Inventory for Rare and Uncommon Plants in Fen and Fen-like Ecosystems on Colville National Forest and Two Districts of Okanogan-Wenatchee National Forest

West over the main body of Bunchgrass Meadows, Sullivan Lake Ranger District, Colville National Forest, from a groundwater-fed slope on the NE edge of the wetland/meadow complex. The fen indicator taxon tall cottongrass (*Eriophorum angustifolium*) is in full fruit across this slope.

Rick Dewey
Deschutes National Forest
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Tall cottongrass (*Eriophorum angustifolium*) at Halliday Fen, Sullivan Lake Ranger District, Colville National Forest.

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Summary

Visits to sites known, or suspected to include groundwater-fed wetlands were conducted during the 2015 field season on Naches and Tonasket Ranger Districts on Okanogan National Forest and during portions of the 2015 and 2017 field seasons on Colville National Forest. The intent of these visits was to inventory for rare plants associated with these wetlands, and to record a coarse biophysical description of these wetlands. Project-wide, 54 sites were visited and new occurrences of nine target species and seven other notable (apparently rare) plant species were detected, accounting for a total of 47 new rare plant sites within or adjacent to fen ecosystems. On the Naches Ranger District, new detections of four target species and one otherwise notable species accounted for detection of nine new sites of rare bryophytes in or adjacent to fens. On the eastern Tonasket Ranger District, which has been subject to much previous rare plant inventory, a new site each for one target bryophyte species and two otherwise notable bryophyte species were detected in or adjacent to fens. On the western Tonasket Ranger District, where apparently little prior rare plant inventory has occurred, seven target species and seven otherwise notable species were newly detected, accounting for a total of 24 new sites of fen-loving rare sedges and bryophytes. On Colville National Forest, new detections of seven target species and two otherwise notable species accounted for documentation of 11 new rare, fen-loving plant sites. Detections of the sedge *Carex tenuiflora* and the moss *Calliergon richardsonii* appear to be first records for these species on Colville National Forest. For 13 bryophyte species that appear to be strongly associated with groundwater-fed wetlands, it is proposed that there is now sufficient data to defensibly assess the actual rarity of these bryophyte species within the state of Washington.

Fruits of the sparseflower sedge (*Carex tenuiflora*) at Headwaters Sinlahekin Creek wetland, western Tonasket Ranger District, Okanogan-Wenatchee National Forest.

Introduction

This project is part of a series of Forest-level inventories within USFS Region 6 that are focused on better understanding the regional distribution of rare and uncommon fen-loving plants, as well as of the fen and fen-like ecosystems which include them. These inventories typically involve several days of pre-field analysis followed by 3-4 weeks of fieldwork by 1-2 persons. To date, the project lead has conducted either focused or opportunistic surveys for fens and fen-loving rare plants on the Deschutes, Ochoco, Fremont-Winema, Malheur, Umatilla, Wallow-Whitman, and Mt. Hood National Forests, and the Klamath Falls Resource Area of the Lakeview BLM District in Oregon, and Gifford Pinchot, Olympic, Okanogan-Wenatchee and Mt. Baker/Snoqualmie National Forests in Washington.

The highly biodiverse north fen at the Headwaters Sinlahekin Creek wetland complex, western Tonasket Ranger District, Okanogan-Wenatchee National Forest.

While probably somewhat dependent on geographic locale, fens have been noted to play important roles in water quality maintenance and carbon retention. Fen ecosystems in Oregon and Washington are particularly notable for at least two other reasons. First, these ecosystems are locally either rare or uncommon, tending to be quite small in their individual aerial extent, and are generally very sparsely distributed within the mountains of these two states. For instance, on Deschutes National Forest in central Oregon, which is one of the most thoroughly inventoried and fen-rich forests in Oregon or Washington, the collective acreage of currently known fens is only about 460 acres, a mere 0.03% of the total acreage of the 1.6 million acre forest. Second, and as noted by Bedford and Godwin (2003), in spite of being an extremely tiny spatial component of the regional landscape, fen ecosystems contribute very disproportionately to local levels of plant biodiversity, particularly with regard to rare and uncommon plant species. For instance, taxa found in seasonally or persistently groundwater-fed wetlands account for more than a third of vascular and non-vascular plant species documented on Deschutes National Forest

and listed (Lists 1-4) in the 2016 Oregon Biodiversity Information Center's Rare, Threatened and Endangered Species of Oregon. It is likely that fen-loving plant species make large contributions to local biodiversity on many other forests that include lands along or east of the Cascade crest in Oregon and Washington.

Objectives

The geographic scope of this project was all four ranger districts of Colville NF and two ranger districts on Okanogan-Wenatchee NF, the Naches and Tonasket Ranger Districts, which were not included in the initial fen/rare plant surveys conducted on the Okanogan Wenatchee National Forest in 2013. The intent of this study was to identify a group of sites on these forest lands that were reasonably likely to include fen or fen-like ecosystems, and could be visited and examined with preferably no more than 1-2 hours hiking time, each way. Examination was to include development of a list of on-site bryophytes and vascular plants, including sensitive and other notable plant species, and a cursory description of vegetative structure, site wetness, soils and site condition. It was hoped that this examination would allow identification of sites including at least some fen habitat, and allow some type of comparison among these sites. "Target species" are 1) species with status as sensitive or strategic species, or 2) listed on the Washington Natural Heritage Program (WNHP) Rare Mosses list, or 3) prior to project initiation, were identified by the project lead as possibly rare in Washington, even if previously unnoted as such by WNHP. "Notable species" are those that the project lead, during the course of the project, came to understand as likely being rare in Washington, even if previously unnoted as such by WNHP.

The mosses *Meesia triquetra* (l) and *Helodium* (*Elodium*) *blandowii* (r) at Pinegrass Ridge fen, Naches Ranger District, Okanogan-Wenatchee National Forest.

Methods

During this project the project lead utilized a variety of data sources during the pre-field analysis process. Primary among these was wetland mapping provided by the USF&WS National Wetland Inventory (NWI). Important secondary data sources included field unit staff recommendations and site information for selected fen indicator taxa (FIT) extracted from the Consortium of PNW Herbaria website. The NWI utilizes a very large set of wetland categories. Prior experience with the NWI has allowed the project lead

to understand that the PEMB category is perhaps the single category most likely to be associated with fens and fen-like ecosystems. Other NWI categories such as PEMC and PSSB may also include fen and fen-like ecosystems. A more detailed explanation of these codes is available at http://www.fws.gov/wetlands/data/wetland-codes.html, but briefly, “P” = palustrine, “EM” = emergent, and “B” = substrate saturated to surface for extended periods during the growing season. “C” = seasonally flooded, and “SS” = scrub-shrub. Ultimately, the list of candidate fen and fen-like ecosystems for this project was derived from an initial collection of NWI PEMB and PEMC sites screened for ease of access and promise as assessed by examining NAIP aerial imagery views. Field visits to fen candidate sites usually involved driving, parking, and some amount of trail and/or cross-country hiking. Upon arrival at a site, an effort was made to identify and walk through structurally differentiable plant communities within the site. Typically, the time spent at any site was directly related to the size of the site and the extent and pattern of biophysical diversity within that site. Types of information collected at a site included a plant species list, plant collections, a brief description of site character (vegetation structure, wetness and adjacent topography), soil probes, photographs and GPS coordinates of selected features. Plant species lists were never comprehensive. Known taxa were generally always recorded. Unknown taxa, after consideration of taxon’s potential significance in interpreting site conditions, were either collected to provide an opportunity for later identification, simply noted in field notebook, or left for some other, less time-sensitive visit. Field visits to fen candidate sites were necessarily conducted from June through September, but are best done in late summer or fall, in order to better assess the relative contributions of seasonal surface water vs. persistent, diffusely-discharging groundwater in contributing to wetness at the sites.

Far western portion of the amazing Pinegrass Ridge fen/wetland complex, Naches Ranger District, Okanogan-Wenatchee National Forest.

Cattle hoof damage in the south fen at the Pinegrass Ridge fen/wetland complex, Naches Ranger District, Okanogan-Wenatchee National Forest.

Results

Naches Ranger District, Okanogan- Wenatchee NF

Twelve sites were visited during seven field days within the periods of 7/7/2015 to 7/9/2015 and 8/31/2015 to 9/3/2015. These sites are mapped in Appendix F. Site elevations ranged from 3800 – 6000 feet. A biophysical description of these sites is presented in Appendix B. Ninety plant taxa/66 species, including 15 *Carex* species and 23 bryophyte species were noted among the fen and fen-like ecosystems visited. This group of plants is presented in Appendix C. Four target species and one otherwise notable species accounting for nine distinct occurrences/populations were detected during site visits. Detected occurrences of these species are presented in Table 1 below.

Table 1. Project target taxa and otherwise notable taxa detected on Naches Ranger District (target taxa in bold).

Site	**Vascular Taxa**	**Bryophyte Taxa**
1204-755 Rd. (Pinegrass Ridge)		***Helodium blandowii***
		Meesia triquetra
		Hamatocaulis vernicosus
1900-837 Rd.		***Helodium blandowii***
Conrad Meadows		***Helodium blandowii***
		Hypnum pratense
Section 3 Lake		***Harpanthus flotovianus***
Bumping River		***Helodium blandowii***
		Meesia triquetra

Tonasket Ranger District, Okanogan-Wenatchee NF

Twelve sites were visited during five field days within the periods of 7/20/2015 to 7/24/2015. These sites are mapped in Appendix F. Site elevations ranged from 3600 – 6500 feet. A biophysical description of these sites is presented in Appendix B. Ninety plant taxa/65 species, including 12 *Carex* species and 35 bryophyte species were noted among the fen and fen-like ecosystems visited. This group of plants is presented in Appendix C. New sites for seven target species and seven otherwise notable species accounting for 27 new distinct occurrences/populations were detected during site visits. Detected occurrences of these species are presented in Table 2 below.

Table 2. Project target taxa and otherwise notable taxa detected on Tonasket Ranger District (target taxa in bold). Asterisk denotes taxa previously documented at site.

Site	**Vascular Taxa**	**Bryophyte Taxa**
Eastern half Tonasket RD		
Hdws. Box Creek	***Carex capillaris****	***Calliergon richardsonii****
		*Hypnum pratense**
		Thuidium recognitum
3400 Rd.		***Helodium blandowii****
		Tomentypnum nitens*
Bonaparte fen	***Carex tenuiflora****	***Harpanthus flotovianus***
		Helodium blandowii*
		*Paludella squarrosa**
		Tomentypnum nitens*
Hdws. Middle Fork Cedar Creek		***Helodium blandowii****
		*Hypnum pratense**
		Tomentypnum nitens*
3575-200 Road		*Hypnum pratense*
Western half Tonasket RD		
Thunder Mountain		***Helodium blandowii***
Hdws. Sinlahekin Creek	***Carex tenuiflora***	***Calliergon richardsonii***
	Carex magellanica ssp. ***irrigua***	*Fissidens osmundioides*
		Helodium blandowii
		Paludella squarrosa
		Scorpidium cossonii
		Scorpidium scorpioides
		Splachnum sphaericum
		Tomentypnum nitens
Hdws. South Fork Twentymile Creek (northeast)		***Calliergon richardsonii***
		Harpanthus flotovianus
		Tomentypnum nitens
Tiffany Meadows		***Calliergon richardsonii***
		Fissidens osmundioides

		Helodium blandowii
		Hypnum pratense
		Scorpidium cossonii
		Paludella squarrosa
		Tomentypnum nitens
Baldy Pass		***Calliergon richardsonii***
		Campylium stellatum
		Paludella squarrosa
		Tomentypnum nitens

Nine target or otherwise notable species accounting for 15 occurrences were detected during site visits on the eastern half of Tonasket Ranger District. All but three of these occurrences were previously documented, primarily by Erica Heinlen, a District botanist. The mosses *Thuidium recognitum* at headwaters of Box Creek, *Hypnum pratense* at the 3575-200 Road wetland, and the liverwort *Harpanthus flotovianus* at the Bonaparte fen, were newly documented during this project. Twelve target or otherwise notable species accounting for 24 occurrences were detected during site visits on the western half of the Tonasket Ranger District. All of these occurrences were newly documented during this project. Three additional species detected during the western Tonasket Ranger District surveys should also be noted. The liverworts *Lophozia bantriensis* and *Moerckia hibernica*, and the moss *Rhizomnium gracile* were observed here and nowhere else during the project's surveys on the Okanogan-Wenatchee and Colville National Forests. No Washington records for any of these species exist within the Consortium of Pacific Northwest Herbaria database. All three species occurred within groundwater-fed wetlands. Vitt's (1988) distribution map for *Rhizomnium gracile* shows a boreal distribution with no extension into the Pacific Northwest U.S. The species is said to occur primarily in fens and seeps.

The remarkably wet, smallish, but rare species-rich, sloping fen near Baldy Pass, western Tonasket Ranger District, Okanogan-Wenatchee National Forest.

Colville National Forest

Twenty sites were visited during 12 field days within the periods of 8/10/2015 to 8/19/2015 and 9/9/2015 to 9/12/2015. Extensive wildfires on Colville National Forest in the summer of 2015 prevented planned visits to a number of fen candidate sites. In 2017, 10 additional sites were visited during 8 field days between 8/14/2017 to 8/22/2017. Sites visited during the summers of 2015 and 2017 are mapped in Appendix F. Site elevations ranged from 2550 – 5900 feet. A biophysical description of these sites is presented in Appendix B. One hundred and forty-five plant taxa/109 species, including 21 *Carex* species and 35 bryophyte species were noted among the fen and fen-like ecosystems visited. This group of plants is presented in Appendix C. Nine target species and three otherwise notable species were detected during site visits. A number of these detections were of species previously documented at sites, but new detections were made for seven target species and two notable taxa for a collective total of 11 new sites. Detected occurrences of target and notable tax are presented in Table 3 below.

Table 3. Project target taxa and otherwise notable taxa detected on Colville National Forest (target taxa in bold). Asterisk denotes taxa previously documented at site. Due to taxonomic revision, the moss *Drepanocladus revolvens*, previously documented at Halliday fen, is apparently now best referred to as *Scorpidium cossonii*.

