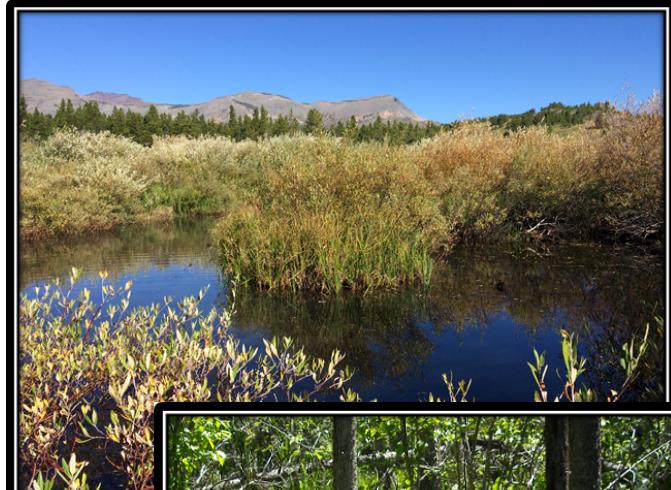


Montana Ecological Integrity Assessment Field Manual

May 2017



MONTANA
**Natural Heritage
Program**

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WETLAND ECOLOGICAL INTEGRITY ASSESSMENT PROTOCOL
May 2017

Section 1. Assessment Area Information

A. General Principles of AA Establishment:

1. The AA should be 0.5 ha (5,000m²) whenever possible, but can be as small as 0.1 ha (1,000 m²) if necessary.
2. The maximum AA length is 200 meters, regardless of shape.
3. The minimum AA width is 20 meters, regardless of shape.
4. The AA should contain no more than 10% water > 1 meter in depth. This includes water in a stream channel.
5. The AA can cross and contain a stream channel that is < 1 meter in depth. The AA should not cross streams that are too deep or unsafe to wade.
6. If the wetland is < 25 meters in width and linear (e.g., riparian zone or lacustrine fringe), the AA will be a rectangle starting at the point and moving upstream no more than 200 m. The AA will be **smaller** than 0.5 ha. For example, if the wetland habitat is 20 m wide, the AA would be $20 \times 200 = 4,000\text{m}^2 = 0.4 \text{ ha}$. Note: The AA should occur on only one side of the channel.
7. The AA should contain no more than 10% upland inclusions.
8. The AA center should be as close to the site's original target point as possible.
9. The AA should be established so that the entire wetland is represented, meaning that the AA should encapsulate the variety of plant communities, plant species, water regimes, soil types, etc... in the approximate ratio that they occur in the entire wetland.

Before establishing an AA, the field crew should write down the latitude (Y) and longitude (X) of the original target AA Center coordinates, noting the GPS unit make, model, and designated unit # on the field form. Once the AA is established, take a waypoint at the established AA center, whether it is centered on the original target coordinates or not, using the waypoint naming conventions outlined in Appendix J. Write down the waypoint ID, datum, zone, elevation (m), latitude (Y), longitude (X), and accuracy (m) on the form. **RECORD THE GPS COORDINATES OF ALL WAYPOINTS.**

B. Establishing the Assessment Area (AA)

1. **Standard Layout of the AA:** Navigate to the original target coordinates using the GPS; this is the AA center. In open vegetation, pull a tape out 40 meters to the north and walk in a circle, flagging the boundary of the AA with pin flags or flagging tape. At least eight flags should be used to mark the AA boundary, one in each of the four cardinal directions (N, S, E, W) and one in each of the ordinal directions (NE, SE, SW, NW). More flagging can be used if it is difficult to see all of the flagging. This 40-m radius circular plot (0.5 hectares) is the AA. If the total area of the wetland is smaller than 0.5 hectares, then the entire wetland is the AA. If the entire wetland can hold an AA with a 40-m radius, but the original target coordinates are too close to the wetland perimeter, then go to Alternate AA Layout 1, below. If the wetland is linear (e.g., riverine sites) and cannot hold an AA with a 40-m radius, then go to Alternate AA Layout 2, below. If the wetland area is smaller than 0.5 ha OR the wetland is larger than 0.5 ha but the wetland boundaries are such that a 0.5 ha AA cannot be established, then go to Alternate AA Layout 3, below.

- 2. Alternate AA Layout 1 -**

Adjusting the AA for wetlands that can hold an AA with a 40-m radius: If the entire wetland can hold an AA with a 40-m radius, but the original target coordinates for the AA center are too close to the wetland perimeter, then the center of the AA can be moved from the original coordinate location, but should be as close to the original target point as possible.

3. Alternate AA Layout 2 – Rectangle:

Adjusting the AA for wetlands that are too narrow to hold an AA with a 40-m radius: If a 40-m radius circle does not fit within the wetland area, then field crews may decide to use a rectangular shape to define the AA. Rectangle dimensions should reflect the target AA size of 0.5 ha (5,000 m²). For example, a square AA should be 71 meters on each side (71 x 71 = 5041). If the wetland is 50 meters wide, the rectangle should be 50 x 100 m. The *maximum* length of a rectangular AA is 200 meters and the *minimum* width is 20 meters. Beyond 200 meters in length, the wetland may be highly variable and too difficult to assess in one visit. An AA less than 20 meters in width is too difficult to establish the vegetation plot. Rectangular AAs may be centered on the point. **Rectangular AAs should only be used where the wetland area is generally straight, and the size of the AA is not compromised by bends in the wetland boundary.** The boundary of the AA should be flagged as often as necessary so the boundary is easily visible. GPS waypoints should be taken at each of the four corners of rectangular AAs, and their coordinates should be recorded on page 1 of the field form under AA Corner #1, AA Corner #2, AA Corner #3, and AA Corner #4

If the wetland is >25 m wide and linear, then the AA will be laid out beginning at the point and moving upstream the distance needed to produce a rectangular AA of 0.5 hectares . For example, if the wetland habitat along a river is 40 m wide, then the length of the AA would be $5,000 \text{ m}^2 / 40 \text{ m}^2 = 125 \text{ m}$.

4. Alternate AA Layout 3 – AA Polygon:

If the wetland area is smaller than 0.5 ha OR the wetland is larger than 0.5 ha but the wetland boundaries are such that a 0.5 ha AA cannot be established, then the AA shape can be determined by the shape of the wetland itself. If the entire wetland is smaller than 0.5 ha, then the entire wetland becomes the AA. If the wetland is large enough but oddly shaped, the field crew must estimate the general dimensions of the wetland using the aerial photos provided and determine the best way to establish a 0.5 ha AA. The field crew will walk the AA perimeter with the GPS in TRACK mode, flagging the AA perimeter as they walk. Once the perimeter is walked and the shape is complete, the GPS unit will calculate the area of the shape and the crew can adjust it as needed to create a 0.5 ha AA. The GPS track is saved to the GPS unit and named by the point code (e.g., RV001AATRACK).

The field crew should note any changes to the AA and the reasoning behind such selection (e.g., wetland too narrow, required a rectangular AA of 40 x 125 m).

C. General Assessment Area (AA) Information

Note that Omernik Ecoregions (Level 3 & 4), USGS Hydrologic Unit Codes (e.g., HUC4/HUC5/HUC6), and USGS Quadrangle (Quad) Name should all be assigned in the office using a GIS.

- 1. Site ID:** This is the unique identifier assigned during the sample selection process. This identifier MUST be maintained throughout the project duration. Place the Site ID on each sheet of the data form.
- 2. Site Name:** This is not required, but assigning a name to an assessment area may help organize different sites in the field.
- 3. Visit Number:** Indicate whether this is the first, second, etc. visit to the site.

4. **Level of Assessment:** Indicate whether this is a Level 2 or a Level 3 assessment.
5. **Date:** Record the date the wetland was assessed written as month, day, year (e.g., 7/12/2014)
6. **Observers:** List the full names of all observers present during the wetland assessment.
7. **County:** This will help the Botanist hone their potential plant list (e.g., SOC list, Lesica 2012).
8. **Nearest Town:** This is helpful for organizing datasheets and recollecting site locations later.
9. **Land Ownership:** This should be determined prior to any site visit and then filled in on the form during the assessment.
10. **Is This a Mitigation Wetland?:** Select Yes or No. If yes, answer questions regarding pre- and post-construction visits.
11. **Slope and Aspect 1 and 2:** The field form contains two places to record slope and aspect for assessment areas that have two general slopes and aspects (e.g., a riverine wetland might slope down to the river channel and also with the general gradient and direction of the stream). Use a compass to measure both the slope and the aspect. Aspect should be measured while pointing downhill/down the slope.
12. **AA location relative to the target AA coordinates:** Check the appropriate case for the location of the AA relative to the original target coordinates. Determine if the AA is centered around the original target coordinates; the AA center is shifted and >60m from original target coordinates; shifted but ≤60 meters of the original target coordinates; or there were no original target coordinates.
13. **AA dimensions:** Check the appropriate case for the AA dimensions. The AA is a 40 meter radius circle; the AA is a rectangle (record width and length); the AA has an alternate layout.

D. GPS Coordinates at the AA Center

1. **Target AA Center Coordinates:** Record the original target coordinates of the selected AA center.
2. **GPS Unit Information and Unit Number:** Record the make and model of the GPS unit and, if applicable, the unit number.
3. **Actual Waypoint ID:** This is the ID assigned to the waypoint taken at the actual center of the AA. Rename the automatically assigned three digit number to a logical Waypoint ID as per Appendix J. Be certain to keep the waypoint ID consistent between the data form and the GPS.
4. **Accuracy:** Record the accuracy in meters given on the GPS unit. Consult the user's manual if it is necessary to change units from feet to meters.
5. **Datum:** This should be NAD83. Methods for changing the datum on the GPS will depend upon the model used. Consult the user's manual if necessary.
6. **Elevation:** Record the elevation in meters given on the GPS unit. Consult the user's manual if necessary to change units from feet to meters.
7. **Longitude (X) and Latitude (Y):** Since the AA Center can be moved from the original target coordinates, these may or may not be different from the target coordinates. Record coordinates in UTM. Changing the coordinate system on the GPS unit depends upon the model used. Consult the user's manual if necessary to change from degrees-minutes-seconds or from decimal degrees to UTM.
8. **GPS Coordinates for alternate AA layout:** Record each waypoint ID, coordinates, and accuracy for the AA corners (rectangular OR polygonal AA) or the name of the GPS track. Rename the automatically assigned three digit number to a logical Waypoint ID/Track Name as per Appendix J.

E. General Assessment Area Description

Include a general description of the assessment area and the surrounding uplands. Describe the wetland type, dominant vegetation, general location, and any notable feature about the AA that may not have been captured in the classification or other information. Note surrounding vegetation (including uplands) and land use.

F. Directions to the Assessment Area and Access Comments

Detailed directions to the site can be written back at the office using the gazetteer. Note any issues that affected access to the AA.

G. Topographic Position and Water Information

1. **Topographic Position:** Select the appropriate topographic position category based on the position of the AA in the landscape.
 - *Slope*- Intermediate slope position, not the toe of the slope but actually on a sloping face.
 - *Toeslope*- Outermost gently inclined surface at base of a slope. In profile, commonly gentle and linear and characterized by alluvial deposition.
 - *Basin floor*- Nearly level to gently sloping, bottom surface of a basin.
 - *Valley bottom*- Valley floor or shoreline representing the former position of an alluvial plain, lake, or shore.
 - *Floodplain* - The nearly level alluvial plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artificially. It is usually a landform built of sediment deposited during overflow and lateral stream migration.
2. **Amount of Assessment Area Covered by Standing Water:** Select the appropriate cover of standing water in the AA.
3. **Estimated Depth of Standing Water:** Select the appropriate depth of standing water (averaged over the entire AA).
4. **Surface Water Permanence:** Based on vegetation, soil characteristics, and topographic position, select whether the AA is generally saturated during the growing season, or if the AA surface water is semipermanent, seasonal, or temporary during the growing season.

H. Photos of the Assessment Area

The Photo Card appears in the corner of each photo (Figure 1). Using a dry erase pen, fill in the Site ID, date, and bearing of the photo on the Photo Card. Be sure that the Photo Card takes up very little of the photo, but that the information on the Photo Card is visible in the photo.

Note: Watch for glare off of the Photo Card.

Record a description on the data form, when necessary. Record the number of the photo from the camera onto the form. Be certain that this number is maintained when the photos are downloaded onto the computer.

Take a GPS point at each overview and additional photo location. Rename the automatically assigned three digit number to a logical Waypoint ID as per Appendix J. Record each waypoint ID, coordinates, and accuracy on the data form.

- 1. Camera Information:** Record the camera make, model, and serial number.
- 2. Photos from the AA Center:** From the AA center, take four photos; one in each cardinal direction.
- 3. AA Overview:** Take two photos showing an overview of the entire AA. This may require standing at a distance or climbing a nearby hill to gain some perspective. The first overview should include the Photo Card, while the second overview should only include the AA landscape view. Record the bearing of both photos (should be the same) on both the form and the Photo Card (when used)."
- 4. Additional Photos:** Take any additional photos that you feel would provide additional information for the AA. Record the number of the photo from the camera onto the form. Be certain that this number is maintained when the photos are downloaded onto the computer.



Figure 1. Examples of AA photos. Note placement of photo card in the corner of each photo.

I. Classification of the Assessment Area

For EACH of the following classifications, select the appropriate Confidence Level for your selection and provide reasoning for your selection on the data form.

1. Ecological System:

Select the appropriate Ecological System of the AA from the list using the Key to Wetland Ecological Systems of Montana (Appendix A). If none of the provided Ecological Systems is appropriate, check "Other" and provide a detailed explanation. If possible, select only one dominant Ecological System.

2. Hydrogeomorphic (HGM) Class:

Select the appropriate HGM class of the AA using the Key to the Hydrogeomorphic Classification of Wetlands in the Rocky Mountains (Appendix B). The AA should encompass only one dominant HGM class.

3. Cowardin Classification:

Record all appropriate Cowardin classification codes using the definitions provided in the Key to the Cowardin Systems and Classes of the Rocky Mountains (Appendix C; FGDC 2013). Select the appropriate Water Regime based on the descriptions on p.2 of the field form. Each complete Cowardin code (System + Class + Water Regime + Special Modifier (optional)) should be applied to no less than 1% of the AA. The percentages of each Cowardin code + "other" Cowardin codes not listed (e.g., Riverine System, Rocky Shore Class, etc...) + the % of Upland in the AA (from p.1) should equal 100% of the AA.

Section 2. Plant Zone Description for the Assessment Area

See Table 1 for the following scales and values used in this Section: Height Scale, Cover Scale, Stratum, Avg. Water Depth for Each Plant Zone, Plant Community (adapted from Eggers & Reed 2015).

A. Distinguishing Individual Plant Zones: Plant zones usually consist of more than one plant species, but some zones can be monospecific. Identify and describe the plant zones that occur within the assessment area. A plant zone should be described if it meets the following rules:

1. The plant zone is dominated by...
 - a. A stratum distinctly different from the stratum that dominates other plant zones; OR
 - b. The same stratum as other plant zones, BUT each plant zone is dominated by different species.
2. The plant zone makes up more than 5% of the AA (e.g., 250 m² for an AA of 0.5 ha).
3. Each individual patch of the plant zone is greater than 10m².

B. Summary of Each Plant Zone Within the AA:

1. **% of AA:** Estimate the percent cover of each plant zone within the AA using the cover class scales.
2. **Cowardin Code:** Assign a Cowardin code to each plant zone. The plant zone Cowardin codes and the %'s in which they exist should correlate to the Cowardin codes and %'s assigned on p.2 of the field form (See Section 1.I.3.). There can be multiple plant zones with the same Cowardin code, as long as they are distinguishable according to the rules outlined in Section 2.A. above. For example, if there is 50% PEMC and 50% PSSA recorded on p.2 in the 'Cowardin Classification' section of the field form, then there should be at least two plant zones recorded in this 'Summary...' section, e.g., Plant Zone #1 = 50% of the AA and is PEMC, Plant Zone #2 = 20% of the AA and is PSSA, and Plant Zone #3 =30% of the AA and is PSSA, where Plant Zone#2 may be dominated by *Cornus sericea* and Plant Zone #3 may be dominated by *Alnus incana*.
3. **Avg. H2O Depth:** Estimate the average water depth of each plant zone within the AA using the depth scale found in Table 1.
4. **Plant Community:** Assign a Plant Community to each plant zone using the Key to Wetland Plant Communities in Montana (Appendix L; adapted from Eggers & Reed (2015) and the values in Table 1). Make sure that the Cowardin Code assigned to a zone coordinates with the Plant Community by using Appendix M.
5. **Comments:** Make any pertinent comments about each plant zone as needed.
6. **"Other":** Fill in the % of the AA that is composed of Cowardin codes not listed on p.2 of the field form (e.g., Riverine System, Rocky Shore Class, etc...) + the sum of all plant zones that are <5% of the AA (these are usually NOT described Plant Zone #1-5)
7. **"Upland":** The % of Upland in the AA (from p.1)

The percentages of each plant zone + the % of "Other" + the % of Upland should equal 100% of the AA.

Indicate the location of each plant zone on the AA drawing and on the aerial photo.

Table 1. Classes and values for height, cover, stratum, average water depth for each plant zone, and plant community for each plant zone (adapted from Eggers & Reed (2015)).

PLANT ZONES WITHIN ENTIRE ASSESSMENT AREA							
Identify and describe the plant zones that occur within the assessment area. Identify the dominant plant species within each stratum. To be considered a separate plant zone, it must make up more than 5% of the AA (e.g., 250 m ² for an AA of 0.5 ha).							
Height Class				Cover Class			
1	<0.5 m	6	10-<15 m	1	Trace	6	10-<25%
2	0.5-1 m	7	15-<20 m	2	<1%	7	25-<50%
3	1-<2 m	8	20-<35 m	3	1-<2%	8	50-<75%
4	2-<5 m	9	35-<50 m	4	2-<5%	9	75-<95%
5	5-<10 m	10	≥50 m	5	5-<10%	10	≥95%
Stratum							
(FO) Forest/Woodland (Trees/Shrubs >6 m)		(SH) Shrubland (Shrubs 0.5-6 m)		(SV) Sparsely Vegetated (including bare ground)			
(H) Herbaceous (e.g., Graminoids, Forbs, Ferns)		(DS) Dwarf Shrubland (<0.5 m)		(CW) Coarse Woody Debris (≥ 7.6 cm diameter)			
(SF) Submerged/Floating (Rooted or floating)		(SD) Standing Dead (>45° angle)		(FW) Fine Woody Debris (≤ 7.5 cm diameter)			
(NV) Nonvascular (Bryophytes, cryptogamic crusts)		(V) Vines		Plant Community for Each Plant Zone			
Avg. Water Depth for Each Plant Zone				AB	Aquatic Bed	HF	Herbaceous Fen
1	Dry	8	30-<40 cm	ShMa	Shallow Marsh	SSF	Scrub-Shrub Fen
2	Moist	9	40-<50 cm	DeMa	Deep Marsh	SSW	Scrub-Shrub Wetland
3	Saturated	10	0.5-<0.75 m	SeMe	Sedge Meadow	CF	Coniferous Fen
4	< 5 cm	11	0.75-<1 m	WeMe	Wet Meadow	CW	Coniferous Wetland
5	5-<10 cm	12	1-<1.5 m	WWMP	Wet/Wet Mesic Prairie	FF	Floodplain Forest
6	10-<20 cm	13	1.5-<2.5 m	SFM	Seasonally Flooded Mudflat	SD	Saline Depression
7	20-<30 cm	14	≥2.5 m	SFBDF	Seasonally Flooded Basin/Depression/Flat		

C. Identify and Describe Each Plant Zone Within the AA:

- Stratum:** Select the appropriate strata (e.g., forest, shrubland, herbaceous, etc.) from Table 1 that coordinates with each dominant species within each plant zone.
- Dominant Species:** Record the dominant species within each plant zone.
- Height Class & Cover Class:** Record the height and cover class of each plant species using the height and cover class scales in Table 1.
- Comments:** Make any pertinent comments about each plant species as needed.

Section 3. Assessment Area Drawing

Provide a drawing of the assessment area, including north arrow, plant zones, vegetation plot/module placement (Level 3 assessment only), soil pit placement (S1 & S2), direction of surface water inlets and outlets with solid arrows, and direction of groundwater/subsurface drainage with dashed arrows. Anthropogenic features like culverts, berms, or impoundments should also be included in the sketch.

Also, indicate any major plant zones on the aerial photo of the AA.

Section 4. Physical Patch Types within the Assessment Area

Physical patches such as open water, mudflats, floating mats, etc. increase the structural complexity of wetlands as well as perform important ecological functions and can be important indicators of wetland function. Patch types are recorded on the datasheet by selecting all that apply from a checklist of different physical surfaces or features that may provide habitat for species (Table 2). For patch types that occur within the AA, estimate the overall cover class of each in the AA.

Table 2. Checklist and Descriptions for Physical Patch Types.

PHYSICAL PATCH TYPE	Present in AA	Percent Cover within AA	Description
Cover Classes 1: trace 2: <1% 3: 1-<2% 4: 2-<5% 5: 5-<10% 6: 10-<25% 7: 25-<50% 8: 50-<75% 9: 75-<95% 10: >95%			
Open water-pond or lake			Medium to large natural water body
Open water -pools			Areas that hold stagnant or slow moving water from groundwater discharge but are not associated with a defined channel.
Open water-river/stream			Areas of flowing water associated with a sizeable channel.
Open water-small rivulet			Areas of flowing water associated with a narrow stream channel.
Open water-oxbow/backwater channel			Areas holding stagnant or slow moving water that have been partially or completely disassociated from the primary river channel.
Open water-tributary/secondary channel			Areas of flowing water entering the main channel from a secondary source.
Open water-beaver pond			Areas that hold stagnant or slow moving water behind a beaver dam.
Active beaver dam			Debris damming a stream clearly constructed by beaver (note gnawed ends of branches)
Beaver canals			Canals cut through emergent vegetation by beaver.
Braided river channel			River channel consisting of a network of small channels separated by small and often temporary islands or bars.
Adjacent or onsite springs/seeps			Localized point of emerging groundwater, often on or at the base of a sloping hillside.
Debris jams/woody debris			Aggregated woody debris in a stream channel deposited by high flows.
Pool/riffle complex			Deep, slow-moving pools alternating with shallow, fast-moving riffles along the relatively straight course of a stream or river.
Point bars			A low ridge of sediment (sand or gravel) formed on the inner bank of a meandering stream.
Bank slumps or undercut banks in channel or along shoreline			A bank slump is the portion of a stream or other wetland bank that has broken free from the rest of the bank but has not eroded away. Undercut banks are areas along the bank or shoreline of a wetland that have been excavated by waves or flowing water.
Mudflats			An accumulation of mud at the edge of shallow waters, such as a lake or pond. Often intermittently flooded or exposed.
Salt flat/alkali flat			Dry open area of fine-grained sediment and accumulated salts. Often wet in the winter months or with heavy precipitation.
Animal mounds or burrows			Mounds or holes associated with animal foraging, denning, predation, or other behaviors.
Plant hummocks			A mound composed of plant material resulting in a raised pedestal of persistent roots or rhizomes.
Water tracks/hollows			Depressions between hummocks or mounds that remain permanently saturated or inundated with slow moving surface water.
Natural island			Naturally occurring islands surrounded by water. Island can be dominated by either wetland or upland vegetation.
Anthropogenic island			Island created by artificial means, often for nesting waterfowl.
Floating mat			Mats of peat held together by roots and rhizomes of sedges. Floating mats are underlain by water and /or very loose peat.
Marl/limonite beds			Marl is a calcium carbonate precipitate often found in calcareous fens. Limonite forms in iron-rich fens when iron precipitates from the groundwater incorporating organic matter.
Other:			

Section 5. Level 2 Assessment Metrics

A. Landscape Context Metrics

1. Landscape Connectivity: This metric measures the percent of unfragmented landscape within a 200 m envelope around the AA perimeter (non-riverine) or the degree to which the riverine corridor above and below a floodplain area exhibits connectivity with adjacent natural systems (riverine). Use either metric a. or metric b. depending on the HGM class.

Metric Measurement Protocol:

a. Non-riverine: The intensity of human activity in the landscape often has a proportionate impact on the ecological processes of natural systems. The percentage of altered landscape (e.g., anthropogenic patches) provides an indirect estimate of connectivity among natural ecological systems. To assess this metric, estimate the percent unfragmented area within the 200 meter envelope. Dirt roads count as fragmentation, but hiking trails can be included in unfragmented blocks. Estimate the landscape connectivity using the following narrative descriptions:

Metrics for Landscape Connectivity – Non-riverine.

(1)	Intact: Assessment area embedded in >90–100% unfragmented, natural landscape.
(2)	Variegated: Assessment area embedded in >75-90% unfragmented, natural landscape.
(3)	Fragmented: Assessment area embedded in >50-75% unfragmented, natural landscape.
(4)	Severely fragmented: Assessment area embedded in 25-50% unfragmented, natural landscape
(5)	Relict: Assessment area embedded in <25% unfragmented, natural landscape.

b. Riverine: For Riverine wetlands (where the channel is within or adjacent to the AA), landscape connectivity is the continuity of the riparian corridor 200 m upstream and 200 m downstream of the AA. Of special concern is the ability of wildlife to enter the riparian area at any place within 200 m of the AA and to move easily through adequate cover along the riparian corridor from either upstream or downstream. Refer to maps and aerial photos provided to estimate the percent of anthropogenic, non-buffer patches within the riparian corridor (the width of the geomorphic floodplain) 200 m upstream and downstream of the AA. Anthropogenic patches include heavily grazed pastures, roads, bridges, urban/industrial development, agriculture fields, and utility right-of-ways. Estimate the landscape connectivity using the following narrative descriptions:

Metrics for Landscape Connectivity – Riverine.

(1)	Intact: Assessment area embedded in >90–100% unfragmented, natural landscape.
(2)	Variegated: Assessment area embedded in >75-90% unfragmented, natural landscape.
(3)	Fragmented: Assessment area embedded in >50-75% unfragmented, natural landscape.
(4)	Severely fragmented: Assessment area embedded in 25-50% unfragmented, natural landscape
(5)	Relictual: Assessment area embedded in <25% unfragmented, natural landscape.

2. Buffer Index: Wetland buffers are vegetated, natural (non-anthropogenic) areas that surround a wetland (Table 3). This metric calculates the overall area and condition of the buffer immediately surrounding the AA using three measures: percent of AA with buffer (buffer length), average buffer width, and buffer condition.

Metric Measurement Protocol:

a. Buffer Length: This metric can be assessed first using aerial photography but must be verified in the field. Visually estimate the total percentage of the AA perimeter that adjoins land cover types that provide buffer functions. To be considered as a buffer, a suitable land cover type must be at least 30 meters in width. For Riverine wetlands, do not include the area immediately upstream or downstream as part of the buffer. Only consider areas on one side of the channel or the other.

Use the following narrative descriptions to estimate the buffer length:

Metrics for Buffer Length.

(1)	A buffer of at least 30 m occurs around 76–100% of the AA perimeter.
(2)	A buffer of at least 30 m occurs around 51–75% of the AA perimeter.
(3)	A buffer of at least 30 m occurs around 25–50% of the AA perimeter.
(4)	A buffer of at least 30 m occurs around <25% of the AA perimeter, OR NO BUFFER EXISTS.

Table 3. Examples of land cover that should be included and excluded from wetland buffer calculations.

Examples of Land Cover Included in Buffers	Examples of Land Cover Excluded from Buffers
<ul style="list-style-type: none"> • Additional wetland/riparian area • Natural upland habitats • Nature or wildland parks • Bike trails • Foot trails • Horse trails • Open rangeland with light grazing • Swales and ditches • Open water • Vegetated levees 	<ul style="list-style-type: none"> • Commercial developments • Residential developments • Paved roads • Dirt roads • Railroads • Parking lots • Fences that interfere with the movements of wildlife • Sound walls • Intensive agriculture (row crops, orchards, vineyards) • Dryland farming • Horse paddocks, animal feedlots • Rangeland with intensive grazing • Lawns • Golf courses • Sports fields • Urbanized parks with active recreation • Paved or heavily used pedestrian/bike trails (frequent traffic)

b. Buffer Width: This metric can be assessed first using aerial photography but must be verified in the field. Where buffers exist, visually estimate the average distance between the perimeter of the AA and the edge of the buffer at eight evenly spaced intervals up to 200 meters from the perimeter of the AA. For Riverine wetlands, do not include the area immediately upstream or downstream as part of the buffer. Only consider areas on one side of the channel or the other. See Table 3 for land covers included and excluded from buffers. Use the following narrative descriptions to estimate the buffer width:

Metrics for Buffer Width.

(1)	Average buffer width between edge of the AA and the edge of the buffer is >200 m.
(2)	Average buffer width between edge of the AA and the edge of the buffer is >100–200 m.
(3)	Average buffer width between edge of the AA and the edge of the buffer is 50–100 m.
(4)	Average buffer width between edge of the AA and the edge of the buffer is <50 m, OR NO BUFFER EXISTS.

c. Buffer Condition: Estimate the overall condition of the buffer within 200 meters of the AA perimeter based on plant species composition, extent of soil disturbance, and the extent of trash or evidence of human visitation or recreation using the narrative descriptions below. ONLY consider portions of the 200 m envelope considered buffer (i.e., exclude non-buffer areas such as roads).

Metrics for Buffer Condition-Plant Species Composition.

