or point was mapped on the roadside nearest the wetland to indicate its location. If the wetland was a stream, a *point* was mapped on the roadside at the approximate location of the stream above or below the road. If the wetland was not a stream, a *line* was mapped along the roadside nearest the wetland. This line indicated the distance for which the wetland paralleled the roadway. *It remained impractical to determine the actual acreage of these inaccessible wetlands.* Differential Corrections of the collected data were made using Trimble’s Pathfinder Office software and base files obtained from the Idaho Falls, ID or Missoula, MT base stations. Base stations within Yellowstone National Park were not used due to difficulties accessing the base files. The corrected data was then exported and stored as ArcView shapefiles. These shapefiles indicated the location, shape, acreage, and site numbed of the wetland. These figures are contained in Appendix 3, “GPS Data for Wetlands from East Entrance to Sylvan Pass”. Arcview software provided overlays including contours, aerial photographs, creeks, rivers, and roads. The orthophotos used in the map overlays were dated 8/25/94 and 9/5/94. These files were then archived in Yellowstone National Park’s Spatial Analysis Center.

RESULTS AND DISCUSSION

Two wetland communities were recognized within the project area. There were Palustrine (P) and Riverine/Upper Perennial (R3). Episodes of road construction in the past have altered the character of many wetlands. Many wetlands, particularly ditch wetlands, were created as a result of the road construction. A prolonged drought appeared to have reduced the level of saturation and inundation throughout the wetlands.

Palustrine

Two classes of Palustrine wetlands were present, Palustrine/Shrub-Scrub wetlands (PSS) and Palustrine/Emergent wetlands (PEM).

The PSS wetland type represented marshy, *Salix* and *Alnus*-dominated wetlands found along the Middle Creek terraces. Only a few were encountered in this survey, because the roadway departed the Middle Creek floodplain at an early juncture. There was a component of this wetland class in larger seeps and other wetlands on the Middle Creek floodplain, but not enough to classify them as PSS wetlands.

The PEM wetlands were found along the Middle Creek banks, mucky spring seeps dominated by *Carex* and *Juncus* species, and roadside ditches dominated by *Carex* and *Juncus* species. The variations within the EM wetland class were in the *water regime*, that is, the level of saturation or flooding. The most common variant was permanent saturation followed by seasonally flooded. Several of the seeps on exposed andesite, while saturated to the surface in June, were completely dry by August. An argument may have been made that they were seasonally saturated seeps, but the extreme drought this year made that determination uncertain. While none of these wetlands had any readily apparent surface water flow, most of the seeps were saturated to the surface and had small creeks or rivulets exiting at their base.

These wetlands were often disturbed by previous road construction. Four types of disturbances were observed. 1) Some wetlands were excavated. In many locations the road construction truncated the natural contours of a spring seep resulting in the exit of waters from the seep into a ditch along the road. Current road repairs had excavated several wetlands, particularly 078, 081, 082, 083, and 084, resulting in a nearly complete removal of vegetation. However, older excavated wetlands had demonstrated vigorous regrowth of wetland vegetation. 2) Some wetlands were buried in large amounts of roadfill. For example, at site 022 near the East Entrance, floodplain wetlands were partially buried by roadbed. 3) Some wetlands were created by the road construction. Many seeps emitted water at the roadcut and this water channeled into a ditch that paralleled the road then directed beneath the road by a culvert. Elsewhere, at wetlands 15, 16, 17,and 30, it appeared that the roadbed was damming the water from spring seeps and associated creeks. 4) Some wetlands appeared to be displaced. Where the seep or creek ran from the north side into a culvert it appeared that at times the exit point for the waters was east of the original wetland.

Vegetation: The vegetation in the EM class wetlands varied due to elevations ranging from 6,950 feet to 8,537 feet. Dominant vegetation in lower areas included *Carex aquatilis,* *Carex utriculata, Carex microptera, Juncus ensifolius, Alnus incana, Epilobium glabberimum, Agrostis stolonifera,* and *Aster hesperius.* In higher elevations this vegetation showed *more Glyceria elata, Aster eatonii*, *Alnus sinuata,* and other *Salix* species. Two rare plant sites were located within the EM class wetlands. Site 002, along the Middle Creek banks, had *Carex deweyana* and Site 037, a seep on a cliff face, had *Deschampsia danthonioides*. The vegetation in the SS class wetlands was dominated by a variety of *Salix* species and *Alnus incana.* Greater than 50% of the dominant plants were hydrophytic in both the PEM and PSS wetland systems. Since more than half of the dominant plants were hydrophytic, a wetland was indicated for the vegetation parameter.

Soil: According to *Soils of Yellowstone National Park* (Rodman and others, 1996), all soils in this were of seven types. The most common types were 5419 – Bedrock Outcrop-Silverleaf Family Complex, 2261 – Gallatin Family and Bearmouth Family and Aquic Cryoborolls Undifferentiated Group. Far less common were 2159 – Greyback Family-Shadow Family-Igneous Bedrock Complex, 2207 - Greyback Family-Bearmouth Family Complex, 2541- Greyback Family-Igneous Bedrock-Arrowpeak Family Complex, 2662 – Gallatin Family and Cryaquolls and Histisols Undifferentiated Group, and 522 – Bedrock Outcrop-Hobacker Family Complex.