Site		**Vascular Taxa**	**Bryophyte Taxa**
Sullivan Lake Ranger District			
Stewart Meadow (south)			***Meesia triquetra****
			Tomentypnum nitens*
Halliday fen			***Campylium stellatum****
			Helodium blandowii*
			*Scorpidium cossonii**
			*Thuidium recognitum**
			Tomentypnum nitens*
Bunchgrass Meadows (main)		***Carex magellanica* ssp. *irrigua****	***Helodium blandowii***
			Tomentypnum nitens
			Hamatocaulis vernicosus
			Harpanthus flotovianus
Bunchgrass Meadows (w)		***Carex magellanica* ssp. *irrigua***	***Calliergon richardsonii***
1935 rd. section 28		***Carex magellanica* ssp. *irrigua****	
Newport Ranger District			
Rufus Meadow		***Carex magellanica* ssp. *irrigua****	
Three Rivers Ranger District			

7018-600 rd.			*Hypnum pratense*
Republic Ranger District			
South Fork O'Brien Creek			***Helodium blandowii***
			Thuidium recognitum
			Tomentypnum nitens
2149 Road		***Carex tenuiflora***	

Project-wide

Target species and otherwise notable species detected during this project are presented in Appendix A. Among all sites visited during this project there appears to be general correspondence between a site's strength of fen expression and its count of fen indicator taxa and notable species (target and other notable species) detected. Data pertaining to these site features is presented in Table 4 below.

Table 4. Fen expression and counts of Fen Indicator Taxa (FIT) and notable species per site for all project sites. Sites with at least some included portion identifiable as fen are denoted with single asterisk. Two or three asterisks rank sites according to a combination of their greater amount of included fen habitat and larger extent of persistent surface or near-surface saturation with groundwater. As presented here, "notable" species includes both project target species and any other apparently rare species detected at a site.

Field Unit	**Site**	**FIT/notable spp. count**		**Field unit**	**Site**	**FIT/notable spp. count**
Okanogan-Wenatchee N.F., Naches R.D.	1204-755 rd.***	16/3		Colville N.F., Sullivan Lake R.D. (cont.)	Stewart Meadow (s)**	15/2
	Bumping River**	15/2			1935 rd. section 28*	10/1
	Conrad Meadows**	10/2			3140-485 rd. ("rabbit ears mdw.")	3/0
	Pickle Prairie**	9/0			3160-326 rd. (Lime Ck.)	2/0
	1900-837 rd.*	7/1			Stewart Meadow (n)	1/0
	1205-738 rd. (s)*	5/0			1710-500 rd.	0/0
	Section 3 Lake*	4/1			1700-462 rd.	0/0
	1800/680 jct. (ne)*	4/0			Hwy. 31 border crossing	0/0
	1800 rd.	3/0		Colville N.F., Newport R.D.	2712 rd., Rufous Mdw.**	16/1
	1800/680 jct. (e)	1/0			1200-250 rd.**	8/0
	1205-738 rd. (n)	1/0			3116-015 rd.*	5/0

Field Unit	Site	FIT/notable spp. count		Field unit	Site	FIT/notable spp. count
	Twin Sisters Lakes	0/0			2712 rd. upper Ruby Ck.*	4/0
Okanogan-Wenatchee N.F., Tonasket R.D. (east)	Meyer's Ck. fen***	11/5			2700 rd., section 9	2/0
	3400 rd. (n)**	8/2			1921-055 rd.	2/0
	Hdws. Middle Fork Cedar Ck.**	8/3			2700-110 rd.	1/0
	Hdws. Box Ck.*	4/4			5030-166 rd.	1/0
	3400 rd. (s)*	3/0			3116-004 rd.	0/0
	3575-200 rd.	3/1		Colville N.F., Three Rivers R.D.	7018-600 rd.**	7/0
	3300-040 rd.	0/0			9500-585 rd.*	7/0
Okanogan-Wenatchee N.F., Tonasket R.D. (west)	Hdws. Sinlahekin Ck.***	17/10			9565-260 rd.	5/0
	Tiffany Meadows**	15/6			Little Twin Lakes, C4920 rd.	1/0
	Baldy Pass***	8/4			Elbow Lake	1/0
	Hdws. South Fork Twentymile Ck.**	6/3		Colville N.F., Republic R.D.	2149 rd.**	6/1
	Thunder Mountain*	4/1			Hall Creek Ponds, 2050-600 rd.**	5/0
Colville N.F., Sullivan Lake R.D.	Bunchgrass Meadows (main)***	24/5			South Fork O'Brien Creek**	4/3
	Halliday Fen***	14/6			5330-100 rd.	3/0
	Bunchgrass Meadows (w)**	17/2			Sherman Pass, State Hwy. 20	2/0

Discussion

Notes on rare species detected in the course of this project

Beginning in 2010, the project lead has had the opportunity to visit a wide variety of Washington wetlands that are wholly, or in part, predominantly wetted by groundwater. In the course of these visits, it has become apparent that collectively, these groundwater-fed wetlands, or fens, have a characteristic and distinct flora that often includes bryophytes that are either reportedly or apparently rare within the state. Presented below is an assemblage of site records for 13 of these bryophyte taxa. Information sources include:

1. USFS fen and associated rare plant inventories by the project lead (Dewey 2017, 2013, 2011, and this report)
2. Consortium of Pacific Northwest Herbaria (online)
3. Colville National Forest Bryophyte List (Ahlenslager 2015)
4. Okanogan County collections lists of Erica Heinlen
5. Olympic National Forest wetland bryophyte list developed following participation in an OLY NF ISSSSP wetland/rare plant field project in 2013 (Dewey 2013).

Evidence that these 13 bryophyte species are strongly associated with fens includes both the field observations of the project lead and those of Vitt (1988), who specifically refers to 10 of these species as fen associates. Because these species appear to be associated with a relatively well-defined and uncommon habitat type within the state, and because the project lead has conducted extensive botanical surveys in Washington focused on this habitat type, it is seems reasonable to presume that there is now sufficient data to defensibly assess the actual rarity of these bryophyte species within the state.

1. *Calliergon richardsonii* (CARI70). This moss is listed in neither the Washington Natural Heritage Program (WNHP) Rare Moss List (2012) (online) nor the 2015 R6 Regional Forester's Threatened, Endangered or Sensitive (R6 TES) (online) species list. There are currently seven documented sites in Washington, five of which were detected in the course of this ISSSSP project. The first modern Washington record for this species is on eastern Tonasket Ranger District in 2000. There is a single 1904 record from King County. This species is not included in Vitt (1988), but the five modern Washington records are all associated with fens. There is one documented CARI70 site in Oregon, where it occurs within a robust fen.

2. *Campylium stellatum* (CAST51). This moss is included in the WNHP Rare Moss List; its State Rank is not yet determined. CAST51 is not included in the 2015 R6 TES list. This species appears to have 14 Washington records, distributed on both sides of the Cascades crest and dating back to 1919. The species is known from perhaps 11 sites in Oregon, dating back to 1996.

3. *Hamatocaulis vernicosus* (HAVE70). This moss is listed in neither the WNHP Rare Moss List (2012) nor the 2015 R6 TES list for Washington. There are perhaps eight Washington records for this species, distributed on both sides of the Cascade crest. The earliest of these records dates to 1898.

4. *Harpanthus flotovianus* (HAFL9). Liverworts are not currently included in the WNHP species rarity ranking process. This species has perhaps a dozen Washington records with the oldest dating back to 1931, but most being post-2000. Although often found in wetland complexes that include clearly expressed fens, this species is not unambiguously a fen associate, although numerous field observations indicate that it is consistently associated with microsites with at least thin organic soil crust that is primarily dampened by groundwater through most or all of the snow-free season.

5. *Helodium* (*Elodium*) *blandowii* (HEBL2). This moss is WNHP S1 and 2015 R6 TES list WA STR. With at least 32 records detected, this species currently appears to be the most abundant of the presumed rare, fen-associated Washington bryophytes being reviewed here. These records represent both sides of the Cascades, excluding the Olympic Peninsula, and date to 1883. Because of its frequency of

occurrence and fidelity to groundwater-fed habitats, HEBL2 is perhaps the most useful bryophyte fen-indicator species in Washington.

Jeanmarie Wheeler (l) and Kelsey Middleton (r) assisting in fieldwork on Naches Ranger District, Okanogan-Wenatchee National Forest.

6. *Hypnum lindbergii* (HYLI70). This moss is listed in neither the WNHP Rare Moss List (2012) nor the 2015 R6 TES list for Washington. The species was added to the Oregon Biodiversity Information Center's (ORBIC) rare plants list as S1, List 3 in 8/2016. There appear to be at least seven Washington records for this species. Ten HYLI70 records are listed at the Consortium of Pacific Northwest Herbaria (CPNWH) website, but only five of these represent clearly distinct collection sites. The most recent CPNWH HYLI70 record is over 55 years old. Non-sexual material of HYLI70 is morphologically very similar to that of *Hypnum pratense* (HYPR70), and misidentification within this species pair is readily possible. Vitt (1988) regards both HYLI70 and HYPR70 as fen associates, although habitat descriptions available through the CPNWH website do not specifically reference groundwater-rich sites for HYLI70.

7. *Hypnum pratense* (HYPR70). This moss is listed in neither the WNHP Rare Moss List (2012) nor the 2015 R6 TES list for Washington. The species was added to the ORBIC rare plants list as S1, List 3 in 8/2016. There appear to be 12 Washington records for this species, all east of the Cascades crest, and none dating back further that 2000.

8. *Meesia triquetra* (METR70). This moss is WNHP S1 and 2015 R6 TES list WA STR. There appear to be 15 Washington records for this species, distributed on both sides of the Cascades crest. The seven records east of the crest are widely spread from the south-central to the far northeastern corner of the state. The remaining eight records are all within Skamania County, with the oldest of these dating to 1893. This small, but highly morphologically distinct moss has a very high fidelity to habitats with robust and persistent groundwater feed.

9. *Paludella squarrosa* (PASQ70). This moss is listed in neither the WNHP Rare Moss List (2012) nor the 2015 R6 TES list for Washington. PASQ70 is a higher latitude fen associate whose first Washington location was documented in 2000. An additional three Washington sites were detected during this project. All four Washington sites occur in Okanogan County on the Tonasket Ranger District of Okanogan-

Wenatchee National Forest. Like its close relative *Meesia triquetra*, PASQ70 presents a very striking and distinctive morphology.

The moss *Paludella squarrosa* at the Baldy Pass fen, western Tonasket Ranger District, Okanogan-Wenatchee National Forest.

10. *Scorpidium cossonii* (SCCO18). This moss is listed in neither the WNHP Rare Moss List (2012) nor the 2015 R6 TES list for Washington. It appears likely that there are nine Washington records for this moss, none dating back further that 2000. In his treatment of *Scorpidium* within the family Amblystegiaceae in the Bryophyte Flora of North America, Hedenäs (2000) (online) recognizes the three species *S. cossonii*, *S. revolvens* and *S. scorpioides*. All of these species are principally higher latitude species in North America, dipping into the contiguous U.S. in the Rockies and some northern and northeastern states. Existing nomenclature for the former two species can be confusing. The NRCS Plants Database and the WTU Herbarium prefer use of the generic name *Limprichtia* for Hedenäs' *Scorpidium cossonii* and *S. revolvens*. Further, the old but still much used Moss Flora of the Pacific Northwest (Lawton, 1968) and Vitt (1988) recognize the taxon *Drepanocladus revolvens*, which Hedenäs considers a synonym of the name *Scorpidium revolvens*. As treated by Hedenäs, sterile material of *Scorpidium cossonii* and *S. revolvens* is very similar, differing most reliably in the shape and length of certain stem leaf cells. Anyone using Lawton's key to *Drepanocladus* when attempting to identify material referable to *Scorpidium cossonii* by Hedenäs, would certainly identify that material as *Drepanocladus revolvens*. Prior to 2015 there were no records of *Scorpidium cossonii* (or *Limprichtia cossonii*) in Washington, but there are five recent records of *Drepanocladus revolvens* from Colville National Forest, all of which resulted from the collections and identifications of a single worker. An abundantly available moss resembling *Drepanocladus revolvens* was collected during a 2015 revisit to one of the five Colville NF record sites for this species. Using the Hedenäs key, this material was

identified as *Scorpdium cossonii* by both the project lead and by the regional bryophyte expert Dr. David Wagner. Additionally, collections of material resembling *Drepanocladus revolvens* were made at two sites on the western Tonasket Ranger District of Okanogan-Wenatchee NF in 2015, and again, both the project lead and David Wagner, using the Hedenäs descriptions, identified this material as *Scorpidium cossonii*. A 2013 collection from Methow RD on OKW NF was re-examined by the project lead in 2016 and identified as SCCO18; Wagner confirmed this identification. Hence, there are now four records of Scorpidium cossonii in Washington. Although original collections need to be reexamined, it seems likely that the remaining five Washington records of *Drepanocladus revolvens* (four on Colville NF, one on eastern Tonasket Ranger District) are now best referable to *Scorpidium cossonii*. Actual *Drepanocladus revolvens*, as a synonym of Hedenäs' *Scorpidium revolvens*, is apparently not yet recorded in Washington.

11. *Scorpidium scorpioides* (SCSC70). This moss is listed in neither the WNHP Rare Moss List (2012) nor the 2015 R6 TES list for Washington. There appear to be only two Washington records of this primarily boreal moss, the earliest of which dates to a 1970 collection in Pend Oreille County and a 2015 collection from western Tonasket Ranger District, Okanogan County.

12. *Splachum sphaericum* (SPSP70). This moss is listed in neither the WNHP Rare Moss List (2012) nor the 2015 R6 TES list for Washington. There appear to be only five modern Washington records. This moss may not have a high fidelity to groundwater-fed wetlands, as its dung substrate may simply need to sit atop persistently wet soil, regardless of water source. The 2013 site on Methow Ranger District and the 2015 site on western Tonasket Ranger District are both in Okanogan County and both located within robust fens. Likewise, the only two Oregon records (2014) of this species, are from robust, groundwater-fed wetlands.

These few shoots of *Tomentypnum nitens* appear to be the first record of this fen-loving moss at the Bunchgrass Meadows Research Natural Area, Sullivan Lake Ranger District, Colville National Forest.

13. *Tomentypnum nitens* (TONI70). This moss is on the WNHP Rare Moss List with State Rank not yet determined; the species has no status in the R6 TES list. There appear to be 21 Washington records for this species dating back to as early as 1901. All records are east of the Cascade crest and none further south than Fish Lake bog in Chelan County. The large majority of records are from Okanogan County. The relative rarity and restricted distribution of this moss within Washington is curious given the multiple dozens of sites of this moss east of the Cascade crest in Oregon, where it can be defensibly regarded as the single best fen-indicating plant taxon in the state.

Two other apparently rare, but not necessarily fen-associated mosses were encountered during this project.