(1)	Abundant (>95%) native vegetation cover and little or no (<5%) cover of non-native plants.
(2)	Substantial (>75–95%) native vegetation cover and low (5–25%) cover of non-native plants.
(3)	Moderate (50-75%) native vegetation cover.
(4)	Low (<50%) cover of native vegetation, OR NO BUFFER EXISTS.

Metrics for Buffer Condition-Extent of Soil Disturbance.

(1)	Soils are intact.
(2)	Soils are slightly to moderately disturbed.
(3)	Soils are moderately to extensively disturbed.
(4)	Soils are highly disturbed OR ground is unnaturally bare, OR NO BUFFER EXISTS.

Metrics for Buffer Condition-Extent of Trash or Evidence of Human Visitation or Recreation.

(1)	No trash present OR no evidence of human visitation or recreation.
(2)	Little trash OR evidence of minor human visitation or recreation.
(3)	Moderate or greater amounts of trash OR evidence of moderate human visitation/recreation.
(4)	Excessive amounts of trash OR evidence of high intensity human visitation/recreation, OR NO BUFFER EXISTS.

B. Vegetation Structure Metrics

1. Relative Cover of Native Plant Species: A measure of the relative percent cover of all plant species that are native to the region.

Metric Measurement Protocol

Estimate the percent of the vegetation cover within the AA that is comprised of native plant species. Note: If 50% of the AA is covered by water and 50% of the AA is covered by vegetation, then estimate the percent of the AA covered by vegetation that is comprised of native vegetation. Estimate the relative cover of native plant species in the AA based on the following narrative descriptions:

Metrics for Relative Cover of Native Plant Species

(1)	>99% of the vegetation cover within the AA is comprised of native vegetation.
(2)	95-99% of the vegetation cover within the AA is comprised of native vegetation.
(3)	80-94% of the vegetation cover within the AA is comprised of native vegetation.
(4)	50-79% of the vegetation cover within the AA is comprised of native vegetation.
(5)	<50% of the vegetation cover within the AA is comprised of native vegetation.

2. Relative Cover of Listed Noxious Weed Species within the AA: A measure of the relative percent cover of listed noxious weed species and the distribution of noxious weed species in the AA.

Metric Measurement Protocol

Estimate the percent of the relative vegetation cover within the AA that is comprised of listed noxious weed species plant species from the Montana Noxious Weed List (Appendix D). If noxious weed species are present in the AA, then identify and rank the three most common species observed. Estimate the relative cover of listed noxious weed species and the distribution of noxious weed species in the AA based on the following narrative description:

Metrics for Cover of Listed Noxious Weed Species

(1)	No noxious weed species are present in the AA.
(2)	<1-3% of the vegetation cover within the AA is comprised of noxious weed species. If weeds occur in patches, then patches are small and isolated (1-2 patches) within the AA.
(3)	>3-10% of the vegetation cover within the AA is comprised of noxious weed species. If weeds occur in patches, then patches are moderate in size and common (3-5 patches) within the AA.
(4)	>10% of the vegetation cover within the AA is comprised of noxious weed species. If weeds occur in patches, then patches are relatively large and abundant (>5 patches) within the AA.

3. Relative Cover of Aggressive Graminoids within the AA: For the purposes of this metric, aggressive graminoids include reed canarygrass (*Phalaris arundinacea*), common reed (*Phragmites australis*), cattail (*Typha* ssp.), smooth brome (*Bromus inermis*), Kentucky bluegrass (*Poa pratensis*), common timothy (*Phleum pratense*), and meadow foxtail (*Alopecurus pratensis*). Both native and non-native ecotypes of reed canarygrass and common reed occur in Montana. The nativity of these species often cannot be known with certainty because they are difficult to distinguish in the field. Similarly, two cattail species can occur in Montana, *Typha latifolia* is a native species, whereas *T. angustifolia* is native to the eastern U.S. Both species tend to increase and dominate sites with excessive nutrients. Smooth brome, Kentucky bluegrass, common timothy, and meadow foxtail are aggressive, non-native pasture grasses that often invade temporarily and seasonally flooded wetlands.

This metric is a measure of the absolute percent cover of graminoids that are aggressive competitors with other native plant species and are obviously changing the species composition of the wetland.

Metric Measurement Protocol

Estimate the absolute percent cover of aggressive graminoids within the AA. If aggressive graminoids are present in the AA, then identify and rank the three most common species observed. Estimate the absolute percent cover of aggressive graminoids within the AA using the following narrative descriptions:

Metrics for Relative Cover of Aggressive Graminoids

(1)	No aggressive graminoid species are present in the AA.
(2)	Aggressive graminoids are present in the AA, but with low cover (<10% relative cover of cattails or <5% cover of reed canarygrass, common reed, smooth brome, Kentucky bluegrass, common timothy, or meadow foxtail).
(3)	Aggressive graminoids are common in the AA (10-25% relative cover of cattails or 5-10% relative cover of reed canarygrass, common reed, smooth brome Kentucky bluegrass, common timothy, or meadow foxtail).
(4)	Aggressive graminoids are abundant in the AA (>25-50% relative cover of cattails or 10-25% relative cover of reed canarygrass, common reed, smooth brome, Kentucky bluegrass, common timothy, or meadow foxtail).
(5)	Aggressive graminoids are dominant in the AA (>50% relative cover of cattails or >25% relative cover of reed canarygrass, common reed, smooth brome, Kentucky bluegrass, common timothy, or meadow foxtail).

4. Herbaceous Litter/Woody Debris Accumulation: The accumulation of litter and/or woody debris is integral to a variety of wetland functions, such as surface water storage, percolation and recharge, nutrient cycling, and support of wetland plants. Intact litter layers and/or woody debris provide areas for primary production and decomposition that are important to maintaining functioning food chains. They nurture fungi essential to the growth of rooted wetland plants. They support soil microbes and other detritivores that comprise the base of the food web in many wetlands. The abundance of litter and/or woody debris on the substrate surface can significantly influence overall species diversity and food web structure. Fallen debris serves as cover for macroinvertebrates, amphibians, rodents, and even small birds. Litter is the precursor to detritus, which is a dominant source of energy for most wetland ecosystems.

Note: The site must have the potential to accumulate woody debris (i.e., woody plant species should be present at the site).

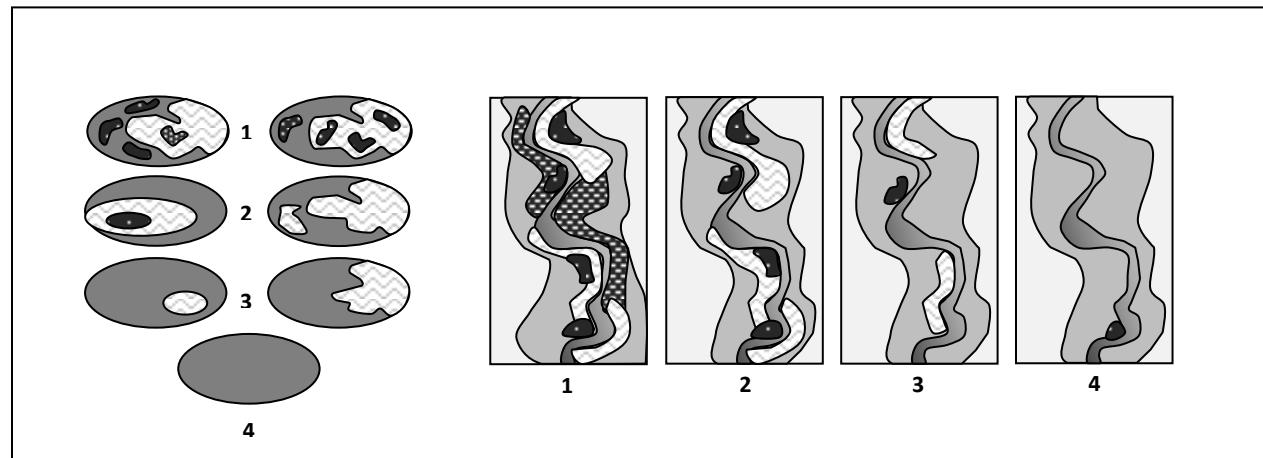
Metric Measurement Protocol

Use the following narrative descriptions to describe the herbaceous litter/woody debris accumulation within the AA:

Metrics for Herbaceous Litter/Woody Debris Accumulation

(1)	Site has moderate amount of fine litter/woody debris. New growth is more prevalent than previous years' growth. Layers of litter in pools or areas of topographic lows are thin.
(2)	Site is characterized by small amounts of litter/woody debris, with little plant recruitment, OR litter/woody debris is somewhat excessive.
(3)	Site has scant litter/woody debris OR litter/woody debris is excessive and is blocking plant recruitment.

6. Interspersion of Plant Zones within the AA: Refer to the diagrams below and circle the number that best illustrates the interspersion of plant zones within the AA. Use the plant zones identified on pages 5 and 6 of the field form. Along with the plant zones, include zones of open water when evaluating interspersion.



7. Woody Species Establishment and Regeneration within the AA: Select the statement on the form that best describes the regeneration of native woody species establishment and regeneration within the AA.

Metric Measurement Protocol

Use the following narrative descriptions to describe the woody species establishment and regeneration within the AA:

Metrics for Native Woody Species Establishment and Regeneration within the AA

(1)	All age classes of native woody species present OR woody species are naturally uncommon or absent.
(2)	Middle age group(s) absent with all others well-represented OR early successional saplings only.
(3)	Seedlings and saplings absent and stand comprised of mainly mature species.
(4)	Woody species predominately consist of relict or dying individuals or AA has a > 5% canopy cover of Russian Olive and/or Salt Cedar.

8. Tree and Shrub Utilization Within the AA: Estimate the extent of browse on woody species within the AA.

Metric Measurement Protocol

Use the following narrative descriptions to describe the extent of browse on woody species within the AA:

Metrics for Tree and Shrub Utilization within the AA

(1)	0-5% of the available second year and older stems are browsed OR woody species are naturally uncommon or absent.
(2)	>5%-25% of the available second year and older stems are browsed.
(3)	>25%-50% of the available second year and older stems are browsed.
(4)	More than 50% of the available second year and older stems are browsed.

C. Physicochemical Metrics

1. Soil Surface Integrity: An indirect measure of soil condition based on stressors that increase the potential for erosion or sedimentation, assessed by evaluating intensity of human dominated land uses on the site.

Metric Measurement Protocol: Use the narrative descriptions provided to describe the soil surface integrity of the AA.

Metrics for Soil Surface Integrity within the AA

(1)	Soil disturbance is limited to naturally caused disturbances such as flood deposition or game trails.
(2)	Some soil disturbance due to human causes (including livestock) is present but the extent and impact is minimal. The depth of disturbance is limited to only a few inches and does not show evidence of ponding or channeling water. Any disturbance is likely to recover within a few years after the disturbance is removed.
(3)	Soil disturbance due to human causes is common and will be slow to recover. Damage is not excessive and the site will recover with the removal of degrading human influences and moderate recovery times.
(4)	Soil disturbance is widespread and substantially degrades the site. Water, if present, would be channeled or ponded. The site will not recover without restoration and/or long recovery times.

2. Water Quality: An assessment of water quality based on visual evidence of water clarity and eutrophic species abundance.

Metric Measurement Protocol: Use the narrative descriptions provided to describe the water quality of the AA.

Metrics for Water Quality-Algae.

(1)	No visual evidence of degraded water quality. No potential source of water quality degradation observed. Water is clear with minimal algae growth.
(2)	Some negative water quality indicators are present and/or some potential sources of water quality degradation observed. Algae are limited to small and localized areas within the wetland. Water may have a minimal greenish tint, cloudiness, or sheen.
(3)	Algal growth occurs in large patches throughout the AA. Potential sources of water quality degradation are apparent. Water may have a moderate greenish tint or sheen.
(4)	Algal mats may be extensive, blocking light to the bottom. Potential sources of water quality degradation are apparent. Water has strong greenish tint, sheen, or turbidity. The bottom is difficult to see during the growing season.

Metrics for Water Quality-Turbidity.

(1)	No visual evidence of degraded water quality. No potential source of water quality degradation observed.
(2)	Water is slightly cloudy and/or some potential sources of water quality degradation observed, but there is no obvious source of sedimentation.
(3)	Water is cloudy, but the bottom is still visible. Potential sources of water quality degradation are apparent.
(4)	Water is milky and/or muddy. The bottom is no longer visible. Potential sources of water quality degradation are apparent.

Metrics for Water Quality-Sheen (petroleum-based. *Note: Sheens can be caused by bacteria. When disturbed, a bacterial sheen will break up into small platelets; petroleum sheens will quickly reform.*)

(1)	No visual evidence of degraded water quality. No potential source of water quality degradation observed. Water is clear with no sheen.
(2)	Some negative water quality indicators are present and/or some potential sources of water quality degradation observed. Sheen on the water is limited to small and localized areas within the wetland/AA.
(3)	Sheen occurs in large patches throughout the surface water of the wetland/AA. Potential sources of water quality degradation are apparent. Water may have a moderate sheen.
(4)	Sheen is extensive throughout the surface of the water in the wetland/AA. Potential sources of water quality degradation are apparent. Water has a strong sheen.

D. Hydrology

1. Water Inputs into the AA: Water inputs encompass the forms or places of direct inputs of water into the AA. Inputs of water affecting conditions during the growing season are especially important because these strongly influence the structure and composition of wetland plant and animal communities. The water inputs metric focuses on conditions affecting growing season hydrology.

Natural water sources include precipitation, ground water discharge, and flooding of the AA due to naturally high flows, seasonal runoff, etc. Examples of unnatural sources include storm drains that empty directly into the AA or into an immediately adjacent area. For seeps and springs that occur at the toe of an earthen dam, the reservoir behind the dam is an unnatural water source. Large reservoirs and lakes that do not drain directly into the AA should not be considered water sources, although they can have systemic, ubiquitous effects on the condition of the AA. Engineered hydrological controls, such as pumps, weirs, flashboards, grade control structures, check dams, etc., are not considered water sources.

Metric Measurement Protocol:

The assessment of this metric is the same for all wetland systems. For all wetlands, including fringe habitat, this metric focuses on *direct* inputs of water as defined above. The natural sources will tend to be more obvious than the unnatural sources. Evaluation of this metric should therefore emphasize the identification of the unnatural sources or diversions that directly affect the dry season conditions of the AA.

Use the narrative descriptions provided to describe the water inputs into the AA.

Metrics for Water Inputs into the AA.

(1)	Sources are precipitation, groundwater, and/or natural runoff, or natural flow from an adjacent freshwater body, or the AA naturally lacks water in the dry season.
(2)	Sources are mostly natural but can include occasional or small effects of modified hydrology. No large point sources or dams control the overall hydrology.
(3)	Sources are primarily from anthropogenic sources (e.g., urban runoff, pumped water, impoundments, regulated releases through a dam).
(4)	Natural sources have been eliminated based on the following indicators: impoundment of all possible wet season inflows, diversions of all dry-season inflows, predominance of xeric vegetation, etc.

Identify all *major* water sources/inflow feeding the AA during the growing season in the table provided on the form (Table 4). Rank the top sources (up to three) as 1, 2, 3. Mark all others present as 4 and those not present as NA. For discrete inlets (stream channels, springs, ditches, etc.), count the number of each within the AA and a 200 m envelope of the AA. Enter NA for those not present. Mark all inlets on the aerial photo and those within the AA on the site sketch. If there is an indication that inflow during the growing season is controlled by artificial water sources, please explain in comments.

Table 4. Checklist of major water sources into the assessment area.

Natural Sources/Inflow:	Count of Discrete Inlets:
Overbank flooding	Channels
Alluvial storage/hyporheic flow	Spring
Throughflow (if yes, rank in Outputs)	Ditches
Non-channelized flow from contiguous wetland area	Culvert
Groundwater discharge	Pipes
Precipitation	Pumps
Snowmelt	Other/Comments:
Anthropogenic Sources/Inflow:	
Irrigation run-off/ditches	
Urban run-off	
Pipes directly feeding into wetland	
Culvert	
Pumps	
Other:	

2. Water Outputs from the AA: Whether or not water can leave the wetland and where it goes can also influence the structure and composition of wetland plant and animal communities. Identify all major pathways through which water leaves the AA during the growing season in the table provided on the form (Table 5). Rank the top pathways/outflow (up to three) as 1, 2, 3. Mark all others present as 4 and those not present as NA. For discrete outlets (stream channels, culverts, ditches, etc.), count the number of each within the AA and a 200 m envelope of the AA. Enter 'NA' for those not present. Mark all outlets on the aerial photo and those in the AA on the site sketch. If there is an indication that outflow is modified by anthropogenic disturbance, please explain in comments.

Metric Measurement Protocol:

The assessment of this metric is the same for all wetland systems. For all wetlands, including fringe habitat, this metric focuses on water outlets as defined above. Evaluation of this metric should therefore emphasize the identification of the unnatural outlets that directly affect the dry season conditions of the wetland/AA.

Use the narrative descriptions provided to describe the water outlets of the wetland/AA.

Metrics for Water Outputs from the Wetland/AA.

(1)	Water leaves the site through natural runoff, natural flow, evaporation, or outlet is blocked by natural features (e.g., beaver dam), OR the site naturally lacks water in the growing season.
(2)	Outflow is mostly natural, but there is some modification due to anthropogenic restrictions (e.g., filling or development, channelization).
(3)	Withdrawals are primarily from anthropogenic sources, and outflow has been significantly altered by flow obstructions (culverts, paved stream crossings, impoundments, ditching).
(4)	Natural outflow has been completely eliminated due to the following indicators: dike/levees, railroads, or roads with no culverts.

Table 5. Checklist of major water pathways out of the assessment area.

Natural Outflow	Count of Discrete Outlets:
Channelized flow (headwater wetland)	Channels
Recharge to adjacent stream	Culvert
Throughflow (if yes, rank in Sources/Inflow)	Ditches
Non-channelized flow to contiguous wetland area	Pumps
No natural outlet	Other/Comments:
Anthropogenic Outflow:	
Culverts under roadways / trails	
Ditches established to drain wetland	
Natural outlet blocked/bermed	
Water is being pumped out of the wetland	
Other:	

3. Hydroperiod: An assessment of the characteristic frequency and duration of inundation or saturation of a wetland during a typical year. Depressional, lacustrine, and riverine wetlands typically have daily variations in water height that are governed by diurnal increases in evapotranspiration, and seasonal cycles that are governed by wet season rainfall and runoff. Slope wetlands that depend on groundwater may have relatively slight seasonal variations in hydroperiod.

Metric Measurement Protocol:

This metric evaluates recent changes in the hydroperiod, flow regime, or sediment regime of a wetland and the degree to which these changes affect the structure and composition of the wetland plant community. Common indicators are presented for the different wetland classes. This metric focuses on changes that have occurred in the last 2-3 years.

Depressional, Lacustrine, and Slope Wetlands (except fens): Assessment of the hydroperiod for these kinds of wetlands should be initiated with an office-based review of diversions or augmentations of flows to the wetland. Field indicators for altered hydroperiod include pumps, spring boxes, ditches, hoses and pipes, encroachment of terrestrial vegetation, excessive exotic vegetation along the perimeter of the wetland, and desiccation during periods of the year when comparable wetlands are typically inundated or saturated. Use the following narrative description to describe the hydroperiod of the AA:

Metrics for Hydroperiod for depressional, lacustrine, and slope wetlands (*except fens*).

(1)	Hydroperiod of the AA is characterized by natural patterns of filling or inundation and drying or drawdowns.
(2)	The filling or inundation patterns in the AA are of greater magnitude or duration than would be expected under natural conditions, but thereafter the AA is subject to natural drawdown or drying.
(3)	Hydroperiod of the AA is characterized by natural patterns of filling or inundation, but thereafter, is subject to more rapid or extreme drawdown or drying, as compared to more natural wetlands. OR The filling or inundation patterns in the AA are of substantially lower magnitude or duration than would be expected under natural conditions, but thereafter, the AA is subject to natural drawdown or drying.
(4)	Both the inundation and drawdown of the AA deviate from natural conditions (either increased or decreased in magnitude and/or duration).

Metrics for Hydroperiod for fens.

(1)	Hydroperiod of the site is characterized by stable, saturated hydrology, or by naturally damped cycles of saturation and partial drying.
(2)	Hydroperiod of the site experiences minor altered inflows or drawdown/drying, as compared to more natural wetlands (e.g., ditching).
(3)	Hydroperiod of the site is somewhat altered by greater increased inflow from runoff, or experiences moderate drawdown or drying, as compared to more natural wetlands (e.g., ditching).
(4)	Hydroperiod of the site is greatly altered by increased inflow from runoff or experiences large drawdown or drying, as compared to more natural wetlands (e.g., ditching).

4. Surface Water Connectivity: An assessment of the ability of the water to flow into or out of the wetland, or to accommodate rising flood waters without persistent changes in water level that can result in stress to wetland plants and animals.

Metric Measurement Protocol:

Assessment of this metric is based solely on field indicators and is different by HGM class. See tables and figures below for guidance.

Metrics for Surface Water Connectivity for depressional, lacustrine, and slope wetlands (*except isolated fens*).

(1)	Water, when present, has unrestricted access into or out of the wetland. There are no artificial obstructions to surface water flow.
(2)	Artificial obstructions limit the access of surface water into or out of the wetland, but the limitations exist for < 50% of the AA perimeter.
(3)	Artificial obstructions limit the access of surface water into or out of the wetland for 50–90% of the AA perimeter. Flood flows may exceed the obstructions, but drainage into or out of the AA is probably obstructed.
(4)	Artificial obstructions limit the access of surface water into or out of the wetland for >90% of the AA perimeter.

Metrics for Surface Water Connectivity for fens that are naturally isolated.

(1)	No natural surface water connectivity with surrounding water bodies.
(2)	Partial surface water connectivity with surrounding water bodies exists via artificial means (e.g., ditching or draining to dry the fen).
(3)	Substantial to full surface water connectivity exists via artificial means that has obvious drying effects on the peat body.

Section 6. Onsite and Surrounding Disturbances

Definition: Document the scope and impact of disturbances observed *and* expected to impact the site both within a 200 m envelope around the AA perimeter and within the AA. Using Table 6 (provided below and on the field form), check each land use/disturbance that occurs and enter the total on the form. Note also the field indicator observed. Estimate the scope and impact of each disturbance using the ratings in Table 7.

Table 6. Level 2 Onsite and Surrounding Disturbances.

Disturbances Observed <i>and</i> Expected to Impact the Site	Scope		Impact		Field Indicator Observed
	200 m	AA	200 m	AA	
Transportation Disturbances					
Paved surfaces (e.g., roads, parking lots)					
Unpaved roads					
Railroads					
Land Use Disturbances-Development or Recreation					
Domestic or commercial development					
Intensively managed sports fields, golf courses					
Recreation or human visitation					
Filling or dumping of sediment or fill					
Trash or refuse dumping					
Land Use Disturbances-Agriculture					
Dryland farming (e.g., wheat, barley, etc.)					
Open range livestock grazing					
Horse paddock or private barnyard					
Feedlot operation					
Irrigated cropland					
Irrigated hay pasture					
Irrigation ditches affecting wetland					
Cropland treated with pesticides					
Disturbed fallow lands dominated by exotic species					
Haying of native grassland					
Fallow fields (no human use in past 10 years)					
Fields with recent plowing or discing					
Shelterbelts					
Fences that impede wildlife					
Permanent tree plantation					

Disturbances Observed <i>and</i> Expected to Impact the Site	Scope		Impact		Field Indicator Observed
	200 m	AA	200 m	AA	
Land Use Disturbances-Resource Extraction					
Gravel pits, open pit mining					
Small scale mining activity or abandoned mines					
Abandoned oil/gas wells					
Oil/gas pump jacks (active)					
Injection wells, tank batteries, collection facilities, or other oil/gas-associated infrastructure					
Intensive logging (50-75% trees of >50 cm diameter removed)					
Selective logging (<50% of trees >50 cm diameter removed)					
Land Use Disturbances-Vegetation Removal/Conversion					
Chemical vegetation control					
Evidence of intentional burning					
Mechanical vegetation removal					
Vegetation conversion (e.g., from shrubland to grassland)					
Natural or Environmental Disturbances					
Beetle-killed <i>Pinus</i> species					
Other diseased conifers					
Evidence of recent fire (<5 years)					
Beaver activity					
Evidence of prolonged drought					
Browsing of woody vegetation by native ungulates					
Hydrologic Disturbances					
Upstream spring box					
Impoundment of flowing water					
Potential for agricultural runoff					
Potential for urban runoff					
Culvert					
Upstream dam					
Reservoir/stock pond					
Weir or drop structure					
Dredged inlet/outlet channel					
Engineered channel (e.g., riprap)					
Pumps, diversions, or ditches that move water <i>into</i> wetland					
Pumps, diversions, or ditches that move water <i>out of</i> wetland					
Berms/Dikes/Levees					

Table 7. Scope and Impact Ratings for Disturbances.

Scope of Disturbances	
5	Pervasive – Affects nearly all (>75%) of the envelope or AA.
4	Large – Affects most (>50-75%) of the envelope or AA.
3	Moderate – Affects much (>25-50%) of the envelope or AA.
2	Restricted – Affects some (>10-25%) of the envelope or AA.
1	Small – Affects a small (1-10%) portion of the envelope or AA.
0	Nil – Affects little to none (<1%) of the envelope or AA.

Impact of Disturbances	
4	Extreme – likely to extremely modify, degrade, destroy, or eliminate the wetland.
3	Serious – likely to seriously modify, degrade or reduce wetland function or condition.
2	Moderate – likely to moderately modify, degrade or reduce wetland function or condition.
1	Slight – likely to only slightly modify, degrade, or reduce wetland function or condition.

Intensive Level 3 Disturbance Evaluation

Using Table 8., within the 200 m envelope around the AA perimeter, estimate the percent of the 200 m envelope affected by disturbances listed on the field form. For linear features such as roads, estimate the length in meters of each disturbance within the 200 m envelope.

Table 8. Level 3 Onsite and Surrounding Disturbances.

Disturbances Observed <i>and</i> Expected to Impact the Site	Meters within 200 m envelope	Field Indicator Observed
Transportation Disturbances		
Paved surfaces (e.g., roads, parking lots)		
Unpaved roads		
Railroads		
Disturbances Observed <i>and</i> Expected to Impact the Site	Percent of 200 m envelope affected	Field Indicator Observed
Land Use Disturbances-Development or Recreation		
Domestic or commercial development		
Intensively managed sports fields, golf courses		
Recreation or human visitation		
Filling or dumping of sediment or fill		
Trash or refuse dumping		
Land Use Disturbances-Agriculture		
Dryland farming (e.g., wheat, barley, etc.)		
Open range livestock grazing		
Horse paddock or private barnyard		
Feedlot operation		
Irrigated cropland		
Irrigated hay pasture		
Irrigation ditches affecting wetland		
Cropland treated with pesticides		
Disturbed fallow lands dominated by exotic species		
Haying of native grassland		
Fallow fields (no human use in past 10 years)		
Fields with recent plowing or discing		
Shelterbelts		
Fences that impede wildlife		
Permanent tree plantation		
Land Use Disturbances-Resource Extraction		
Gravel pits, open pit mining		
Small scale mining activity or abandoned mines		
Abandoned oil/gas wells		
Oil/gas pump jacks (active)		

Disturbances Observed <i>and</i> Expected to Impact the Site	Meters within 200 m envelope	Field Indicator Observed
Injection wells, tank batteries, collection facilities, or other oil/gas-associated infrastructure		
Intensive logging (50-75% trees of >50 cm diameter removed)		
Selective logging (<50% of trees >50 cm diameter removed)		
Land Use Disturbances-Vegetation Removal		
Chemical vegetation control		
Evidence of intentional burning		
Mechanical vegetation removal		
Vegetation conversion (e.g., from shrubland to grassland)		
Natural or Environmental Disturbances		
Beetle-killed conifers		
Other diseased conifers		
Evidence of recent fire (<5 years)		
Beaver activity		
Evidence of prolonged drought		
Browsing of woody vegetation by native ungulates		
Hydrologic Disturbances		
Upstream spring box		
Impoundment of flowing water		
Potential for agricultural runoff		
Potential for urban runoff		
Culvert		
Upstream dam		
Reservoir/stock pond		
Weir or drop structure		
Dredged inlet/outlet channel		
Engineered channel (e.g., riprap)		
Pumps, diversions, or ditches that move water <i>into</i> wetland		
Pumps, diversions, or ditches that move water <i>out of</i> wetland		
Berms/Dikes/Levees		

Section 7. Soil Profile Descriptions

A. Placement of the Soil Pit: Dig two soil pits within the AA. Make every attempt to place each soil pit in a different area of zonation. This will likely be evident from differences in vegetation. Whenever possible, place the soil pits in or near the vegetation plot.

1. General soil pit information:

- a. Record the Soil Pit #(1 or 2), circle whether the soil pit is located in a Level 2 Plant Zone or in a Level 3 Vegetation Module, and record either the Plant Zone # or the Veg Module #.
- b. Record the soil pit GPS coordinates and their accuracy.
- c. If standing surface water is present, record the depth of standing surface water.
- d. After digging the soil pit and removing the soil sample, record the depth to soil saturation in the pit.
- e. After digging the soil pit and removing the soil profile, record the depth to free water in the pit. If no water is present, record NP (not present).

2. Digging the soil pit:

- a. Use the auger to dig a hole to a depth of 80 centimeters if possible; remove the soil and auger and carefully lay the soil on the ground. Slice open the entire soil core lengthwise to split the core into 2 long, parallel halves. This will expose the soil from the inside of the sample to ensure a clean sample is used.
- b. Changes in soil texture or soil matrix color are indicators of distinct soil layers. Insert golf tees at the intersections between each different soil layer. Lay a measuring tape along the side of the entire soil profile, with 0 cm at the top of the soil profile at what was once the surface of the soil pit.