Soil unit 5419 forms on very steep sides of glaciated valley walls and uplands. No aquic conditions are mentioned. However, the wetlands found in this soil unit were situated on cliff faces, in narrow steep valleys, and on talus slopes.

Soil unit 2261 forms in stream bottoms, at times under aquic conditions, and is dominated by wet shrub and wet forest habitat types. This is where the abandoned river channel, oxbow, and *Salix* and *Alnus* dominated wetlands of the Palustrine wetland system were to be found.

Soil unit 2159 forms on steeper slopes on glaciated valleys and uplands. It has small areas of soil with aquic condition. It is these small aquic areas where some of the spring seeps of the PEM wetland systems were to be found.

Soil unit 2207 forms on alluvial fans. It has no mention of aquic conditions. The Palustrine wetland found on this type was an ordinary spring seep.

Soil unit 2541 forms on glaciated head slopes, valley walls, bedrock outcrops, and on stream banks. The wetlands found in this type were seeps on steep slopes or in talus, and waterfalls on steep slopes.

Soil unit 2662 forms on alluvial basins. It is generally a nonforested type dominated by *Carex* and *Salix* species. Soils with aquic conditions commonly make up 50 percent of the map unit. Histisols are present. The wetland found in this unit was an ordinary seep wetland at the outlet of a road culvert.

Soil unit 522 forms on stream banks, and steep sided, glacial valley walls and uplands. It is primarily a forested habitat type, dominated by *Pseudotsuga menziesii*, with sparse nonforested habitats. The wetlands formed in this unit were along a forested sideslope uphill from Middle Creek and along the floodplain of Middle Creek.

Only one soil pit was dug in these wetlands, at Site 002, in the Middle Creek terraces. This site was a fair representative of the PEM wetlands, typifying the soils found on the river terraces and floodplain. It was in soil type 2261 and in wetland system Palustrine/Emergent/ Cobble-Gravel (PEM1B). It had a C horizon composed of sand, gravel, and cobble, doubtless the result of stream deposition in times gone by. The soil had poor horizonation, a reflection of the recent abandonment of the terrace. There were mottles in the B horizon. The vegetation was a mix of wetland and dryland species. These features gave the appearance of a wetland that has seen a gradual drop in the water table and a decline in the frequency of flooding as a result of the downcutting of the creek. It is in transition to dryland.

No other soil pits were dug, so no data was gathered for other soils in the Palustrine wetland system, such as soils of the seep areas. However, it was readily apparent from a visual inspection that these other soils were wetland soils. Seep areas had dense, fibrous upper horizons with a distinct sulfidic odor. It appeared that many of these were soils with histic epipedons, that is, a rich organic layer at least 8 inches deep. Many of the seep soils had complete saturation. Apparently, these soils had an aquic moisture regime. Thus, the presence of an aquic moisture regime, sulfidic odors, and histic epipedons indicated a wetland for the soil parameter.

Hydrology: Most of the sites exhibited either inundation from creeks or saturation of the soil in the root zone. Some sites, such as the dry seeps at Site 38, had no evidence of saturation of soil into the root zone but had other evidences such as watermarks, water stained leaves, drift lines, sediment deposits, or drainage patterns. These seeps were completely saturated during an inspection in mid-June. These factors all served to indicate a wetland for the hydrologic parameter.

Determination: The Palustrine wetland system presented wetland indicators for all three of the parameters and as such was jurisdictional wetlands.

Riverine/Upper Perennial

Two classes of Riverine/Upper Perennial wetlands were present, Riverine/Upper Perennial/Rock Bottom/Rubble (R3RB2) and Riverine/Upper Perennial/Streambed/Cobble-Gravel (R3SB3).

The R3RB2 wetland system was represented by Middle Creek, site EESP103. It was permanently flooded. It formed the southern boundary of the wetlands along the eastern quarter of the survey area. To the west it veered to the south and exited the 200 feet limit. Being permanently flooded this creek was clearly wetlands and required no routine wetland determination procedure.

The R3SB3 wetlands were represented by small creeks or rivulets that cascaded down the andesite cliffs to the north of the road or that consolidated waters emerging from seeps. All remaining riverine wetlands were of this sort. Each was a tributary to Middle Creek. These creeks were no more than two or three meters wide at best, and were more often less than 50 cm wide. Many of these wetlands were intermingled with Palustrine wetlands, usually PEM1B. The variations within this wetland was simply a matter of *subclass,* that is, creek bottom material. While some creeks exhibited some mud, others some bedrock, all streams exhibited cobble and gravel to a large degree. Thus, all sites were assigned a subclass of 3, Cobble-Gravel.