1. *Thuidium recognitum* (THRE7). This moss is listed in neither the WNHP Rare Moss List (2012) nor the 2015 R6 TES list for Washington. THRE7 may have no more than nine Washington records. All three occurrences detected during this project were at the edges of groundwater-fed wetlands.

2. *Fissidens osmundioides* (FIOS70). This moss is WNHP S1, although it is not included in the R6 TES list. The species appears to have no more than six Washington records, the earliest of which date back to 1964. The two occurrences detected during this project were within groundwater-fed wetlands.

This project also resulted in new records for two rare Washington sedges.

1. *Carex tenuiflora* (CATE5). This sedge is WNHP S1 and R6 TES WA SEN. Prior to this project, CATE5 was known in Washington from a single, predominantly groundwater-fed wetland in Okanogan County on eastern Tonasket Ranger District. This project added two new records, one in Okanogan County on the western Tonasket Ranger District, and another in Ferry County on Republic Ranger District, Colville National Forest. The latter is the first record of this species on Colville NF. The new site on western Tonasket Ranger District includes dozens of plants within a large, biodiverse, robustly groundwater-fed wetland. The Republic Ranger District site occurs within a fen-like plant community on wet peat apparently situated above an over-topped pond.

2. *Carex magellanica* ssp. *irrigua* (CAMA12). This sedge is WNHP S2/S3 and R6 TES WA SEN. According to Wilson et al., (2008), CAMA12 is distributed across all of far northern Washington. The one new site detected during this project is a co-occurrence with *Carex tenuiflora* in the western Tonasket Ranger District wetland described above.

Defining fens

There is no consensus concerning the definition of a fen. There is universal agreement that fens are wetlands predominantly wetted by groundwater, with many authors referring to fens as a type of peatland (Warner and Rubec, 1997; MacKenzie and Moran, 2004; Cooper and Wolf, 2006; USDI USFWS, 1999). The composition and thickness of peat that characterizes a peatland is generally not standardized, or even described. The USFWS (USDI USFWS, 1999) recommends that a fen definition include soil character and that, specifically, fen soil needs to meet the USDA Natural Resources Conservation Service definition of a Histosol or Histic epipedon. Multiple qualifying criteria allow Histosols to have an organic layer of

indefinite thickness, as long as that organic layer constitutes at least two-thirds of the total soil thickness above a "densic, lithic or para lithic contact and have no mineral horizons or have mineral horizons with a total thickness of 10 cm or less." Hence, according to the USFWS, fens need not necessarily have thick organic soils. Alternatively, other authors have proposed defining fens without consideration of soil character, but instead, *simply define fens as predominantly groundwater-fed wetlands* (Bedford and Godwin, 2003), *or groundwater-fed wetlands dominated by mosses, sedges, and sedge relatives* (Hájek et al., 2006). These authors have extensive experience with lower latitude wetlands (contiguous U.S., central Europe) that exhibit the hydrology and vegetation of fens, but lack the prominent organic soils typically associated with boreal fens. Soil probes in Oregon and Washington groundwater-fed wetlands (GFW) demonstrate that these sites are typically associated with peaty soils, but these peaty layers may be thin or barely existent. GFW with thick organic soils generally appear to include a larger diversity of fen-loving plant species, but even GFW with thin organic soils may support rare fen-loving species. For this reason, the project lead favors use of the Bedford-Hajek fen definitions for conservation-minded management of USFS lands in R6.

The roundleaf sundew (*Drosera rotundifolia*) at Rufus Meadows, Newport Ranger District, Colville National Forest.

Recognizing fens in the field

Efforts at fen recognition in the field sometimes result in an uncertain assessment, and generally require considering multiple lines of evidence including hydrology, site wetness, topography, plant community structure and composition and soil character. Although fens may occupy mid-slope locations, sites in valley bottoms or along toe slopes are particularly well-situated to intercept groundwater flow from adjacent slopes. Side slope and toe slope fens are generally the least ambiguous. Valley bottom fens can be challenging to assess largely due to issues with hydrologic interpretation. Favorable topography and soppy soil late in the summer are especially suggestive. If possible, it is very helpful to assess site

wetness in late summer. Many fen candidate sites have wet soil in the spring or early summer due to direct, on-site wetting by rain or snow-melt and/or due to surface transport and delivery of rain and melt-waters by laminar or channeled flow, or even seasonal groundwater discharge. In late summer, high water tables are most likely due to proximity to lakes, perennial streams, or to a groundwater aquifer perennially at or near the soil surface. To the unpracticed eye, and particularly in valley bottoms and other low-relief settings, fens can be difficult to recognize because the general character of their vegetation may cause them to very much resemble the primarily surface water-wetted open or shrubby meadows with which they are often associated.

The project lead is most familiar with groundwater as a shallowly subsurface mass, or a shallow discharged layer upon saturated soil, which are *moving* along a topographic gradient, however slight. It has recently become evident that largely stationary subsurface water may also necessarily be regarded at the primary water source for fens. This can occur when characteristic fen vegetation is either actively overtopping a pond or, apparently, has recently completed the overtopping of a pond. The former has been seen at Duck Lake on the Hells Canyon RD of Wallowa-Whitman NF, Fish Lake Bog on the Wenatchee River RD on Okanogan-Wenatchee NF, and Hall Creek Ponds on the Republic RD of Colville NF. Fen vegetation on peat completely overtopping a pond appears to be present at Pickle Prairie on Naches RD, Okanogan-Wenatchee NF, and at the 2149 rd. wetland on the Republic RD, Colville NF. In each of the cases referenced above, there appears to be no reason to suppose that these ponds represent perched water tables, as would be necessary to regard the overlying wetlands as bogs. Finally, vegetation and especially, the presence, abundance and diversity of fen indicator taxa, is also an important guide in the recognition of fens.

The northland botanists Erica Heinlen (Tonasket Ranger District, Okanogan-Wenatchee National Forest) left, and Amy Cabral (Colville National Forest) right, introduced the project lead to several high quality fen/wetland complexes.

Fen indicator taxa

These are taxa that the project lead has consistently detected within fens, especially short-statured fen communities, during his visits to fen candidate sites across multiple national forests within the Pacific Northwest (Appendix D). This list, which is admittedly subjective and always open to edits, seems to be

largely applicable across the Cascadian national forests visited to date, although the incidence of certain species can change geographically. For instance, *Eleocharis quinqueflora*, *Carex jonesii*, *Vaccinium uliginosum* and the mosses *Tomentypnum nitens* and *Meesia triquetra* are more frequently encountered in the Cascadian fens of Oregon than those of Washington. Conversely, *Salix pedicellaris*, *Vaccinium oxycoccos*, *Eriophorum* species and the mosses *Campylium stellatum* and *Calliergon* species appear to be better represented in fens of the Washington Cascades than those of Oregon. Notably, several taxa on this list (*Scheuchzeria palustris* ssp. *americana*, *Drosera rotundifolia*, *Triantha glutinosa*, *Vaccinium oxycoccos* and *Vaccinium uliginosum* appear to be scarcely present or lacking in fens in of the NE Oregon National Forests. The distributions of several boreal fen-loving taxa reach south to far northern Washington but apparently, not, or scarcely, beyond. Included in this set are the sedges *Carex tenuiflora* and *Carex magellanica* var. *irrigua*, and the mosses *Paludella squarrosa*, *Scorpidium cossonii*, *Scorpidium scorpioides* and *Splachnum sphaericum*. These appear to be good fen indicating taxa, but of limited geographic application in Washington and Oregon.

Vegetation and fen description

The project lead has found that a comprehensive plant species list with an emphasis on fen indicator taxa is the most economical means of gathering useful, vegetation-based descriptive information during a fen visit. These lists provide insight concerning biodiversity as well as the range of physical-chemical conditions within a site. However, multiple other uses of vegetation to describe fens exist.

Water chemistry and fen vegetation. Discussions of the relationship between pH and plant community composition appear to be very common in fen literature. It is in this context that "poor fen"-"rich fen" gradient is generally discussed.

Plant associations. Although likely sometimes undertaken without regard to wetland classification, per se, description of wetland plant associations has been undertaken over much of Oregon and Washington. Based on physical site descriptions, or more importantly, plant association names (e.g., *Eleocharis quinqueflora*/*Vaccinium uliginosum* plant association), it is evident that numerous plant associations have been recognized within the fens of Oregon and Washington. Fen plant association description has the potential to be particularly informative if associated physical data (e.g., wetness, soil character, nutrient availability, and pH) is simultaneously collected.

Vegetation structure. Coarse classes of fen vegetation structure can be rather easily described. The project lead finds it convenient to use the categories of *short-statured*, *tall sedge*, *shrub*, and *forested* when recording field notes. Of course, these structural types can, and frequently do, intergrade. These structural types are briefly described below.

Short-statured fen communities are characterized by persistently high water tables, high diversity of graminoids, forbs and bryophytes, and low stature of the vegetation. Height of vegetation in these communities is typically 12-16" or less, even while some included species are generally much taller outside of this community (e.g., *Carex aquatilis*, *Carex utriculata*, *Betula glandulosa*, *Kalmia microphylla*, and several *Vaccinium* and *Salix* species). This is the structural community type in which rare and uncommon vascular and nonvascular plant species, including sensitive species, are most likely to

be found. Few-flowered spikerush (*Eleocharis quinqueflora*) is frequently either dominant or abundant among the vascular plants in this community. This is also the basic fen community type that includes the "brown mosses" which typify *rich* and *extremely rich* fens (Hájek et al., 2006; Bedford and Godwin, 2003); examples of brown mosses include species of *Tomentypnum*, *Hamatocaulis*, *Drepanocladus*, *Warnstorfia*, *Calliergon*, *Calliergonella*, *Campylium* and *Scorpidium*. The short-statured fen community appears to be the type of fen community to which Bedford and Godwin (2003) refer in noting that low nutrient availability may underlie "the low stature, distinctive flora, and high species diversity of some rich fen vegetation." This is also the basic fen community type from which most of the project lead's fen indicator species set is drawn.

Fruits of rannoch-rush (*Scheuchzeria palustris* ssp. *americana*) at Pickle Prairie (l) and sticky tofieldia (*Triantha glutinosa*) at Section 3 Lake wetland (r), Naches Ranger District, Okanogan-Wenatchee National Forest.

Tall sedge fen communities generally have low species diversity, little moss or forb ground cover, and are often dominated by 30-48" tall *Carex aquatilis* and/or *Carex utriculata*. It currently appears that the soil surface in tall-sedge fen communities is commonly saturated or inundated early in the growing season, but becomes damp, moist or even dry by late summer.

Shrub fen communities are often intermediate between short-statured and tall sedge fen communities with regard to species diversity, and likely include a patchy cover of graminoids, forbs and mosses. High early-season water tables commonly dip down towards the end of the growing season, but perhaps not so much as within tall sedge communities. In the Oregon Cascades, *Vaccinium uliginosum* (bog huckleberry) is perhaps the most frequent and abundant species within shrub communities, but is often accompanied by *Betula glandulosa*, *Kalmia microphylla* and various *Salix* species. In Washington, fen shrubs are likely to include *Vaccinium*, *Ledum*, *Betula*, *Salix*, *Alnus* and *Spiraea*.

Forested fen communities appear to be uncommon within the forests visited to date by the project lead. These generally are areas that, in viewing aerial imagery, have more the character of forest than of meadow. On the ground, however, the wetland character of the site is evident. Persistent groundwater-fed wetness and a moderate level of species diversity (shrubs, graminoids, forbs and bryophytes) may be

typical of forested fens. Lodgepole pine (*Pinus contorta*) and/or Engelmann spruce (*Picea engelmannii*) are most commonly present but a variety of other conifer species may be represented as well.

Biogeography of fen indicator taxa

The OR-WA fen indicator taxa recognized by the project lead are largely higher latitude, boreal taxa. North American distributions of 12 of these taxa that are generally representative of the group are illustrated in Appendix E (species maps from NRCS Plants Database). It's evident from Appendix E that the distributions of the fen indicator taxa have one or more southward extensions into decidedly non-boreal latitudes. For the most part, these southward distributional extensions are possible due to the presence of mountains (e.g., in the western US, the Cascades, Sierra Nevada, Ochoco, Blue and Wallowa Mountains, Kettle River Range, Selkirk Mountains and the Rockies). This seems to be simply another case of the long-standing observation that, at lower latitudes, sites at higher elevations can be climatically similar to sites at higher latitudes. Hence, while at higher latitudes these OR-WA fen indicator species are components of *boreal fen communities*, in Oregon and Washington, these same species are components of *montane fen communities*. But while the presence of mountains makes the presence of the OR-WA fen communities possible, it is the presence of particular, coincident topographic, geologic and hydrologic features that seem to dictate the distribution of suitable montane fen habitats. Along the Cascade crest and east, this coincidence of fen-enabling features among R6 forests is generally uncommon at best.

Slender cottongrass (*Eriophorum gracile*) at Meyer's Creek fen/wetland complex, eastern Tonasket Ranger District, Okanogan-Wenatchee National Forest.

Particularly notable sites – Naches Ranger District

1204-755 rd. (Pinegrass Ridge fen). This is the most outstanding groundwater-fed wetland encountered during project-related surveys on the Naches District. It is relatively large, has a highly robust and persistent groundwater feed, and supports the largest number of both fen indicator taxa (16) and rare fen-loving bryophytes (3) of any Naches Ranger District site visited during this project. This site merits immediate management assessment as the wetland is being *heavily* impacted by current grazing practices.

Particularly notable sites – western Tonasket Ranger District

Wetland complexes along the 39-37 road corridor. These fen-including wetland complexes, including those at Headwaters of Sinlahekin Creek, Tiffany Meadows, and Baldy Pass are remarkable in their inclusion of multiple habitat types, their hydrological complexity, and large number of rare, fen-loving plants, particularly, bryophytes. The former two sites are particularly notable for their high numbers of detected fen indicator taxa and notable (rare) species (Sinlahekin Creek = 17/10; Tiffany Meadows = 15/6).

Particularly notable sites- Colville National Forest.

South Fork O'Brien Creek and 2149 rd. wetlands. These are very different wetlands. The South Fork O'Brien Creek wetland is a smallish reach of valley bottom where rare, fen-loving bryophytes are supported by robust, persistent groundwater discharge. The 2149 rd. wetland sits at a topographic saddle within a valley bottom. Much of the soil of this long wetland is damp or wet deep peat, but the water source for this soil moisture is not evident. A short-statured fen community in the broad central portion of this wetland overlies deep peat that appears to have overtopped a now buried, but still water-bearing pond. The first Colville NF record of a very rare, fen-loving sedge *Carex tenuiflora* is now documented here. Cattle are causing conspicuous impact to soil condition around the edges of this wetland, but hoof impacts are currently only lightly evident within the short-statured fen community. These physically very different wetlands each support fen plant communities that include rare plants. Their occurrence on western Colville NF, which is not locally regarded as promising fen habitat, strongly suggests that this part of the Forest warrants additional inventory for these special habitats.