If an impenetrable layer is encountered at a depth of < 80 cm (e.g., bedrock, large rock, cemented layer, log, etc.), excavate the pit as deeply as possible, describe soils as the depth of the pit allows, and note the occurrence and depth to bedrock or the cemented layer (i.e., depth of refusal).

3. Distinguishing among different soil layers:

For each soil layer, record the depth, texture, matrix color and hydric soil indicators on the field form that apply, as well as any % fibers, modifiers or redoximorphic features present. See Appendix E for Soil Profile Description Procedures.

For each distinct soil layer, record the following:

- a. Soil Layer: Record the layer (e.g., 1, 2, etc.).
- b. Depth to the lower boundary of the layer in centimeters.
- c. Soil Texture for Mineral Soils (refer to Appendix E)
- d. Soil Texture Modifier (if appropriate, for mineral soils ONLY)
- e. Organic Layer: If an organic layer is present, indicate what type of organic material it is (definitions from NRCS (2016)):
 - i. Peat (P): fibric organic soil material in which plant forms can be identified in virtually all of the organic material.
 - ii. Muck (M): sapric organic soil material in which nearly all of the organic material is so decomposed that identification of plant forms is not possible.
 - iii. Mucky Peat (MP): hemic organic material, which is characterized by decomposition that is intermediate between that of fibric material and that of sapric material.
- f. Percent visible plant fibers, if applicable.
- g. Soil Matrix Color: This is the Hue/Value/Chroma for the soil matrix that matches most closely from the Munsell Soil Color Chart. If soils are dry, slowly wet the sample until it no longer changes color. Always have the sun at your back when comparing the soil to the color chart to find the best match.

- h. Redox Concentration Features: Redox concentrations are the result of iron oxidation as groundwater levels fluctuate throughout the growing season. These concentrations are orange/reddish-brown (because of iron) and dark reddish-brown/black (because of manganese).

Redox concentrations can occur as:

- nodules or concretions-firm irregularly shaped bodies with diffuse boundaries
 - masses-other bodies occurring throughout the matrix (also known as mottles)
 - pore linings-redox concentrations along root channels as a result of oxygen diffusion from the roots of plants into the surrounding soil matrix reacting with iron in the soil (also known as oxidized rhizospheres).
- i. Redox Concentration Abundance (%): Estimate the percentage of redox concentrations in each soil layer.
 - ii. Hue/Value/Chroma of Redox Concentrations
- i. Redox Depletions: Redox depletions occur when soils are flooded and iron and manganese are reduced to their soluble forms. These soluble forms of iron and manganese can be leached out of the soil, leaving the natural color (gray or black) of the parent sand, silt, or clay (i.e., the matrix) behind.
 - i. Redox Depletion Abundance (%): Estimate the percentage of redox depletions in each soil layer.
 - ii. Hue/Value/Chroma of Redox Depletions
 - j. Hydric Soil Indicators Observed: Check all that apply using the Hydric Soil Indicators checklist (Table 9).
 - k. Soil Profile Photos: Take photos of the entire soil core, complete with golf tees, measuring tape, and photo board with Site ID #, date, and Soil Pit #. Take additional photos of soil layers &/or features as appropriate.
 - l. Remarks: make any remarks or clarifications on the field form.
 - m. Depth to saturation/Depth to standing water: Allow approximately 30 minutes for equilibration of the soil pit. Measure the depth to standing water in the pit or to where water is seeping from the soil onto pit walls. If the pit contains standing water, measure the depth to the water surface and record on the form. If no standing water is present, record "NP" (not present) on the form. If soils at the margins of the pit are saturated with water, record the depth to the saturated layer. Saturation is indicated by a sheen or glistening of the soil. At or below the depth of soil saturation, water may also be oozing from the soil into the pit. Identify that it is not free water, but that the soil is saturated.
 - n. Backfill the excavation: Return the soil to the pit.

Table 9. Hydric soil indicators (NRCS 2016).

Hydric Soil Indicators
Histosol (≥ 40 cm of upper 80 cm is organic soil, i.e., P, MP, or M)
Histic Epipedon (Top layer is ≥ 20 cm of organic soil, i.e., P, MP, or M)
Sulfidic (rotten eggs) odor
Organic streaking (dark vertical streaks in the subsurface layers)
Gleyed or Low Chroma Colors

Section 8. Adjacent Upland Vegetation Characterization

Use the aerial photo of the AA to determine if upland vegetation occurs within 200 meters of the AA perimeter. If the AA is surrounded by wetland vegetation within 200 meters of the AA perimeter, then record NO UPLAND VEGETATION WITHIN 200 M OF THE AA for each quadrat on the field form. If upland vegetation does occur within 200 meters of the AA perimeter, then walk in each of the four cardinal directions until you enter upland vegetation. Once you enter upland vegetation, place a 1-m² quadrat on the ground and record the stratum, height, and cover of all dominant species. Record ALL NON-NATIVE plant species observed in the quadrat.

Section 9. Vegetation Measurements for Intensive Wetland Assessment

Intensive assessments involve the collection of plant species cover and composition data. The vegetation plot is adapted from the flexible-plot method developed by Peet et al. (1998). The entire plot measures 20 m x 50 m (1,000 m² = 0.1 ha). The plot is comprised of ten 10 m x 10 m modules (100 m² = 0.01 ha). In general, an AA area consisting of a 0.5 ha circular plot will hold a standard vegetation plot, consisting of a two by five array of ten 10 m x 10 m modules (Figure 2). Vegetation is measured in four intensive modules.

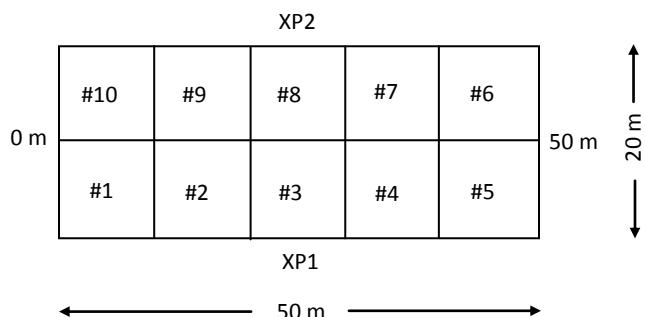


Figure 2. Schematic of the 20 m x 50 m vegetation plot with a two by five array of ten 10 m x 10 m modules.

The location and layout of the vegetation plot within the AA is based on the AA size and site characteristics. In most AAs, a single standard vegetation plot will be used to assess the vegetation of the AA. For situations where AAs are not 0.5 hectare circular plots, alternate plot configurations may be required, such as changing the shape of the plot array. Vegetation plots should be placed within the AA to maximize abiotic/biotic heterogeneity within the AA. Capturing heterogeneity of the AA ensures adequate representation of vegetation patterns and local variations in environment such as directional gradients, microtopography, natural disturbances such as flooding, and anthropogenic disturbances such as grazing. The following guidelines should be used to determine plot locations within the AA:

1. The plot should be located in a representative area of the AA that incorporates as much microtopographic variation as possible.
2. If the AA is homogeneous and there is no obvious direction or orientation for vegetation plot placement, then the plot should be centered within the AA and laid out either N to S or E to W. Use the second hand on a watch to determine the direction randomly (e.g., 00-29 seconds = N to S orientation; 30-59 seconds = E to W orientation).
3. If the AA is not homogeneous, is oddly shaped, or is directional (i.e., follows a stream), then the plot should be oriented to adequately represent the wetland features. In the case of a riverine wetland, the plot may be placed along the stream bank or cut across the stream.
4. If the wetland is an irregularly shaped polygon and the 20 m x 50 m plot does not fit within the AA, the 2 x 5 array of modules can be restructured to accommodate the shape of the AA. For example, a 1 x 5 array of 100 m² modules can be used for narrow, linear areas and a 2 x 2 array of 100 m² modules can be used for small, circular sites.

5. The plot should attempt to capture the range of diversity within the AA but should avoid crossing over into upland vegetation. No more than 10% of the plot should include upland vegetation beyond the wetland. Modules that do include upland should not be sampled as intensive modules.
6. If a small patch of another wetland type is present in the AA, then the plot should be placed so that at least a portion of the patch is in the plot.

The symbols depicted in the legend below are used in all of the plot placement diagrams (Figure 3). Detailed examples of how to place the vegetation plot based on the above rules are provided in Figures 4 through 9 to aid in decision making. These diagrams show examples of how to locate standard or alternate plots within different kinds of AAs. Note: ALTERNATE PLOT CONFIGURATIONS ARE ONLY USED WHEN THE STANDARD PLOT WILL NOT FIT INTO THE AA. All diagrams and accompanying text courtesy of Teresa Magee, US EPA Office of Research and Development, Corvallis, Oregon.

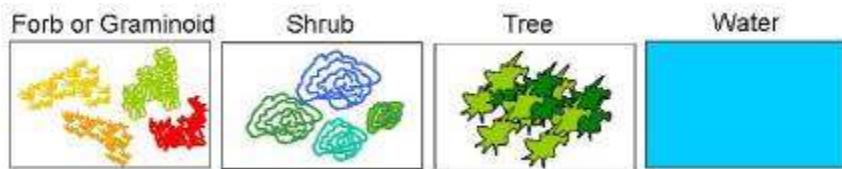


Figure 3. Legend for Figures 4 through 9.

Examples of Vegetation Plot Locations

Standard plot, centered in AA for homogeneous vegetation or mosaic. When the vegetation and abiotic features are homogeneous or distributed in a uniform or random mosaic pattern, a standard plot should be centered in the AA (Figure 4). For example, scrub-shrub, cattail marsh, grass-sedge wetlands, wet prairie, fen, forest communities, etc.



Figure 4. Standard plot centered in AA in homogeneous or mosaic vegetation.

Standard plot, placed within AA to include as many vegetation or community patch types as possible. When the vegetation is organized in distinct patches, lay out the plot so that it proportionally represents patch types for the AA as much as possible (Figure 5). Example situations include patches of scrub-shrub or trees in emergent wetlands, a variety of distinct emergent or shrub plant communities interspersed in the AA, etc.

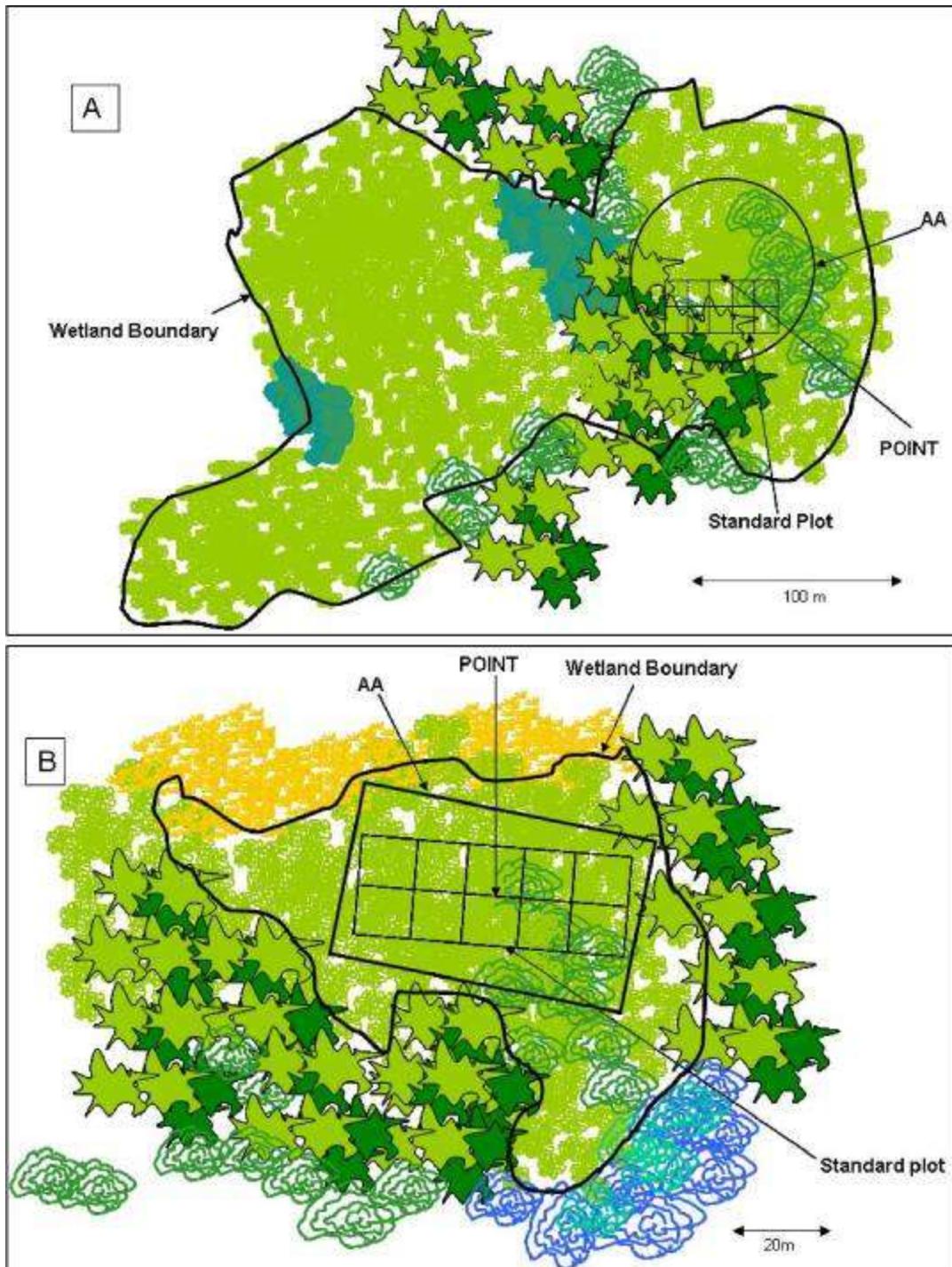


Figure 5. Standard plot placed in AA to include multiple vegetation or community patches.
A = Circular AA, B= Rectangular AA.

Standard plot, placed within AA so long axis parallels primary environmental gradient or is perpendicular to vegetation zonation. If the AA occurs along an environmental gradient, like a lake shore or the zones of a marsh, lay out the standard vegetation plot so the long axis follows the gradient and cuts across multiple vegetation zones. In the examples below, the vegetation plot is laid out so the long axis captures the gradient from close to the lake edge to farther from the lake edge (Figure 6) or from high marsh to low marsh (Figure 7).

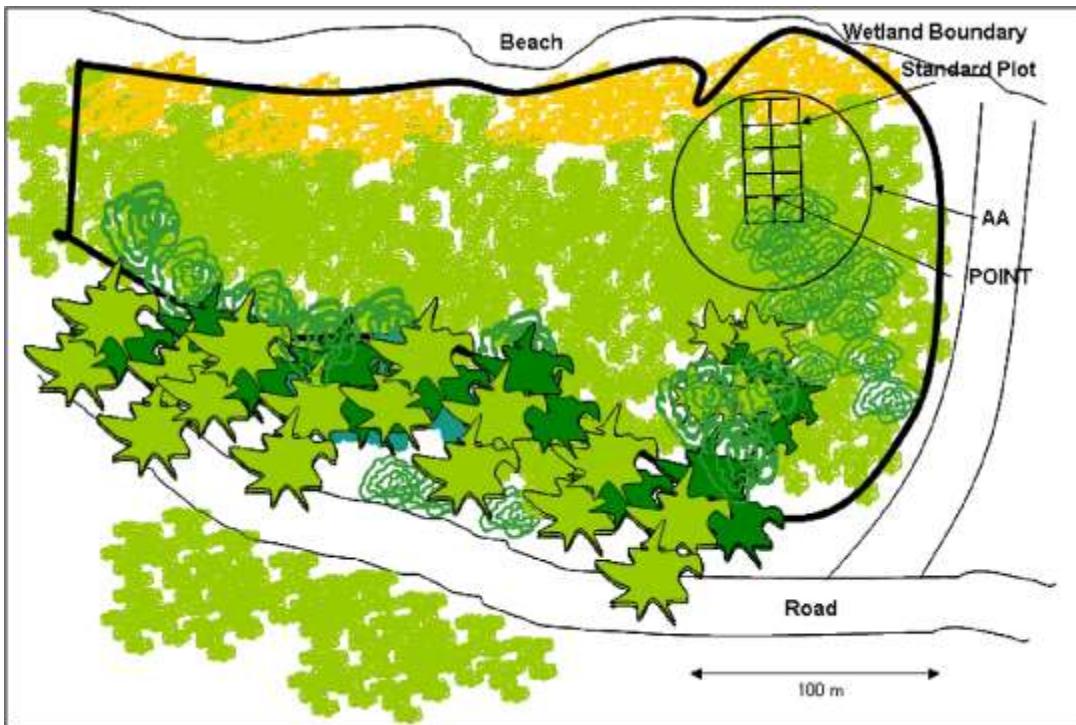


Figure 6. Standard plot placed in AA so long axis of plot parallels primary environmental gradient.

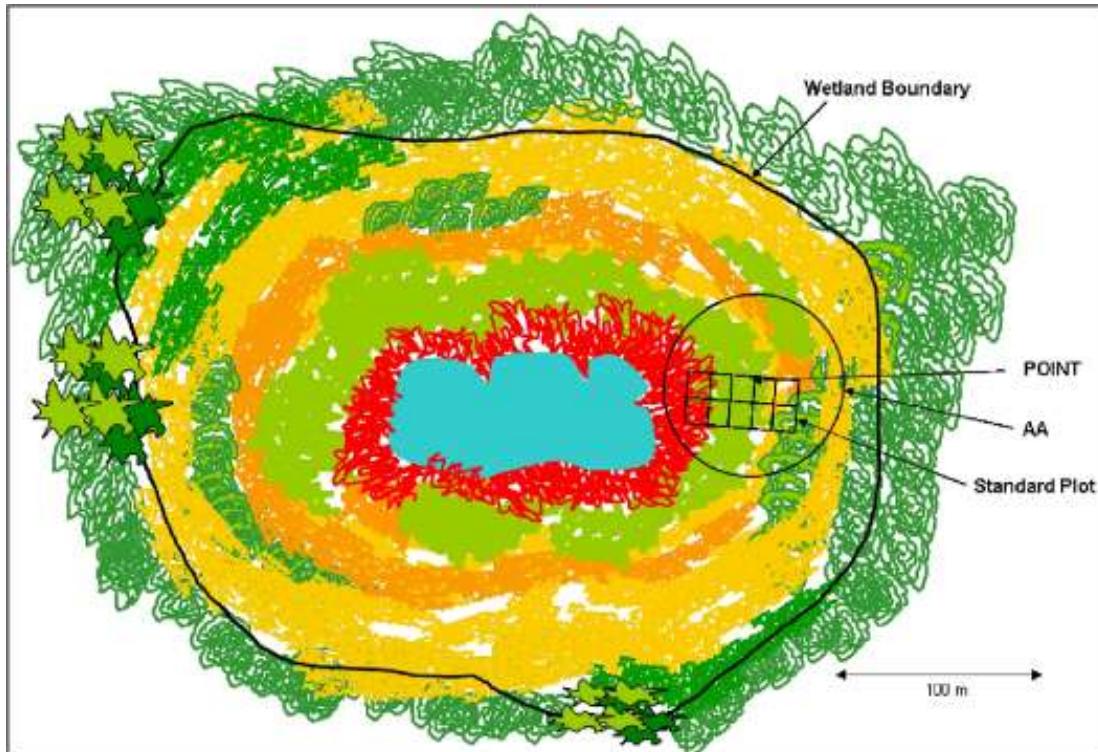


Figure 7. Standard plot placed in AA with long axis of plot perpendicular to vegetation zonation.

Placement of an alternate plot within the AA. If the AA has an irregular shape (e.g., long narrow riparian strip, lake edge, wetland smaller than 0.1 ha) that is incompatible with the standard plot configuration, an alternate plot configuration must be selected. For example, modules may be placed individually or in groupings other than the 2 x 5 array of the standard plot. Modules may be disarticulate to fit in a free-form shaped AA (Figure 8) or arranged as one long row in a narrow riparian area (Figure 9). To facilitate comparisons among AAs, the number of modules making up a standard plot or any alternate plot configuration should, normally, be the same (four 100-m² intensive modules and ten modules in total) so that equal levels of sample effort are maintained across AAs.

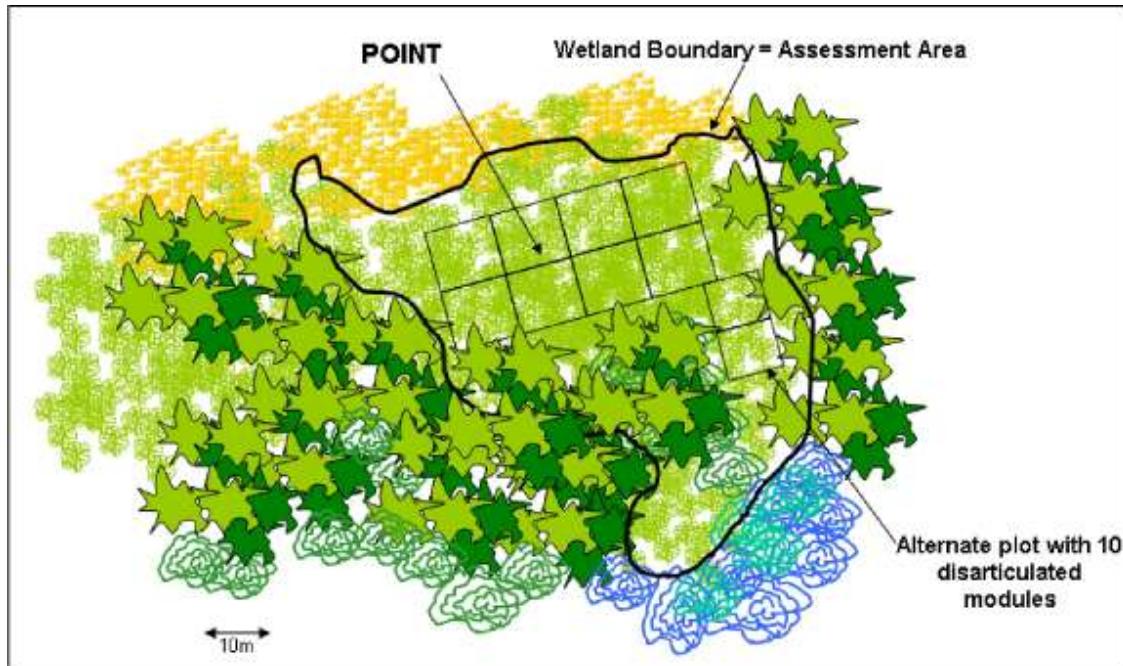


Figure 8. Alternate plot placed in AA that is the boundary of wetland < 0.1 ha. The alternate plot configuration is defined by arranging as many 100-m² modules as will fit into the shape of AA.

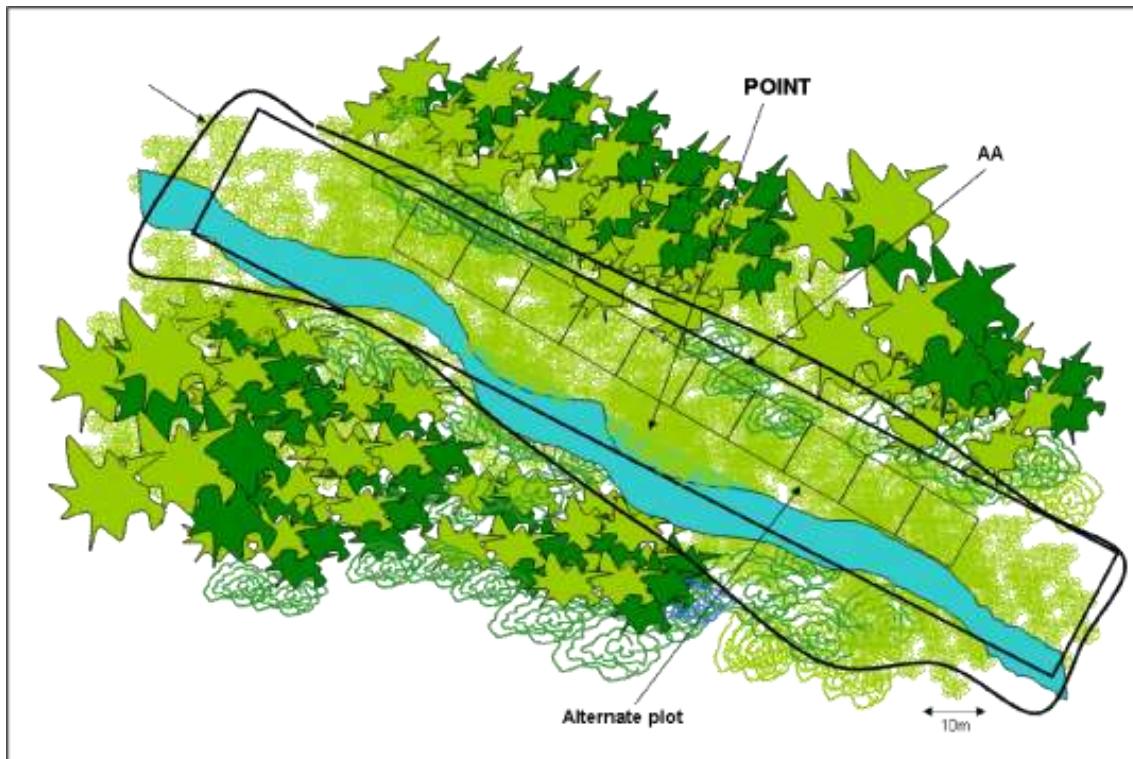


Figure 9. Alternate Plot placed in rectangular AA in a narrow riparian wetland.

1. Establishing and Documenting the Vegetation Plot

- a. Vegetation Plot Set Up: Pull a tape out 50 meters and use a flagged pin to stake the tape. The tape functions as the centerline for the vegetation plot. If necessary, flag the centerline at 10 m intervals, so that the centerline is visible throughout data collection.
- b. Using ropes or multiple 10-m tapes, layout your first 10 x 10 meter modules. Starting at one end of the 50-m tape, one crew member holds the end of the 10-m rope on the center line while the other walks out perpendicular to the center line. Once at 10 meters, the second crew member will place a pin flag or use flagging tape to mark the corner of the plot. Repeat this at 10-m intervals along the center line, flagging the corners of each 10 x 10 meter module. After one side of the vegetation plot is established, the crew will walk back to the beginning of the 50-m tape and repeat the previous steps on the opposite side of the center line.
- c. GPS Waypoints: Collect a GPS waypoint at both the 0 m (plot origin) and the 50-m end point to capture the location of the beginning and the end of the plot. Take two additional waypoints at two cross plot locations called XP1 and XP2.
- d. Vegetation Plot Photos: Take a photo of the entire vegetation plot from the plot origin (0 m) and from the 50-m end and record the photo number and bearing. Take two additional photos at each cross plot location.
- e. Selecting Modules for Intensive Vegetation Sampling: If the vegetation is homogenous, intensive modules will be modules 3, 7, 9, and either 1 or 5, giving the broadest spread of modules across the vegetation plot. If the vegetation is heterogeneous, the crew can decide which modules should be sampled to best capture the variability of the vegetation.
- f. Intensive Vegetation Module Photos: Take a photo of each intensive vegetation module sampled, standing at the centerline.
- g. Vegetation Plot Comments: Circle the location of the intensive modules and note any changes made to the layout of the plot.
- h. Plot Representativeness: Discuss the decisions made for plot placement and/or whether the plot is representative of the AA. This often involves discussing the nature of each intensively sampled module and how it represents the AA and even particular plant zones.
- i. References used for species identification: If the species is identified using a reference other than the Manual of Montana Vascular Plants (Lesica 2012), then note any additional floras as secondary.

2. Vegetation Plot Ground Cover

Within each of the four intensive vegetation modules, record the following ground cover information:

- a. Cover of deep water >0.2 m/Cover of vegetated deep water: Using the cover classes provided on the field form, estimate the cover of deep water within the module.
- b. Cover of shallow standing water <0.2 m: Using the cover classes provided on the field form, estimate the cover of shallow standing water within the module.
- c. Depth of deep standing water: Take up to four measurements of deep standing water (in centimeters) and record the average depth.
- d. Depth of shallow standing water: Take up to four measurements of shallow standing water depth (in centimeters) and record the average depth.
- e. Cover of bare ground: Using the cover classes provided, estimate the cover of bare ground within the module for three separate categories: 1) soil, sand, or sediment; 2) gravel or cobble 2-250 mm; and 3) bedrock, rock, or boulders >250 mm in diameter.
- f. Cover of litter: Using the cover classes provided on the field form, estimate the cover of litter within the module. Include litter underneath vegetation.

- g. Depth of litter: Take up to four measurements of litter depth (in centimeters) and record the average depth. Do NOT include standing dead herbaceous vegetation. Do not compress litter when taking depth measurements.
- h. Coarse woody debris: Using the cover classes provided on the field form, estimate the cover of coarse woody debris. Coarse woody debris consists of fallen trees and large branches ≥ 7.6 cm in diameter. Do NOT include standing dead.
- i. Fine woody debris: Using the cover classes provided on the field form, estimate the cover of fine woody debris. Fine woody debris consists of small branches and twigs ≤ 7.5 cm in diameter. Do NOT include standing dead.
- j. Cover of nonvascular species: Using the cover classes provided on the field form, estimate the cover of nonvascular plant species, including beneath litter and vegetation.
- k. Cover of algae: Using the cover classes provided on the field form, estimate the cover of algae.