Disturbance was common. Large amounts of roadfill were deposited on some creeks. Other creeks had been excavated. The creeks always entered a culvert or grate that diverted the waters beneath the road, to exit on the south side and run downslope into the Middle Creek. Some of these creeks may have been relocated by road construction to form a new channel on the south or downslope side of the highway. Current road repairs had excavated several wetlands resulting in a near complete removal of vegetation. Revegetation of older road-cut creeks was observed. These disturbances are noted in the Wetform™ data forms.

Vegetation: The vegetation in this community was dominated by *Alnus incana, Agrostis stolonifera, Glyceria elata, Aster hesperius, Epilobium glabberimum, Heracleum lanatum,* and *Urtica dioica.* In higher elevations the vegetation community saw the appearance of *Alnus sinuata, Aster eatonii,* and other *Salix* species. Greater than 50% of the dominant plants were hydrophytic. Since more than half of the dominant plants were hydrophytic, a wetland was indicated for the vegetation parameter.

Soil: Similar soil conditions prevailed for the Riverine wetlands as were for the Palustrine wetlands. According to the publication, *Soils of Yellowstone National Park*, all soils in this were of six types. The most common types were 5419 – Bedrock Outcrop-Silverleaf Family Complex, 2261 – Gallatin Family and Bearmouth Family and Aquic Cryoborolls Undifferentiated Group. Far less common were 2159 – Greyback Family-Shadow Family-Igneous Bedrock Complex, 2207 - Greyback Family-Bearmouth Family Complex, 2541-Greyback Family-Igneous Bedrock-Arrowpeak Family Complex, and 522 – Bedrock Outcrop-Hobacker Family Complex.

Soil unit 5419 forms on very steep sides of glaciated valley walls and uplands. No aquic conditions are mentioned. However, the wetlands found in this soil unit were situated on cliff faces, in narrow steep valleys, and on talus slopes.

Soil unit 2261 forms in stream bottoms, at times under aquic conditions, and is dominated by wet shrub and wet forest habitat types. The Riverine wetlands found on this type were creeks the abandoned river channel, oxbow, and *Salix* and *Alnus* dominated wetlands along Middle Creek.

Soil unit 2159 forms on steeper slopes on glaciated valleys and uplands. It has small areas of soil with aquic condition. It is these small aquic areas where some of waterfalls were to be found.

Soil unit 2207 form on alluvial fans. It has no mention of aquic conditions. The Riverine wetland found on this type was a small waterfall.

Soil unit 2541 forms on glaciated head slopes, valley walls, bedrock outcrops, and on stream banks. The wetland found in this type was a waterfall on a steep slope.

Soil unit 522 forms on stream banks, and steep sided, glacial valley walls and uplands. It is primarily a forested habitat type, dominated by *Pseudotsuga menziesii*, with sparse nonforested habitats. The wetlands formed in this unit were creeks associated with seeps along a forested sideslope uphill from Middle Creek.

No soil pits were dug in this wetland system. However, it was readily apparent from a visual inspection that these other soils were wetland soils. Seep areas had dense, fibrous upper horizons with a distinct sulfidic odor. All soils likely had aquic moisture regimes. Soil in the rocky creek corridors was saturated, the organic matter was high in upper horizons, and chromas were low. It appeared that these were soils with histic epipedons, that is, a rich organic layer at least 8 inches deep. The presence of histic epipedons and aquic moisture regimes, mottles, gleying, sulfidic odors, and histic epipedons indicated a wetland for the soil parameter.

Hydrology: Most of the sites exhibited either inundation from creeks or saturation of the soil in the root zone. Other sites were dry creeks. These had watermarks, water stained leaves, drift lines, sediment deposits, or drainage patterns. These factors all served to indicate a wetland for the hydrologic parameter.

Determination: The R3SB vegetation community presented wetland indicators for all three of the parameters and as such was jurisdictional wetlands.

Table 2. *Soil Pit Data*

	A Horizon			B Horizon			C Horizon	Notes
SITE	**Matrix**	**Mottle**	**Gley**	**Matrix**	**Mottle**	**Gley**		
002	7.5YR4/3	None	No	10YR5/4	7.5YR5/8	No	Sand, cobbles	A: sandy loam/coarse organic B:sand

Ditches

A total of nine ditch wetlands were observed covering a total of 0.099 acres.

Inaccessible Wetlands

Many sites were too steep to access without risk of life and limb. As a result, vegetation, soil, and hydrologic characteristics were inspected at a distance. Wetland locations were indicated by either a point where the wetland intersected the road or a line along the shoulder of the road which ran the distance that the wetland paralleled the road. These inaccessible wetlands are indicated in Table 3, “GPS Data for Wetlands from East Entrance to Sylvan Pass”. Twelve of these wetlands were of a linear nature and were indicated by a point. These were mountain streams classified as R3SB3 wetlands. Twenty-four wetlands were polygons. These were indicated by a line. These were spring seeps or seeps associated with mountain streams classified as PEM1B wetlands. Three wetlands were indicated by a point but were actually polygonal in nature. These were wetlands EESP067, EESP082, and EESP102. *The acreage total for these point and line wetlands was not possible to obtain.*

Rare Plants

Several rare plant sites had been known to exist along the East Entrance-Sylvan Pass road. In addition, Yellowstone National Park botanist Jennifer Whipple completed a search for rare plants in the project area. Her findings are documented in a separate report. Also, during the wetland survey one new rare plant site was observed and documented. The species *Carex deweyana* was found at site EESP002. It was verified and documented by Jennifer Whipple.