Bunchgrass Meadows complex. This is a very large wetland/meadow system that has been included within the Bunchgrass Meadows Research Natural Area. The main contiguous wetland/meadow within this complex - "Bunchgrass Meadows (main)" - in this report, supports the largest number of fen indicator taxa detected (24) at any site visited during this project, including sites on the Naches and Tonasket Ranger Districts. The western extent of the Bunchgrass Meadows wetland/meadow complex, in this report referred to as "Bunchgrass Meadows (w)", is itself a very biodiverse ecosystem with 17 detected fen indicator taxa and now the first Colville National Forest record for the very rare fen-loving moss *Calliergon richardsonii*.

Stewart Meadow (s). A sizeable portion of this smallish wetland/meadow is unambiguous sloping fen featuring a moderately high number (15) of detected fen indicator taxa. Along with the Bunchgrass Meadows complex and the Halliday Fen, Stewart Meadow (s) is included in the most species-rich

groundwater-fed sites visited on Colville National Forest during this project. Stewart Meadow (s) is particularly notable in the fact that it is currently open to cattle, and its current management direction needs to be re-assessed.

Fens as unique ecosystems

Some familiarity with fens and fen-like ecosystems should cause hesitation in accepting their inclusion as "riparian" landscape features. The species composition of plant communities included within fen ecosystems is largely distinct among plant communities across the R6 forests visited to date by the project lead. With some notable exceptions (e.g., overtopped ponds and lakes) this distinctness appears to be very much tied to the community water source being primarily *nutrient-poor groundwater*, near the source of its initial, diffuse, surface/near surface discharge. The project lead's current concept is that fen ecosystems may or may not contribute surface water output to riparian systems, but they do not receive significant amounts of water and nutrients from these systems. A meadow that is regularly wetted by relatively *nutrient-enriched, surface-sourced* riparian water – often by means of seasonal or episodic channel flooding - will not support the plant communities associated with fens and fen-like ecosystems (Bedford and Godwin, 2003). With this view, the project lead would offer that fens are not just wet "riparian" habitats that may support notable numbers of rare or uncommon plant species, but are themselves biophysically distinct, variously rare or uncommon *groundwater-supported ecosystems* that in their own right, merit recognition and appropriate restorative or protective management.

Looking south from the far north end of the very interesting 2149 road wetland on the Republic Ranger District, Colville National Forest. The far south end of this long wetland supports the Forest's only known population of the rare sedge *Carex tenuiflora*. Impacts of visiting cattle conspicuously evident in the foreground.

High value fens

Resources for managing/conserving groundwater-fed wetlands on public land will likely always be constraining. An ability to prioritize use of resources available for fen conservation is a necessity. In concept, identifying "high value" fens will be an important component, along with risk/threat assessment, of fen conservation efforts. While clearly a somewhat subjective matter, the project lead would recommend consideration of a set of factors such as total **amount** of groundwater-fed habitat, **volume and persistence** of groundwater discharge, and **abundance and diversity** of fen indicator taxa and rare and uncommon fen-loving plant species in identifying high value fens/groundwater-fed wetlands. Table 4 in this report is an effort to rank sites visited during this project according to these factors.

Follow-up recommendations

Naches Ranger District

1. Perform a multi-disciplinary condition assessment at the 1204-755 rd. wetland complex. In the project lead's professional opinion, the current grazing practices at this site are in great need of redress.
2. Find opportunities to incrementally enlarge the District-level fen inventory initiated with this project.

Tonasket Ranger District

Find opportunities to incrementally enlarge the fen inventory initiated in the western portion of the District with this project; there is much promising habitat yet to explore.

Colville National Forest

1. Initiate monitoring and continue discussion of management options at South Fork O'Brien Creek and 21449 rd. wetlands on Republic Ranger District.
2. Conduct condition assessment of Stewart Meadow (s) and consider means of reducing or eliminating grazing impacts at this site.
3. Perform a multi-disciplinary condition assessment of the 7018-600 rd. wetland on Three Rivers Ranger District. This site warrants a discussion of restoration opportunities.

All field units

As part of a continuing effort to promote awareness and conservation of rare, high value, groundwater-fed wetlands, and the rare and uncommon plant species included within them, the project lead would invite consideration of the following specific recommendations.

1. Because of a) the presence of persistently wet, generally peaty soils, b) the high susceptibility of these soils to habitat damaging alteration due to livestock use, and c) the general rarity of fen ecosystems on the Forest, fens should be regarded as *unsuitable* for livestock grazing. Accordingly, livestock presence (grazing, bedding, transit) in fens should be regarded as inappropriate and unauthorized.
2. The Forests need to develop or adopt a protocol for the identification and condition assessment of groundwater-fed wetlands (fens). This protocol should include at least the following components:
    a. A pre-field Forest-wide systematic analysis aimed at identifying potential fen sites.
    b. Conduct brief visits to candidate fen sites in order to i) identify sites that actually include fen habitat and ii) economically describe the character and condition of detected fen habitats,

permitting both an assessment and ranking of sites that include high value fens. It would be highly desirable to complete this initial Forest-wide inventory in a matter of years, rather than decades. This ISSSSP-funded project can be considered a good start in this direction.

c. Return visits to selected sites for more detailed data collection may be desirable to better inform site management recommendations.

d. Protection/restoration prescriptions will need to be prepared and implemented for high value fens determined to be negatively impacted by livestock use or other management activities.

3. Please review USDI USFWS (1999). Although this document embraces a traditional fen definition that includes soil properties, it is notable in presenting the rationale and direction for the protection of fens in Region 6 of USFWS.

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Appendix A

Target species and notable species with sites that were newly detected during the course of this project. "Target species" are 1) species with status as sensitive or strategic species, are 2) listed on the Washington Natural Heritage Program (WNHP) Rare Mosses list, or, 3) prior to project initiation, were identified by the project lead as possibly rare in Washington, even if previously unnoted as such by WNHP. "Notable species" are those, during the course of project fieldwork, were identified by the project lead as possibly rare in Washington, even if previously unnoted as such by WNHP. In the table below, "VP" indicates vascular plant; "B" denotes a bryophyte species.

Target species		**Notable species**
Carex magellanica ssp. *irrigua* (VP)		*Fissidens osmundioides* (B)
Carex tenuiflora (VP)		*Hypnum pratense* (B)
Calliergon richardsonii (B)		*Paludella squarrosa* (B)
Campylium stellatum (B)		*Scorpidium cossonii* (B)
Hamatocaulis vernicosus (B)		*Scorpidium scorpioides* (B)
Harpanthus flotovianus (B)		*Splachnum sphaericum* (B)
Helodium (*Elodium*) *blandowii* (B)		*Thuidium recognitum* (B)
Meesia triquetra (B)		
Tomentypnum nitens (B)		

Appendix B

Site descriptions for 2015 Naches-Tonasket-Colville ISSSSP project. Fen indicator taxa in bold. Species codes follow the PLANTS database (USDA, NRCS 2017).

Naches Ranger District, Okanogan-Wenatchee NF

1. Pickle Prairie
Elevation: 4300 feet
TRS: T13N, R14E, S15
Date: 7/7/2015
Rationale: Naches staff recommendation; NWI PEMC
Plants: Graminoids – CACA11, CAUT, **ELQU2**, **ERAN6**, **CASI2**
Forbs - **SCPAA3**, **METR3**, SPARG, EQUIS, EPBR3, **SPRO**, VERAT
Shrubs – SALIX, ALIN2, **VAUL**, LEDUM
Bryophytes – **SPHAG2**, DRCA12, **CAST70**
Soil probes: At SE portion, and central quaking central portion of SE corner of larger, irregularly shaped, interconnected meadow system, pure organic soil to 60+"; low density, especially in the quaking portion.
Notes: Only the eastern half of this irregularly shaped meadow-wetland was explored. The northern portion of this eastern half is seasonally wet meadow with soil too firm to be penetrated by soil probe. Much of the southern portion of this eastern half is soppy wet. Two soil probes here detected low-density peat greater than 60" deep. The west-central portion of this eastern half supports a short-statured fen community, some of which sits atop quaking peat which offers virtually no resistance to passage of the soil probe. The soil probe behavior here suggests that peat may be overtopping water at this location. The source of water creating soppiness in the southern portion of the eastern half of this meadow-wetland is not strongly evident. Because no routes of intermittent flow were detected entering this portion of the meadow-wetland, it appears likely that groundwater discharge accounts for a significant, if not primary source of wetness within the SE portion of this meadow-wetland. Notably, a moderate number of fen indicator taxa were detected within the soppy portion of this meadow wetland, which due to its flora and apparent hydrology, is probably best identified as a fen. NAIP shows apparently similar meadow-wetlands in vicinity but these not visited.
Photos: #s2562, 2563, 2564, 2565.

2. 1205-738 rd. (n)
Elevation: 4400 feet
TRS: T13N, R13E, S17
Date: 7/7/2015
Rationale: NWI PEMC
Plants: Graminoids – CAUT, **CAJO**, CACA11, JUBA
Bryophytes – MAPO16, BRPS70
Soil probe: None undertaken
Notes: Shaded riparian zone along southern edge of meadow. This is apparently a seasonally wet meadow, with mostly dry soil at the time of visit. No mosses observed outside of the riparian zone.

3. 1205-738 rd. (s)
Elevation: 4500 feet
TRS: T13N, R13E, S17
Date: 7/7/2015
Rationale: NWI PEMC
Plants: Graminoids – **ELQU2**, **CAUT**, **CAJO**, **CAAQ**
Bryophytes – **DRAD2**
Soil probe: in SE portion of meadow, organic soil to firm base at 40".
Notes: SE portion of this meadow-wetland is a squishy-wet, shrub-less, ELQU2-sedge-dominated wetland that is apparently, but not obviously, primarily wetted by groundwater. Depth of organic soil indicates that this hydrology has been in place for many centuries. Appears appropriate to refer to the SE portion of this meadow-wetland as fen. Meadow-wetland progressively less wet towards it northern end. Smaller, "y-shaped" meadow, not mapped in NWI, is a seasonally wet meadow with some grasses. Whitebark pine encountered between meadows and 738 spur at 634818, 5163867, NAD 83.

4. 1204-755 rd. /Pinegrass Ridge wetland complex.
Elevation: 4944-4997 feet
TRS: T13N, R13S, S30
Date: 7/7/2015, 9/1/2015
Rationale: NWI PEMC
Plants: Graminoids – **ELQU2**, **ERGR8**, CAUT, **CAJO**, CACA11, **CAAQ**
Forbs – **PLDI3**, **PEGR2**, EQAR, **TRGL5**, **SAOR2**, EPILO, **HYAN2**, POOC2, **MIPR**
Shrubs – **VAUL**, SALIX
Bryophytes – **SPHAG2**, PHFO6, **HAVE70**, **CACU18**, **METR70**, **HEBL2**
Soil probe: In the four probes made in the soppy-wet western 1/3 of the main wetland, thickness of organic layer ranged from 14" at the far eastern edge of the soppy zone, to 52". In the two probes made in the detached, smaller wetland shortly to the south of the main wetland, thickness of the organic layer ranged from 44" to 52+".
Notes: It's hard to imagine that a more physically robust or biologically diverse wetland-fen exists on the Naches R.D. The main wetland consists of a primary, elongated portion with an E-W axis, with two shorter northern lobes. While ELQU2 and VAUL are abundant in the relatively flat eastern 2/3 of the main wetland-fen, only the western 1/3 of the wetland-fen is easily declarable as soppy-wet sloping fen. All 17 of the fen indicator taxa, including two target moss taxa, detected in this wetland-fen complex are found within this sloping fen ecosystem. A separate, smaller, soppy-wet sloping fen occurs shortly to the south, separated from the western portion of the main wetland-fen by less than 100 m of forested wetland, that itself, seems appropriately regarded as forested fen. All fens appear to be wetted by a groundwater feeding into the wetlands from the west. Both sloping fens are extensively and intensively pitted by hooves of cattle. **Both of these fens urgently need immediate and permanent relief from use by livestock.**
Photos: #s 2566-2569, 2570, 2571-2572, 2754, 2755-2756, 2757-2758, 2759, 2760, 2761-2764.

5. 1900-837 rd.
Elevation: 4400 feet
TRS: T18N, R11E, S12
Date: 7/8/2015
Rationale: NWI PEMC
Plants: Graminoids – CAUT, SCMI2, CANE6, CACA11, CASC12, **CAEC**, CALU7, **CAJO**
Forbs – **PLDI3**, NUPHA, VIOLA
Shrubs – SALIX
Bryophytes – AUPA70, **SPHAG2**, PHFO6, **DRAD2**, **HEBL2**, MAPO16, BRPS70, **PLEL2,** CACO70
Soil probe: Probes on opposite sides of this wetland found soil with high organic content and complex layering, with no inorganic base layer reached at 52+".
Notes: Damp-wet soil commonly encountered in this relatively flat, valley-bottom wetland; one smallish soppy-wet area along upper western edge of wetland; this was the strongest expression of fen-like habitat observed within the wetland. Sphagnum is the dominant moss within the wetland, but much bare soil occurs as well; much of the moss cover within the wetland was not in contact with a direct or capillary water source and straw-colored or largely bleached of color. The thickness of apparent organic soil within this wetland suggests a long history of persistent wetness, but the source of this wetness is not obvious. The forest/wetland interface around the perimeter of the wetland presents little evidence of groundwater discharge. The large number of small seasonal channels entering the wetland from adjacent uplands and the abundance of *Scirpus microcarpus*, suggest that seasonal input of surface water from adjacent uplands is this wetland's primary water source. The modest count of fen indicator taxa indicates that seasonal groundwater discharge may be a smaller, but significant water source for portions of the wetland.
Photos: #s 2573, 2575, 2576, 2577.