3. Vegetation Plot Species Measurements

- a. Floristic measurements: Record the presence, stratum, and percent canopy cover of all vascular plant species within each of the four intensive modules. Examples of canopy cover percentages can be found in Figure 10. Within each of the four intensive vegetation modules, denote the presence of each species that is encountered in the module with a check (\checkmark) or a one (1) in the "Presence" column. All species will be recorded on the field form by their complete scientific name (e.g., *Carex utriculata*).
For woody species, identify and estimate the cover of seedlings, saplings, and mature individuals separately, if they occur in different strata. This helps determine the extent of regeneration.
- b. Unknown Species: Any **unknown species** will be entered on the field form with a descriptive name. If the genus of the species is known, the descriptive name should include the genus name (e.g., *Carex* sp. or *Aster* sp.). The descriptive name should also include some identifiable characteristics to distinguish multiple unknown species from the same genus (*Carex* sp. elongate black head or *Carex* sp. clustered brown head). If the genus is not known, the descriptive name should include any descriptors necessary (fuzzy round basal leaves or purple tubular corolla). All unknown species will be collected by the field crew when the species is encountered. All unknown species should be collected, even if the species appears to be unidentifiable. The crew may find the same species further developed at a later site and can compare the further developed specimen with the earlier voucher. *The only species the crew should not collect are those identified as or suspected to be listed as threatened or endangered under the U.S Endangered Species Act. (Appendix F)*. All crew members should be aware of the listed species in Montana and should document occurrences with photographs.
- c. Residual Species: After the four intensive modules have been sampled, walk the remaining modules (usually six) and record additional species found in the residual "R" column. Estimate percent cover for each species across the remaining modules.

- 4. Plant Specimen Collection: see Appendix G for detailed Plant Collection Protocol.**
- 5. Quality Assurance (QA) of Plant Specimens**
 - a. Use a random number generator or a random number table to select one species identified from each vegetation module. Do not include Unknown specimens.
 - b. Count the first known species listed on the field form for a particular module as number 1.
 - c. If a species has been selected as a QA specimen, it cannot be selected as a QA specimen from another vegetation module in the same AA.
 - d. After Unknown Species have been identified, 10% of these should be submitted to the botanist for QA.

Section 10. Site Wrap Up and Other Considerations

A. Preventing the spread of invasive species

Field personnel will check clothing, boots, shoes and equipment to ensure that no plant materials, noxious weed seeds or aquatic invasives are transmitted from one assessment location to another. All water will be eliminated from equipment prior to transport. Prior to being used again, everything that has come in contact with water will be cleaned and thoroughly dried and/or sprayed with a bleach solution.

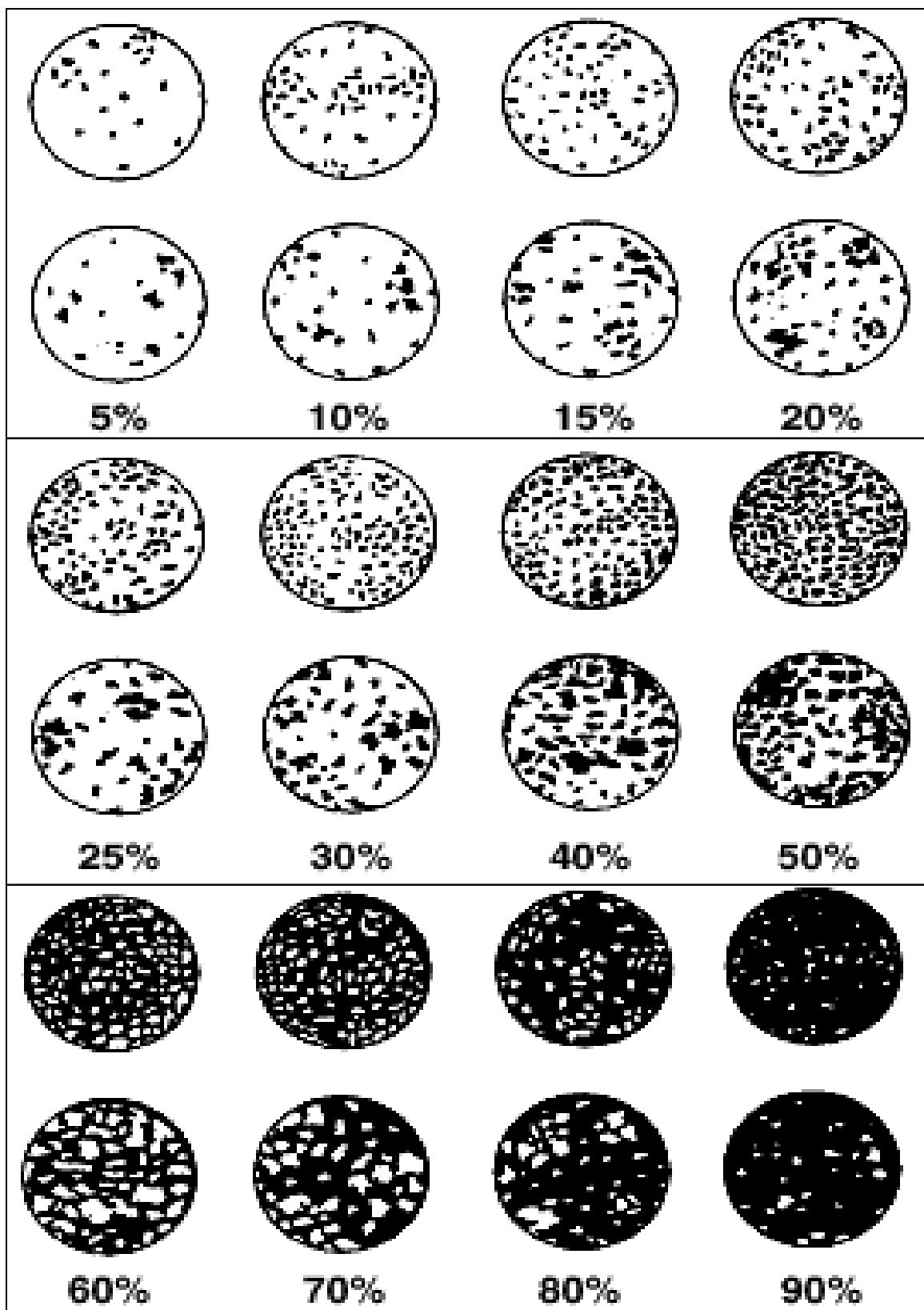


Figure 10. Canopy cover estimate examples

REFERENCES

- Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems. NatureServe, Arlington, Virginia.
- Eggers, S.D., and D.M. Reed. 2015. Wetland plants and plant communities of Minnesota and Wisconsin. Version 3.2. U.S. Army Corps of Engineers, St. Paul District. 478 pp.
- Federal Geographic Data Committee (FGDC). 2013. Classification of wetlands and deepwater habitats of the United States. FGDC-STD-004-2013. Second Edition. Wetlands Subcommittee, Federal Geographic Data Committee and U.S. Fish and Wildlife Service, Washington, DC.
- Natural Resources Conservation Service (NRCS). 2016. Field indicators of hydric soils in the United States, Version 8.0. L.M. Vasilas, G.W. Hurt, and J.F. Berkowitz (eds.). U.S. Department of Agriculture, NRCS, in cooperation with the National Technical Committee for Hydric Soils.
- NatureServe. 2009. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 06 Feb 2009.
- Peet, R. K., T. R. Wentworth, and P. S. White. 1998. A flexible, multipurpose method for recording vegetation composition and structure. *Castanea* 63:262-274.

APPENDICES

- Appendix A.** Field Key to Wetland and Riparian Ecological Systems of Montana, Omernik Level III Ecoregions, and NatureServe Ecological Divisions
- Appendix B.** Hydrogeomorphic (HGM) Classification of Wetlands in the Rocky Mountains
- Appendix C.** Key to the Cowardin Systems and Classes of the Rocky Mountains, Descriptions of Cowardin Water Regimes, & NWI Water Regime Restriction Table
- Appendix D.** Montana Noxious Weed Lists
- Appendix E.** Soil Profile Description Procedures
- Appendix F.** Montana's Threatened or Endangered Plant Species
- Appendix G.** Plant Collection Protocol
- Appendix H.** First Aid Considerations and Common Field Ailments
- Appendix I.** Field Equipment and Trip Preparation Checklist
- Appendix J.** GPS Instructions
- Appendix K.** Hanna pH Meter User's Manual
- Appendix L.** Key to Wetland Plant Communities of Montana
- Appendix M.** Coordination of Montana Wetland Plant Communities with Classification of Wetland & Deepwater Habitat of the U.S., Cowardin 2.0

Appendix A: Field Key to Wetland and Riparian Ecological Systems of Montana

(Comer et al. 2003, NatureServe 2009)

- 1a.** Wetland defined by groundwater inflows and peat (organic soil) accumulation of at least 40 cm (unless underlain by bedrock). Vegetation can be woody or herbaceous. If the wetland occurs within a mosaic of non-peat forming wetland or riparian systems, then the patch must be at least 0.1 hectares (0.25 acres). If the wetland occurs as an isolated patch surrounded by upland, then there is no minimum size criteria **Rocky Mountain Subalpine-Montane Fen**
- 1b.** Wetland does not have at least 40 cm of peat (organic soil) accumulation or occupies an area less than 0.1 hectares (0.25 acres) within a mosaic of other non-peat forming wetland or riparian systems **2**
- 2a.** Total woody canopy cover generally 25% or more within the overall wetland/riparian area. Any purely herbaceous patches are less than 0.5 hectares and occur within a mosaic of woody vegetation. Note: Relict woody vegetation such as standing dead trees and shrubs are included here **GO TO KEY A: Woodland and Shrubland Ecological Systems**
- 2b.** Total woody canopy cover generally less than 25% within the overall wetland/riparian area. Any woody vegetation patches are less than 0.5 hectares and occur within a mosaic of herbaceous wetland vegetation **GO TO KEY B: Herbaceous Ecological Systems**

KEY A: Woodland and Shrubland Ecological Systems

- 1a.** Woody wetland associated with any stream channel, including ephemeral, intermittent, or perennial (Riverine HGM Class) **2**
- 1b.** Woody wetland associated with the discharge of groundwater to the surface or fed by snowmelt or precipitation. This system often occurs on slopes, lakeshores, or around ponds. Sites may experience overland flow but no channel formation. (Slope, Flat, Lacustrine, or Depressional HGM Classes) **8**
- 2a.** Riparian woodlands and shrublands of the montane or subalpine zone **3**
- 2b.** Riparian woodlands and shrublands of the plains, foothills, or lower montane zone **4**
- 3a.** Montane or subalpine riparian woodlands (canopy dominated by trees), occurring as a narrow streamside forest lining small, confined low- to mid-order streams. Common tree species include *Abies lasiocarpa*, *Picea engelmannii*, *Pseudotsuga menziesii*, and *Populus tremuloides* **Rocky Mountain Subalpine-Montane Riparian Woodland**
- 3b.** Montane or subalpine riparian shrublands (canopy dominated by shrubs with sparse tree cover), occurring as either a narrow band of shrubs lining the streambank of steep V-shaped canyons or as a wide, extensive shrub stand (sometimes referred to as a shrub carr) on alluvial terraces in low-gradient valley bottoms. Beaver activity is common within the wider occurrences. Species of *Salix*, *Alnus*, or *Betula* are typically dominant **Rocky Mountain Subalpine-Montane Riparian Shrubland**

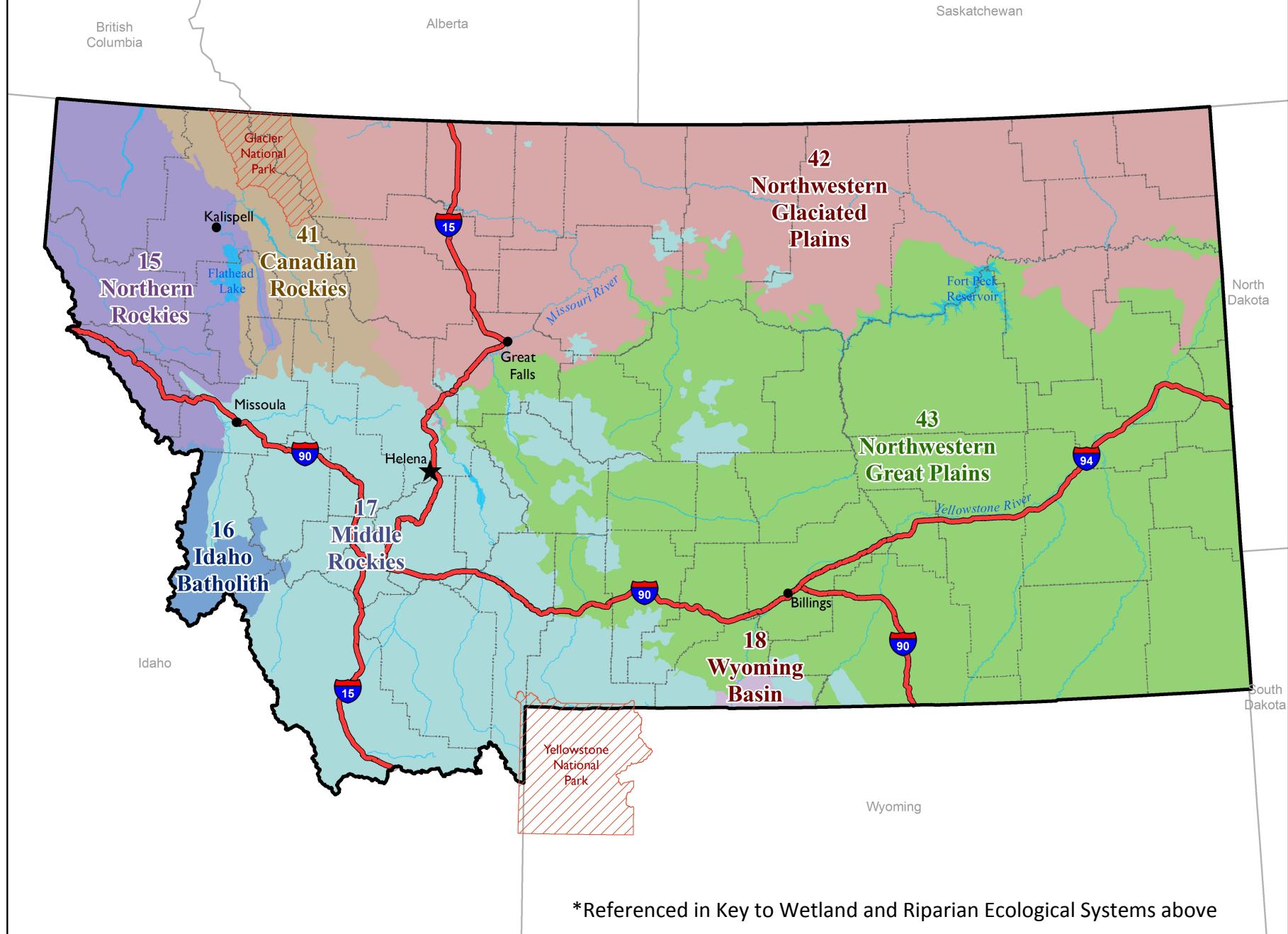
- 4a.** Riparian woodlands and shrublands of the foothills or lower montane zones of the Northern and Middle Rockies and the Wyoming Basin **5**
- 4b.** Riparian woodlands and shrublands of the Northwestern or Western Great Plains of eastern Montana **6**

- 5a.** Foothill or lower montane riparian woodlands and shrublands associated with mountain ranges of the Northern Rockies in northwestern Montana. This type *excludes* island mountain ranges east of the Continental Divide in Montana. *Populus balsamifera* ssp. *trichocarpa* is typically the canopy dominant in woodlands. Other common tree species include *Populus tremuloides*, *Betula papyrifera*, *Betula occidentalis*, and *Picea glauca*. Shrub understory species include *Cornus sericea*, *Acer glabrum*, *Alnus incana*, *Oplopanax horridus*, and *Symporicarpos albus*. Areas of riparian shrubland and open wet meadow are common
Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland
- 5b.** Foothill or lower montane riparian woodlands and shrublands associated with mountain ranges of the Middle Rockies and the Wyoming Basin. This type also includes island mountain ranges in central and eastern Montana. Woodlands are dominated by *Populus* spp. including *Populus angustifolia*, *Populus balsamifera* ssp. *trichocarpa*, *Populus deltoides*, and *Populus fremontii*. Common shrub species include *Salix* spp., *Alnus incana*, *Crataegus* spp., *Cornus sericea*, and *Betula occidentalis*.
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland
- 6a.** Woodlands and shrublands of draws and ravines associated with permanent or ephemeral streams, steep north-facing slopes, or canyon bottoms that do not experience flooding. Common tree species include *Fraxinus* spp., *Acer negundo*, *Populus tremuloides*, and *Ulmus* spp. Important shrub species include *Crataegus* spp., *Prunus virginiana*, *Rhus* spp., *Rosa woodsii*, *Symporicarpos occidentalis*, and *Shepherdia argentea*.
Western Great Plains Wooded Draw and Ravine
- 6b.** Woodlands and shrublands of small to large streams and rivers of the Northwestern or Western Great Plains. Overall vegetation is lusher than above and includes more wetland indicator species. Dominant species include *Populus balsamifera* ssp. *trichocarpa*, *Populus deltoides*, and *Salix* spp.
Northwestern/Western Great Plains Riparian 7
- 7a.** Woodlands and shrublands of riparian areas of medium and small rivers and streams with little or no floodplain development and typically flashy hydrology
Northwestern/Western Great Plains Floodplain
- 7b.** Woodlands and shrublands of riparian areas along medium and large rivers with extensive floodplain development and periodic flooding
Northwestern/Western Great Plains Floodplain
- 8a.** Woody wetland associated with small, shallow ponds in northwestern Montana. Ponds are ringed by trees including *Populus balsamifera* ssp. *trichocarpa*, *Populus tremuloides*, *Betula papyrifera*, *Abies grandis*, *Abies lasiocarpa*, *Picea engelmannii*, *Pinus contorta*, and *Pseudotsuga menziesii*. Typical shrub species include *Cornus sericea*, *Amelanchier alnifolia*, and *Salix* spp.....
Northern Rocky Mountain Wooded Vernal Pool
- 8b.** Woody wetland associated with the discharge of groundwater to the surface, or sites with overland flow but no channel formation.....
Northwestern/Western Great Plains Riparian 9
- 9a.** Coniferous woodlands associated with poorly drained soils that are saturated year round or seasonally flooded. Soils can be woody peat but tend toward mineral. Common tree species include *Thuja plicata*, *Tsuga heterophylla*, and *Picea engelmannii*. Common species of the herbaceous understory include *Mitella* spp., *Calamagrostis* spp., and *Equisetum arvense*.....
Northern Rocky Mountain Conifer Swamp
- 9b.** Woody wetlands dominated by shrubs.....
Northwestern/Western Great Plains Riparian 10
- 10a.** Subalpine to montane shrubby wetlands that occur around seeps, fens, and isolated springs on slopes away from valley bottoms. This system can also occur within a mosaic of multiple shrub- and herb-dominated communities within snowmelt-fed basins. This example of the system has the same species composition as the riverine example of this system and is dominated by species of *Salix*, *Alnus*, or *Betula*.
Rocky Mountain Subalpine-Montane Riparian Shrubland
- 10b.** Lower foothills to valley bottom shrublands restricted to temporarily or intermittently flooded drainages or flats and dominated by *Sarcobatus vermiculatus*
Inter-Mountain Basins Greasewood Flat

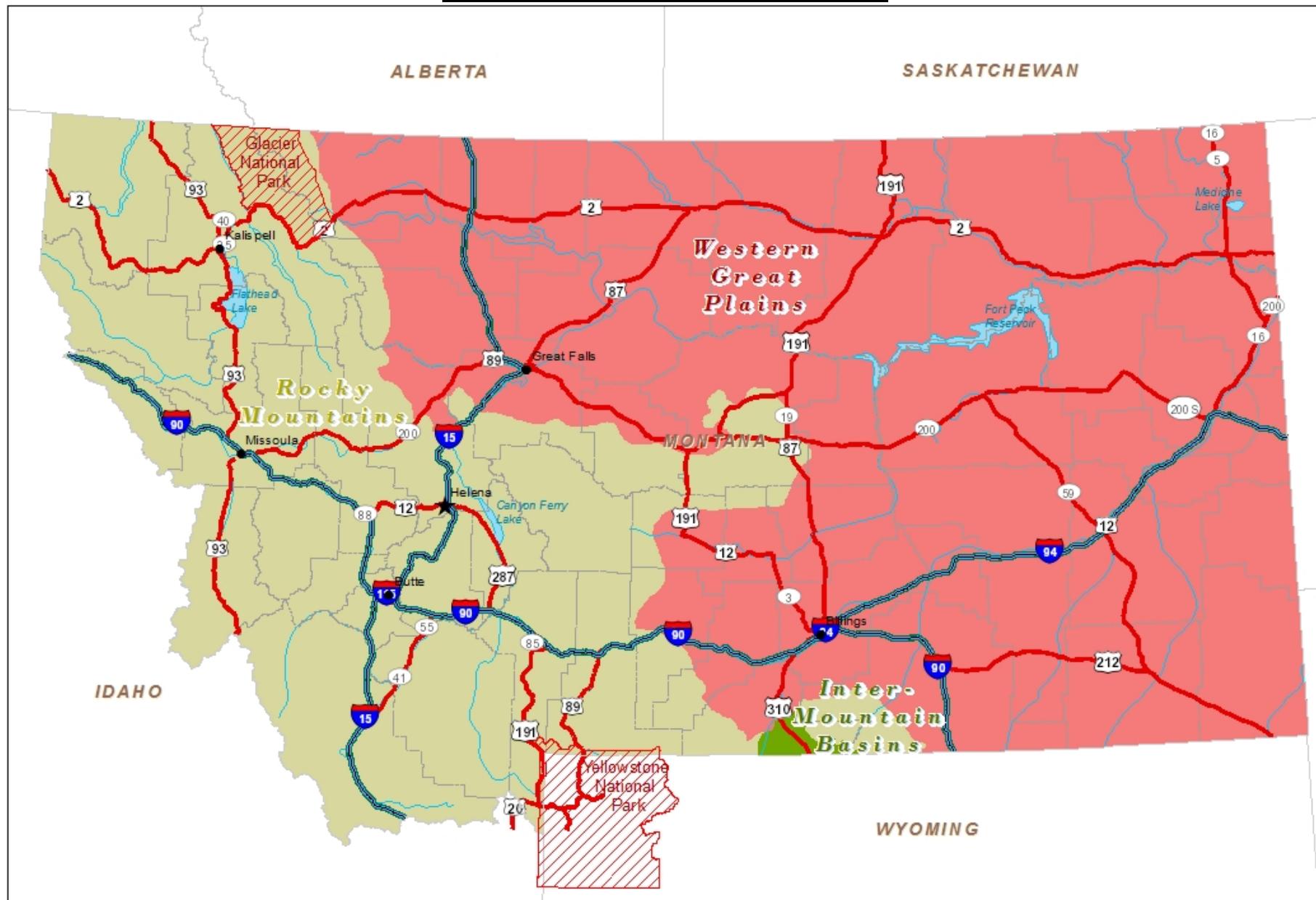
KEY B: Herbaceous Wetland Ecological Systems

- 1a.** Herbaceous wetlands of the Northwestern Glaciated Plains, Northwestern Great Plains, or Western Great Plains regions of eastern Montana..... 2
- 1b.** Herbaceous wetlands of other regions 5
- 2a.** Wetland occurs as a complex of depressional wetlands within the glaciated plains of northern Montana. Typical species include *Schoenoplectus* spp. and *Typha latifolia* on wetter, semi-permanently flooded sites, and *Eleocharis* spp., *Pascopyrum smithii*, and *Hordeum jubatum* on drier, temporarily flooded sites.....
.....**Great Plains Prairie Pothole**
- 2b.** Wetland does not occur as a complex of depressional wetlands within the glaciated plains of Montana..... 3
- 3a.** Depressional wetlands in the Western Great Plains with saline soils. Salt encrustations can occur on the surface. Species are typically salt-tolerant such as *Distichlis spicata*, *Puccinellia* spp., *Salicornia* spp., and *Schoenoplectus maritimus*.....**Western Great Plains Saline Depression Wetland**
- 3b.** Depressional wetlands in the Western Great Plains with obvious vegetation zonation dominated by emergent herbaceous vegetation, including *Eleocharis* spp., *Schoenoplectus* spp., *Phalaris arundinacea*, *Calamagrostis canadensis*, *Hordeum jubatum*, and *Pascopyrum smithii* 4
- 4a.** Depressional wetlands in the Western Great Plains associated with open basins that have an obvious connection to the groundwater table. This system can also occur along stream margins where it is linked to the basin via groundwater flow. Typical plant species include species of *Typha*, *Carex*, *Schoenoplectus*, *Eleocharis*, *Juncus*, and floating genera such as *Potamogeton*, *Sagittaria*, and *Ceratophyllum*.....
.....**Western Great Plains Open Freshwater Depression Wetland**
- 4b.** Depressional wetlands in the Western Great Plains primarily within upland basins having an impermeable layer such as dense clay. Recharge is typically via precipitation and runoff, so this system typically lacks a groundwater connection. Wetlands in this system tend to have standing water for a shorter duration than Western Great Plains Open Freshwater Depression Wetlands. Common species include *Eleocharis* spp., *Hordeum jubatum*, and *Pascopyrum smithii***Western Great Plains Closed Depression Wetland**
- 5a.** Wetlands with a permanent water source throughout all or most of the year. Water is at or above the surface throughout the growing season, except in drought years. This system can occur around ponds, as fringes around lakes and along slow-moving streams and rivers. The vegetation is dominated by common emergent and floating leaved species including species of *Scirpus*, *Schoenoplectus*, *Typha*, *Juncus*, *Carex*, *Potamogeton*, *Polygonum*, and *Nuphar*.....**Western North American Emergent Marsh**
- 5b.** Herbaceous wetlands associated with a high water table or overland flow, but typically lacking standing water. Sites with *no channel formation* are typically associated with snowmelt and not subjected to high disturbance events such as flooding (Slope HGM Class). Sites *associated with a stream channel* are more tightly connected to overbank flooding from the stream channel than with snowmelt and groundwater discharge and may be subjected to high disturbance events such as flooding (Riverine HGM Class). Vegetation is dominated by herbaceous species; typically graminoids have the highest canopy cover including *Carex* spp., *Calamagrostis* spp., and *Deschampsia cespitosa***Rocky Mountain Alpine-Montane Wet Meadow**

Omernik Level III Ecoregions in Montana



NatureServe's Ecological Divisions in Montana



*Referenced in Key to Wetland and Riparian Ecological Systems above

**Comer (2003) adapted this from Bailey's Ecoregions at Division scale

Appendix B: Hydrogeomorphic (HGM) Classification of Wetlands in the Rocky Mountains

If the hydrologic criteria listed in each question do not apply to the entire wetland unit being rated, you probably have a wetland with multiple HGM classes. In this case, identify which hydrologic criteria in Questions 1-5 apply, and go to Question 6.

- 1a. Entire wetland unit is flat and precipitation is the primary source (>90%) of water. Groundwater and surface water runoff are not significant sources of water to the unit..... **Flats HGM Class**
- 1b. Wetland does not meet the above criteria; primary water sources include groundwater and/or surface water..... **2**
- 2a. Entire wetland unit meets ***all*** of the following criteria: a) the vegetated portion of the wetland is on the shores of a permanent open water body at least 8 ha (20 acres) in size; b) at least 30% of the open water area is deeper than 2.5 m (8.2 ft); c) vegetation in the wetland experiences bidirectional flow as the result of vertical fluctuations of water levels due to rising and falling lake levels.....
..... **Lacustrine Fringe HGM Class**
- 2b. Wetland does not meet the above criteria; wetland is not found on the shore of a water body, water body is either smaller or shallower, OR vegetation is not affected by lake water levels **3**
- 3a. Entire wetland unit meets ***all*** of the following criteria: a) wetland unit is in a valley, floodplain, or along a stream channel where it is inundated by overbank flooding from that stream or river; b) overbank flooding occurs at least once every two years; and c) wetland does not receive significant inputs from groundwater. **NOTE:** Riverine wetlands can contain depressions that are filled with water when the river is not flooding such as oxbows and beaver ponds..... **Riverine HGM Class**
- 3b. Wetland does not meet the above criteria; if the wetland is located within a valley, floodplain, or along a stream channel, it is outside of the influence of overbank flooding or receives significant hydrologic inputs from groundwater..... **4**
- 4a. Entire wetland unit meets ***all*** of the following criteria: a) wetland is on a slope (slope can be very gradual or nearly flat); b) groundwater is the primary hydrologic input; c) water, if present, flows through the wetland in one direction and usually comes from seeps or springs; and d) water leaves the wetland without being impounded. **NOTE:** Small channels can form within slope wetlands, but are not subject to overbank flooding. Surface water does not pond in these types of wetlands, except occasionally in very small and shallow depressions or behind hummocks (depressions are usually < 3ft diameter and less than 1 foot deep). **Slope HGM Class**
- 4b. Wetland does not meet all of the above criteria. **5**
- 5a. Entire wetland unit is located in a topographic depression in which water ponds or is saturated to the surface at some time during the year. **NOTE:** Any outlet, if present, is higher than the interior of the wetland..... **Depressional HGM Class**

5b. Wetland does not meet the above criteria..... 6

6. If the wetland is difficult to classify, then it probably contains multiple HGM classes. For example, seeps at the base of a slope may grade into a riverine floodplain, or a small stream within a depressional wetland may have a zone of flooding along its sides. GO BACK AND IDENTIFY WHICH OF THE HYDROGEOMORPHIC CLASSES DESCRIBED IN QUESTIONS 1-5 APPLY TO DIFFERENT AREAS IN THE UNIT (make a rough sketch to help you decide).