Exotic Plants

One new species of exotic plant was encountered in this survey, *Juncus compressus*. A solitary plant was found growing along the roadside in the ditch at site EESP094. It was verified and documented by Jennifer Whipple.

Summary

The vegetation, soil, and hydrologic data gathered in this survey determined that there were 103 jurisdictional wetlands within the 200 foot wide survey areas along the stretch of the road between East Entrance and Sylvan Pass. These wetlands are scattered along 11.59 km (7.2 miles) of highway. The remaining lands within the 200 foot limit are nonwetlands. The wetland vegetation communities are classified as Palustrine/Emergent (PEM) and Riverine/Upper Perennial/Streambed (R3SB). The borders of the wetlands were mapped by the GPS mapping method.

The wetlands covered a total of 10.098 acres. Of these, wetlands in the form of man-made ditches numbered nine and covered a total of 0.099 acres. Due to inaccessibility, thirty-nine wetlands were not delineated but were indicated by a point or a line. The wetland acreage that they contained is unknown.

The majority of the wetlands found in this survey are naturally occurring and intact. Most wetlands are spring seeps, small creeks associated with the seeps, larger creeks that cascade down the andesite cliffs, or marsh wetlands characterized by *Alnus incana* or varieties of *Salix* that formed on the floodplain of the Middle Creek.

Many of the wetlands were altered as a result of the previous road building activity. Typically, the road construction truncated the natural contours of a spring seep resulting in the exit of waters from the seep into a ditch along the road. In one case, floodplain wetlands are partially buried by roadbed. All Riverine wetlands have been diverted into culverts beneath the road. In the western third of the survey area, as the elevation increases, it is more common to see cliff face wetlands that have been excavated in the course of road building. And in higher elevations it is common to see wetlands that are buried beneath rocks and talus used for roadfill. Nevertheless, all older excavated wetlands demonstrated vigorous regrowth of wetland vegetation.

One new rare plant site was discovered within the wetlands. One new exotic plant species was discovered within the wetlands.

CONCLUSION

It appears that any road construction that involves widening or moving the road base would have the potential to impact any or all of the 103 wetlands encountered in these two surveys. However, mitigation sites within the park are being explored. And creative construction plans might limit or avoid any wetland impacts. Some alternatives to wetland dredging or filling include: a) widening a road on the side *away* from the wetland, b) *down-cutting* the road on cliff-sides rather than filling the roadside with rubble to expand roadbed width, c) the use of retaining walls to extend the road base outward over steep down-slopes, d) the use of larger culverts or bridges to avoid contact with the wetland, or e) moving the entire roadbed out of the wetland area.

As it now stands, if construction is to occur that would impact these wetlands it will be necessary to obtain the necessary Wetland Alterations Permits from the U.S. Army Corps of Engineers and Wyoming Department of Environmental Quality.

Copies of this wetland determination are being sent to planning office at Yellowstone National Park and the Federal Highways Program. The Federal Highways Program will be applying for the Section 404 permit. Additional copies are available from Yellowstone Center for Resources, Yellowstone National Park.

- David Schmoller and Cole Irvin
December 5, 2000

SELECTED REFERENCES

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. Publ. No. FWS/OBS-79/31, US Fish and Wildlife Service, Office of Biological Services, Washington, DC. 107 pp.

Dorn, Robert D. 1992. *Vascular Plants of Wyoming*. Mountain West Publishing, Cheyenne, Wyoming.

Environmental Laboratory. 1987. *"Corps of Engineers Wetlands Delineation Manual,"* Technical Report Y-87-1, US Army Engineers Waterways Experiment Station, Vicksburg, Miss.

Federal Interagency Committee for Wetland Delineation. 1989. *Federal Manual for Identifying and Delineating Jurisdictional Wetlands.* U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S.D.A. Soil Conservation Service, Washington, D.C. Cooperative technical publication. 76 pp. Plus appendices.

Hitchcock, C. L., and Arthur Cronquist. 1973. *Flora of the Pacific Northwest.* University of Washington Press, Seattle, Washington.

Reed, P.B., Jr. 1996. *National List of Vascular Plant Species That Occur in Wetlands: 1996 National Summary*. Ecology Section, National Wetlands Inventory, US Fish and Wildlife Service, Washington, DC. 209 pp.

Rodman, A., H. F. Slovic, and D. Thoma. 1996. *Soils of Yellowstone National Park.* Yellowstone Center for Resources, Yellowstone National Park, Wyoming, YCR-NRSR-96-2.