6. 1800 rd.
Elevation: 3800 feet
TRS: T16N, R12E, S33
Date: 7/9/2015
Rationale: NWI PEMC
Plants: Graminoids – CAUT, JUBA, CABU6, **CAEC**, CAVE6
Forbs – POTAM, NUPHA, **UTMI**, DUAR3
Shrubs – SPDO, VAUL, SALIX
Bryophytes – **SPHAG2**, AUPA70, DRCA12, CACO70
Soil probe: Single probe shortly into south-central portion of wetland found organic soil with notable inorganic component to firm base at 48".
Notes: Most of wetland bare of mosses and forbs and otherwise presenting strong evidence of seasonal inundation. Eastern half of wetland with shallow water and emergent or aquatic vegetation. Western half of wetland a bit less wet, with more CAVE and less DUAR3. Southwest and northwest corners showing less evidence of seasonal inundation, and the only portion or wetland in which mosses, CAEC, CABU6 and VAUL were detected.
Photos: #2578

7. Conrad Meadows
Elevation: 4100 feet
TRS: T12N, R12E, S23/26
Date: 8/31/2015
Rationale: Staff recommendation; NWI PEMC
Plants: Graminoids – CAUT, JUBA, **JUEN**, **ELQU2**, CACU5, **ERAN6**
Forbs – **HYAN2**, **MIPR**, **PEGR2**, VERON, MIGU, POOC2, GEMA4, VIOLA
Shrubs – SALIX, VACCI
Bryophytes – **PLEL2**, MAPO16, **HEBL2**, PHFO6, AUPA70, **HYPR70**, **CACU18**
Soil probes: Three probes spanning the length of the main meadow found an organic soil ranging from 44" thick (with intermixed sand) in the northern portion of meadow, to 52+" thick in the southern part of the meadow. A single probe in the detached wetland on the east side of the creek found organic soil 52+" thick.
Notes: This is a sprawling groundwater-rich wetland system consisting of a long (1000+m) main meadow occupying a moderate, SE aspect slope situated above an often wide, meandering perennial creek, and an adjacent, detached, much smaller, very low-relief wetland on the eastern side of the creek. The main meadow features numerous small areas of seasonal groundwater discharge, and multiple areas of persistent groundwater discharge, with HEBL2 occupying at least five of these persistently groundwater-wetted areas. A GIS ownership layer indicates that this main meadow is primarily in private ownership. The detached wetland on the eastern side of the perennial creek, which is fully in USFS ownership, appears to occupy the single largest area of persistent groundwater discharge within the wetland system, with robust groundwater discharge occurring all along the NE quadrant of its perimeter. This wetland has a small, apparently perennial surface outflow into the adjacent perennial creek. The entire wetland complex, on both sides of the river is intensively grazed by cattle, as is evident in the extensive occurrence of hoof pits and mini-pedestals.
Photos: #s 2738-2741, 2742-2743, 2744-2745, 2746.

8. Section 3 lake
Elevation: 6000 feet
TRS: T12N, R12E, S3/4
Date: 9/1/2015
Rationale: NWI PEMC
Plants: Graminoids – CASC12, PHLEU, **ELQU2**, CANI2
Forbs – SPARG, ASTER, TRGL5, **HYAN2**, **PEGR2**, VERAT, GENTI
Shrubs – **KAMI**, LUPE, PHYLL3, CASSI3, VACCI
Bryophytes – PHFO6, AUPA70, BRFR70, MAPO16, SCIR, SAUN8, HAFL9, CAFI12
Soil probes: Several probes on the groundwater-wetted slopebreak shortly east of the south meadow's main pond found 14-20" of sandy-organic over a firm base.
Notes: This site features two meadows. 1) The meadow immediately south of the end of the 1204 road includes two ponds and a groundwater-wetted slope break immediately east of the east-most and largest of the two ponds. The primary source of water for the two ponds, the surrounding meadow, and the slopebreak appears to be groundwater moving into the meadow from the west. The groundwater water table appears to have dropped markedly from its presumed early season high. The water level in the lower, east-most, larger pond was very low at the time of visit. The upper pond was dry. Each pond has a

distinctive, sharply recessed margin. The rather small, east-aspect slope break is the only portion of the meadow that has fen-like hydrology and vegetation; flowering ELQU2 occurs here. A small spring mound sits at the top of this slopebreak. 2) The second meadow is actually a meadow-system situated west and northwest of the end of the 1204 road. The main, lower meadow of this system slopes downward both to the east and north. Soil dampness within this meadow is primarily associated with meandering spring creeklets, one of which enters the meadow from the forested southern edge of the meadow. Upslope and to the west of the main meadow is a pair of smaller, steeper-sloped, loosely connected meadows seasonally wetted by diffuse groundwater discharge. Each meadow was no more than moist at the time of visit; the upper meadow supports the groundwater-loving ELQU2.
Photos: #s 2747-2748, 2749, 2750, 2751, 2752, 2753.

9. Twin Sisters Lakes
Elevation: 5050 feet
TRS: T14N, R11E, S2
Date: 9/2/2015
Rationale: NWI PEMC in area; much NWI PUBH indicating standing water.
Plants: No species typically associated with fens, or fen-like ecosystems, detected.
Soil probes: Soil consistently very dense, +/- not penetrable with rod.
Notes: Very interesting landscape. Generally with very low relief, but with many swales and low rises. Much moss cover by *Polytrichum*. Evidence of collection movement of large amounts of surface water; would speculate that precipitation tends to collect on surface of landscape and move wherever gentle topographic gradient directs. Dry pond basins common, these typically with sharply recessed margins. Large, sharp-edged rocks lining water courses and these rocks apparently just below soil surface elsewhere. No evidence of groundwater discharge anywhere.

10. Shortly east of the 1800/680 junction (Bumping Lake area)
Elevation: 3500 feet
TRS: T16N, R12E, S26
Date: 9/2/2015
Rationale: NWI PEMC
Plants: Graminoids – CARE4, CABU6, **CAEC**, CAVE6, SCIRP
Forbs – EQUIS
Shrubs – VACCI
Bryophytes – AUPA70
Soil probe: A probe +/- centrally located in northern third of meadow found 52+" organic soil with a minor component of sand.
Notes: This site is a very flat, sedge-bulrush dominated, apparent filled-in lakebed. Soil surface is mostly bare peat with a whitish, drying, flakey crust that lacks both mosses and forbs; seasonal inundation is indicated. No evidence of groundwater input; seems likely that primary water source for this wetland is seasonal surface water input, both channeled and diffuse.
Photos: #s 2765-2766

11. Shortly northeast of the 1800/680 junction (Bumping Lake area)
Elevation: 3500 feet
TRS: T16N, R12E, S26
Date: 9/2/2015 & 9/3/2015
Rationale: NWI PEMC
Plants: Graminoids – **JUEN**, CAUT, **CAAQ**, CAVE6
Forbs – ASTER, EQUIS, ATHYR, LYAM3
Shrubs – LEDUM, ALNUS
Bryophytes – AUPA70, **SPHAG2**, RHIZO2, **WAEX**
Soil probes: Five probes beginning at mid-valley bottom and extending into open woods and then progressively more dense woods to eastern edge of valley bottom. The first four probes detected low-density organic soil to 52+". The east-most probe found organic soil atop a firm base at 52".
Notes: This site features a relatively broad sedge and grass valley bottom with relatively flat terrain upslope on its west side and an abrupt, steep slope and ridge on its east side. It is situated only about 400 m up-channel from the site described immediately above (shortly east of the 1800/680 junction). An active, low-volume, centrally located creek meanders through this site. Vegetation of the eastern side of the valley bottom transitions from herb-dominated meadow to open and then closed *Alnus* and *Thuja plicata* woods. Thick mats of the brown moss WAEX are common in the eastern side of the valley bottom. A smaller, low-volume creek runs along the far eastern edge of this valley bottom. Valley bottom soils are generally wet, with wetness increasing with travel from the valley's western edge to its eastern edge. Source of this general wetness is not altogether obvious. The western portion of the valley bottom may be largely wetted by lateral subsurface movement of water out of the active channel. It appears likely that the eastern portion of the valley bottom is primarily wetted by groundwater discharge from the base of the steep slope abruptly rising from the valley's eastern edge. This is quite an interesting site in that, while it seems appropriate to refer to the landform as valley bottom, it is very gently sloped both along the channel axis and in cross-section. Surface waters may once have been an erosive force in this valley, but apparently not so much at present. The apparent presence of deep (4 feet+) peat across this valley bottom, and the presence of active, low-volume water channels embedded in this peat, suggests that all water within this valley bottom is derived either from direct or very proximately discharge groundwater. Accordingly, it is reasonable to suspect that the active surface channels within this valley bottom flow at a relatively steady rate, and are not prone to seasonal, or perhaps, even episodic flooding. Hydrogeomorphically, this site does not seem to fit well within the common classes of *sloping* or *basin* fen. While very few fen indicator taxa were detected during the survey of this site, it may be appropriate to regard this site as representing another hydrogeomorphic class of fen which we might call a *valley bottom* fen.

12. Bumping River, above end of 1800 rd.
Elevation: 3635-3664 feet
TRS: T15N, R11E, S11
Date: 9/3/2015 - 9/4/2015
Rationale: NWI PEMC
Plants:`Graminoids – CAUT, **ERAN6**, **JUEN**, CABU6, **ELQU2**, CALU7, **CAJO**, AGROS2, SCMI2, CALE10, **CAEC**, CASC12
Forbs – **HYAN2**, **PEGR2**, GALIU, **TRGL5**, **PLATA2**, EQAR

Shrubs – SALIX, LEDUM, VACCI

Bryophytes – RHSQ70, **SPHAG2**, RHIZO2, CHPO14, **WAEX**, **CACU18**, AUPA70, **HEBL2**, **METR70**, BRFR70, SCPA24, **CAST70**

Soil probes: Probes in the northern half of this meadow system found an organic soil, with at least one thin, embedded sandy layer (18-24" below surface), extending down to 52+".

Notes: This narrow, approximately 700m long, very low relief wetland-meadow system is located in the Bumping River valley within the William O. Douglas Wilderness. The wetland-meadow lies between the Bumping River and the upland forest to the west. The wetland-meadow is separated from the Bumping River by a narrow band of forest, and may occupy slightly higher ground than the River. A portion of the western edge of the wetland-meadow is directly accessible by trail #971. A wooded partition separates the +/- open, southern 300m of the wetland-meadow from the northern half. The southern 100m of the northern half is open meadow, while the remainder is a mix of smallish open patches within a lightly wooded matrix. A likely groundwater-wetted meadow lies nearby on the eastern side of Bumping River, but was not accessible due to depth of water within the River channel. Soil wetness within the wetland-meadow is not evenly distributed. Within the southern half of the wetland-meadow, wet soils were found only along the edges of seasonal, groundwater-fed creeklets. The southern portion of this half of the wetland-meadow system has a wet-soiled south-central portion, not evidently associated exclusively with creeklet channels. In the northern half of the wetland-meadow, much of the central and southwestern portions of the open meadow are soppy-wet. Much of this wetness appears to be associated with active groundwater-fed creeklets feeding into the meadow from its western edge. To the north of this open meadow, the openings within the lightly wooded matrix are initially very wet-soiled, but become less wet with northward travel. The hydrology of the full wetland-meadow system is not easily interpreted. Groundwater-fed creeklets account for a certain amount of observed wetness, but certainly not all of it. The high number of fen indicator taxa detected within the wetland-meadow system (16) indicates that groundwater is strongly influencing the composition of local, wet-soiled plant communities. While it seems appropriate to recognize the presence of multiple fens within this wetland-meadow system, it is not apparent what topographic class is appropriate for them. They are clearly not *basin* fens, but likewise, given their topographic settings and often, the evident influence of groundwater-fed creeklets, inclusion as *sloping* fens is not a satisfying fit. Perhaps, as with site #11 above, these fens should be regarded as *valley bottom* fens.

Tonasket Ranger District (east), Okanogan-Wenatchee National Forest

1. Headwaters Box Creek (off 3300-040 rd.)
Elevation: 3800 feet
TRS: T39N, R30E, S22
Date: 7/20/2015, 7/22/2015
Examiners: Heinlen, Loftis, Dewey
Rationale: CARI70 site in CPNWH; Tonasket RD staff recommendation (Erica Heinlen)
Plants: Graminoids – CACA12, CAUT, CACA11, ELPA3
Forbs - RANUN, LYCOP2, EQAR
Shrubs - SALIX
Bryophytes – BRPS70, AUPA70, **CARI70**, **SPHAG2**, **PLEL2**, MAPO16, BRWE70, PLAS6, **HYPR70**, THRE7, PLSC70, DREPA3
Soil probes: Near large area of pooled water with soppy-wet, deep-soiled margins, 48" to firm base; soil mostly organic but including strata with minor component of sand. At CARI70 site, +/- organic soil to semi-firm base at 30".
Notes: Entered drainage from NW, slightly more than 100m NE of its origin in saddle crossed by 3300-040 road, just as drainage bends in its downslope travel from NE to SE. Large area of sedge-dominated, pooled water bordered by deep, soppy-wet soil. Little evidence of significant groundwater influence; perhaps site is collecting and holding seasonal surface flow from steepish head of channel situated to SW. First evidence of groundwater influence about 140m down SE-bearing channel with first detections of PLEL2, BRPS70, AUPA70 and DREPA3. The rare sedge CACA12 is previously documented along this reach, and was relocated during this visit. The most notable expression of fen, with sloping, subsurface groundwater-feed, is at point where SE-bearing channel bends abruptly to ENE, about 460 m from point of entry to channel. Groundwater expression at this site is not robust, and relatively few fen indicator taxa were detected here. Nevertheless, this site is notable in its inclusion of the rarely reported mosses CARI70 and THRE7, the former having been previously documented here by Heinlen. The CARI70 site is small; all detected shoots were included within an area of less than 1m sq. Heinlen had previously collected TONI70 at this site, but the species was not relocated during this visit. The drainage was not explored down-channel from here.
Photos: #s 2608, 2609.

2. 3400 rd. (s)
Elevation: 3600 feet
TRS: T39, R30E, S20
Date: 7/20/2015
Examiners: Dewey, Heinlen, Loftis
Rationale: NWI PEMC
Plants: Graminoids – CAUT, CADI6, CAIN11
Forbs – PETAS, **PEGR2**, **PLATA2**, GEMA4, EQAR
Shrubs – ALNUS
Bryophytes – BRPS70, AUPA70, DREPA3, BRWE70, **PLEL2**
Soil probes: Western portion of meadow with moist, inorganic soil; eastern portion with damp to soppy organic soil 24-36" deep above soft but firm base.