If you have two HGM classes present within your wetland, then identify the HGM class that represents 10% or more of the assessment area using the following table.

HGM Classes observed within the wetland being assessed	HGM Class to use in assessment (must represent 10% or more of the assessment area)
<i>Slope + Riverine</i>	<i>Riverine</i>
<i>Slope + Depressional</i>	<i>Depressional</i>
<i>Slope + Lacustrine Fringe</i>	<i>Lacustrine Fringe</i>
<i>Depressional + Riverine along stream within assessment area boundary</i>	<i>Depressional</i>
<i>Depressional + Lacustrine Fringe</i>	<i>Depressional</i>

NOTE: If the HGM class listed in column 2 represents less than 10% of the assessment area, then classify the wetland using the HGM class that represents more than 90% of the total assessment area. If you are still unable to determine which of the above criteria apply to your wetland, or if you have more than 2 HGM classes within an assessment area, classify the wetland as Depressional for the assessment and note reasoning.

Modified from: Hruby, Tom, (2004). *Washington State Wetland Rating System for Eastern Washington - Revised*. Publication #04-06-15. Washington State Department of Ecology, Olympia, Washington.

Appendix C: Key to the Cowardin Systems and Classes of Montana

Cowardin 2.0 (FGDC 2013, adapted from Appendix B)

Key to the Cowardin Systems

- 1a.** Persistent emergent herbaceous vegetation, trees, shrubs, or emergent mosses cover 30% or more of the wetland. If the wetland occurs within a mosaic of systems, then the patch must be at least 0.1 hectares (0.25 acres).....**PALUSTRINE**
- 1b.** Persistent emergents, trees, shrubs, or emergent mosses cover less than 30% of substrate, but nonpersistent emergents may be widespread during some portions of the year**2**
- 2a.** Situated in a channel; water, when present, usually flowing.....**RIVERINE**
- 2b.** Situated in a basin, catchment, or on level or sloping ground; water usually not flowing.....**3**
- 3a.** Area 8 ha (20 acres) or greaterLACUSTRINE
- 3b.** Area less than 8 ha4
- 4a.** Wave-formed or bedrock shoreline feature present or water depth 2.5 m (8.2 feet) or more.....**LACUSTRINE**
- 4b.** No wave-formed or bedrock shoreline feature present and water less than 2.5 m deepPALUSTRINE

Key to the Cowardin Classes

- 1a.** During the growing season of most years, areal cover by vegetation is less than 30%.**2**
- 1b.** During the growing season of most years, percentage of area covered by vegetation 30% or greater.....**6**
- 2a.** Water regime permanently flooded (H), intermittently exposed (G), or semipermanently flooded (F).....**3**
- 2b.** Water regime seasonally flooded (C), temporarily flooded (A), intermittently flooded (J), seasonally flooded-saturated (E), or artificially flooded (K).**4**
- 3a.** Substrate of bedrock, boulders, or stones occurring singly or in combination covers 75% or more of the area.....**ROCK BOTTOM**
- 3b.** Substrate of organic material, mud, sand, gravel, or cobbles with less than 75% areal cover of stones, boulders, or bedrock.....**UNCONSOLIDATED BOTTOM**
- 4a.** Contained within a channel that does not have permanent/continuously flowing water (i.e., Intermittent Subsystem of Riverine System).....**STREAMBED**
- 4b.** Contained in a channel with perennial/continuously flowing water or along the shore of a lake/pond.....**5**
- 5a.** Substrate of bedrock, boulders, or stones occurring singly or in combination covers 75% or more of the area (RIVERINE OR LACUSTRINE ONLY).**ROCKY SHORE**
- 5b.** Substrate of organic material, mud, sand, gravel, or cobbles; with less than 75% of the cover consisting of stones, boulders, or bedrockUNCONSOLIDATED SHORE

6a. Vegetation composed of pioneering annuals or seedling perennials, often not hydrophytes, occurring only at time of substrate exposure	7
6b. Vegetation composed of algae, mosses, liverworts, lichens, or vascular plants that are usually hydrophytic perennials	8
7a. Contained within a channel that does not have permanent flowing water.....	STREAMBED (VEGETATED)
7b. Contained within a channel with permanent water, or not contained in a channel	UNCONSOLIDATED SHORE (VEGETATED)
8a. Vegetation composed predominantly of nonvascular species.....	9
8b. Vegetation composed predominantly of vascular species.....	10
9a. Vegetation macrophytic algae, mosses, or lichens growing in water or the splash zone of shores.	AQUATIC BED
9b. Vegetation mosses or lichens usually growing on organic soils and always outside the splash zone of shores.....	MOSS-LICHEN WETLAND
10a. Vegetation herbaceous	11
10b. Vegetation trees or shrubs	12
11a. Vegetation emergents	EMERGENT WETLAND
11b. Vegetation submergent, floating-leaved, or floating	AQUATIC BED
12a. Dominants less than 6 m (20 feet) tall.....	SCRUB-SHRUB WETLAND
12b. Dominants 6 m tall or taller	FORESTED WETLAND

*In addition, if neither the cover of trees or the cover of shrubs are individually $\geq 30\%$, but the summation of their percentages IS $\geq 30\%$**SCRUB-SHRUB WETLAND**

From FGDC (2013) Appendix A: Glossary

- Boulder = Rock fragment larger than 60.4 cm (24 inches) in diameter.
- Stone = Rock fragment larger than 25.4 cm (10 inches) but less than 60.4 cm (24 inches).
- Cobble = Rock fragment 7.6 cm (3 inches) to 25.4 cm (10 inches) in diameter.
- Gravel = Mixture composed primarily of rock fragments 2 mm (0.08 inch) to 7.6 cm (3 inches) in diameter. Usually contains much sand.
- Sand = Unconsolidated mineral sediment composed predominantly of particles >0.074 mm & <2 mm.
- Mud = Wet soft earth composed predominantly of clay- and silt-sized mineral particles <0.074 mm.

From FGDC (2013) Appendix E: Criteria for Differentiating between Mineral Soils and Organic Soils

"If a soil has both organic and mineral horizons, the relative thickness of the organic and mineral soil materials must be considered. [M]ineral soils [are] those that have both thick mineral soils layers and no more organic material than the amount permitted in the Histic Epipedon [(surface horizon $\geq 20\text{cm}$)]. [A]ny O horizon at the surface is considered an organic horizon if it meets the requirements of organic soil material...and its thickness is added to that of any other organic horizons to determine the total thickness of organic soil materials. It is a general rule that a soil is classified as an organic soil (Histosol) if more than half of the upper 80 cm (32 in) of the soil is organic or if organic soil material of any thickness rests on rock or on fragmental material having interstices filled with organic materials."

Descriptions of Cowardin Water Regimes

(FGDC 2013, Sec.3.3)

For MINERAL SOILS:

Permanently Flooded (H) - Water covers the substrate throughout the year in all years.

Intermittently Exposed (G) - Water covers the substrate throughout the year except in years of extreme drought.

Semipermanently Flooded (F) - Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface.

Seasonally Flooded (C) - Surface water is present for extended periods (generally for more than a month) during the growing season, but is absent by the end of the season in most years. When surface water is absent, the depth to substrate saturation may vary considerably among sites and among years.

Temporarily Flooded (A) - Surface water is present for brief periods (from a few days to a few weeks) during the growing season, but the water table usually lies well below the ground surface for the most of the season.

Intermittently Flooded (J) - The substrate is usually exposed, but surface water is present for variable periods without detectable seasonal periodicity. Weeks, months, or even years may intervene between periods of inundation. The dominant plant communities under this Water Regime may change as soil moisture conditions change. Some areas exhibiting this Water Regime do not fall within our definition of wetland because they do not have hydric soils or support hydrophytes. This Water Regime is generally limited to the arid West.

For ORGANIC SOILS:

Seasonally Flooded-Saturated (E) - Surface water is present for extended periods (generally for more than a month) during the growing season, but is absent by the end of the season in most years. When surface water is absent, the substrate typically remains saturated at or near the surface.

Continuously Saturated (D) - The substrate is saturated at or near the surface throughout the year in all, or most, years. Widespread surface inundation is rare, but water may be present in shallow depressions that intersect the groundwater table, particularly on a floating peat mat.

Seasonally Saturated (B) - The substrate is saturated at or near the surface for extended periods during the growing season, but unsaturated conditions prevail by the end of the season in most years. Surface water is typically absent, but may occur for a few days after heavy rain and upland runoff.

NWI Water Regime Restriction Table

*Use in conjunction with Key to the Cowardin Systems and Classes of Montana above

Class/Subclass	Code	Marine		Estuarine		Riverine				Lacustrine			Palustrine
		Subtidal M1	Intertidal M2	Subtidal E1	Intertidal E2	Tidal R1	Lower Perennial R2	Upper Perennial R3	Intermittent R4	Limnetic L1	Littoral L2	P	
ROCK BOTTOM	RB	L		L		TV		FGH		V	GHK	TV	FGHK
Bedrock	RB1	L		L		TV		FGH		V	GHK	TV	FGHK
Rubble	RB2	L		L		TV		FGH		V	GHK	TV	FGHK
UNCONSOLIDATED BOTTOM	UB	L		L		TV	FGH	FGH		V	GHK	TV	FGHK
Cobble-Gravel	UB1	L		L		TV	FGH	FGH		V	GHK	TV	FGHK
Sand	UB2	L		L		TV	FGH	FGH		V	GHK	TV	FGHK
Mud	UB3	L		L		TV	FGH	FGH		V	GHK	TV	FGHK
Organic	UB4			L		TV	FGH			V	GHK	TV	FGHK
AQUATIC BED	AB	L	MN	L	MN	QTV	CFGH	CFGH		V	GHK	QTV	CFGHK
Algal	AB1	L	MN	L	MN	TV	FGH	FGH		V	GHK	TV	FGHK
Aquatic Moss	AB2					TV	FGH	FGH		V	GHK	TV	FGHK
Rooted Vascular	AB3	L	M	L	M	QTV	CFGH	CFGH		V	GHK	QTV	CFGHK
Floating Vascular	AB4			L	MN	QTV	CFGH	CFGH		V	GHK	QTV	CFGHK
REEF	RF	L	MN	L	MN								
Coral	RF1	L	MN										
Mollusk	RF2			L	MN								
Worm	RF3	L	MN	L	MN								
STREAMBED	SB			MNP		Q			ACJ				
Bedrock	SB1			MNP		Q			ACJ				
Rubble	SB2			MNP		Q			ACJ				
Cobble-Gravel	SB3			MNP		Q			ACJ				
Sand	SB4			MNP		Q			ACJ				
Mud	SB5			MNP		Q			ACJ				
Organic	SB6			MNP		Q			C				
Vegetated	SB7								ACJ				
ROCKY SHORE	RS		MNP		MNP	Q	AC	AC		Q	ACJK		
Bedrock	RS1		MNP		MNP	Q	AC	AC		Q	ACJK		
Rubble	RS2		MNP		MNP	Q	AC	AC		Q	ACJK		
UNCONSOLIDATED SHORE	US		MNP		MNP	Q	ACEJ	ACEJ		Q	ACEJK	RS	ACEJK
Cobble-Gravel	US1		MNP		MNP	Q	ACJ	ACJ		Q	ACJK	RS	ACJK
Sand	US2		MNP		MNP	Q	ACJ	ACJ		Q	ACJK	RS	ACJK
Mud	US3		MNP		MNP	Q	ACJ	ACJ		Q	ACJK	RS	ACJK
Organic	US4		MNP		MNP	Q	E	E		Q	E		E
Vegetated	US5						ACJ	ACJ		Q	ACJK		ACJK

Saltwater Tidal = **BROWN** Water Regimes; Freshwater Tidal = **BLUE** Water Regimes; Nontidal = **RED** Water Regimes.

Class/Subclass	Code	Marine		Estuarine		Riverine				Lacustrine		Palustrine
		Subtidal M1	Intertidal M2	Subtidal E1	Intertidal E2	Tidal R1	Lower Perennial R2	Upper Perennial R3	Intermittent R4	Limnetic L1	Littoral L2	P
MOSS-LICHEN	ML											BCDE
Moss	ML1											BCDE
Lichen	ML2											BCDE
EMERGENT												
Persistent	EM1					NP					RST	ABCDEFJK
Non persistent	EM2					NP	QTV	FGH			QTV	FGHK
Phragmites australis	EM5					P					RST	ABCDEFK
SCRUB-SHRUB												
Broad-Leaved Deciduous	SS1					P					RST	ABCDEFJK
Needle-Leaved Deciduous	SS2					P					RST	ABCDEFJK
Broad-Leaved Evergreen	SS3					NP					RS	ABCDEK
Needle-Leaved Evergreen	SS4					P					RS	ABCDEK
Dead	SS5					MNP					TV	FGHK
Deciduous	SS6					P					RST	ABCDEFJK
Evergreen	SS7					NP					RS	ABCDEK
FORESTED												
Broad-Leaved Deciduous	FO1					P					RST	ABCDEFK
Needle-Leaved Deciduous	FO2					P					RST	ABCDEFK
Broad-Leaved Evergreen	FO3					NP					RS	ABCDEK
Needle-Leaved Evergreen	FO4					P					RS	ABCDEK
Dead	FO5					MNP					TV	FGHK
Deciduous	FO6					P					RST	ABCDEFK
Evergreen	FO7					NP					RS	ABCDEK

Saltwater Tidal = **BROWN** Water Regimes; Freshwater Tidal = **BLUE** Water Regimes; Nontidal = **RED** Water Regimes.

Appendix D. Montana Noxious Weed Lists

Montana Noxious Weed List

Montana Department of Agriculture (<http://agr.mt.gov/Weeds>)

Effective: February 2017

PRIORITY 1A These weeds are not present or have a very limited presence in Montana. Management criteria will require eradication if detected, education, and prevention:

- (a) Yellow starthistle (*Centaurea solstitialis*)
- (b) Dyer's woad (*Isatis tinctoria*)
- (c) Common reed (*Phragmites australis* ssp. *australis*)
- (d) Medusahead (*Taeniatherum caput-medusae*)

PRIORITY 1B These weeds have limited presence in Montana.

Management criteria will require eradication or containment and education:

- (a) Knotweed complex (*Polygonum cuspidatum*, *P. sachalinense*, *P. x bohemicum*, *Fallopia japonica*, *F. sachalinensis*, *F. x bohemica*, *Reynoutria japonica*, *R. sachalinensis*, and *R.x bohemica*)
- (b) Purple loosestrife (*Lythrum salicaria*)
- (c) Rush skeletonweed (*Chondrilla juncea*)
- (d) Scotch broom (*Cytisus scoparius*)
- (e) Blueweed (*Echium vulgare*)

PRIORITY 2A These weeds are common in isolated areas of Montana. Management criteria will require eradication or containment where less abundant. Management shall be prioritized by local weed districts:

- (a) Tansy ragwort (*Senecio jacobaea*, *Jacobaea vulgaris*)
- (b) Meadow hawkweed complex (*Hieracium caespitosum*, *H. praealtum*, *H. floridundum*, and *Pilosella caespitosa*)
- (c) Orange hawkweed (*Hieracium aurantiacum*, *Pilosella aurantiaca*)
- (d) Tall buttercup (*Ranunculus acris*)
- (e) Perennial pepperweed (*Lepidium latifolium*)
- (f) Yellowflag iris (*Iris pseudacorus*)
- (g) Eurasian watermilfoil (*Myriophyllum spicatum*, *Myriophyllum spicatum* x *Myriophyllum sibiricum*)
- (h) Flowering rush (*Butomus umbellatus*)
- (i) Common buckthorn (*Rhamnus cathartica L.*)

PRIORITY 2B These weeds are abundant in Montana and widespread in many counties. Management criteria will require eradication or containment where less abundant. Management shall be prioritized by local weed districts:

- (a) Canada thistle (*Cirsium arvense*)
- (b) Field bindweed (*Convolvulus arvensis*)
- (c) Leafy spurge (*Euphorbia esula*)
- (d) Whitetop (*Cardaria draba*, *Lepidium draba*)
- (e) Russian knapweed (*Acroptilon repens*, *Rhaponticum repens*)
- (f) Spotted knapweed (*Centaurea stoebe*, *C. maculosa*)
- (g) Diffuse knapweed (*Centaurea diffusa*)
- (h) Dalmatian toadflax (*Linaria dalmatica*)
- (i) St. Johnswort (*Hypericum perforatum*)
- (j) Sulfur cinquefoil (*Potentilla recta*)
- (k) Common tansy (*Tanacetum vulgare*)
- (l) Oxeye daisy (*Leucanthemum vulgare*)
- (m) Houndstongue (*Cynoglossum officinale*)
- (n) Yellow toadflax (*Linaria vulgaris*)
- (o) Saltcedar (*Tamarix spp.*)
- (p) Curlyleaf pondweed (*Potamogeton crispus*)
- (q) Hoary alyssum (*Berteroia incana*)

PRIORITY 3 Regulated Plants:

(NOT MONTANA LISTED NOXIOUS WEEDS)

These regulated plants have the potential to have significant negative impacts. The plant may not be intentionally spread or sold other than as a contaminant in agricultural products. The state recommends research, education and prevention to minimize the spread of the regulated plant.

- (a) Cheatgrass (*Bromus tectorum*)
- (b) Hydrilla (*Hydrilla verticillata*)
- (c) Russian olive (*Elaeagnus angustifolia*)
- (d) Brazilian waterweed (*Egeria densa*)
- (e) Parrot feather watermilfoil (*Myriophyllum aquaticum* or *M. brasiliense*)

County Listed Weeds

Montana Weed Control Association (<http://mtweed.org/>)

Updated January 30, 2015

Weed	Counties that list it
Baby's Breath	Jefferson, Deer Lodge, Blaine, Broadwater, Silver Bow, Chouteau, Daniels, Flathead, Richland, Sheridan,
Bellflower	Flathead
Black Henbane	Deer Lodge, Beaverhead, Big Horn, Broadwater, Lewis & Clark, Meagher, Powder River, Powell, Ravalli, Stillwater,
Bugloss, Common	Ravalli
Campion, bladder	Meagher
Campion, White	Flathead,
Chicory	Lincoln
Common Burdock	Big Horn, Blaine, Broadwater, Fallon, Lewis & Clark, Lincoln, Pondera, Stillwater,
Common Crupina	Lincoln,
Common Mullin	Yellowstone, Deer Lodge, Beaverhead, Lewis & Clark, Mineral, Stillwater,
Common Teasel	Yellowstone, Beaverhead, Ravalli
Curly Dock	Deer Lodge,
Dwarf Snapdragon	Lincoln,
Field Scabious	Jefferson, Beaverhead, Gallatin, Madison, Ravalli,
Halogeton	Beaverhead,
Kochia	Deer Lodge, Flathead, Lincoln, Rosebud
Matrimony vine	Silver Bow,
Mayweed/dogfennel	Mineral,
Meadow Knapweed	Gallatin,
Poison Hemlock	Yellowstone, Big Horn, Chouteau, Fallon, Gallatin, Lincoln, Powder River, Rosebud,
Puncturevine	Yellowstone, Powder River, Rosebud,
Scentless Chamomile	Beaverhead, Gallatin, Lincoln, Mineral,
Scotch Broom	Lincoln,
Speedwell, Common	Lincoln
Speedwell, Germander	Lincoln
Spurge, Cypress	Beaverhead,
spurge, Myrtle	Beaverhead,
Swainsonpea	Beaverhead,
Thistle, Musk	Teton, Deer Lodge, Beaverhead, Broadwater, Gallatin, Lewis & Clark, Liberty, Lincoln, Madison, Pondera, Toole,
Thistle, perennial Sow	Deer Lodge, Broadwater, Liberty, Pondera,
Thistle, Plumeless	Lincoln
Thistle, Russian	Flathead,
Thistle, Scotch	Broadwater, Carbon, Gallatin, Lincoln, Meagher, Rosebud,
Western Water Hemlock	Yellowstone, Missoula,

Appendix E. Soil Profile Description Procedures

SOIL PROFILE DESCRIPTION PROCEDURES

-  EXPOSE SOIL PROFILE BY TAKING SOIL CORE OR DIGGING SOIL PIT
-  DELINEATE SOIL HORIZONS OR LAYERS
-  FOR EACH HORIZON/LAYER, DETERMINE MATRIX COLOR
-  IF REDOX CONCENTRATIONS OR DEPLETIONS ARE PRESENT,
DETERMINE PERCENT SURFACE AREA OF SOIL MATRIX
AND COLOR FOR EACH
-  DETERMINE IF SOIL PROFILE HAS ORGANIC OR MINERAL SOIL
HORIZONS/LAYERS
-  DISTINGUISH BETWEEN MINERAL SOIL LAYERS WITH MUCKY MINERAL MODIFIER
AND
ORGANIC SOIL LAYERS
-  IF SOIL HAS ORGANIC HORIZONS/LAYERS,
DISTINGUISH ORGANIC MATTER DECOMPOSITION STAGE
OF THOSE HORIZONS/LAYERS
-  DETERMINE SOIL TEXTURE FOR ALL MINERAL SOIL HORIZONS/LAYERS
(INCLUDING THOSE HORIZONS/LAYERS WITH MUCKY MINERAL MODIFIER)
-  DETERMINE IF A COARSE FRAGMENT TEXTURE MODIFIER
IS APPROPRIATE TO USE FOR SOIL HORIZONS/LAYERS OF ROCKY SOILS



DELINEATE SOIL HORIZONS OR LAYERS

The figure consists of several images related to soil profile analysis:

- A top-left diagram of a soil slab labeled "Soil Pit Bottom" and "Ground Surface". A vertical dimension line indicates a depth of "60 cm".
- An inset photo at the bottom left shows a hand pointing to a soil profile.
- Four smaller photos on the right show different soil profiles, each with a vertical scale bar.

Distinguishing Soil Horizons. *Left top:* Soil slab diagram with horizons marked. *Left bottom:* Soil slab photo (Eric Vance, EPA). *Right:* Example soil profiles illustrating horizons distinguished by different colors, structure, or texture. Profile photos from USDA, NRCS (2010).

- Take your sunglasses off!
- First, eliminate smearing of the profile from auger or shovel. If you have a soil pit take a clean slice from an uncompacted side of the pit with the sharpshooter. If sharpshooter smears profile, use a putty knife to “clean up” profile to expose clear layer boundaries. If you are using auger, carefully break open your soil to get clean, non-smear profile.
- Place marker (e.g., golf tee) at bottom of each layer. Number layer in order from the top of the profile (see figure at left).
- Take a photo of the profile.
- Measure depth from the top of the soil profile to the bottom of each layer in centimeters (a metric fiberglass seamstress tape works well). Record the depth to the lower boundary of each layer.

Note: This may be an iterative process as sometimes visual clues may be difficult to differentiate. As you examine the soil texture, you may have to adjust the placement of soil layer markers but always start by separating layers based on differences in color and other visual cues.



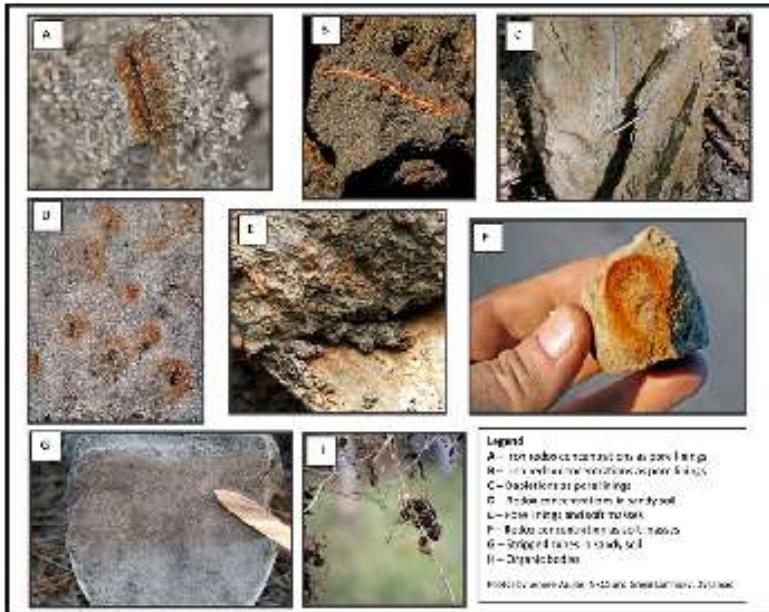
FOR EACH HORIZON/LAYER DETERMINE MATRIX COLOR



Photo courtesy of Vermont Department of Environmental Conservation

- ↳ Take off your sunglasses!
- ↳ For each layer, record the Soil Matrix Color using the Munsell Soil Chart. Soil Matrix Color is recorded as the Hue/Value/Chroma that matches most closely to the chips of the Munsell Soil Color Chart.
- ↳ If soils are dry, wet the sample until moist (not saturated), and until sample no longer changes color.
- ↳ Soil samples may start to dry quickly when exposed to air, re-wet the sample as needed.
- ↳ Always have the sun at your back so that the soil sample is well lit when comparing the soil to the color chart to find the best match.

**IF REDOX CONCENTRATIONS OR DEPLETIONS ARE PRESENT,
DETERMINE PERCENT SURFACE AREA OF SOIL MATRIX
AND COLOR FOR EACH**



- ↳ For each Layer, record the Hue/Value/Chroma of Redox Concentrations. Redox concentrations are the result of iron oxidation as groundwater levels fluctuate throughout the growing season. These concentrations are orange/reddish-brown (due to iron) or dark reddish brown/black (due to manganese). Redox concentrations can occur as:
- ↳ Record Redox Concentration Abundance (%): Estimate the percentage of redox concentrations in each soil layer (see Plate 3).

Plate 3. Examples of Surface Area Estimation for Soil Features. Percent surface area of soil matrix occupied by other components, (e.g., rocks, roots, redox and other features with contrasting colors).



1. For each Layer, record the Hue/Value/Chroma of Redox Concentrations. Redox concentrations are the result of iron oxidation as groundwater levels fluctuate throughout the growing season. These concentrations are orange/reddish-brown (due to iron) or dark reddish brown/black (due to manganese). Redox concentrations can occur as:
 - ↳ Nodules or concretions: firm irregularly shaped bodies with diffuse boundaries
 - ↳ Masses: other bodies occurring throughout the matrix (also known as mottles)
 - ↳ Pore linings: redox concentrations along root channels as a result of oxygen diffusion from the roots of plants into the surrounding soil matrix reacting with iron in the soil (also known as oxidized rhizospheres)
2. Record Redox Concentration Abundance (%): Estimate the percentage of redox concentration in each soil layer (see Plate 3).

Photos and Figures courtesy of NRCS



DETERMINE IF SOIL PROFILE HAS ORGANIC OR MINERAL SOIL HORIZONS/LAYERS

Step 1.

Determine whether the horizon/layer is an organic or mineral soil

- ↳ For each layer, take a dime-sized chunk of moist soil in your hand and gently rub the wet soil between forefinger and thumb 10 times.
 - ↳ If the soil feels greasy and leaves a light to dark stain on your hand, then the soil is either mucky mineral or organic soil (**Go to Step 2.**)
 - ↳ If soil does not feel greasy, the soil is a mineral soil (**Go to Step 4.**)



Mineral Soil



Organic Soil

Photos accessed at <http://soils.usda.gov/technical/classification/orders/images/histosol.jpg> and <http://soils.usda.gov/technical/classification/orders/images/histosol.jpg>



DISTINGUISH BETWEEN MINERAL SOIL LAYERS WITH MUCKY MINERAL MODIFIER AND ORGANIC SOIL LAYERS

Step 2.

Texturing Soils with High Organic Matter Content- Distinguishing between mucky mineral and organic layers

- ↳ For each organic soil layer, distinguish between mucky mineral or organic. Squeeze a chunk of wet soil and determine which of the following best describes the layer:
 - ↳ **Organic** – The soil has an organic texture if, when squeezed, it either extrudes liquid or much of the soil material does not stick to your hand. Identifiable plant parts are common (**Go to Step 3**).
 - ↳ **Mucky Mineral (modifier)** – The soil has a mucky mineral modifier if it is gritty or sticks to your hand when squeezed and rubbed. Identifiable plant fibers are rare to none (**Go to step 4** and determine soil texture. It will be more difficult to determine soil texture of mucky mineral soils than mineral soils but do your best).



**IF SOIL HAS ORGANIC HORIZONS/LAYERS,
DISTINGUISH ORGANIC MATTER DECOMPOSITION STAGE
OF THOSE HORIZONS/LAYERS**

Step 3.

Distinguishing among organic matter decomposition stages for organic soil layers

- ↳ Organic textures include Peat, Mucky-Peat, or Muck. The three textures are based on differences in percent volume of plant fibers visible with a hand lens after rubbing between thumb and forefinger 10 times.
 - ↳ To distinguish between the organic soils, take a fresh dime-sized chunk of moist soil. Rub that sample between your thumb and forefinger 10 times, and then visually estimate the percent volume of plant fibers and dead roots. Use the chart below to determine the organic matter decomposition state of the organic soil layer.