APPENDIX 1. ***Plant Names and Wetland Indicator Status.***

A list for plants found in wetlands within 200 feet of the East Entrance Road between East Entrance and Sylvan Pass. Nomenclature follows that used by Reed (1996), Dorn (1992), and Hitchcock and Cronquist (1973).

STRATUM	COMMON NAME	SCIENTIFIC NAME	STATUS *
TREE	Balsam poplar	*Populus balsamifera*	FAC
SHRUB	Speckled alder	*Alnus incana*	FACW
	Sitka alder	*Alnus sinuata*	FACW
	Hudson Bay currant	*Ribes hudsonianum*	FACW
	Prickly currant	*Ribes lacustre*	FAC+
	Swamp red currant	*Ribes triste*	FAC
	Barclay willow	*Salix barclayi*	FACW
	Bebb willow	*Salix bebbiana*	FACW
	Booth's willow	*Salix boothii*	OBL
	Hoary willow	*Salix candida*	OBL
	Drummond willow	*Salix drummondiana*	FACW
	Geyer willow	*Salix geyerana*	FACW
	Pacific willow	*Salix lasiandra*	FACW+
	Lemmon's willow	*Salix lemmonii*	FACW+
	Dusky willow	*Salix melanopsis*	OBL
	Scouler willow	*Salix scoulerana*	FAC
SEDGE	Water sedge	*Carex aquatilis*	OBL
	Inland sedge	*Carex interior*	FACW-
	Nebraska sedge	*Carex nebrascensis*	OBL
	Small-wing sedge	*Carex microptera*	FAC
	Beaked sedge	*Carex utriculata*	OBL
SPIKERUSH	Creeping spikerush	*Eleocharis palustris*	OBL
WOODRUSH	Smooth woodrush	*Luzula hitchcockii*	NI
BULRUSH	None	---	---
RUSH	Baltic rush	*Juncus balticus*	OBL
	Flattened rush	*Juncus compressus*	OBL
	Three-stamen rush	*Juncus ensifolius*	FACW
	Regel's Rush	*Juncus regelii*	FACW

	Slender rush	*Juncus tenuis*	FAC
GRASS	Cutting wheatgrass	*Agropyron caninum*	FAC-
	Redtop	*Agrostis alba*	FACW
	Spreading bentgrass	*Agrostis stolonifera*	FAC
	Bentgrass	*Agrostis exarata*	FACW
	Fringed brome	*Bromus ciliatus*	FAC
	Smooth brome	*Bromus inermis*	UPL?
	Blue-joint reedgrass	*Calamagrostis canadensis*	FACW+
	Annual hairgrass	*Deschampsia danthonioides*	FACW-
	Blue Wild-Rye	*Elymus glaucus*	FACU
	Tall Manna Grass	*Glyceria elata*	FACW+
STRATUM	**COMMON NAME**	**SCIENTIFIC NAME**	**STATUS***
GRASS	Kentucky Bluegrass	*Poa pratensis*	FACU+
	Alpine Timothy	*Phleum alpinum*	FACW
	Timothy	*Phleum pratense*	FAC-
	Fowl bluegrass	*Poa palustris*	FAC
FORB	Columbia Monkshood	*Aconitum columbinum*	FACW
	Brandegee onion	*Allium brandegei*	NI
	Common pearly everlasting	*Anaphalis margaritaceae*	NI
	Lyall's angelica	*Angelica arguta*	FACW
	Pussy-toes	*Antennaria spp.*	NI
	Hairy rockcress	*Arabis hirsuta*	FACU
	Seep Spring Arnica	*Arnica longifolia*	FACW
	Twin arnica	*Arnica sororia*	NI
	Western meadow aster	*Aster campestris*	NI
	Eaton aster	*Aster eatonii*	FAC+
	Siskiyou aster	*Aster hesperius*	OBL
	Thick-stemmed Aster	*Aster integrifolius*	NI
	Pennsylvanica bitter-cress	*Cardamine pensylvanica*	FACW
	Indian paintbrush	*Castilleja spp.*	NI
	Chickweed	*Cerastium fontanum*	NI
	Creeping thistle	*Cirsium arvense*	FACU+

	Field horsetail	*Equisetum arvense*	FAC
	Rough horsetail	*Equisetum hyemale*	FACW
	Fireweed	*Epilobium angustifolium*	FACU+
	Smooth willow-herb	*Epilobium glabberimum*	FACW
	False mermaid-weed	*Floerkia proserpinacoides*	FACW
	Catchweed bedstraw	*Galium aparine*	FACU
	Small bedstraw	*Galium trifidum*	FACW+
	Groundsmoke	*Gayophytum spp.*	FACW+
	Richardson's cranesbill	*Geranium richardsonii*	FAC-
	Sticky cranesbill	*Geranium viscosissimum*	FACU-
	Large-leaf avens	*Geum macrophyllum*	FACW+
	Cow parsnip	*Heracleum lanatum*	FAC+
	Four-line honeysuckle	*Lonicera involucrata*	FAC+
	Creeping Oregon-grape	*Mahonia repens*	NI
	Lily of the valley	*Maianthemum stellatum*	NI
	Field mint	*Mentha arvensis*	FAC
	Streamside bluebells	*Mertensia ciliata*	FACW+
	Floriferous monkey-flower	*Mimulus floribundus*	OBL
	Common monkey-flower	*Mimulus guttatus*	OBL
	Lewis' monkey-flower	*Mimulus lewisii*	FACW+
	Muskflower	*Mimulus moschatus*	FACW+
	Five-point bishop's cap	*Mitella pentandra*	FAC
	Mountain sweet-cicely	*Osmorhiza chiliensis*	NI
	Gairdner's Yampah	*Perideridia gairdneri*	FAC
	Leafy white orchid	*Platanthera dilatata*	FACW+
STRATU	**COMMON NAME**	**SCIENTIFIC**	**STATUS**