Notes: This meadow is the larger, N-most of a pair of meadows immediately adjacent to the W edge of the 3400 road, approx. one mile N of its junction with the 3300 road. This appears to be mostly a seasonally wet, densely graminoid-dominated meadow with extremely sparse moss cover over a mineral soil. An active creek passes in and out of the meadow's northern edge. Groundwater-wetted damp to soppy-wet organic soil occurs in the far eastern portion of the meadow. This is the location of the mosses included in the plant list above. This portion of the meadow would appear to constitute a small, but not especially robust fen.

3. 3400 rd. (n), a.k.a. Buster Mtn. fen
Elevation: 3600 feet
TRS: T39N, R30E, S17
Date: 7/20/2015
Examiners: Heinlen, Loftis, Dewey
Rationale: NWI PEMC; Tonasket RD staff recommendation (Erica Heinlen)
Plants: Graminoids – CAIN11, **CAAQ**, CAUT, **ELQU2**, **JUEN**, CAAU3, CABU6
Forbs – ALVA, POTEN, ZIGAD
Shrubs – **BEGL**, SABR
Bryophytes – BRFR70, CAGI70, **SPHAG2**, **TONI70**, **HEBL2**, AUPA70, **PLEL2**
Soil probes: Probes in the eastern extent of the wetland, within TONI70 and mixed TONI70-HEBL2 populations found organic soil to 52+".
Notes: This is a largish, robust wetland with a heterogeneous vegetative structure featuring a mix of open meadow, shrubs and lightly wooded areas. The portion explored consisted of a swath approximately 100m wide, running about 300m along the E-W-oriented USFS/private land fence line along the northern edge of the wetland. This area appears to be well endowed with subsites describable as fens. Multiple intermittent and perennially active water courses exist within the area visited, with soil wetness increasing into the western portion of this area. The area appears to be very groundwater-rich, with subsurface movement down the gentle slope gradient to the north. It seems likely that local groundwater discharge accounts for much of the volume in the active channels within this area. Both TONI70 and HEBL2 were previously documented at this site. Okanogan-Wenatchee NF TES includes records of several rare vascular plants at this site, including *Botrychium crenulatum*, *Sisyrinchium septentrionale* and *Platanthera obtusata*.
Photos: #s 2585, 2587, 2589, 2590-2591, 2592-2593.

4. 1 mile NE of Mount Bonaparte, a.k.a., Bonaparte fen/Meyer's Ck. fen
Elevation: 5500 feet
TRS: T38N, R30E, S7
Date: 7/21/2015
Examiners: Heinlen and Dewey
Rationale: NWI PEMC; TONI70 and PASQ70 records in CPNWH; Tonasket RD staff recommendation (Erica Heinlen)
Plants: Graminoids – CASC12, **CATE5**, **ERGR8**, CAUT, ELPA3
Forbs – EQAR, **PLATA2**, ASTER, ARNIC, PYROL, SETR, **PLDI3**
Shrubs – SALIX

Bryophytes – **TONI70**, **PASQ70**, **HEBL2**, **PLEL2**, BRPS70, MAPO16, **CAST70**, **WAEX**, **SPHAG2**, HAFL9

Soil probes: Probes in northern and southern portions of wetland all found 52+" of organic soil in a complex of densities and minor inorganic components.

Notes: This is a relatively large (approx. 90x160m), wet-soiled, mostly herb-dominated wetland that gently slopes downward from south to north. Actually, much of the northern, lower half of the wetland may actually be shrub-dominated, the SALIX that is abundant here, is so low in stature, that it is not easily noticed amidst the herbaceous vegetation with which it is intermixed. Meandering channels with slowly moving water are a prominent feature in the upper southern and western portions of the wetland. Much of the wetness of this wetland is likely traceable to groundwater discharge, although the path of groundwater movement through this relatively large wetland is not obvious. Several plant species notably detected during this visit – *Carex tenuiflora*, and the mosses *Paludella squarrosa*, *Tomentypnum nitens*, *Helodium blandowii* – were all previously documented at this site.

Photos: #s 2595, 2596, 2597-2598, 2599-2600, 2601-2602, 2603.

5. 3300-040 rd. (n)

Elevation: 4000 feet

TRS: T39N, R30E, S16

Date: 7/21/2015

Examiner: Dewey

Rationale: NWI PEMC

Plants: Graminoids – CAUT

Soil probes: None.

Notes: NAIP imagery and NWI mapping indicates that this is a narrow body of water with PEMC wetland located at both its N and S ends. The body of water appears to be best regarded as a sedge marsh including CAUT and possibly other sedge species. The mapped PEMC features on either end of the marsh show not evidence of groundwater influence, either in pattern of soil moisture or composition of vegetation. The southern end of the marsh features much lightly vegetated much while the northern end of the marsh was dry, closely cropped meadow at the time of visit. Cattle appear to regulars around the edges of the marsh, and two cows were actually grazing while standing well into the marsh at the time of visit. The entire perimeter of the marsh was walked, and surprisingly, no exit or input channels where detected at any point along this walk. The source of the marsh water is not evident.

6. Headwaters Middle Fork of Cedar Creek

Elevation: 3500 feet

TRS: T40N, R31E, S17

Date: 7/22/2015

Examiners: Heinlen and Dewey

Rationale: NWI PEMC; Tonasket RD staff recommendation (Erica Heinlen)

Plants: Graminoids – CAUT, CALE10, CADI6, **JUEN**

Forbs – EQAR, GALIU, **PLATA2**

Shrubs – **BEGL**, ALNUS, SALIX

Bryophytes - **DRAD2**, BRPS70, AUPA70, **HEBL2**, **TONI70**, MAPO16, **PLEL2**, **HYPR70**, GEGR8

Soil probes: Multiple probes in the lightly wooded, shrubby, soppy wet fen habitat in the southern portion of the wetland detected a layer of organic soil 24-30" thick.
Notes: This wetland features a soppy-wet, shrubby/lightly wooded southern portion and a sedge-dominated, damp-soiled northern portion. Strong groundwater influence and fen character is evident in the southern portion of the wetland. This is also the portion of the wetland that includes the detected sites of TONI70 and HEBL2. Each of these two moss species was previously documented at this wetland.
Photos: #s 2604, 2605, 2606, 2607.

7. 3575-200 road
Elevation: 3700 feet
TRS: T40N, R31E, S15
Date: 7/22/2015
Examiners: Dewey and Heinlen
Rationale: NWI PEMC
Plants: Shrubs – SYMPH
Bryophytes – MAPO16, BRPS70, RHIZO2, AUPA70, **PLEL2**, **HYPR70**, **DRAD2**
Soil probes: Single probe at wetland's southern edge = mucky to firm base at 33".
Notes: This is a smallish, sedge-dominated meadow which appears to be located in a topographic bowl. There is little evidence of significant groundwater influence at this site. There is no clearly developed output channel from this small basin, but a possible seasonal high water outflow route exists at the SE corner of the basin. Similarly, the basin lacks a clearly developed input channel, but a low relief draw on the northern end of the basin may seasonally/episodically carry surface water into the meadow.

<u>Tonasket Ranger District (west), Okanogan-Wenatchee National Forest</u>

8. Thunder Mountain wetland
Elevation: 6400 feet
TRS: T38N, R23E, S26/27
Date: 7/23/2015
Examiners: Dewey and Heinlen
Rationale: NWI PEMC/PSSC
Plants: Graminoids – CASC12, CACA11
Forbs – CALTH, ASTER, LUPIN, CASTI2, ACMI2
Shrubs – SALIX
Bryophytes – **WAEX**, **SPWA70**, AUPA70, **HEBL2**, **PLEL2**, BRPS70, PHFO6, BRFR70
Soil probes: Thin, dense sandy layer at 18", otherwise apparently an organic soil with sparse sandy component to 52+".
Notes: Upper portion of wetland mapped as PSSC; lower portion mapped PEMC. Upper NW corner of the wetland is the only portion that is evidently persistently wetted by groundwater. NE corner is a maze of steep-walled, narrow, 8" deep channels bordering small islands covered in dense but fluffy, deep cushions of CASC12/SPHAG2/SALIX. The lower portion of the meadow/wetland, which is mapped as NWI PEMC, is the least wet portion of the entire wetland/meadow.
Photos: #s 2610.

9. Headwaters of Sinlahekin Creek
Elevation: 6300 feet
TRS: T37N, R23E, S2/11
Date: 7/23/2015
Examiners: Dewey and Heinlen
Rationale: NWI PEMC/PSS/EMC; promising topographic location.
Plants: Graminoids – CASC12, CADI6, CACA11, **CATE5**, CAUT, **CAMA12**
Forbs – EPAN2, ASTER, **PLDI3**, **UTMI**, **METR3**
Shrubs – SALIX, **BEGL**, DAFR6
Bryophytes – AUPA70, **SPHAG2**, **PLEL2**, **HEBL2**, **TONI70**, RHIZO2, **SPSP70**, CAGI70, **CARI70**, **SCSC70**, **SCCO18**, **DRAD2**, SAUN8, **WAEX, PASQ70**, FIOS70, LOBA6.
Soil probes: Probe at the lower, northern end of this wetland found organic layer 34" thick, but probes between here and the mid-section of the wetland found organic soil layer 52+" thick. At northern edge of southern leg, organic soil layer 10-12" thick; central in southern leg, about 100m south of its northern edge, organic soil layer 52+" thick; at eastern edge of leg at PASQ70 site, organic soil layer 52" thick.
Notes: This is a long, continuous, zig-zag-shaped wetland extending over a half mile in length. This wetland is not uniformly wet, but large portions of it are very soppy wet, particularly midsections and northern and southern ends. The failure to detect well-developed surface water input channels to the wetland suggests that groundwater discharge is a primary source of water for the wetland. The mid-section of the wetland occupies a topographic saddle at an elevation of 6280 feet. From this saddle, the wetland slopes gently to the north, forming the headwaters of Sinlahekin Creek, and slopes equally gently to the south, forming the headwaters to a tributary to the South Fork of Twentymile Creek. The northern and southern extents of the open wetland each occur at an elevation of approximately 6273 feet. Slopes, particularly within the central portion of this wetland are very gentle, and it was possible to determine directionality of slopes only by use of the R6 Digital Elevation Model GIS layer. The peaty soil in the central portion of the mid-section of the wetland, which is the only mapped PEMC within the wetland, was too soppy-wet and soft to allow passage on foot at the time of visit. An unusual feature of this wetland is the depth of the largely moss-dominated thatch cushions sitting atop the actual underlying peat surface. Additionally, these cushions are themselves perched on pedestals separated from one another by gaps ranging from 6-24" wide and 6-18" deep. This microtopography makes for very difficult passage on foot through the wetland. Multiple rare or, at least, rarely reported plant species, were detected in this wetland, including the sedges *Carex tenuiflora* and *C. magellanica* ssp. irrigua, the mosses *Splachnum sphaericum*, *Calliergon richardsonii*, *Scorpidium scorpioides*, Scorpidium cossonii, *Paludella squarrosa*, *Tomentypnum nitens*, *Fissidens osmundioides* and the liverwort *Lophozia bantriensis*.
Photos: #s 2612, 2615, 2616, 2617, 2618.

10. Headwaters South Fork Twentymile Creek (northeast tributary)
Elevation: 6300 feet
TRS: T37S, R23E, S11
Date: 7/24/2015
Examiners: Dewey, Heinlen
Rationale: Incidental; close proximity to wetlands with newly documented rare plant species (on 7/23/2015); promising NAIP image and topographic location.

Plants: Graminoids – CASC12, CAUT, CADI6, CACA11
Forbs – CASTI2, **PEGR2**, **PLDI3**
Shrubs – SALIX
Bryophytes – **SPWA70, SPCO70**, AUPA70, **WAEX**, **TONI70**, **CARI70**, BRPS70, MAPO16, HAFL9, PHFO6, SAUN8,
Soil probes: Probes on west and east sides of wetland found organic layers 12-18" thick.
Notes: This is a smallish, mostly very low gradient wetland that sits at the headwaters of a small tributary to the South Fork of Twentymile Creek. Perhaps 50% of the wetland is lightly wooded, causing the wetland to be somewhat difficult to delineate with NAIP imagery. The western portion of the wetland's primary meadow features well-developed polygonous microtopography with pedestals typically 12" tall and associated troughs 12-24" wide. With brief examination it was determined that the trough system does not form an interconnected drainage system, but rather, is composed of a large number of irregularly shaped closed loops or dead-end linear features. These observations suggest that this polygonous microtopography is not a product of erosion, but of some other physical process, perhaps such as freeze-thaw cycles. Nowhere within the portion of wetland explored was soil especially wet, generally no more than audibly squishy at best.
Photos: #s 2620, 2621.

11. Tiffany Meadows
Elevation: 6200 feet
TRS: T37N, R23E, S21/20
Date: 7/24/2015
Examiners: Dewey, Heinlen
Rationale: Whole meadow system mapped as NWI PSS/ECM, which project lead has never explored for its correspondence with fen habitats, but accessibility, size, elevation, and topographic setting made this meadow system a desirable site to visit.
Plants: Graminoids – CASC12, **ELQU2**, **ERIOP**, CAUT, CADI6, DANTH
Forbs – ASTER, CASTI2, TARAX, **PLDI3**, **PEGR2**, LUPIN, ACMI2
Shrubs – DAFR6, SALIX,
Bryophytes – AUPA70, SCAPA, **TONI70**, **PASQ70**, **SPWA70**, **HYPR70**, **WAEX**, SAUN8, **SCCO18, CARI70**, **CAST70**, CAPO17, CEPL3, **DRAD2**, **HEBL2**, BRPS70, RHGR5, FIOS70, MOHI3, **PLEL2**, BRWE70, PHFO6
Soil probes: Five probes conducted along length of wetland; upper four probes found organic layers 14-26" thick; probe in lowest portion of meadow detected organic layer 52+" thick.
Notes: This is a long (900+m), vegetationally and hydrologically complex meadow-wetland system situated in the upper part of the North Fork Boulder Creek drainage. Groundwater discharge is abundant, but irregularly distributed, and evidently most commonly expressed along the upper SE edges. Groundwater fed minor, active channels meander through the system, particularly its middle and lower portions. The bryophyte flora at the site was found to be notably diverse; the plant species list for the site grew at a fairly constant rate over the several hour period devoted to the site's examination. Detected species that are either rare or rarely reported in Washington include *Paludella squarrosa*, *Scorpidium cossonii*, *Rhizomnium gracile*, *Fissidens osmundioides*, and *Moerkia hibernica*. Target species detected included *Calliergon richardsonii*, *Tomentypnum nitens* and *Helodium blandowii*.
Photos: #s 2622, 2623, 2624.