Wetter Soils	% Fibers Visible with Hand Lens after Rubbing
Peat	> 40 %
Mucky Peat	20-40 %
Muck	< 20 %

Table modified from United States Department of Agriculture, Natural Resources Conservation Service. 2010. *Field Indicators of Hydric Soils in the United States, Version 7.0*. L.M. Vasiles, G.W. Hurt, and C.V. Noble (eds.). USDA, NRCS, in cooperation with the National Technical Committee for Hydric Soils.

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DETERMINE SOIL TEXTURE FOR ALL MINERAL SOIL HORIZONS/LAYERS (INCLUDING THOSE HORIZONS/LAYERS WITH MUCKY MINERAL MODIFIER)

A. Grain size	
Pebbles	
4–64 mm	
Gravel*	
2–4 mm	
Coarse sand	
0.5–2 mm	
Medium sand	
0.25–0.5 mm	
Fine sand	
0.06–0.25 mm	
Silt	
0.004–0.06 mm	
Clay	
< 0.004 mm	

Scale of Particle Size

Image from Jones & Jones (2003). Accessed at <http://www-personal.umich.edu/~jmperes/Sedimentary.htm>.

8

Soil Texture Flow Chart

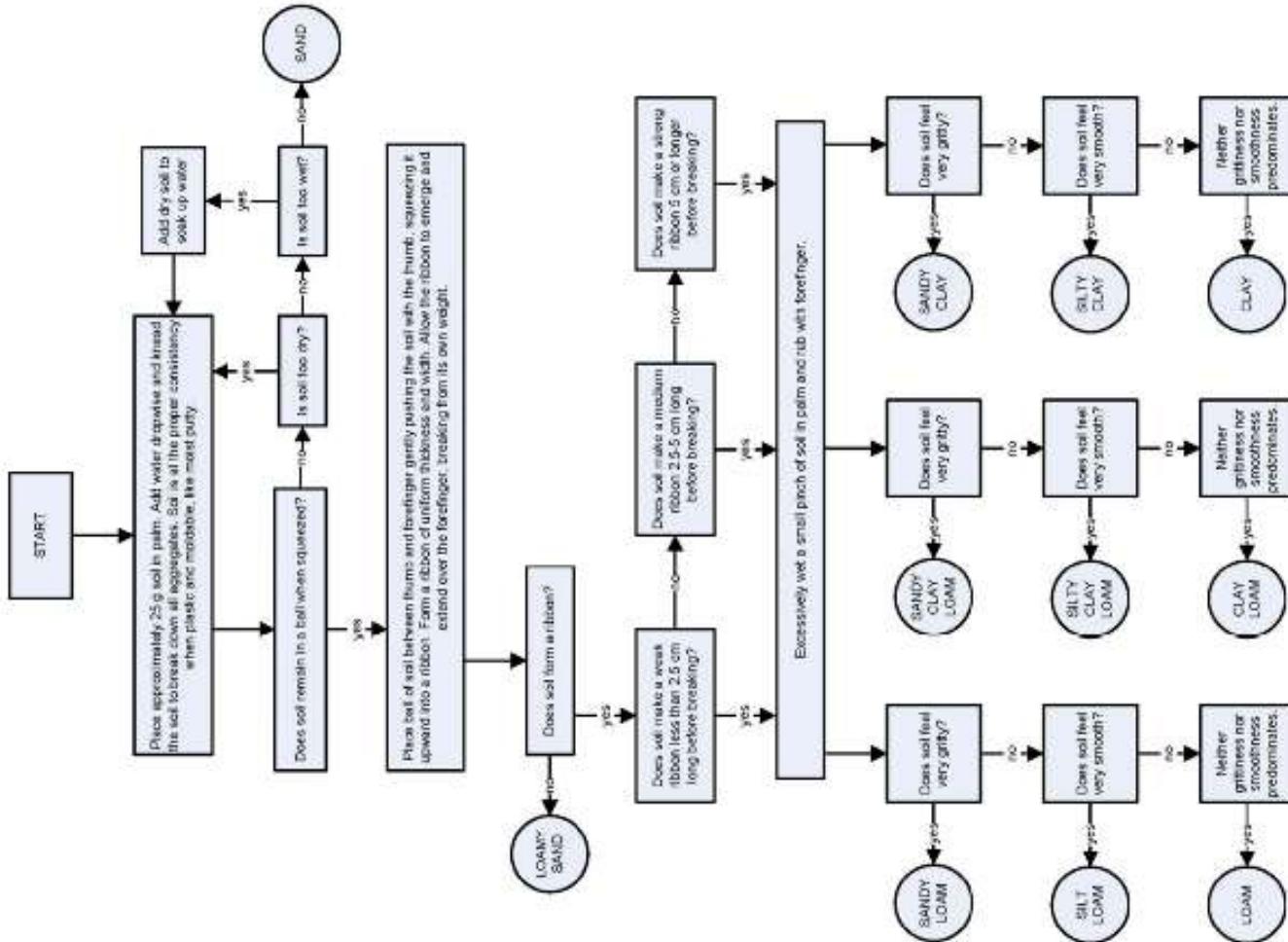


Image accessed at https://soils.usda.gov/education/resources/lesson/texture/soil_texture_low.jpg

General Description of Soil Textures				
Soil Texture	Visual detection of particle size and general appearance of the soil	Squeezed in hand and pressure released		Soil ribboned between thumb and finger when moist
		When air dry	When moist	
Sand	Soil has a granular appearance in which the individual grain sizes can be detected. It is free-flowing when in a dry condition.	Will not form a cast and will fall apart when pressure is released.	Forms a cast which will crumble when lightly touched.	Cannot be ribboned.
Sandy Loam	Essentially a granular soil with sufficient silt and clay to make it somewhat coherent. Sand characteristics predominate.	Forms a cast which readily falls apart when lightly touched.	Forms a cast which will bear careful handling without breaking.	Cannot be ribboned.
Loam	A uniform mixture of sand, silt and clay. Grading of sand fraction quite uniform from coarse to fine. It is mellow, has somewhat gritty feel, yet is fairly smooth and slightly plastic.	Forms a cast which will bear careful handling without breaking.	Forms a cast which can be handled freely without breaking.	Cannot be ribboned.
Silt Loam	Contains a moderate amount of the finer grades of sand and only a small amount of clay. Over half of the particles are silt. When dry, it may appear quite cloddy and can be readily broken and pulverized to a powder.	Forms a cast which can be freely handled. Pulverized it has a soft flourlike feel.	Forms a cast which can be freely handled. When wet, soil runs together and puddles.	It will not ribbon, but it has a broken appearance; it feels smooth and may be slightly plastic.
Silt	Contains over 80% of silt particles with very little fine sand and clay. When dry, it may be cloddy, readily pulverizes to powder with a soft flourlike feel.	Forms a cast which can be handled without breaking.	Forms a cast which can freely be handled. When wet, it readily puddles.	It has a tendency to ribbon with a broken appearance, feels smooth.
Clay Loam	Fine textured soil breaks into very hard lumps when dry. Contains more clay than silt loam. Resembles clay in a dry condition; identification is made on physical behavior of moist soil.	Forms a cast which can be freely handled without breaking.	Forms a cast which can be handled freely without breaking. It can be worked into a dense mass.	Forms a thin ribbon which readily breaks, barely sustaining its own weight.
Clay	Fine textured soil breaks into very hard lumps when dry. Difficult to pulverize into a soft flourlike powder when dry. Identification based on cohesive properties of the moist soil.	Forms a cast which can be freely handled without breaking.	Forms a cast which can be handled freely without breaking.	Forms long, thin flexible ribbons. Can be worked into a dense, compact mass. Considerable plasticity.
Organic Soils	Identification based on the high organic content. Muck consists of thoroughly decomposed organic material with considerable amount of mineral soil finely divided with some fibrous remains. When considerable fibrous material is present, it may be classified as peat. The plant remains or sometimes the woody structure can easily be recognized. Soil color ranges from brown to black. They have high shrinkage upon drying.			

Table taken from United States Department of Labor. Accessed at <http://www.osha.gov/doc/outreachtraining/htmlfiles/soiltex.html>



DETERMINE IF A COARSE FRAGMENT TEXTURE MODIFIER IS APPROPRIATE TO USE FOR SOIL HORIZONS/LAYERS OF ROCKY SOILS

Step 5:

Determine if a coarse fragment texture modifier is appropriate for soils with large volume of coarse fragments

- ↳ When a soil has more than 15% coarse fragments (particles >2.0 mm), the soil texture needs a coarse fragment modifier.
 - ↳ Go to table A. (below) and determine the appropriate coarse fragment texture modifier adjective (e.g., "very" or "extremely").
 - ↳ Use that modifier with the appropriate coarse fragment type (See table B. for definitions of coarse fragment type by size class).
 - ↳ Combine the adjective from table A. with the fragment type from table B. for the coarse fragment texture modifier which you will attach to the soil texture for a given layer (see table C for examples).

A. Modifier Usage (see Plate 3 on page 4 for surface area estimation)

Fragment Content % By Volume	Rock Fragment Modifier Usage
<15%	No texture adjective is used (noun only; e.g., loam). Only record soil texture determined through flow chart on page 9.
15% to < 35%	Use adjective for appropriate size class; e.g. gravelly. (See table B for appropriate size class)
35% to < 60%	Use "very" with the appropriate size class; e.g., very gravelly. (See table B for appropriate size class)
60% to < 90%	Use "extremely" with the appropriate size class; e.g., extremely gravelly. (See table B for appropriate size class)

B. Coarse Fragment Size Class

Coarse Fragment Type	Size Class
Gravel	2-64mm
Cobbles	64-250 mm
Stones	250-600 mm
Boulders	> 600 mm

C. Examples of how to use Coarse Fragment Modifiers

Rock Fragments: Size & Quantity	% Coarse Fragment surface area in layer
Gravelly	20% gravel in a layer
Very Gravelly	37% gravel in a layer
Extremely Gravelly	88% gravel in a layer

Tables modified from United States Department of Agriculture, Natural Resources Conservation Service. 2010. Field Indicators of Hydric Soils in the United States, Version 7.0. L.M. Vastas, G.W. Hurt, and C.V. Noble [eds.]. USDA, NRCS, in cooperation with the National Technical Committee for Hydric Soils.

Glossary

Depleted matrix. For loamy and clayey material, a depleted matrix refers to the volume of a soil horizon or subhorizon in which the processes of reduction and translocation have removed or transformed iron, creating colors of low chroma and high value. A, E, and calcic horizons may have low chromas and high values and may therefore be mistaken for a depleted matrix; however, they are excluded from the concept of depleted matrix unless the soil has common or many distinct or prominent redox concentrations occurring as soft masses or pore linings. In some areas the depleted matrix may change color upon exposure to air (see Reduced matrix); this phenomenon is included in the concept of depleted matrix.

Fabric. See Peat.

Gleyed matrix. Soils with a gleyed matrix have the following combinations of hue, value, and chroma (the soils are not glauconitic): 1. 10V, 5GY, 10GY, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value of 4 or more and chroma of 1; or 2. 5G with value of 4 or more and chroma of 1 or 2; or 3. N with value of 4 or more; or in some places the gleyed matrix may change color upon exposure to air. (See Reduced matrix). This phenomenon is included in the concept of gleyed matrix.

***Hemic.** See Mucky peat.

Horizon. A layer, approximately parallel to the surface of the soil, distinguishable from adjacent layers by a distinctive set of properties produced by soil-forming processes.

Layer(s). A horizon, subhorizon, or combination of contiguous horizons or subhorizons sharing at least one property referred to in the indicators.

Matrix. The dominant soil volume that is continuous in appearance and envelopes microsites. When three colors occur, such as when a matrix, depletions, and concentrations are present, the matrix may represent less than 50 percent of the total soil volume.

***Muck.** Sapric organic soil material in which virtually all of the organic material is so decomposed that identification of plant forms is not possible. Bulk density is normally 0.2 or more. Muck has less than one-sixth fibers after rubbing, and its sodium pyrophosphate solution extract color has lower value and chroma than 5/1, 6/2, and 7/3.

***Mucky modified mineral soil material.** A USDA soil texture modifier, e.g., mucky sand. Mucky modified mineral soil material that has 0 percent clay has between 5 and 12 percent organic carbon. Mucky modified mineral soil material that has 60 percent clay has between 12 and 18 percent organic carbon. Soils with an intermediate amount of clay have intermediate amounts of organic carbon. Where the organic component is peat (fibric material)

***Mucky peat.** Hemic organic material, which is characterized by decomposition that is intermediate between that of fibric material and that of sapric material. Bulk density is normally between 0.1 and 0.2 g/cm³. Mucky peat does not meet the fiber content (after rubbing) or sodium pyrophosphate solution extract color requirements for either fibric or sapric soil material.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Organic soil material. Soil material that is saturated with water for long periods or artificially drained and, excluding live roots, has 18 percent or more organic carbon with 60 percent or more clay or 12 percent or more organic carbon with 0 percent clay. Soils with an intermediate amount of clay have an intermediate amount of organic carbon. If the soil is never saturated for more than a few days, it contains 20 percent or more organic carbon. Organic soil material includes muck, mucky peat, and peat.

***Peat.** Fibric organic soil material. The plant forms can be identified in virtually all of the organic material. Bulk density is normally <0.1. Peat has three-fourths or more fibers after rubbing, or it has two-fifths or more fibers after rubbing and has sodium pyrophosphate solution extract color of 7/1, 7/2, 8/2, or 8/3.

Redox concentrations. Bodies of apparent accumulation of Fe-Mn oxides. Redox concentrations include soft masses, pore linings, nodules, and concretions. For the purposes of the indicators, nodules and concretions are excluded from the concept of redox concentrations unless otherwise specified by specific indicators.

Redox depletions. Bodies of low chroma (2 or less) having value of 4 or more where Fe-Mn oxides have been stripped or where both Fe-Mn oxides and clay have been stripped. Redox depletions contrast distinctly or prominently with the matrix.

Redoximorphic features. Features formed by the processes of reduction, translocation, and/or oxidation of Fe and Mn oxides; formerly called mottles and low-chroma colors.

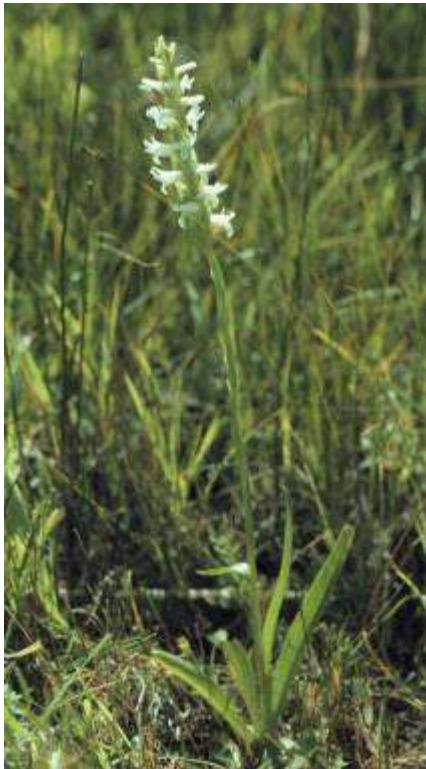
Reduced matrix. A soil matrix that has low chroma and high value, but in which the color changes in hue or chroma when the soil is exposed to air.

***Sapric.** See Muck

Soil texture. The relative proportions, by weight, of sand, silt, and clay particles in the soil material less than 2 mm in size.

*** All definitions taken from United States Department of Agriculture, Natural Resources Conservation Service. 2010. *Field Indicators of Hydric Soils in the United States, Version 7.0.* L.M. Vasilas, G.W. Hurt, and C.V. Noble (eds.). USDA, NRCS, in cooperation with the National Technical Committee for Hydric Soils.

Appendix F: Montana's Threatened or Endangered Plant Species



Spiranthes diluvialis Ute Ladies' Tresses—Listed Threatened

Distribution in Montana

Spiranthes diluvialis is known from only a handful of occurrences in southwest and south-central Montana in the Missouri, Jefferson, Beaverhead, Ruby and Madison River drainages. *S. diluvialis* is restricted in area by specific hydrologic requirements. Many populations have less than 100 individuals, though a couple have over 500 plants. Sites are susceptible to hydrologic changes and weed invasion. Large areas of habitat have been converted to agricultural uses. Livestock grazing is also a common use of these habitats. Two populations occur along highway right-of-ways. Most populations occur on private lands and no occurrences are currently protected or managed for their conservation value.

General Description

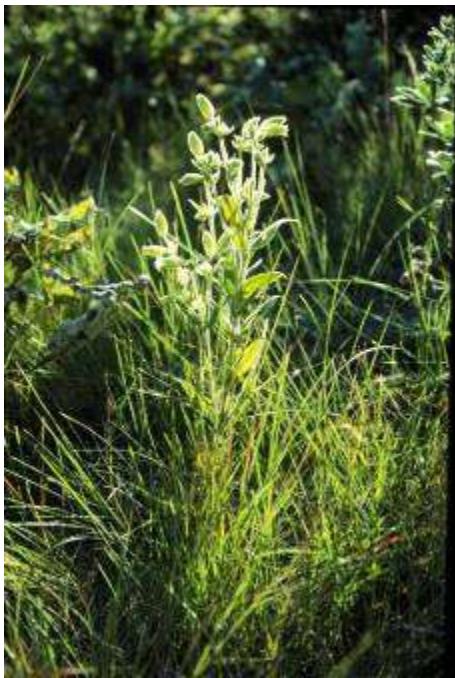
Ute Ladies' Tresses is a perennial orchid with usually 1 stem that is 20-50 cm tall and arising from tuberously thickened roots. Its narrow leaves are 1 cm wide, can reach 28 cm long, are longest at their base, and persist during flowering. The inflorescence consists of few to many white or ivory flowers clustered in a spike of 3-rank spirals at the top of the stem. The sepals and petals are ascending or perpendicular to the stem. The lateral sepals often spread abruptly from the base of the flower, and sepals are free or only slightly connate at the base. The lip petal is somewhat constricted at the median.

Phenology

Flowering in August-early September. Species is often not in full flower until mid-August.

Diagnostic Characteristics

S. diluvialis is intermediate between its putative progenitors, *S. romanzoffiana* and *S. magnicarporum*; the latter is not known from Montana. *S. diluvialis* is distinguished from *S. romanzoffiana* by its whitish, stout, ringent (gaping at the mouth) flowers, by its lip petal being exposed in lateral view, and by its sepals being free or connate at the base for a short distance rather than fused to form a hood above the lip. Additionally, the 2 species occupy different habitats, *S. romanzoffiana* almost always in mesic montane and subalpine settings, only rarely occurring in lower valley locations, whereas, *S. diluvialis* occurs in alkaline wetlands in the valley bottoms



Silene spaldingii Spalding's Catchfly

Distribution in Montana

Silene spaldingii exists in only a few locations in the northwest corner of the state. Extant occurrences are known in the following areas: Tobacco Plains area, Lost Trail National Wildlife Refuge, the Niarada area and on Wild Horse Island. The majority of occurrences have less than 100 individuals, though the largest population range-wide occurs in the state and is estimated to contain several thousand plants. One historical occurrence exists from the Columbia Falls area. Several threats affect the long-term viability of the species in the state. Invasive weeds are the most widespread threat and are negatively impacting the bunchgrass habitat occupied by *S. spaldingii*. Housing development and subdivision are directly impacting one occurrence and has the potential to further isolate other populations. Cattle grazing is affecting five populations and two other occurrences have apparently been extirpated recently from the severe impacts associated with llama grazing. Fire exclusion and the successive build-up of litter compared to historical conditions appears to be having negative impacts on survival and reproduction. Populations are also at risk due to the small numbers of individuals and their isolated nature, which reduces the chances of cross-pollination and gene flow between populations.

Long- and short-term trends are difficult to gauge due to the lack of survey and monitoring data. Estimates of trends and population size are also compounded by *S. spaldingii* plants exhibiting summer dormancy at rates that vary widely from year to year.

General Description

Spalding's Campion is a perennial with a simple or branched rootcrown. There are 4-7 pairs of sessile, broadly lance-shaped leaves that are 6-7 cm long below and gradually reduced in size upward. Herbage is long-hairy and very sticky. There are few to many flowers in a leafy, somewhat open inflorescence. The tubular calyx is ca. 15 mm long, has 10 nerves on its surface, and is very sticky. The corolla has 5 separate, white petals, each composed of a narrow claw that is ca. 15 mm long expanding into a broadened blade above. Only the entire or shallowly-lobed blade with 4 tiny wings at the base protrudes beyond the mouth of the calyx. The fruit is a capsule that is 10-15 mm long and filled with numerous tiny seeds.

Phenology

Flowering in July and usually continuing through August. Dried flower/fruiting stalks are often visible into the Fall.

Diagnostic Characteristics

This species can be distinguished from other perennial *Silene* spp. by its very sticky foliage and by its petals that are entire or only shallowly lobed.



Howellia aquatilis Water Howellia

Distribution in Montana

Water howellia is restricted in Montana to depressional wetlands in the Swan Valley, typically occupying small basins where the water level recedes partially or completely by the Fall. Montana contains the largest number of occupied ponds and wetlands though population numbers are generally small and the occupied habitat is clustered in a very small portion of the state, making it vulnerable to localized events and management actions. Reed canary grass (*Phalaris arundinacea*) has invaded into some wetlands in the Swan Valley and it has the potential to form dense monocultures, thereby decreasing the amount of available habitat. Additionally, water howellia is an annual species which is solely dependent on recruitment from seed and it has very narrow habitat and moisture requirements which leaves it vulnerable to extirpation as a result of consecutive years of unfavorable growing conditions.

General Description

Water *Howellia* is a glabrous, much-branched, annual, aquatic herb with fragile, submerged and floating stems that are up to 100 cm tall. The simple, alternate or occasionally opposite or whorled stem leaves are narrowly linear, 1-5 cm long, and entire-margined. Beneath the surface of the water, small flowers that produce seeds without opening are solitary in the leaf axils. Once the stems reach the surface, small, white flowers are borne in a narrow, terminal, leafy-bracted inflorescence. The white corolla is 2-3 mm long. Flowering occurs on the surface of the water. The fruit, which forms below the attachment of the petals, is a capsule that is 1-2 cm long containing elongate seeds that are up to 2-4 mm long.

Phenology

A winter annual which germinates in the Fall, overwinters, and continues growing in the Spring when conditions are favorable. Chasmogamous (flowers that open and allow for pollination) flowers bloom at the surface in late July-early August; the submerged cleistogamous (flowers that do not open and are self-pollinated) flowers begin in late June.

Diagnostic Characteristics

Vegetatively, this species resembles a small-leaved pondweed (*Potamogeton*) or a water starwort (*Callitriches*), but the flowers in these two groups lack petals, and they have much smaller seeds.

Appendix G. Plant Collection Procedures

When selecting plants, collectors need to be sensitive to whether the plant to be collected is rare, and whether the population will be adversely affected by having one or several individuals removed. A rule of thumb sometimes given is the "1 to 20" rule---for every plant collected, there should be at least 20 others left in the population.

Ideally, the entire plant, including roots or other underground structures, should be collected or, in the case of trees, shrubs, vines, or other large species, ample material representative of the plant should be obtained. The best specimens have both flowers and fruits---while this may not always be possible, all specimens should have some reproductive structures (e.g., spores, cones, flowers, or fruits). **This is necessary for positive identification to species.** Because most taxonomic keys are based on reproductive characters, specimens consisting of vegetative parts only are often of little use. For example, some plants may not be flowering in early summer. In this case, with some effort, you may be able to locate specimens that may have remnant flowering stems or fruits from the previous year still present.

Rare and Uncommon Species

It is best to document the occurrence of a Species of Concern (SOC), with a specimen if it meets the "1 to 20" rule OR with several very high quality photographs.

The Manual of Montana Vascular Plants (Lesica 2012) has our most current plant species distribution to date. If an identified specimen does not have an occurrence represented for the county in which you have identified it, then collect the specimen (if it meets the "1 to 20" rule) or take several high quality photographs.

If a species has few occurrences documented in the Manual (< 6 counties), then collect the specimen (if it meets the "1 to 20" rule) or take several high quality photographs.

Other Special Circumstances:

Aside from the common *Botrychium* spp. (*B. multifidum* or *B. virginianum*), any *Botrychium* encountered should be collected (if it meets the "1 to 20" rule) or otherwise documented with several high quality photographs.

Label Data Form for Plant Specimens:

1. Assign each unknown specimen with a unique specimen number. For example, a combination of the Site ID and the order the specimen was collected.
2. Assign each unknown specimen with a descriptive name that refers to identifying characteristics of the specimen.
3. Scientific name of the specimen if known.
4. Collector's name
5. Collection date.
6. Site ID
7. Plant habit (e.g., tree, shrub, perennial bunchgrass, etc.).
8. Any plant characteristics that may be lost upon drying (e.g., flower color, fragrance, etc.).

Collection Protocol:

1. For each specimen to be collected, select one or more healthy plants that are typical of its population within the assessment area.
2. Collect at least enough plant material for species identification and to fill a standard herbarium sheet (11.5 x 16.5 inches). Each specimen should consist of a stem with attached leaves, flowers, fruits, and if possible, roots.
3. Flowers and/or fruits are particularly important as they are generally needed to determine species identity.
4. If the plant is small enough, collect the entire plant including the roots.

5. If the plant is too large to fit on a herbarium sheet, collect 1) sufficient leaves and stems to illustrate leaf shape and size, opposite or alternate branching, and buds; 2) some of the root or rhizome; and 3) the inflorescence (flowering stem).
6. For grasses and grass-like plants, try to include roots or rhizomes. Also place part of the mature inflorescence in a small envelope to protect it from damage. Mature fruits are important for identification of these species, especially for *Carex* (sedge) species.
7. In the case of trees, shrubs, or vines, material should be selected to illustrate the overall characteristics of the plant and the range of variation in flowers, leaves, and other structures.
8. If the species has separate male plants and female plants or male and female flowers on the same plant, collect specimens from both sexes whenever possible, e.g., *Salix* (willow) spp. and some *Carex* (sedge) spp.
9. If it is not possible to provide a complete specimen for an unknown species (e.g., the plant is immature or senescent), collect a sample that illustrates as many key diagnostic parts of the plant as possible. In many cases, this may be sufficient for a regional expert botanist to identify the species.

Transporting and Storage of Specimens:

1. Place each specimen in a separate Ziplock or plastic bag of appropriate size and label with appropriate information referenced above
2. If a plant press is available and logistics and time permits, press the plants immediately before leaving the Assessment Area and label newspaper with appropriate collection information. Otherwise, place the filled Ziplock or plastic bags in a large cooler for transport. Plants should be pressed within one or two days of collection.

Pressing Plant Specimens:

Standard Plant Press 12 X 18 inches:

1. A rigid, breathable wooden frame
2. Corrugated cardboard ventilators to allow air flow through the press
3. Blotter paper to absorb moisture
4. Folded newsprint to contain the plant material
5. Straps with buckles to tighten the press

Assembling the Press:

1. Each newspaper specimen folder with plant material is sandwiched between 2 moisture-absorbing blotters.
2. The "blotter-newsprint sandwiches" are sandwiched between corrugated cardboard.
3. The corrugations of the cardboard should run parallel to the shorter dimension for best air circulation.

Pressing Plant Specimens:

1. On the bottom wooden frame of the press, place a piece of cardboard, blotter paper, folder newsprint on top of the blotter paper.
2. Place plant material between the folded newsprint. Remove as much dirt as possible from the plant before placing it in the newsprint folder.
3. For each plant specimen, write on the outside of the newsprint folder using waterproof ink (a "Sharpie" marker works well). Record all of the specimen information (above).
4. Arrange the plant material on the bottom fold of the newsprint to display diagnostic features. Lay the plants flat and avoid overlapping plant parts. Spread flowers, leaves, and fruits so they can be easily observed from different perspectives. Show upper and lower surfaces of the leaves and flowers. If possible, arrange pressed material to show some flowers with the blossom open, and some flowers and fruits are pressed in longitudinal and transverse views.
5. Multiples of smaller plants should be pressed together.
6. For specimens that are larger than the page, bend stems sharply into a V, N, or W shape so they fit within the press frame. Do not curve or twist the stems.
7. Thick stems or large fruits may require additional newspaper or blotter paper.

8. Small loose plant parts such as seeds should be placed in a small envelope inside of the newsprint with the rest of the plant.
9. Once the specimen is arranged, close the newsprint, add another piece of blotter paper, then a piece of cardboard.
10. To add another specimen, place blotter paper over the cardboard, add a folded piece of newsprint and repeat steps 1-9 until all plants are collected or the press is full.
11. Use the two adjustable straps to firmly hold the plant press and its contents. The plant press must be kept tight to prevent shrinkage and wrinkling of the plant material. It should not be possible to move the blotter paper or cardboard from the side in a properly tightened press.

Essential to collect:

Reproductive Structures. All specimens must have reproductive structures (flowers and/or fruits on flowering plants; or cones (conifers), or spores (ferns and their relatives). If fruits are not yet formed, then it is essential to collect a specimen with flowers.

Fruits. Specimens of several families are difficult or impossible to identify unless fruits, or fruits and flowers, are obtained. Fruits are required or strongly recommended for specimens of the following families: Cyperaceae (sedge family), Juncaceae (rush) family, Salicaceae (Willow family), Ranunculaceae (Buttercup family), Apiaceae (Carrot family), Poaceae (Grass Family).