M		NAME	*
FORB	Douglas' knotweed	*Polygonum douglasii*	FACU
	Tall cinquefoil	*Potentilla arguta*	FACU
	Pink wintergreen	*Pyrola asarifolia*	FACU
	One-sided wintergreen	*Pyrola minor*	FACU+
	Celery-leaf buttercup	*Ranunculus scleratus*	OBL
	White water-crowfoot	*Ranunculus uncinatus*	FAC-
	Bog yellow-cress	*Rorippa palustris*	OBL
	Woods rose	*Rosa woodsii*	FACU
	Western thimbleberry	*Rubus parviflorus*	FAC-
	Curly dock	*Rumex crispus*	FAC+
	Brook saxifrage	*Saxifraga arguta*	FACW+
	Red-pod stonecrop	*Sedum rhodanthum*	FACW
	Golden groundsel	*Senecio pseudaureus*	FACW
	Butterweed gourndsel	*Senecio serra*	FACU
	Arrow-leaf groundsel	*Senecio triangularis*	FACW+
	Canada goldenrod	*Solidago canadensis*	FACU
	Hooded ladies tresses	*Spiranthes romanzoffiana*	OBL
	Western meadow-rue	*Thalictrum occidentale*	FACU
	Alsike clover	*Trifolium hybridum*	FAC
	White clover	*Trifolium repens*	FACU+
	Broad-leaf cattail	*Typha latifolia*	OBL
	Stinging nettle	*Urtica dioica*	FAC+
	American speedwell	*Veronica americana*	OBL
	Small white violet	*Viola macloskeyi*	OBL
BRYOPHYTE	Moss	*Moss spp.*	NI
	Liverwort	*Liverwort spp.*	NI
FERN	Lady fern	*Athyrium filix-femina*	FAC
	Brittle fern	*Cystopteris fragilis*	FACU

*Wetland Indicator Status categories are defined as follows (Environmental Laboratory, 1987, and Reed, 1996):

OBL = OBLIGATE WETLAND PLANT: Occurs almost always (probability > 99%) in wetlands.

FACW = FACULTATIVE WETLAND PLANT: Usually occurs in wetlands (probability 67% - 99%).

FAC = FACULTATIVE PLANT: Has a similar probability (probability 33% - 67%) of occurring in both wetlands and non-wetlands.

FACU = FACULTATIVE UPLAND PLANT: One that occurs less often in a wetland as compared to a non-wetland (1% - 33% probability of occurring in a wetland).

APPENDIX 2. ***Wetland Classifications of Delineated Wetlands.***

A list of all of the wetlands and their respective Cowardin Classifications (Cowardin, 1979) that were observed within the survey area on the road between East Entrance and Sylvan Pass.

SITE	CLASS	FEATURE
001	PEM1C	
002	PSS1J	
003	PSS1J	
004	PEM1B	
005	PEM1B	
006	PEM1B	
007	R3SB3	
008	PEM1B	
009	R3SB3	
010	PSS1J	
011	PEM1B	
012	R3SB3/PEM1B	
013A	PEM1B/R3SB3	
013**d**	PEM1D**x**	ditch
014A	PEM1B	
014**d**	PEM1D**x**	ditch
015A	PEM1B	
015**d**	PEM1D**x**	ditch
016	PEM1B/R3SB3	
017	PEM1B	
018	PEM1B	
019	R3SB3	
020	PEM1B	
021	PEM1B	
022	PEM1B	
023	PEM1B	
024	PEM1B	
025	PEM1B	
026	R3SB3	
027	PEM1B/R3SB3	
028	R3SB3	
029	PEM1B	
030	PEM1B	
031	PEM1B	
032	R3SB3	
033	R3SB3	
034	PEM1B	
035	R3SB3	
036	R3SB3	
SITE	**CLASS**	**FEATURE**
037A	PEM1B	
037B	PEM1B	
037C	PEM1B	
038	PEM1B	
039	PEM1B	
040A	PEM1B/R3SB3	
040**d**	PEMD**x**	ditch
041	PEM1B	
042	PEM1B	
043	PEM1B	
044A	PEM1B	
044B	PEM1B	
044**d**1	PEM1B**x**	ditch
044**d**2	PEM1B**x**	ditch
045	PEM1B	
046	PEM1B	
047	PEM1B	
048	PEM1B	
049	PEM1B	
050	PEM1B	
051	R3SB3	
052	R3SB3	
053A	PEM1B	
053**d**	PEM1B**x**	ditch
054	R3SB3	
055	R3SB3	
056**d**	PEM1B**x**	ditch
057	PEM1B	
058	PEM1B	
059	PEM1B	
060	R3SB3	
061	R3SB3	
062	R3SB3	
063	R3SB3	
064	PEM1B	
065	PEM1B	
066	R3SB3/PEM1B	
067	PEM1B	
068	PEM1B	
SITE	**CLASS**	**FEATURE**
069	PEM1B	
070	PEM1B	
071	R3SB3/PEM1B	
072	R3SB3	
073	PEM1B	
074	R3SB3	
075	R3SB3	
076	R3SB3	
077	R3SB3	
078	PEM1B	
079	R3SB3	
080	R3SB3	
081	PEM1B	
082	PEM1B	
083	PEM1B	
084	PEM1B	
085A	PEM1B/R3SB3	
085**d**	PEM1B**x**	ditch
086	PEM1B/R3SB3	