12. Baldy Pass wetland.
Elevation: 6500 feet
TRS: T36N, R23E, S22
Date: 7/24/2015
Examiners: Dewey
Rationale: NWI PEMC
Plants: Graminoids – CASC12, CADI6, **JUEN**
Forbs – **PLDI3**, EQAR, PAFI3, ASTER, VALER, LONIC
Shrubs – SALIX
Bryophytes – BRPS70, **SPHAG2**, AUPA70, **PASQ70**, **TONI70**, **WAEX**, **CARI70**, **CAST51**. PACO47.
Soil probes: Two probes within the wetland detected organic soil layers 48" and 52+" thick.
Notes: This is a steepish, extensively soppy-wet wetland that sits at the head of a small, apparently perennial tributary to the Middle Fork of Boulder Creek. The lowest, western-most portion of the wetland, which exhibits the lowest gradient slope within the wetland, terminates in a rather abrupt slope-break. Below this slope-break, several much smaller groundwater-rich terraces and sideslopes occur before groundwater expression along the drainage greatly weakens and the perennial creek becomes well defined. In spite of the relative steep-sloped middle and upper portions of the wetland, several pools were found here. The lower two-thirds of the wetland is very lightly wooded; the wetland's upper third is moderately wooded. The full, E-W length of the wetland is about 160m. In contrast with the other five west Tonasket wetland-fens examined in the prior two days, this wetland completely lacks the polygonous microtopography that characterizes so much of those wetlands. This distinction also corresponds with very low gradient slopes exhibited by the other wetlands, and the rather notable slope of this Baldy Pass fen. Whereas much of the upper, living portion of the moss cushions associated with polygonous microtopography appears to be struggling with seasonal loss of capillary connection with free water in the peat beneath them, the living moss layer within the Baldy Pass fen is in direct contact with the soppy-wet peat underlying it. Target species found at this fen include the mosses *Calliergon richardsonii*, *Campylium stellatum* and *Tomentypnun nitens*. Another occurrence of the very rare (Washington) high-latitude moss, *Paludella squarrosa*, was also noted here. In its biophysical character, the Baldy Pass fen is singular among those groundwater-fed wetlands visited on Tonasket RD during this project.
Photos: #s 2626, 2627-2629, 2630, 2631, 2632-2634.

Colville National Forest – Sullivan Lake Ranger District

1. Stewart Meadow south
Elevation: 3500 feet
TRS: T37N, R42E, S28/29
Date: 8/10/2015
Examiners: Cabral, Dewey
Rationale: NWI PEM1C; CPNWH records; staff recommendations
Plants: Graminoids – CAUT, **CACU5**, ERCH7, **ELQU2**, **CALI7**, **JUEN**, DECE, CALE10, **ERAN6, ERGR8**
Forbs – COPA28, **PLDI3**, **PEGR2**, **DRRO**, **METR3**, POOC2, SAXIF, **SPRO**, EQAR, BOTRY
Bryophytes – **SPHAG2**, **METR70**, **WAEX**, CAGI70, **TONI70**
Soil probes: Five probes over the extent of wetland found an organic layer 18", 39", 48", 49" and 54" thick.
Notes: This is a sloping wetland/meadow that can be comfortably referred to as a fen owing to the unambiguously primary role of groundwater as a water source, and to the high percentage of total plant cover that is attributable to moss and sedge species. The fen is situated within a broad, low gradient drainage that includes numerous small, seasonally wet meadows and at least two, minor, low volume water courses. The wetland is composed of two elongate, N-S-oriented meadows incompletely separated by a narrow band of trees. The meadows slope downward from S to N along their long axes, and from W to E across their widths. The upper, W meadow appears to be only seasonally wetted by groundwater over much of its area, but nevertheless features a peat layer three or more feet thick. Much of the surface of the lower, E meadow was soppy wet at the time of the visit. This wetland has one of the highest fen indicator taxon counts among the Colville NF sites during this project. Notable botanical detections at this site include the mosses *Meesia triquetra* and *Tomentypnum nitens*. Each of these species had been previously detected at this wetland. Other notable moss species previously detected at this wetland but not detected during this visit include DERE70 and HAVE70.
Photos: # 2636, 2637-2638, 2639, 2640-2641, 2642-2643, 2644-2645, 2646. 2647.

2. Stewart Meadow north
Elevation: 3600 feet
TRS: T37S, R42E, S20/21
Date: 8/11/2015
Examiners: Dewey
Rationale: NWI PEM1C
Plants: Graminoids – CAUT, CAFL4, CALAA, **JUEN**, CAVE6, CALAM, CACU5
Forbs – EQAR, COPA28
Shrubs – SALIX, ALNUS, SPDO
Bryophytes – AUPA70
Soil probes: One probe at mid-meadow found at least 54" organic layer over inorganic base.
Notes: This is a long (nearly 600m), N-S oriented, very flat meadow, separated by a willow thicket from a NW lobe that includes a large, heavily used livestock pond. This is a seasonally wet sedge and grass dominated meadow whose deep peaty soil was generally no more than moist at the time of visit. Very little forb and virtually no bryophyte cover was detected. No evidence of significant, even seasonal

groundwater influence was detected anywhere within the meadow. This meadow presents a bit of an enigma in the presence of deep peat at a site that currently appears to experience no more than seasonal wetting by surface water. Botanically, this meadow is perhaps most notable in the presence of the sedge *Carex flava*.
Photos: #s 2648-2649, 2650, 2651, 2652.

3. 3140-485 rd. ("rabbit ears meadow")
Elevation: 3600 feet
TRS: T37N, R42E, S22
Date: 8/11/2015
Examiners: Cabral, Dewey
Rationale: NWI PEM1C
Plants: Graminoids – SCMI2, CABU6, CAVE6, **JUEN**, CALAA, CAUT, DECE
Forbs – COPA28, **METR3**, VIOLA, RUMEX
Bryophytes – AUPA70, **SPHAG2**
Soil probes: Soil in main body of meadow dry, impenetrable with probe; probe in NW "ear" found remarkably low-density peat to 54+"; probe in NE "ear" found initial high resistance and then strata of varying density, but clearly all organic soil to 54+"; probe in small, detached opening NW of far N end of NE "ear" detected organic soil to firm base at 48".
Notes: The main body of this meadow is likely seasonally wet, but was dry at the time of visit, with closely grazed grasses and sedges over a moss-less, dense, dry soil. Meadow relief is very flat and apparently slopeless. The edges of the meadow were dry, with no input channels or groundwater discharge evident. In contrast to the main body of this meadow, both the NW and NE "ears" were found to have organic soils, the base of which exceeded the reach of the soil probe (54+"). Low soil density in the center of the NW "ear" was particularly surprising, allowing full soil probe penetrance with the use of essentially just one arm. Soil in both "ears" was little more than moist, raising the question of how such deep organic soils developed and persist with such little persistent soil moisture. As with the main body of this meadow, the edges of the "ears" provided little evidence of surface water input channels or of groundwater discharge. A very unusual opening NW of the N extent of the NE "ear" features large tufts of *Carex vesicaria* perched atop narrow soil pedestals 12-16" tall. Soil between the pedestals was very soft and damp at the time of the visit, and bare of vegetation. It appeared quite possible that seasonal groundwater discharge around the edges of this opening is the primary source of soil moisture at this site. It seems likely that meltwater from seasonally overlying snow pack is an important source of water for the entire meadow system.
Photos: #s 2653, 2654, 2655, 2656-2657.

4. 1710-500 rd.
Elevation: 2720 feet
TRS: T37N, R42E. S2
Date: 8/11/2015
Examiners: Cabral, Dewey
Rationale: NWI PEM1C
Plants: Graminoids – CAUT, SCMI2, PHAR3
Forbs – GEMA4, MEAR4, CIAR4, HYPE, VETH, HICA10, LEVU

Shrubs – ALNUS
Bryophytes – MAPO16
Soil probes: At mid-meadow, organic soil to 50+".
Notes: This is an essentially flat, no-slope, weedy meadow dominated by tall sedge. Sedge thatch covers much of the meadow soil which is bare of mosses. S end of meadow includes a sedge-lined 16"-deep canal/channel with standing water. Meadow topography and vegetation provide no evidence of notable groundwater influence. Presence of deep peat seems at odds with apparent absence of persistent wetness across much of this meadow. Meltwater from seasonal overlying snowpack is likely an important source of water for this meadow.
Photos: None taken.

5. 1700-462 road.
Elevation: 3260 feet
TRS: T37S, R42E, S3
Date: 8/11/2015
Examiners: Cabral, Dewey
Rationale: NWI PEM1C
Plants: Graminoids – SCMI2
Forbs – LEVU, CIAR4, MEAR4, POTAM
Bryophytes – CLDE70
Soil probes: None
Notes: E-W green swath (NAIP image) immediately E of mapped PEM1C polygon is an alder/sedge-grass riparian corridor; creek bed is wet but with negligible flow. Impoundment of this creek appears to formed pond at E edge of PEM1C polygon. Sedge community on western edge of pond likely wetted, particularly seasonally, by water table of pond. No evidence of notable groundwater influence within area examined.
Photos: # 2658.

6. Highway 31 border crossing.
Elevation: 2550 feet
TRS: T40N, R43E, S1
Date: 8/12/2015
Examiners: Cabral, Dewey
Rationale: NWI PEM1C
Plants: Graminoids – SCIRP, PHAR3, CAUT, TYPHA,
Forbs – EQUIS, SPARG
Soil probes: Two probes found organic soil intermixed with sand, to a firm base at 34-36, and pure organic soil to a firm base at 48".
Notes: This is an elliptical-shaped wetland with a long axis approximately 200m long. Broad, wet, mucky, seasonally active channels enter from the west and are discernable well out into body of meadow. Wetland appears to be species-poor, with reed canarygrass, bulrush, cattails and beaked sedge dominating the flora. Primary water source for this wetland is not obvious, although it seems likely to be seasonal surface water input. Plant species composition within the wetland does not indicate important groundwater influence.

Photos: None.

7. 3160-326 rd. (Lime Creek).
Elevation: 3050 feet
TRS: T40N, R44E, S7
Date: 8/12/2015
Examiners: Cabral, Dewey
Rationale: Staff recommendation; NWI PEM1C
Plants: Graminoids – CAVE6, CALAA, CAUT, CAFL4
Forbs – **PLDI3**, SETR, MIGU, PEFR5, **UTMI**
Bryophytes – AUPA70, PHFO6, BRPS70, CAGI70
Soil probe: Single probe found pure, uniform, organic soil to 54+".
Notes: This is an extensively, soppy-wet wetland whose source of wetness is difficult to interpret. The low count of fen indicator taxa suggests that groundwater discharge is not a primary source of this wetness. The Lime Creek valley bottom is broad and flat within the area of examination, potentially allowing the Lime Creek water table to broadly contribute to the observed wetness of this site. The presence of the sedge *Carex flava* at this site is botanically notable. There is a moss at this site that resembles CAST51, although it exhibits a morphology that is very atypical for this species; this moss remains unidentified. The mosses DRRE70 (a.k.a. LIRE13), THRE7 and HEBL2 are previously documented at this site, but were not detected during this brief visit.
Photos: # 2659.

8. Halliday Fen.
Elevation: 2956-2992 feet
TRS: T40N, R44E, S31
Date: 8/12/2015-8/13/2015
Examiners: Dewey
Rationale: Staff recommendation; NWI PEM1C
Plants: Graminoids – **CACU5**, CAFL4, CALAA**, CAIN11**, SCACA, CABU6, **ELQU2**, CAUT, CALE10, TYPHA
Forbs – EQUIS, SOILD, EQAR, RUMEX, PEFR5, ANMA, PLATA2, **PLDI3**, **UTMI**, ASTER, CASTI2, EPILO, **PEGR2**, SETR, **METR3**, MIGU, LEMNA
Shrubs – **BEGL**, SALIX, ALNUS, COSE16
Bryophytes – CAGI70, BRPS70, PHFO6, AUPA70, **TONI70**, **CAST51**, **LICO16** (Scorpidium cossonii), **HEBL2**, THRE7, PLAS6, **PLEL2**, MAPO16, **SPHAG2**, CACO70
Soil probes: Eight of nine probes within and along edges of meadow found an organic soil layer 54+" thick. One probe groundwater-rich woods at far SE corner of meadow found organic soil to apparent inorganic base at 48".
Notes: This is a challenging but rewarding wetland to explore. It is challenging because of the combination of its size (approximately 200mx400m) and the tallish, dense graminoid vegetation that dominates its main body. Notable cover of bog birch and willow also occurs within the meadow. Moving through this vegetation, while attempting to not overlook the bryophyte and shorter statured vascular plant species under foot, is a tedious affair. Then too, the meadow/forest interface along much of the meadow's periphery, especially the long northeastern edge and southeastern corner, is a complex

habitat, offering a diverse set of microhabitats to examine. Overall, the meadow soils appear to be persistently wet, deep peats, with groundwater being the primary water source. Groundwater discharge is particularly evident along much of the meadow's northeastern edge, and especially, its southeastern corner. Groundwater discharge appears to be primarily seasonal along much of the northeastern edge, but was robustly active toward the eastern portion of the northeastern edge and remarkably so, in the southeastern corner. Although three lateral and one terminal (southeastern corner) water courses are mapped as entering the meadow, no well-developed (or even, evident) channels were detected along the meadow's margins. Topographic contour lines suggest that the primary water course entering the meadow is that at the meadow's southeastern corner, but while exploration well up into the woods at this corner detected a broad, robust groundwater discharge site, but no well-defined channel, or even valley bottom, was detected. Away from some soppy-wet areas along the meadow's northeastern edge and the largely impassibly wet southeastern corner, the main body of the meadow is not audibly wet underfoot. The surface of much of the main meadow is covered with a thick, dry mat composed of sedge thatch and dead, overgrown moss shoots. Kneeling into this generally dry mat typically resulted in wet knees, as the dry mat was compressed down to contact with the wet peat beneath it. It's a curious development that mosses that require direct contact, or at least capillary connection with a water source, should over much of the meadows surface, appear to have lost contact with the wet peat beneath, and are too dry to conduct photosynthesis and generally appear to be metabolically inactive. It is not obvious how water initially presenting itself as seasonal or persistent groundwater discharge along the meadows edges, is the same water that is wetting the soil everywhere else within the meadow. Nevertheless, it appears appropriate to refer to this wetland/meadow as a fen. The meadow appears to be fairly flat and slopeless, but the pattern of wetness, including the course of small, weakly developed channels within the meadow suggests that the meadow slopes downward from NE to SW, and primarily, from SE to NW. A well-developed discharge channel that occurs at the NW end of the meadow was wet, but not actively transporting water at the time of visit. Notable botanical detections during the visit include *Carex flava* and the mosses *Tomentypnum nitens*, *Campylium stellatum*, *Helodium blandowii*, *Thuidium recognitum*, and *Scorpidium cossonii*. It is likely that all of these taxa were previously documented at this wetland. The moss species *Drepanocladus revolvens* was previously documented at this meadow. This species was not detected at the Halliday wetland during this project, but the morphologically extremely similar *Scorpidium cossonii* was abundantly present. It seems likely that the currently documented *Scorpidium cossonii* and the previously identified *Drepanocladus revolvens* are the same taxon. It is possible that the four other documented sites of *Drepanocladus revolvens* on Colville NF are also currently best identified as *Scorpidium cossonii*. These collections need to be re-examined.
Photos: #s 2660, 2662, 2663-2664, 2665, 2667-2668, 2669, 2670, 2671, 2673, 2674-2675, 2676.