Leaves and Stems. Leaves from the flowering stem as well as basal leaves are needed.

The plant specimen itself. The best specimens are whole plants, including roots, basal and cauline leaves, and reproductive structures. All diagnostic morphological features should be observable without having to disturb the mount. The best herbarium specimens have been pressed carefully, and then are neatly mounted with no material hanging off the sheet. Both sides of structures like leaves should be visible.

Appendix H. First Aid Considerations and Common Field Ailments

First: If you have the time and resources take a Wilderness First Aid (1 day) or Wilderness First Responder (week) course.

Second: In any accident scenario (injury or just a flat tire) remain calm and **make sure the scene around you is safe** (before attempting to help someone make sure the bear is not going to get you too or the car will not fall on top of you as you jack it up).

Third: Pay attention to how far you are from help or your vehicle, this can have a huge impact on an injury or weather scenario. (*Always take a GPS point of the location of your vehicle before heading out into the field.*) Pay attention to the weather, sun exposure etc.

First Aid/Safety List

In your Pack:

- **Your car keys, ID, emergency contact info, insurance card**
- Sun hat and sun screen
- Rain coat/pants
- Plenty of water and food for the time you'll be out **plus** time you may be out given an injury or other change of plans
 - Map and Compass (GPS units run out of batteries and lose signals)
 - Whistle or radio for signaling others in the group or nearby
 - Lighter or matches
 - Firestarter (e.g., cotton balls soaked in Vaseline stored in a film canister)
 - Tape and Gauze (Quick-clot is a new super gauze)
 - Mole skin and bandaids
 - Needle and thread
 - Tweezers
 - Anti-biotic ointment
 - Painkillers (make sure they do not dehydrate or compromise your ability to get out of your situation)
 - Knife/leatherman type tool
 - Salt and sugar packets (especially if low blood sugar is an issue)
 - Other meds or allergy equipment (epi-pen) you may want or need
 - Water purification (iodine one 8ppm tab per quart or filter)
 - Headlamp
 - Bandana (can double as triangular bandage)
 - Reflective blanket or emergency bag

In the Vehicle:

- Full size spare tire
- Jack and all the parts to the jack (including knowledge of how to use the jack)
- Lug nut wrench
- More food, water, coffee etc.
- Sleeping bag, warm clothes
- More sun block
- More mole skin
- Cell phone or radio

Heat Exhaustion and Heatstroke

It can get hot in Montana, even at the higher elevations. Physical exertion at high temperatures can lead to **heat exhaustion** - becoming dehydrated increases the chances of it. Insufficient water in your body inhibits sweating, and you won't cool down to the degree that you would otherwise.

Symptoms of heat exhaustion include:

- rapid breathing
- high pulse rate
- heavy sweating
- paleness, fatigue
- muscle cramps
- dizziness
- moderately elevated temperature
- headache
- nausea

More severe symptoms include vomiting and fainting.

Some of the less severe symptoms also commonly accompany heavy physical exertion. You have to listen to your body. One good (usually early) sign that you are pushing yourself too hard is if you start feeling a little dizzy or woozy. If so, take a break and let your body recoup before resuming physical activity.

If someone does appear to have heat exhaustion, have the person lay down in the shade (if possible), rest with their feet raised a few inches and drink some water.

If heat exhaustion symptoms are ignored and the person keeps on with their physical exertion, the problem can become more severe and lead to **heatstroke**. This is life-threatening. With heatstroke the ability of the brain to regulate body temperature ceases -- the person's temperature can go up to 104 F or higher.

Heatstroke symptoms can include:

- confusion
- highly elevated temperature
- strong rapid pulse
- delirium
- seizures
- unconsciousness

If someone appears to have heatstroke you should do the following: remove some clothing and cool the person with water and by fanning them. If there is a stream or pond nearby, put them in it to cool them down. After the person appears to be getting better (with their temperature having dropped to about 101 F) have the person assume the first aid recovery position. Get medical attention for the person as soon as possible even if they appear to be recovering. Heatstroke involves a serious disruption of normal body functions, and a victim can appear to be recovering, and then go into a dangerous relapse.

Hypothermia ("exposure")

Hypothermia relates to drops in human body temperature to levels at which physical and mental abilities deteriorate. The process is progressive and can lead to death. It is not the same thing as "freezing" -- many instances of hypothermia in Montana occur at temperatures around 50 degrees Fahrenheit. Hypothermia is a modern term for a condition that used to be referred to as "exposure".

The root cause of hypothermia is simple: loss of body heat at a higher rate than it is created. The loss of body heat is caused by things like low surrounding temperatures, wet clothes that have lost their insulation properties, and

wind creating wind-chill affects on the body. Your clothes can get wet from rain or body perspiration. The inability of the body to make up for heat loss is amplified by factors like fatigue, dehydration and lack of food.

Hypothermia goes through several stages defined by body temperature and symptoms. First, there is **mild hypothermia** which occurs at body temperature ranging down to 96 F. Typical **symptoms** are **involuntary shivering** and the **loss of the ability to do complex motor functions**. The person can still walk and converse.

Next comes **moderate hypothermia**, with body temperature ranging from 95 to 93 F. **Symptoms** include **dazed consciousness, loss of fine motor coordination** (particularly in the hands), slurred **speech, violent shivering** and **strange behavior** (including taking their clothes off).

Severe hypothermia occurs with body temperature in the 92 to 86 F range, and is life threatening. **Symptoms** include **waves of shivering, inability to walk, taking a fetal position to conserve heat, muscle rigidity and a major drop in pulse rate**.

Victims of advanced hypothermia can appear dead but in fact still be alive with imperceptibly slow rates of breathing and pulse. The best way to deal with hypothermia is to get the victim into dry clothes, give them warm drinks and food, and put them in a sleeping bag, possibly with another person to speed up their warming. Get advanced hypothermia victims to a medical professional (MD or EMT) as fast as possible, even if they look like a goner - they may be revivable with the right procedures.

Altitude adjustment and altitude sickness

Gaining altitude has physiological effects on everyone. However, the effects vary considerably among individuals and do not seem to correlate very much with physical condition, sex or age. A young well conditioned athlete could find himself more set back by a substantial rise in altitude than some inactive out of shape person.

Altitude affect is such that a fit person used to running several miles daily, who then comes up to a location 5,000 feet higher than they are used to, may become exhausted after a half-mile of their usual running workout. A week to several weeks may have to pass at the new higher altitude before the usual level of performance ability exists again.

What causes this change? Two physiological factors have been identified as resulting from altitude gain. The first and most obvious effect is caused by a reduction in concentration of oxygen in the air breathed. Going from sea level to 12,000 feet results in a reduction of oxygen concentration of about 40 percent. It takes time for the body to adjust to this reduction. The other factor involves leakage of fluid from the capillaries into the lungs and brain. These physiological effects result in two considerations: a reduction in physical stamina and the potential for developing altitude sickness. Given time for adjustment, the body will compensate by such methods as producing more red blood cells, increasing the pressure in pulmonary arteries, increasing the production of certain enzymes and deeper breathing.

Loss of physical stamina with altitude gain is easily detected. The symptom is feeling tired after a relatively small amount of physical exertion. The cure is to be at high-altitude until your body can make the necessary adjustments, and to take it easy until then. In a practical way, this temporary loss of stamina can lead to bad results if you are on a hike, and you are the only one suffering from altitude associated weakness. The best thing you can do is to be honest with yourself and the others and slow down and take necessary rests before (not after) you drive yourself to physical exhaustion. If you start feeling woozy - don't be ashamed to take a break. It's harder for the body to regain strength after you drive yourself to near collapse.

Altitude sickness

The medical profession recognizes several types of altitude sickness. They go by the names of acute mountain sickness, high altitude pulmonary edema and high-altitude cerebral edema. Mostly, they are due to fluid buildups in the lungs or brain. It's not important for a hiker to be able to diagnose and differentiate between them. Some of the symptoms associated with one or more of these altitude sicknesses are listed below. If you or a member of your

party have some of these after a gain of substantial altitude, the best first step is to come down and lose at least 1,000 to 2,000 feet of altitude. Return to town as soon as possible and get medical attention.

Some general altitude sickness symptoms:

- headache
- dizziness
- fatigue
- shortness of breath
- respiratory symptoms worsening at night
- loss of appetite
- nausea
- disturbed sleep
- tightness in the chest
- persistent productive cough bringing up white, watery, or frothy fluid
- mental confusion
- loss of coordination
- disorientation
- loss of memory
- hallucinations
- psychotic behavior
- coma

(From http://www.hence-forth.com/Colorado_Hiking/1_Hiking_topics/safety.htm)

4x4 Driving Techniques

The Basics

Wear Seatbelts: Put on your seatbelt, and instruct passengers to put them on as well. A good belt will help restrain you when driving difficult terrain, and can save your life in case of a rollover or other accident.

Lock the Hubs: the first thing to do when you get in the dirt is to put the transfer case in four-wheel drive and lock the hubs—if your vehicle is so equipped. With all four wheels hooked together, your control is increased, braking is improved, and you won’t get stuck as fast when you make a mistake. This also spreads the tractive force over four tires instead of two, minimizing breakage of drivetrain parts. However, with practice, flipping back and forth between 2WD and 4WD can be advantageous for turning, sliding, and other advanced maneuvers, but it’s best to learn while in four-wheel drive.

Use 4 Low: Using low range in the transfer case is important. In low range the available power is greater, and the speed with which you can drive is diminished. By driving slowly over obstacles rather than pretending you’re in a SUV commercial and flying over them, you’re more likely to make it to the other side instead of breaking your rig or yourself. Going downhill is also easier in low range, as compression braking from the engine is increased. This allows you to stay off the brake more often for optimum control.

Hold the Wheel: While gripping the steering wheel, make sure that your thumbs aren’t wrapped around it. If the wheel should suddenly whip around from a tire hitting a rock, your thumbs won’t get broken or mangled.

Listen to the car: Turn your stereo off, so you can hear what your vehicle is telling you. The sounds of slipping tires, scraping metal, and engine rpm can all help you be a better driver, but not if you can’t hear them. Just like drinking and driving, distractions from what is happening with your vehicle can distract you at the wrong time.

Know the car: Know your rig inside and out. This means being familiar with all of the controls in the cab, as well as how to use them for what purpose. On the outside, make a mental note of what hangs down underneath, and what side the front differential is on so you won’t bang the underside on obstacles.

Don't ride the clutch: Staying off the clutch unless you need it is important in many situations. While automatic-equipped 4x4s can have an easier time crawling over things, a manual transmission rig is capable of outdoing an auto as long as the clutch isn't always used. Try driving with your feet on the floor for practice, and see what your rig can do. Once you push in the clutch you've unhooked the drivetrain, and only your brakes will be holding you on a hill.

Lower tire pressure: Consider lowering your tire pressure according to the terrain and speed. Tire pressure lower than the manufacturer's recommendations can provide greater tire traction, flexibility, flotation, and smoother ride. Because the tire will tend to spread out at lower pressures, a bigger footprint is formed, but the tire is more susceptible to sidewall damage. Never air down farther than what you are comfortable with, and remember to air them back up before you hit the pavement.

Get a spotter: If you're unsure of what you're doing while driving an obstacle, ask someone to spot you over the tough areas. An experienced spotter can be your best ally and can make you look like a pro. Remember, though, that you as the driver are the one in command, and it's your decision to trust the spotter or not.

Study the area: Watch the driver in front of you and see how he makes it through. You can learn a lot on what to do and what not to do. Get out and walk the trail or examine the obstacle before you drive through. This allows you to get a mental picture of where you will place your tires before you go. Just as a golfer examines the green before that game-winning putt, you need to know what's ahead of you so you don't get into trouble. Walk ahead and look back; the view is different from the other direction, and other features of the terrain become apparent.

Hills and Dirt

Climbing hills and going back down them is older even than four-wheeling. Usually a steady speed with momentum is adequate, depending on the surface. An occasional blip of the throttle can bump you over some ledges, but rarely will a full-throttle attack do much more than break stuff.

When climbing or descending a hill, keep straight up or down, and don't turn around on the side of a hill. The propensity to roll is far greater, and any stored inertia can send the rig tumbling. Know when to quit and how to back down in a straight line.

The steering seems much more sensitive (and backwards) when you are backing down a hill, and miscues and rolls are common. If you traverse a side hill and are off camber, you need to go slowly to prevent sudden shift of vehicle or cargo weight. A rock on the high side or a hole on the low side can tend to tip you in the wrong direction, as in downhill.

Likewise, spinning the tires on a loose surface when on a side hill breaks traction, causing gravity to pull you off the trail and possibly over the edge. Descending a hill is best done in the lowest gear, for maximum compression braking. Even automatic transmissions will have some compression braking, and a light foot on the brakes is better than locking them up and sliding.

The tires must be rolling to have control, so if you start to slide you need to give it a little gas and be easy on the brake pedal. Easy movements of the steering wheel can help you keep directional control, while whipping the wheel can cause the tires to slide sideways, right into what you are trying to avoid.

Rocks

Lowering the air pressure and going slowly is the best recommendation for rocky trails or hard-core rockcrawling. Tires should be placed on top of the rocks, which allows the axle and undercarriage to avoid hitting the boulders. On IFS rigs or Hummers, for example, the available clearance in the center of the undercarriage is sometimes better, but straddling rocks can still get you stuck in any case.

Your lowest speed that keeps your momentum going is usually the best. If you go too fast you end up bashing and crashing while hurting your rig and generally getting stuck. Rockcrawling is truly the home of elegant driving as coined by the late great Granville King. By making this activity a true art form of fluid motion like a mechanical ballet, a greater amount of obstacles can be scaled with less damage to yourself and the vehicle.

Likewise, raw power and speed can jet you over the boulders, but the hopping and flopping action of bashing and crashing your way through a canyon of boulders is in no sense of the word elegant, and it'll cost you more in the long run. One way to stay in control with an automatic transmission is to use one foot on the brake and one on the gas. On a stick-equipped rig the engine compression braking gives you greater control, but using the two-foot method on an auto will mimic this action.

Sand

Higher gears are great for sand, as speed and momentum keeps you flying on top rather than sinking in. Depending on the type of sand—from fine to coarse and from wet to dry—different speeds and gears may need to be used. Usually, spinning the tires is needed since wheel speed is a factor to keep on top of the sand. Lowering air pressure and running wide tires help in the flotation department as well.

Sand dunes can have steep drop-offs and other obstacles, so being alert is extremely important. If you're climbing a sand hill and realize you've run out of engine power, downshift quickly, and floor it without losing momentum. This is where automatic transmissions excel—virtually instant downshifts with no loss of momentum. Shifting a manual truck usually means the momentum is gone before the clutch is ever let back out. Side hilling in the sand or running a bowl is great if you have enough speed and power, but turn downhill as soon as you start to bog down. Point your ride straight down, and if the nose starts to go sideways give it a little gas to straighten it out.

Water Crossings

Driving through water can be as hazardous as any other terrain. The swift current, unknown bottom conditions, and possibility of engine damage can ruin a nice 4x4 outing. Check the depth and bottom conditions before you attempt to drive across a stream. Look to see where others have made it, and imagine what happens if your rig floats or gets washed downstream.

Cross streams and rivers at an angle upstream to prevent the force of the water from pushing the vehicle downstream. This helps you keep going in a more controlled manner without getting moved downstream. Know where your engine air intake is, and be sure that it is not lower than the deepest part of the stream you are crossing. Many new vehicles have the air intake lower than the front bumper or in the fender. If water gets into the cylinders of a running engine it will hydrolock the engine, stopping it cold, and probably damaging the engine. Avoid spinning tires when they are wet, as wet rubber cuts as easily on sharp rocks.

Mud

Different consistencies of mud call for different styles of driving. Some mud responds to fast driving with a lot of wheelspin, while others may do better with a slower gate with just enough spin to clean out the tires.

Like in snow, skinny tires can dig down to the hard stuff, while wide flotation tires can keep you on top of the goo. Regardless of what the mud is like, a steady forward progress is needed. In other words, keep your momentum up. If you get off the gas, you can risk losing the momentum needed to traverse the slop. Be aware that spinning the tires while stopped may get you going, but quite often you'll simply dig down and get stuck to the gills.

It's always easier to extricate your 4x4 from deep mud before it's resting on the framerails. So if the rig's not moving forward as you spin tires, it's probably going down. Don't be afraid to back out of a sticky situation either; the ruts are already there and you may escape without getting stuck.

Hiking during hunting season

During field work you should be aware of the potential for hunting on the lands in which you are working. The best thing to do is to be aware of the hunting dates and to wear orange when necessary.

Working around wildlife

Black Bears

The following is from the Yosemite National Park Website, (<http://www.nps.gov/yose/wilderness/bsafety.htm>). "Never approach a bear regardless of its size. If you encounter a bear, act immediately: throw small stones or sticks toward the bear from a safe distance. Yell, clap hands, and/or bang pots together. If there is more than one person, stand together to present a more intimidating figure, but do not surround the bear. Use caution if you see cubs, as a

mother may act aggressively to defend them. "When done immediately, these actions have been successful in scaring bears away. Never try and retrieve anything once a bear has it." The group Citizens for Responsible Wildlife Management has a good web page with tips for handling a bear encounter. Check it out if you want more information.
(http://www.responsiblewildlifemanagement.org/bear_safety.htm)

Grizzly Bears

The following is a list of recommended responses to minimize the likelihood of attack or chances of human injury:
<http://fwp.mt.gov/recreation/safety/wildlife/bears/bearEncounter.html>

- Make certain you have **bear pepper spray** at the ready and know how to use it.
- Always maintain a safe distance from bears.
- Stay calm.
- Immediately pick up small children and stay in a group.
- Behave in a non-threatening manner.
- Speak softly.
- Do NOT make eye contact.
- Throw a backpack or other object (like a hat or gloves) on the ground as you move away to distract the animal's attention.
- Slowly back away, if possible. Keep a distance of at least 100 yards.
- Do not run from a bear. Running may trigger a natural predator-prey attack response and a grizzly can easily outrun the world's fastest human.
- Don't climb a tree unless you are sure you can get at least 10' from the ground before the bear reaches you. Many experts recommend against climbing trees in most situations.
- Do not attempt to frighten away or haze a **grizzly bear** that is near or feeding on a carcass.
- If a **grizzly bear** charges your first option is to remain standing and direct your pepper spray at the charging bear. The bear may "bluff charge" or run past you. As a last resort, either curl up in a ball or lie face down (flat). Leave your pack on to provide protection, cover your neck and head with your arms and hands. Do not attempt to look at the bear until you are sure it's gone.
- If a **black or grizzly bear** attacks, and if you have a firearm and know how to use it safely and effectively, Montana law allows you to kill a bear to defend yourself, another person or a domestic dog. If you do kill a bear in self defense you must report it to FWP within 72 hours.
- If you are armed using a weapon on a **grizzly bear** does not guarantee your safety. Wounding a grizzly bear will put you and others in danger.
- If a **grizzly bear** attacks during the day, most experts recommend either curling up in a ball or laying face down (flat). Use your hands and arms to protect the back of your neck and face, and keep your backpack on for added protection. Do not move or make noise until you are sure the bear has left the area.
- If a **black or grizzly bear** attacks at night while you're in a tent, fight back aggressively with whatever you have available to use as a defensive weapon or deterrent. The bear may be seeking food rather than trying to neutralize a threat, so fight back to show the bear you are dangerous.
- Report all encounters to your local authorities. Your report can prevent someone else from being hurt.

Mountain Lions

The following is from the Yosemite National Park Website, (<http://www.nps.gov/yose/wilderness/bsafety.htm>).

Although lion sightings and attacks are rare in the area, they are possible, as is injury from any wild animal. We offer the following recommendations to increase your safety: Avoid walking alone, especially around dawn and dusk. Be aware of your surroundings and how you appear if you are being stalked.

"What should you do if you meet a mountain lion?"

Never approach a mountain lion, especially one that is feeding or with kittens. Most mountain lions will try to avoid confrontation. Always give them a way to escape. Don't run. Stay calm. Hold your ground or back away slowly. Face

the lion and stand upright. Do all you can to appear larger. Grab a stick. Raise your arms. If the lion behaves aggressively, wave your arms, shout and throw objects at it. The goal is to convince it that you are not prey and may be dangerous yourself. If attacked, fight back! "Generally, mountain lions are calm, quiet, and elusive. The chance of being attacked by a mountain lion is quite low compared to many other natural hazards. There is, for example, a far greater risk of being struck by lightning than being attacked by a mountain lion."

Moose

The following is from the Alaska Department of Fish and Game website, (<http://alaska.org/anchorage/advice-moose-courtesy.htm>).

Moose Courtesy

- Never feed moose
- Give moose at least 50 feet. If it doesn't yield as you approach, give it the trail. (Either retreat or walk way around.)
- If its ears lay back or its hackles (the hairs on its hump) rise, it's angry or afraid and may charge; back off pronto
- Moose kick with their front as well as hind feet
- Don't corner moose into fences or houses
- If a moose charges, get behind a tree. You can run around the trunk faster than the gangly creature.
- Never get between a cow and her calf

The following is from the Wrangell-St. Elias National Park and Preserve website, (<http://www.nps.gov/wrst/planyourvisit/moose-safety.htm>).

Moose aren't inherently aggressive, but will defend themselves if they perceive a threat. When people don't see moose as potentially dangerous, they may approach too closely and put themselves at risk.

Give Moose plenty of room! Enjoy viewing them from a distance. Cow moose are extremely defensive of their young so use extra caution around cows with calves.

In the summer months, moose blend in well to their environment and can be surprisingly hard to see for such large animals. They are likely to stand their ground even when they hear people approaching, so pay close attention to your surroundings, especially in prime moose habitat such as willow thickets or around streams or ponds.

If you do find yourself close to a moose: If it hasn't detected you yet, keep it that way. If it knows you're there, talk to it softly and move away slowly. Don't be aggressive – you want to convince the moose that you aren't a threat. If you think the moose is going to charge you, take cover or run away.

Watch for signs that the moose is upset. If its ears are laid back and hackles are up it is likely to charge. Most of the time, when a moose charges it is a 'bluff', or warning for you to get back – a warning you should take very seriously! Once a moose bluff charges it is already agitated. If possible, get behind something solid (*like a tree or a car*).

Unlike with bears, it is okay to run from a moose. They usually won't chase you and if they do, it's unlikely that they'll chase you very far. If a moose knocks you down, curl up in a ball and protect your head with your arms and keep still. Fighting back will only convince the moose that you may still be a threat. Only move once the moose has backed off to a safe distance or it may renew its attack.

Snakes

(From: <http://lomalindahealth.org> and http://www.hence-forth.com/Colorado_Hiking/ and <http://www.fs.fed.us/r8/boone/safety/critters/snakes.shtml>)

Wear boots not sandals or running shoes when hiking - the higher the boot tops the better. Wear long trousers instead of shorts. Bare legs increase the probability of a successful strike. Loose trousers might result in a strike to the wrong spot, or a deflected strike.

Use a hiking stick. Often, the first thing to come close to a rattler will be your stick instead of your leg. When stepping over a log or a fallen tree you can plant the stick first and perhaps stir up the snake before exposing your leg. The snake's first strike may be at the stick versus your leg.

When you come across a rattlesnake that has been startled and is rattling, the first thing to do is stop and hold still, visually locate the snake, let the snake calm down, then move away from it to at least ten feet. Next, take a look around just to make sure there aren't any others nearby, but stay aware of the original snake's location and movements. Then work out a safe route around it, and leave. Unless there is some overriding reason to do it, don't mess around with the snake - that is actually how most bites occur.

Basic first-aid measures for rattlesnake bites:

If you are bitten by a snake, get away from it as fast as you can to avoid any further bites.

You should try not to panic and minimize activity if possible. However, if you are alone in the wilderness or far from access to medical care, you may have to hike out to the nearest phone. Use a cell phone to call for help or send somebody out, or hike out using a slow measured pace with a crutch if necessary. In some cases the most sensible approach will be to notify a medical facility of what has happened (if you can) and to arrange for an EMT vehicle to meet you at the trail head, perhaps with antivenin. The sooner the MD's know they will need antivenin the better - not all medical facilities have it on hand. It is highly desirable to get medical attention within two hours of the bite.

Keep the injured body part motionless and just below heart level.

Remove jewelry and tight-fitting clothes in anticipation of severe swelling.

Do not cut across fang marks and do not try to suck out the venom with your mouth or a suction device.

This could lead to complications and infections. Cutting the bite wounds is NOT RECOMMENDED as this increases damage to the tissue and has not been shown to be beneficial.

A tourniquet is not recommended because it could cut off circulation. However, an ace wrap and splint may delay the time to death in the rare event of a fatal bite, but could risk further injury to an arm or leg. If the victim won't be able to reach medical care within 30 minutes, as will normally be the case in a hiking situation, then slow the venom movement from the bite area by applying a bandage wrap 2 to 4 inches above the bite. This is NOT a tourniquet - it should not cut off the flow of blood - the band should be loose enough to slip a finger under it. Do not take aspirin or ibuprofen after snakebite. Many snake venoms can thin the blood and these medicines may compound this effect, leading to bleeding.

Other first aid that does not help or that is potentially more harmful than the snakebite includes applying electric shock, drinking alcohol, and placing ice directly on the wound. Avoid further injury by staying away from the snake.

Mosquitoes and West Nile virus

(From: http://www.hence-forth.com/Colorado_Hiking/)

The West Nile virus problem is best dealt with by reducing the number of mosquito bites by wearing long sleeved shirts and trousers. Spraying DEET on your clothes and skin works well in keeping mosquitoes and other bugs away. You can also like to wear a baseball cap sprayed with DEET which seems to keep the mosquitoes away from my face and neck. It should be applied to skin and clothing only -- keep it out of open wounds, scrapes, eyes, nostrils or mouth.

If you use a water bladder and tube instead of water bottles - avoid spraying DEET on the end of your drinking tube.

The following info is taken from the CDC's rundown on West Nile virus:

Most people who are infected with the West Nile virus will not have any type of illness.

It is estimated that 20% of the people who become infected will develop West Nile fever with mild symptoms including fever, headache, and body aches, occasionally with a skin rash on the trunk of the body and swollen lymph glands.

It is estimated that about 0.67 percent (less than 1 out of 100) of persons infected with the West Nile virus will develop the severe form of the disease. The symptoms of severe infection (West Nile encephalitis or meningitis) include headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, and paralysis.

If you become ill after outdoor activities and bites, make certain that your physician knows this, and can therefore factor this in when ordering tests and making diagnoses.

Ticks

(From: http://www.hence-forth.com/Colorado_Hiking/)

Ticks attach themselves to humans and other animals in order to feed on blood. They are small roundish dark insects that can cause illness in humans due to viruses and bacteria that they may input to the host during feeding. Using DEET cuts down on the odds of getting ticks on you. There are two types of tick caused illness in Montana and both are rare.

Rocky Mountain Spotted Fever is a bacterial illness which can be life-threatening. The early symptoms are headaches, fever, nausea, abdominal pain, lethargy and a rash which develops on the extremities and spreads to the entire body. It is a rare disease with only a couple of cases reported yearly.

Colorado Tick Fever is a viral illness which is not life-threatening. Its symptoms are headaches, fever, nausea, abdominal pain, and lethargy. These symptoms last four or five days, followed by an apparent recovery. Then the symptoms return for a few more days. Total recovery usually takes several weeks. The disease is not life-threatening and infection results in lifelong immunity. If you become ill after being outdoors, and especially if you have had ticks on your body, let your physician know of the possibility of tick disease exposures so it can be factored in when ordering tests and making diagnoses.

As with the case for mosquitoes, the best defense is long sleeved shirts and trousers and DEET. Look over your body for any ticks and remove them with tweezers by carefully grasping the tick's head as close to your skin as possible. Pull the tick straight out, using firm, steady pressure. Another method is to use a credit card or knife blade to carefully sweep down and force the tick's head out of your skin. The idea is to get the tick's head out of your flesh without exposing the tick's fluids to your blood. Don't prick, heat, smother or crush the tick. These methods may cause the tick to regurgitate into the bite wound which increases the chance of infection.

Lightning

July and August can bring heavy afternoon rainstorms with lightning. See the NOLS lightning guide on the following pages for in depth information on lightning.