087	R3SB3	
088	R3SB3	
089	R3SB3	
090	PEM1B	
091	R3SB3	
092	R3SB3	
093	R3SB3	

094	R3SB3/PEM1B	
095	R3SB3	
096	R3SB3	
097	R3SB3	
098	R3SB3	
099	R3SB3	

100	R3SB3	
101	R3SB3	
102	R3SB3/PEM1B	
103	R3RBH	Middle Cr.

APPENDIX 3. ***GPS Data for Wetlands from East Entrance to Sylvan Pass***

WETLAND NUMBER	SHAPE	FEATURE	DATE CORRECTED	AREA[a] IN METERS²	AREA[a] IN ACRES	PERIMETER[b] IN METERS	PERIMETER[b] IN MILES
eesp001	POLY		8/1/00	28.133	0.007	31.971	0.0199
eesp002	POLY		8/2/00	1092.173	0.270	274.802	0.1708
eesp003	POLY		8/2/00	107.937	0.027	59.075	0.0367
eesp004	POLY		8/9/00	117.866	0.029	65.297	0.0406
eesp005	POLY		8/9/00	514.769	0.127	142.598	0.0886
eesp006	POLY		8/9/00	106.031	0.026	48.047	0.0299
eesp007	POLY		8/9/00	14.236	0.004	18.415	0.0114
eesp008	POLY		8/9/00	42.125	0.010	27.322	0.0170
eesp009	POLY		8/9/00	47.261	0.012	33.735	0.0210
eesp010	POLY		8/29/00	272.264	0.067	140.404	0.0873
eesp011	POLY		8/9/00	1668.501	0.412	259.158	0.1611
eesp012	POLY		8/9/00	226.144	0.056	132.619	0.0824
eesp013a	POLY		8/9/00	113.735	0.028	104.648	0.0651
eesp013d	POLY	**ditch**	8/9/00	58.415	0.014	93.248	0.0580
eesp014a	POLY		8/9/00	281.509	0.070	105.922	0.0658
eesp014d	POLY	**ditch**	8/9/00	57.039	0.014	91.404	0.0568
eesp015a	POLY		8/9/00	284.74	0.070	118.765	0.0738
eesp015d	POLY	**ditch**	8/9/00	62.778	0.016	85.938	0.0534
eesp016	POLY		8/9/00	580.078	0.143	145.082	0.0902
eesp017	POLY		8/9/00	9.629	0.002	12.077	0.0075
eesp018	POLY		8/10/00	477.645	0.118	209.374	0.1302
eesp019	POLY		8/10/00	114.581	0.028	184.829	0.1149
eesp020	POLY		8/10/00	65.996	0.016	47.061	0.0293

eesp021	POLY		8/10/00	38.587	0.010	32.225	0.0200
eesp022	POLY		8/14/00	3947.627	0.975	801.64	0.4983
eesp023	POLY		8/14/00	45.606	0.011	99.296	0.0617
eesp024	POLY		8/14/00	49.686	0.012	49.768	0.0309
eesp025	POLY		8/14/00	265.981	0.066	201.361	0.1252
eesp026	POLY		8/14/00	49.321	0.012	162.681	0.1011
eesp027	POLY		8/15/00	94.034	0.023	76.52	0.0476
eesp028	POLY		8/15/00	129.456	0.032	83.541	0.0519
eesp029	POLY		8/15/00	207.988	0.051	95.164	0.0592
eesp030	POLY		8/15/00	753.502	0.186	195.516	0.1215
eesp031	POLY		8/15/00	5262.251	1.300	472.513	0.2937
eesp032	POINT	**No access**					
eesp033	POLY		8/15/00	207.941	0.051	140.968	0.0876
eesp034	POINT	**No access**					
eesp035	POINT	**No access**					
eesp036	POLY		8/15/00	218.611	0.054	167.009	0.1038
eesp037a	POLY	**A complex**		973.041	0.240	203.102	0.1263
eesp037b	POLY	**A complex**		57.978	0.014	49.433	0.0307
WETLAND NUMBER	**SHAPE**	**FEATURE**	**DATE CORRECTED**	**AREA[a] IN METERS^2**	**AREA[a] IN ACRES**	**PERIMETER[b] IN METERS**	**PERIMETER[b] IN MILES**
eesp037c	POLY	**A complex**		49.647	0.012	36.647	0.0228
eesp038	POLY			772.297	0.191	157.119	0.0977
eesp039	POLY			214.554	0.053	98.469	0.0612
eesp040a	POLY			1166.388	0.288	309.322	0.1923
eesp040d	POLY	**ditch**		89.251	0.022	142.52	0.0886
eesp041	POLY			143.787	0.036	84.581	0.0526
eesp042	LINE	**No access**					
eesp043	POLY			3177.993	0.785	343.313	0.2134
eesp044a	POLY			541.444	0.134	122.446	0.0761
eesp044b	POLY			637.672	0.158	147.412	0.0916
eesp044d1	POLY	**ditch**		28.243	0.007	30.364	0.0189

eesp044d2	POLY	**ditch**		14.508	0.004	25.814	0.0160
eesp045	POLY			3266.163	0.807	659.655	0.4101
eesp046	LINE						
eesp047	POLY			2725.446	0.673	520.046	0.3233
eesp048	LINE	**No access**					
eesp049	LINE	**No access**					
eesp050,052	POLY			4532.729	1.120	518.804	0.3225
eesp051	POLY			136.763	0.034	49.57	0.0308
eesp053a	POLY			227.636	0.056	87.342	0.0543
eesp053d	POLY	**Ditch**		90.66	0.022	189.695	0.1179
eesp054	POLY			122.107	0.030	67.355	0.0419
eesp055	POINT	**No access**					
eesp056d	LINE	**Seep+ditch**					
eesp057	POINT	**No access**					
eesp058	LINE	**No access**					
eesp059	POINT	**No access**					
eesp060	POINT	**No access**					
eesp061	POINT	**No access**					
eesp062a	POLY			290.852	0.072	140.821	0.0875
eesp062b	POLY			17.853	0.004	41.486	0.0258
eesp063	POINT	**No access**					
eesp064	POINT	**No access**					
eesp065	LINE	**No access**					
eesp066	POLY			1444.36	0.357	144.379	0.0898
eesp067	POINT	**No access Actually a polygon**					

		wetland					
eesp068	POINT	**No access**					
eesp069	POINT	**No access**					
eesp070	LINE	**No access**					
eesp071	LINE	**No access**					
eesp072	POINT	**No access**					
eesp073	POINT	**No access**					
WETLAND NUMBER	**SHAPE**	**FEATURE**	**DATE CORRECTED**	**AREA[a] IN METERS²**	**AREA[a] IN ACRES**	**PERIMETER[b] IN METERS**	**PERIMETER[b] IN MILES**
eesp074	POLY			59.683	0.015	73.857	0.0459
eesp075	POINT	**No access**					
eesp076	POINT	**No access**					
eesp077	POLY			268.788	0.066	124.735	0.0775
eesp078	POINT	**Tiny seep**					
eesp079	LINE	**No access**					
eesp080	POINT	**No access**					
eesp081	LINE	**No access**					
eesp082	POINT	**No access Actually a polygon wetland**					
eesp083	LINE	**No access**					
eesp084	LINE	**No access**					
eesp085a	POLY			2270.435	0.561	194.495	0.1209
eesp085b	POLY			16.16	0.004	22.043	0.0137
eesp085d	LINE	**Ditch**					

eesp086	POINT	**No access**					
eesp087	POINT	**No access**					
eesp088	POINT	**No access**					
eesp089	POINT	**No access**					
eesp090	LINE	**No access**					
eesp091	POINT	**No access**					
eesp092	POLY			341.88	0.084	165.65	0.1030
eesp093	POLY			96.631	0.024	50.552	0.0314
eesp094	POLY			358.399	0.089	124.333	0.0773
eesp095	POINT	**No access**					
eesp096	POLY			30.789	0.008	52.013	0.0323
eesp097	POINT		8/29/00				
eesp098	POLY			75.104	0.019	51.539	0.0320
eesp099	POLY			64.181	0.016	68.531	0.0426
eesp100	POINT	**No access**					
eesp101	POLY			1.516	0.000	4.926	0.0031
eesp102	POINT	**No access Actually a polygon wetland**					
eesp103	LINE	**Middle Cr.**	10/11/00				
TOTAL ACRES ALL WETLANDS					**10.098**		
TOTAL ACRES ALL DITCHES					**0.099**		

[a] Refers to acreage or square meters of the wetland found within the survey area, that is, the amount of the wetland that was found within the approximate 200 foot limit.

[b] Refers to perimeter of the wetland found within the survey area, that is, the amount of the wetland that was found within the approximate 200 foot limit.