Appendix I. Field Equipment & Trip Preparation Checklist

Wetland Assessment Projects

May 2017

Personal (supplied by MTNHP)

- Bear spray
- Clipboard
- Compass
- Emergency blankets
- Eraser, big
- Field vest
- Hand lens, 10X – 20X
- Mosquito head net (optional)
- Mechanical pencils
- Rite 'n Rain notebook
- Ruler, 6in.
- Sharpies

Utility

- File box with field equipment/supplies
- File box with protocols, forms and references
- Bleach spray bottle
- Bucket, 5-gal.
- Cargo box
- Duct tape
- Electricians tape
- Fire extinguisher
- Garbage bags
- Masking tape

Navigation & Assessment Area Set-up

- 50m measuring tape
- AA batteries (~20)
- Digital camera
- Dry erase board & markers
- Flagging tape
- GPS units
- Pin flags (~35)
- SD memory cards for camera

Soil Sampling

- Auger
- Gloves (optional)
- Golf tees
- Hanna Instruments Combo pH & EC Tester
- pH & EC Tester Solutions: calibration (1), cleaning (1), storage (1), buffer (3)
- Knife/putty knife
- Measuring tape (seamstress, fabric)
- Munsell Color Chart
- Plastic container for calibrating
- Plastic sheeting (black; 6mil; 4' x 5')
- Rags/Handkerchief
- Shovel: standard & sharpshooter
- Spray bottle

Vegetation Sampling/Collecting

- Baggies – Ziploc Gallon & Quart
- Dissection equipment
- Envelopes (for loose plant parts)
- Garbage bags
- Hori hori
- Plant press w/blotters, cardboard, newspaper, straps
- Rope (10m)

Personal clothing/camping gear (not supplied by MTNHP)

- Boots* or other footwear for wet conditions
- Bug dope
- Cold weather clothing
- Frame backpack*
- Headlamp
- Lighter and/or matches
- Mug
- Rain gear
- Sleeping bag*
- Sleeping pad*
- Sun block
- Sunglasses
- Sun hat
- Tent*
- Two-way radio
- Waders*

*Limited supply available from MTNHP if needed

Group camping/safety gear (supplied by MTNHP)

- Bowls, plates, mugs and silverware
- Cooking pots
- Crazy Creek chairs
- Camping stove (2 burner for car-camping)
- Emergency beacon (if in wilderness/no cell service)
- Emergency first aid kit
- Fuel canister for stove & adapter/connector
- Tarp & ropes (for rain)
- Water jug (7 gal).
- Water purifier & filters

Site Information, Protocols & Forms

- MT Ecological Integrity Assessment Field Manual
- MT Ecological Integrity Assessment Field Forms (Level 2)
- MT Ecological Integrity Assessment Field Forms (Level 3)
- MTNHP Plant Collection protocol
- pH & EC Tester instruction manual
- Site coordinates and directions
- Site maps
- Species of Concern Observation Forms

References & Field Guides

- ___ Road atlas
- ___ SOC lists per county
- ___ MTNHP List of Fen Species and/or Frequent GDE species
- ___ Field Guide to MT's Wetland Vascular Plants (Lesica & Husby 2015) (one per person)
- ___ Field Guide to Intermountain Sedges (USFS 1998)
- ___ Field Guide to Intermountain Rushes (USFS 1994)
- ___ Field Guide to Sedges of Pacific NW (Wilson et al. 2008)
- ___ Field Guide to Willows of E. Central ID (Brunsfeld & Johnson 1985)
- ___ Field Indicators of Hydric Soils (NRCS 2016)
- ___ Grasses of Montana (Lavin & Seibert 2011)
- ___ Grassland Plants of SD & NGP (Johnson & Larson 2007)
- ___ Guide to the Willows of Shoshone NF (USFS 2001)
- ___ Manual of Montana Vascular Plants (Lesica 2012)
- ___ Plants of Black Hills/Bear Lodge Mtns (Larson et al. 1999)
- ___ Plants of the Rocky Mtns. (Kershaw et al. 1998)
- ___ Vascular Plants of Montana (Dorn 1984)
- ___ Vascular Plants of West-Central MT (Lackschewitz 1991)
- ___ Weeds of the West (Burrill et al. 2009)

Before leaving for a field trip:

- ___ **RAT (Request for Authorization to Travel):** Sign and give your current trip RAT to Secretary (RATs are emailed to you).
- ___ **TER (Travel Expense Report):** Sign and give previous trip TER to Secretary (TERs are emailed to you).
- ___ **Motor Pool Trip Ticket:** Print & have Senior Ecologist or Ecologist sign before you pick up the vehicle (Tickets either in field boxes &/or emailed to you).
- ___ **GPS & Camera:** Verify they are working.
- ___ **Extra AA batteries:** Verify you have some.
- ___ **Site Maps, Coordinates, and Directions:** This should be in supervisor's cubicle.
- ___ **Blank Field Forms:** Make sure you have enough (or print from appropriate year:
K:\ECOLOGY\Projects\WETLAND_PROJECTS\Wetland_EIA_FieldMaterials\EIAForms).
- ___ **pH & EC Tester:** Check battery status; Have extras (4 x 1.5v) when the status is 20% or less.
- ___ **pH & EC Tester Solutions:** Make sure you have enough 4.01/7.01/10.01 Buffer, Conductivity Calibration, Cleaning & Storage Solution.
- ___ **Plant Press:** Ensure there are no specimens from the previous trip & that they are clearly labeled; Add more blotter paper & newspaper.

Returning from a field trip:

- ___ **Field Forms:** Place completed forms in a folder and leave them in supervisor's cubicle.
- ___ **GPS Units & Cameras:** Download & organize all data to appropriate K drive folder before next field trip.
- ___ **Dishes:** Clean/dry dishes & other equipment.
- ___ **Field Gear and File Boxes:** Re-organize!!! How you leave them is how you will find them prior to the next field trip.
- ___ **Fuel tanks:** Store at a team member's house.
- ___ Decide as a team how to complete veg ID (& Field Form updates) before the next field trip.
- ___ Leave specimens to be identified/verified by MTNHP Botanist in her cubicle; make sure they are clearly labeled.

Contact information:

MTNHP/1515 E. 6th Ave./Helena, MT 59620-1800
mtnhp@mt.gov
Phone: 406.444.5354/Fax: 406.444.0266

Motor Pool (Work hours)	406-444-2705
Motor Pool (After hours)	406-461-5371

Appendix J. GPS Instructions

Before going to the field:

1. Check that you have the user's manual for the unit you are using. If not, download it here:

Model 76S: http://static.garmin.com/pumac/GPSMAP76S_QuickStartGuide.pdf

Model 76: http://static.garmin.com/pumac/GPSMAP76_OwnersManual.pdf

2. In the Setup Menu, under the Location Tab, make sure that:

a. Location Format is set to "UTM UPS"

b. Datum is set to "NAD83"

c. North is set to "True."

Consult the user's manual if any of these need to be changed.

3. Collect at least 6 spare AA batteries and put them in the case with the GPS unit.

To upload waypoints from your computer to your GPS unit:

1. Connect the GPS to the cable connected to your computer and turn the GPS on.
2. Open ArcMap.
3. Open ArcMap project with the shapefile of the points you want to load.
4. Select the layer that you want to upload in the Table of Contents.
5. Open DNR GPS. This should be installed on your computer. If not, download from
<http://www.dnr.state.mn.us/mis/gis/DNRGPS/DNRGPS.html>
6. It should say 'Connected' at the bottom of the screen.
7. Go to File→Load From ArcMap.
8. In the 'ident' field, select 'siteID'.
9. Then to upload points to your GPS, Waypoints→Upload. The GPS will beep when it has finished uploading all of the points. DNRGPS will say "transfer complete" and the number of waypoints it has uploaded. Make sure it has uploaded all of them.

Renaming the "Waypoint ID" on the GPS unit in the field:

The following are suffixes that should be used when renaming Waypoint IDs, all of which should be preceded by the site name. For example, label the AA Center for site GDE101 as "GDE101AAC".

- 30 AA Center<"...AAC"
- 40 Alternate AA Layout - Polygon with corners:"\$0CCP \$. \$0CCG\$. \$0CCU\$. \$0CCY \$"
N, G."U."("Y "eqtpgtu;"qt"use y j cvgxgt"fkgevqp'ku"cr r tqr tkvg+0" If polygon has many corners, or if it becomes too complex to use directions, could"wg"\$0CC3\$. \$CC4\$. "gve00
- 50 Alternate AA Layout - Track:"\$0CCVTCEM"
- 60 Qxgtxkgy 'Rj qvq<\$0QX\$
- 70 Soils: "...S1" & "...S2" (2 soil samples per site)
- 80 Veg Plot: "...0M" & "...50M" (0m and 50m end of each plot). If alternate module array results in plot being broken up into multiple parts, for example, "...0MP1" and "...30MP1" for first plot (6 modules) and "...0MP2" and "...20MP2" for the second plot (4 modules).
- 90 Inlet(s) & Outlet(s): "...IN" & "...OUT", respectively. If there are multiple inlets/outlets, label "...IN1", "...IN2", etc...
- 80 Parking Location:\$0CAT\$. This is helpful for access purposes.
- ; 0 Qj gt'Rj qvqu< Ncdgn'cr r tqr tkvgn(. g0 0'\$0TQCF \$. "qt"\$0UEEP"

To download waypoints from your GPS unit to your computer:

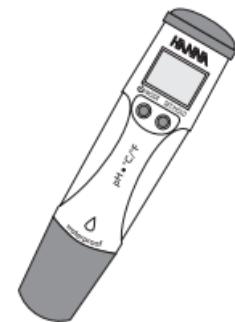
1. Connect the GPS to the cable connected to your computer and turn the GPS on.
2. Open DNR GPS
3. It should say 'Connected' at the bottom of the screen.
4. To download your GPS waypoints, go to Waypoint→Download. The GPS will beep when it has finished downloading all of the points. Make sure it has downloaded all of them.
5. To save your waypoints, go to File→Save to→File. You can save it as a text file (.txt).

Appendix K. HANNA HI 98127 pH Meter User Manual

Download full manual from <http://shop.hannainst.com/products/testers/hi98127-phep4-ph-tester.html>

Instruction Manual

HI 98127 • HI 98128 Waterproof pH Testers with Replaceable Electrode



WARRANTY

HI 98127 and HI 98128 are warranted for one year against defects in workmanship and materials when used for their intended purpose and maintained according to instructions. The electrode is warranted for a period of six months. This warranty is limited to repair or replacement free of charge.

Damages due to accident, misuse, tampering or lack of prescribed maintenance are not covered.

If service is required, contact the dealer from whom you purchased the instrument. If under warranty, report the model number, date of purchase, serial number and the nature of the failure. If the repair is not covered by the warranty, you will be notified of the charges incurred. If the instrument is to be returned to Hanna Instruments, first obtain a Returned Goods Authorization Number from the Customer Service department and then send it with shipment costs prepaid. When shipping any instrument, make sure it is properly packaged for complete protection.

All rights are reserved. Reproduction in whole or in part is prohibited without the written consent of the copyright owner.

Hanna Instruments reserves the right to modify the design, construction and appearance of its products without advance notice.

Dear Customer,

Thank you for choosing a Hanna product. This manual will provide you with the necessary information for correct operation. Please read it carefully before using the meter. If you need additional technical information, do not hesitate to e-mail us at tech@hannainst.com. These instruments are in compliance with the **CE** directives.

PRELIMINARY EXAMINATION

Remove the instrument from the packing material and examine it carefully. If any damage has occurred during shipment, immediately notify your Dealer or the nearest Hanna Customer Service Center.

Each meter is supplied with:

- HI 73127 pH electrode
- HI 73128 electrode removal tool
- batteries (4 x 1.5V) and instructions

Note: Conserve all packing material until the instrument has been observed to function correctly. Any defective item must be returned in its original packing.

US DESIGN PATENT
D462,024

GENERAL DESCRIPTION

HI 98127 and HI 98128 are waterproof pH and temperature meters. The housing has been completely sealed against humidity and designed to float. All pH readings are automatically temperature compensated (ATC), and temperature values can be displayed in °C or °F units.

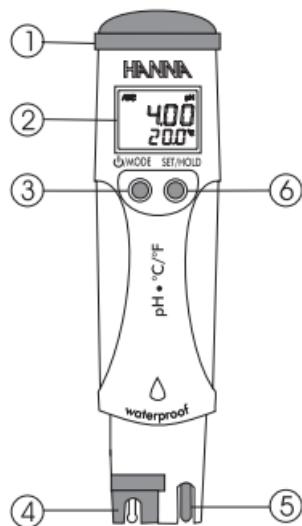
The meters can be calibrated at one or two points with auto-buffer recognition and against five memorized buffer values.

Measurements are highly accurate with a unique stability indicator right on the LCD.

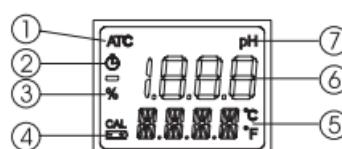
These meters are also provided with battery level indication at start-up, and with a low battery symbol which warns the user when the batteries need to be replaced. In addition the Battery Error Prevention System (BEPS) avoids erroneous reading caused by low voltage level by turning the meter off. The HI 73127 pH electrode, supplied with the meters, is interchangeable and can be easily replaced.

The stainless steel encapsulated temperature sensor facilitates faster and more accurate temperature measurement and compensation.

FUNCTIONAL DESCRIPTION



1. Battery compartment
2. Liquid Crystal Display (LCD)
3. ON/OFF/MODE button
4. HI 73127 pH electrode
5. Temperature sensor
6. SET/HOLD button



1. ATC (Automatic Temperature Compensation) indicator
2. Stability indicator
3. Battery life percentage indicator
4. Low battery indicator
5. Secondary display
6. Primary display
7. Measuring unit for primary display

CE DECLARATION OF CONFORMITY



DECLARATION OF CONFORMITY

We
Hanna Instruments Italia Srl
via L. da Vinci, 10
15018 Sorisole (PV)
ITALY

herewith certify that the pH & temperature meters

HI 98127 and HI 98128

have been tested and found to be in compliance with EEC Directive 89/336/EEC and Low Voltage Directive 73/23/EEC according to the following applicable normative:

EN 50084-2: Electromagnetic Compatibility - Generic Immunity Standard

IEC 61000-4-2: Electromagnetic Discharge

IEC 61000-4-3: RF Radiated

EN 50085-1: Electromagnetic Compatibility - Generic Emission Standard

IEC 61000-4-6: Magnetic Radiation, Class B

EN61131-1: Safety requirements for electrical equipment for measurement, control and laboratory use

Date of Issue: 11/02/2005

A. Marzocchi
A. Marzocchi
On behalf of
Hanna Instruments Srl.

Recommendations for Users

Before using this product, make sure that it is entirely suitable for the environment in which it is used.

The glass bulb at the end of the electrode is sensitive to electrostatic discharges. Avoid touching the glass bulb at all times.

Any variation introduced by the user to the supplied equipment may degrade the instrument's EMC performance.

To avoid electrical shock, do not use this instrument when voltages at the measurement surface exceed 24 Vac or 60 Vdc. To avoid damages or burns, do not perform any measurement in microwave ovens.

ACCESSORIES

- HI 73127 Replaceable pH electrode
- HI 73128 Electrode removal tool
- HI 70004P pH 4.01 solution, 20 mL sachet (25 pcs)
- HI 70006P pH 6.86 solution, 20 mL sachet (25 pcs)
- HI 70007P pH 7.01 solution, 20 mL sachet (25 pcs)
- HI 70009P pH 9.18 solution, 20 mL sachet (25 pcs)
- HI 70010P pH 10.01 solution, 20 mL sachet (25 pcs)
- HI 77400P pH 4 & 7 solutions, 20 mL sachet (5 each)
- HI 7004M pH 4.01 solution, 230 mL bottle
- HI 7006M pH 6.86 solution, 230 mL bottle
- HI 7007M pH 7.01 solution, 230 mL bottle
- HI 7009M pH 9.18 solution, 230 mL bottle
- HI 7010M pH 10.01 solution, 230 mL bottle
- HI 7061M Electrode cleaning solution, 230 mL bottle
- HI 70300M Electrode storage solution, 230 mL bottle

IST98127R5 07/05

SPECIFICATIONS

Range	-2.0 to 16.0 pH (HI 98127)
	-2.00 to 16.00 pH (HI 98128)
	-5.0 to 60.0°C / 23.0 to 140.0°F
Resolution	0.1 pH (HI 98127)
	0.01 pH (HI 98128)
	0.1°C / 0.1°F
Accuracy	±0.1 pH (HI 98127)
(@ 20°C/68°F)	±0.05 pH (HI 98128)
	±0.5°C / ±1°F
Typical EMC Deviation	±0.1 pH (HI 98127)
	±0.02 pH (HI 98128)
	±0.3°C / ±0.6°F
Temp. Compensation	Automatic
Environment	-5 to 50°C (23 to 122°F); RH 100%
Calibration	1 or 2 points with 2 sets of memory buffers (pH 4.01/7.01/10.01 or 4.01/6.86/9.18)
Electrode	HI 73127 pH electrode (included)
Battery	4 x 1.5V with BEPS / approx. 300 hours
Auto-off	after 8 minutes of non-use
Dimensions	163 x 40 x 26 mm (6.4 x 1.6 x 1.0")
Weight	100 g (3.5 oz)

OPERATIONAL GUIDE

To turn the meter on and check the battery status

Press and hold the Δ/MODE button until the LCD lights up. All the used segments on the LCD will be visible for 1 second (or as long as the button is pressed), followed by the percent indication of the remaining battery life (E.g. % 100 BATT).

Taking measurements

Submerge the electrode in the solution to be tested while stirring it gently. The measurements should be taken when the stability symbol \square on the top left of the LCD disappears.

The pH value automatically compensated for temperature is shown on the primary LCD while the secondary LCD shows the temperature of the sample.



To freeze the display

While in measurement mode, press the SET/HOLD button. HOLD appears on the secondary display and the reading will be frozen on the LCD (E.g. pH 5.78 HOLD).



Press any button to return to normal mode.

To turn the meter off

While in normal mode, press the Δ/MODE button. OFF will appear on the secondary display. Release the button.

Notes:

- Before taking any measurements make sure the meter has been calibrated (CAL tag present on the LCD).
- If measurements are taken in different samples successively, rinse the probe thoroughly to eliminate cross-contamination; and after cleaning, rinse the probe with some of the sample to be measured.

CALIBRATION

For better accuracy, frequent calibration of the instrument is recommended. In addition, the instrument must be recalibrated whenever:

- The pH electrode is replaced.
- After testing aggressive chemicals.
- Where high accuracy is required.
- At least once a month.

Calibration procedure

From normal measuring mode, press and hold the Δ/MODE button until OFF on the secondary LCD is replaced by CAL. Release the button. The LCD enters the calibration mode displaying "pH 7.01 USE" (or "pH 6.86 USE" if the NIST buffer set was selected). After 1 second the meter activates the automatic buffer recognition feature. If a valid buffer is detected then its value is shown on the primary display and REC appears on the secondary LCD. If no valid buffer is detected, the meter keeps the USE indication active for 12 seconds, and then it replaces it with WRNG, indicating the sample being measured is not a valid buffer.

For a **single-point calibration** with buffers pH 4.01, 9.18 or 10.01, the meter automatically accepts the calibration when the reading is stable; the meter displays the accepted buffer, with the message "OK 1". After 1 second the meter automatically returns to the normal measuring mode.

If a single-point calibration with buffer pH 7.01 (or pH 6.86) is desired, then after the calibration point has been accepted the Δ/MODE button must be pressed in order to return to normal mode. After the button is pressed, the meter shows "7.01" (or "6.86") - "OK 1" and, after 1 second, it automatically returns to the normal measuring mode.

Note: It is always recommended to carry out a two-point calibration for better accuracy.

For a **two-point calibration**, place the electrode in pH 7.01 (or pH 6.86) buffer. After the first calibration point has been accepted, the "pH 4.01 USE" message appears. The message is held for 12 seconds, unless a valid buffer is recognized. If no valid buffer is recognized, then the WRNG message is shown. If a valid buffer (pH 4.01, pH 10.01, or pH 9.18) is detected, then the meter completes the calibration procedure. When the buffer is accepted, the LCD shows the accepted value with the "OK 2" message, and then the meter returns to the normal measuring mode.

Note: When the calibration procedure is completed, the CAL tag is turned on.

To quit calibration and to reset to the default values

- After entering the calibration mode and before the first point is accepted, it is possible to quit the procedure and return to the last calibration data by pressing the Δ/MODE button. The secondary LCD displays "ESC" for 1 second and the meter returns to the normal measuring mode.
- To reset to the default values and clear a previous calibration, press the SET/HOLD button after entering the calibration mode and before the first point is accepted. The secondary LCD displays "CLR" for 1 second, the meter resets to the default calibration and the CAL tag on the LCD disappears.

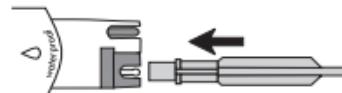
SETUP

Setup mode allows the selection of temperature unit and pH buffer set.

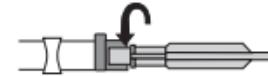
To enter the Setup mode, press the Δ/MODE button until CAL on the secondary display is replaced by TEMP and the current temperature unit (E.g. TEMP °C). Then:

- for **"C"/"F" selection**: Use the SET/HOLD button. After the temperature unit has been selected, press the Δ/MODE button to enter the buffer set selection mode; press the Δ/MODE button twice to return to the normal measuring mode.
- to change the calibration buffer set: After setting the temperature unit, the meter will show the current buffer set: "pH 7.01 BUFF" (for 4.01/7.01/10.01) or "pH 6.86 BUFF" (for NIST 4.01/6.86/9.18). Change the set with the SET/HOLD button, then press Δ/MODE to return to normal measuring mode.

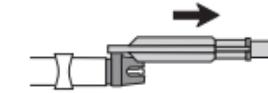
- The pH electrode can be easily replaced by using the supplied tool (HI 73128). Insert the tool into the electrode cavity as shown below.



- Rotate the electrode counterclockwise.



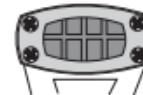
- Pull the electrode out by using the other side of the tool.



BATTERY REPLACEMENT

The meter displays the remaining battery percentage every time it is switched on. When the battery level is below 5%, the \square symbol on the bottom left of the LCD lights up to indicate a low battery condition. The batteries should be replaced soon. If the battery level is low enough to cause erroneous readings, the meter shows "0%" and the Battery Error Prevention System (BEPS) will automatically turn the meter off.

To change the batteries, remove the 4 screws located on the top of the meter.



Once the top has been removed, carefully replace the 4 batteries located in the compartment while paying attention to their polarity.



Replace the top, making sure that the gasket is properly seated in place, and tighten the screws to ensure a watertight seal.

Appendix L. Key to Wetland Plant Communities of Montana (adapted from Eggers & Reed (2015))

*Note: ALL Wetland Plant Communities described here are found in <2.5 m deep water, measured during the lowest part of the year, and usually have $\geq 30\%$ vegetation.

1A. Plant community with $\geq 30\%$ cover woody trees and/or shrubs, usually >1m tall, but includes dwarf shrubs <1m tall.....**2**

1B. Plant community usually with $\geq 30\%$ cover herbaceous vegetation, either emergent, submerged, floating, or floating-leaved.....**6**

2A. Trees >6 m tall dominate community.....**3**

2B. Shrubs and young trees <6 m tall dominate community.....**5**

3A. Located in floodplains that are temporarily inundated during flood events, but are relatively well-drained for much of the growing season; primarily dominated by cottonwoods, but may also have a large coniferous component, particularly in western Montana.....
.....**FLOODPLAIN FOREST**

3B. Located in or near lake basins, slopes, depressions, flats, or high elevation meandering streams that have longer term inundation/saturation during the growing season; dominated by conifers such as Engelmann spruce, western hemlock, and/or subalpine fir.....**4**

4A. Organic soils present with at least a Histic Epipedon (surface horizon ≥ 20 cm organic (O) horizon) if not a Histosol (≥ 40 cm peat, muck, or mucky peat in the upper 80 cm); soils saturated at or near the surface for the duration of the growing season, commonly with pockets of standing water in depressions.....**CONIFEROUS FEN**

4B. Dominated by mineral soils, if organic then neither a Histic Epipedon nor a Histosol; standing water may be present in depressions for a short period during the growing season, but typically drying out during the latter half of the growing season.....**CONIFEROUS WETLAND**

5A. Organic soils present with at least a Histic Epipedon (surface horizon ≥ 20 cm organic (O) horizon) if not a Histosol (≥ 40 cm peat, muck, or mucky peat in the upper 80 cm); soils saturated at or near the surface for the duration of the growing season, commonly with pockets of standing water in depressions; often occurring on slopes fed by groundwater.....**SCRUB-SHRUB FEN**

5B. Dominated by mineral soils, if organic then neither a Histic Epipedon nor a Histosol; water levels and inundation period vary widely; geographically widespread, often along streams, lakes, reservoirs, or springs.....**SCRUB-SHRUB WETLAND**

6A. Uppermost layer of vegetation is $\geq 30\%$ cover of true aquatic plants including submerged, floating, and/or rooted floating-leaved plants or algae; if early in the growing season, submerged and rooted floating-leaved communities may have <30% cover**AQUATIC BED**

- 6B. Uppermost layer of vegetation is $\geq 30\%$ cover of emergent herbaceous plants, true aquatic plants may or may not be present; standing water may or may not be present.....7
- 7A. Plant community dominated by salt-tolerant graminoids and/or forbs; mineral soils have high salinity and salt encrustations may form on soil surface as water evaporates; inundation occurs early in the growing season or after rainfall; herbaceous plant cover $<30\%$ not uncommon; approximately restricted to the eastern 2/3 of Montana.....**SALINE DEPRESSION**
- 7B. Plant community dominated by freshwater graminoids and/or forbs; soils may be mineral or organic; inundation and saturation varies widely.....8
- 8A. Herbaceous plant cover may be $<30\%$ due to seasonal inundation resulting in exposed mudflats for part of the growing season; plant community consists of pioneering emergent annuals or may be cultivated for row crops or hay fields; soils usually mineral.....9
- 8B. Herbaceous plant cover always $\geq 30\%$; soils may be mineral or organic.....10
- 9A. Located on the edges of reservoirs, lakes, ponds, or large wetlands; plant community usually consists of pioneering emergent annuals, including non-native/invasive species; plant cover $<30\%$ common due to regularly fluctuating water levels or drawdown occurring late in growing season; soils almost always mineral.....**SEASONALLY FLOODED MUDFLAT**
- 9B. Shallow depression or flat located in broad basins; early season inundation and drawdown exposes mudflats which become colonized by pioneering annual and perennials, including non-native/invasive species; plant cover usually $\geq 30\%$ unless early season; often cultivated for row crops or hay fields; mineral soils; most common in eastern Montana.....
.....**SEASONALLY FLOODED BASIN/DEPRESSION/FLAT**
- 10A. Plant community dominated by $\geq 50\%$ cover of sedges, primarily *Carex* spp., but also including *Eriophorum* spp., *Trichophorum* spp., and other members of the Family Cyperaceae; typically found in organic soils; saturation at or near the soil surface; inundation varies.....
.....**SEDGE MEADOW**
- 10B. Plant community with $<50\%$ cover of sedges; soils may be mineral or organic; inundation and saturation vary.....11
- 11A. Plant community dominated by emergent vascular plants, mosses, liverworts, and/or lichens; organic soils present with at least a Histic Epipedon (surface horizon ≥ 20 cm organic (O) horizon) if not a Histosol (≥ 40 cm peat, muck, or mucky peat within the upper 80 cm); soils typically saturated to surface throughout growing season with standing water in depressions common; floating mat of sedges and mosses may be present.....**HERBACEOUS FEN**
- 11B. Plant community dominated by emergent vascular plants and/or true aquatic plants; dominated by mineral soils, if organic then neither a Histic Epipedon nor a Histosol; inundation and water depth vary.....12

- 12A. Inundated by water depths ≥ 15 cm (up to 2.5 m) throughout the growing season in most years; community often a mixture of aquatic emergents, floating, floating-leaved and/or submergent plants, although true aquatic plants are <30% of cover.....**DEEP MARSH**
- 12B. Water depth usually <15 cm or absent later in the growing season; community dominated by aquatic emergents or drier plants that tolerate seasonal inundation; floating, floating-leaved and/or submergent plants often absent.....**13**
- 13A. Inundated by water depths <15 cm for more than a month in most years; aquatic emergent layer is dominant; floating, floating-leaved, and/or submergent layers may be present but a minor component.....**SHALLOW MARSH**
- 13B. Often inundated early in the growing season, although not always, drying within a few months, the water table lies from the surface to well below the ground surface most of the season; community consists of aquatic emergent and/or drier plants; floating, floating-leaved and/or submergent plants absent.....**14**
- 14A. Plant community may be dominated by wetland emergents, although plant composition is often a mixture of a wide range of plants adapted to a variety of moisture requirements, centering around facultative graminoids and/or forbs; disturbed areas may be dominated by non-native or invasive species such as Canada thistle; inundation/saturation persists for a couple of months most years, usually drying out by latter half of growing season; geographically widespread.....
.....**WET MEADOW**
- 14B. Plant community dominated by moist prairie graminoids and forbs with some facultative or drier wetland emergents (i.e., Baltic rush, *Equisetum* spp.) present; disturbed areas may be dominated by non-native or invasive species such as Canada thistle; inundation/saturation very brief in early spring most years; mineral soils; often cultivated for row crops or hay fields.....
.....**WET TO WET-MESIC PRAIRIE**

Appendix M. Coordination of Montana Wetland Plant Communities with Classification of Wetland & Deepwater Habitat of the U.S., Cowardin 2.0 (FGDC 2013)

Montana Wetland Plant Community	Classification of Wetlands & Deepwater Habitats of the U.S., Cowardin 2.0 (FGDC 2013)		
	System/ Subsystem	Class	Water Regime
Aquatic Bed	P, L2	AB	F, G, H, K
Deep Marsh	P, L2	EM	F, G (not PEM), K
Shallow Marsh		EM, ML	C, F (EM only), K (EM only)
Sedge Meadow		EM	A, B, C, D, E, F, K
Wet Meadow		EM	A, C, K
Wet to Wet-Mesic Prairie		EM	J, A, K
Seasonally Flooded Basin/Depression/Flat		EM, US	J, A, C, K
Seasonally Flooded Mudflat	P, L2	US	J, A, C, K
Saline Depression	P, L2 (US only)	EM, US	J, A, C, K
Herbaceous Fen		EM, ML	B, D, E
Scrub-Shrub Fen		SS	B, D, E
Scrub-Shrub Wetland		SS	J, A, C, F, K
Coniferous Fen		FO	B, D, E
Coniferous Wetland		FO	A, C, F
Floodplain Forest	Rp1, Rp2, P	FO	A (PFO only)