9a. Bunchgrass Meadows (main - brief 2015 visit)
Elevation: 5050 feet
TRS: T37S, R44E, S24
Date: 8/19/2015
Rationale: Staff recommendations; NWI PEM1C
Examiner: Dewey
Plants: Graminoids – **ELQU2**, CASC12, **ERAN6**, CAUT
Forbs – **PLATA2**, **SAOR2**, SETR, LUPIN, VIOLA
Shrubs – VACCI, **BEGL**

Bryophytes – **SPHAG2**, BRPS70, **CAST70**, **WAEX**, PHFO6, AUPA70, MAPO16, **HEBL2**
Soil probe: Single probe on squishy wet soil in upper, far SE corner of meadow system found resistant, pure organic soil to 52+".
Notes: This is a very large meadow-wetland system composed of a large (400m x 1000m), main body, a spatially complex set of variously connected, smallish mapped wetlands, and two moderately-sized, mapped, non-contiguous wetlands lying west and north of the main body. Prior botanical exploration of this system, along with site elevation, basin topography, and aerial imagery all suggest that this system is rich in areas of primary groundwater influence. It was very disappointing, then, the project lead's exploration of this system was limited to a mere two hours at the system's far SE corner. It was anticipated that a minimum of full two days would be needed to conduct a moderately adequate exploration. The brief duration of the visit was necessitated by a direction to evacuate due to the expanding size of a wildfire shortly NW of the meadow-wetland system. A return to this system to better assess the extent and character of groundwater-influenced plant communities at this site should be regarded as important, unfinished fieldwork.
Photos: #s 2710, 2711, 2713, 2714, 2715, 2716.

9b. Bunchgrass Meadows (main - 2017 extended visit)
Elevation: 5050 feet
TRS: T37N, R44E, S24
Date: 8/16/2017-8/19/2017
Rationale: NWI PEM1C
Examiner: Dewey
Plants: Graminoids – CASC12, **CAMA12**, CAIL, **CAEC**, **CAAQ**, **ERAN6**, CACA11, **ELQU2**, CAUT, DAIN, CACA4, AGSC5
Forbs – ASFO, SETR**, PEGR2, SPRO, DRAN, UTMI, PLST4, METR3,** SARH2, EPILO, **PLDI3**, **SAOR2**, EQAR, LICA2
Shrubs – SALIX, VACCI, **BEGL**, **KAMI**,
Bryophytes – **SPHAG2**, **HEBL2**, **CAST70**, **WAEX**, **TONI70**, **HAVE70**, **DIPA20**, BRWE70, **HAFL9**, SAUN8, PHFO6, AUPA70, BRPS70, PELLI, **PLEL2**
Soil probes: Probes were conducted at a total of 18 sites situated within 6 more or less topographically/botanically distinct portion of the Meadows. Soils are consistently dense to very dense (i.e., resistant to very resistant to the probe) and with residue on the rod generally indicating high organic content, although the extracted rod was often clean. Soil moisture levels within the Meadows were variable, with pockets or larger areas of dry, damp and squishy-wet or soppy-wet soil being found pretty much throughout the wetland/meadow system. Probe results for the distinct portions of the Meadows include: SE edge (toeslope to basin transition zone) = 24-30" until stopped due to resistance; NE groundwater-rich toeslopes = 36" until stopped due to resistance ranging to 51+"; NE sloping, groundwater-rich lobe = 51+"; NW groundwater-rich toeslope = stopped due to resistance at 51"; SW toeslope to basin transition zone = 16" until stopped due to resistance; S side groundwater-rich toeslope/terrace = 23-38" until stopped due to resistance; main Meadows/upland basin = 23-32" to evident dense 1-3" thick aquitard, often overtopping another soil layer to 51+". Parent material never clearly detected. Spring mounds in the western half of the Meadows featured spring wells 5+ feet deep (no bottoms detected).

Upwelling water in a spring well in the eastern half of the Meadows is emanating from a depth beyond the 6.5 feet probed. Barreras (1996) has described the upland basin soils of the Meadows as decomposed organics with very poor drainage that are periodically saturated during the growing season or remaining wet for long periods of time.
Notes: At the time of visit, this very large wetland/meadow system, which is the core of the Bunchgrass Meadows Natural Research Area, was an interesting patchwork of soil moisture conditions ranging from dry to shallowly flooded. Water sources include groundwater-fed perennial creeks entering the Meadows from the south and west, groundwater upwellings/spring mounds within the Meadows, and diffuse groundwater discharge areas on toeslopes, particularly on the eastern and southern edges, and in the Meadows lobe extruding from the northeastern corner of the system. Much of the basin-portion of the Meadows is dominated by a combination of sedges and grasses, including *Carex utriculata*, *C. aquatilis* and *Calamagrostis canadensis*. Floristic species diversity in this area appears to be relatively low. Wetting due to first-order groundwater discharge (initial, local discharge) is not evident over most of the basin area. First-order groundwater discharge appears to be largely restricted to toeslopes, especially on the southern and eastern edges of the Meadows, but also in the northeastern lobe and at the northwestern corner. In places, toeslope groundwater discharge appears to extend well away from the actual toeslope proper, in what might be viewed as transitional zones between the toeslope and the basin. Groundwater influence in this transitional area is particularly notable along the southern and southeastern edges of the Meadows, as well as in the northeastern lobe. It is in the first-order and transitional groundwater discharge zones that most of the rare or uncommon plant species detected during this project were detected. These species include the boreal bog sedge, *Carex magellanica* and the English sundew, *Drosera anglica* (both previously documented at the meadows), as well as the previously undocumented lesser bladderwort, *Utricularia minor*, the mosses *Tomentypnum nitens*, *Hamatocaulis vernicosus*, *Helodium blandowii*, *Dicranella palustris*, and the leafy liverwort *Harpanthus flotovianus*.
Photos: #s 3603, 3604, 3605, 3606, 3607, 3609, 3610, 3611, 3612, 3613, 3614, 3615, 3616, 3617, 3619-3620, 3621, 3623, 3624, 3625, 3626, 3627, 3629-3630, 3631, 3632, 3634-3635, 3636, 3637, 3639, 3640, 3641, 3642, 3643, 3644, 3645, 3646-3647, 3652, 3653.

10. Bunchgrass Meadows (w)
Elevation: 5100 feet
TRS: T37N, R44E, S23
Date: 8/19/2017
Rationale:
Plants: Graminoids – **ERAN6**, **ELQU2**, CASC12, **CAMA12**, CACA11, CAUT
Forbs – **SCPAA3**, **DRAN**, COPA28, **METR3**, **PEGR2**, **SPRO**, **PLDI3**, LICA2, **SAOR2,** ASFO, EQUIS, EPILO, SETR**, PLST4**
Shrubs – **KAMI**, **BEGL**
Bryophytes – **SPHAG2**, **CAST70**, AUPA70, PHFO6, **CARI70**, **WAEX**
Soil probes: Probes were conducted at 1) the point of entry at the meadow's southeastern edge, 2) within the distinctive SCPAA3-DRAN-ERAN6 community at the southern end of the

meadow, 3) at mid-meadow at its eastern side, and 4) in the meadow's upper northwest corner. Probes at these sites had the following results: 1) moderately resistant, uniform character to 51+"; 2) highly resistant to firm base at 48"; 3) resistant to 12", then very resistant to firm base at 42"; 4) moderately resistant to coarse sandy firm base at 30".
Notes: Although included within the Bunchgrass Meadows Research Natural Area, this smaller meadow lying to the west of the main Meadows wetland/meadow system is here treated separately from that main system. This is for several reasons including 1) lack of habitat continuity with the main system, 2) the presence of a distinctive wetland ecosystem in the southern end of the meadow, 3) the presence of good-sized interconnected ponds in the meadow's central portion and 4) detection of a small occurrence of the rare fen moss *Calliergon richardsonii*, a first record for Colville NF. Also notably, while the Colville National Forest GIS stream layer shows a perennial creek draining from this western meadow/wetland into the western edge of the larger, main Bunchgrass system, this drainage was not detected during the visit on 8/19/2017. In fact, higher ground appeared to consistently separate the smaller western meadow/wetland from the larger system to the east. The drainage relationship between these two meadow systems should be further examined on any return visit to these systems. Dominant species in the distinctive plant community at the southern end of this wetland/meadow include *Scheuchzeria palustris* ssp. *americana*, *Eriophorum angustifolium* and *Drosera anglica*. Vegetation within this community is generally sparse, and bare soil is common. The community appears to occupy a very gently sloping basin with a microtopography of numerous depressions and rises. Soil within the community was soft and damp and appears to be subject to seasonal inundation. Current groundwater discharge along the western and northern edges of the meadow/wetland is extensive. Along the western edge of the meadow/wetland this discharge has resulted in common occurrence of a forest/meadow interface moat that is impassible with 12" boots. Groundwater influence typically wains quickly with movement downslope. The strongest expression of sloping fen within the wetland/meadow occurs on the gentle slope lying between the ponds and the northern edge of the wetland/meadow, roughly occupying the northeastern quarter of the wetland/meadow. The upper portion of this northeastern quarter is clearly the most elevated portion of the larger wetland/meadow. The most evident first-order groundwater discharge on this slope is along its upper portion near the forest/wetland interface. The majority of the wetland/meadow's population of *Carex magellanica* occurs on this slope, and the small occurrence of *Calliergon richardsonii* was detected in the northwestern corner of this slope.
Photos: #s 3648, 3649, 3650, 3651.

11. 1935 rd. – section 28.
Elevation: 4000 feet
TRS: T37N, R33E, S28
Date: 8/16/2017
Rationale: NWI PEM1C
Examiner: Dewey
Plants: Graminoids – **CAEC**, **CAMA12**, SCMI2, CALE8, PHAR3, CAUT, **ERIOP**, **ELQU2**, CASC12
Forbs – SPARG, SETR, **PLDI3**, **PEGR2**, **SPRO**

Shrubs – SPDO

Bryophytes – **SPHAG2**, **CAST70**, **CACU18**, AUPA70, PHFO6, SCUN6, SCPA24, CHPO14, CAPO17

Soil probes: Probe in seasonal channel entering upper, SW end of wetland reached first, apparently non-organic soil layer at 24"; probe in center of CAMA12 population detected a dense, apparently organic layer to at least 50" deep; probe on soppy-wet, CAUT-dominated soil in main body of wetland detected apparent organic layer to 27" deep.

Notes: Entering wetland from forest at NE end, first encounter mudflats, dominated by SCMI that are apparently seasonally wetted by drainage from the main body of the wetland. Mudflats abruptly transition into dense SPDO which extends to main body of wetland, where the boundary between is defined by a two foot tall berm, that appears to impound a seasonal collection of water within the area of the main/largest portion of the wetland. The origin of this berm was not obvious during this visit. The berm is so overgrown with vegetation that it is difficult to get a sense of its composition, but its size would require a very extended effort by beavers. If constructed by humans, the function of this impoundment is again, not obvious. There is no current developed drainage or means of extraction of the presumed seasonal standing water behind this berm. No evidence of seasonal drainage into the area of impoundment is evident along the edges of this wetland, but seasonal channels enter the wetland from its upper, SW corner. These channels appear to not persist very far into the woods, and along with caverning about the bases of trees along the channel routes suggests that robust seasonal groundwater discharge may be the main source of water forming these channels. Groundwater influence within this wetland is most clearly expressed in a somewhat raised slope at the interface of the forest and wetland/meadow at its far SW corner. The upper portion of the slope, particularly, is occupied by short-statured vascular plants including CAMA12, ERIOP, ELQU2, CASC, CAEC, PEGR2, SPRO, and the mosses SPHAG2 and CAST70. The relatively high incidence of fen indicator plant species on this slope, and the notably greater thickness of apparent organic soil here, it is understood that groundwater is the primary water source for this slope. Because this slope was little more than anywhere damp at the time of visit, it is also apparent that this is a seasonally groundwater-fed slope. Though hardly unusual in the project lead's experience, this thickness of apparent organic soil within a seasonally groundwater-wetted ecosystem is nevertheless surprising. Is oxidation of organic matter actively occurring in the upper portion of this slope's soil most Augusts and Septembers? Is the robustness of the supporting aquifer lessening with passing years and decades? The CAMA12 site reported here becomes the second of two subpopulations now reported for this wetland.

Photos: #s 3591, 3592, 3593, 3594, 3596-3602.

Colville National Forest – Newport Ranger District

1. 2700 road, section 9.
Elevation: 2700 feet
TRS: T35N, R43E, S9
Date: 8/14/2014
Rationale: NWI PEM1C
Examiner: Dewey
Plants: Graminoids – JUNCU, CANE2, CAUT, **CACU5**, SCMI2, SCACO, **JUEN**
Forbs – GEMA4
Shrubs – ALNUS
Bryophytes – AUPA70, PHFO6
Soil probes: None
Notes: This sloping, mid-sized (200m x 150 m) meadow-wetland is visible from and easily accessed from the 2700 road. Much of the meadow appears to be only briefly, seasonally wet. The southern edge of the meadow supports a narrow band of wetland species including both *Scirpus* and *Carex* spp. This southern edge appears to be wetted by surface flow from a seasonally active channel running downslope along the western edge of the meadow. The northern edge of the meadow bulges bluntly northward along its eastern half. Within the area the soil becomes increasing wetter moving upslope and north toward the wetland-alder-woods interface. This wetness is supported by persistent groundwater discharge at the upper portion of the wetland and into the alder that is transitional into the woods. As with the seasonally wet southern edge of the meadow-wetland, this persistently wet northern portion is heavily grazed by cattle and the existing vegetation exists on small pads of non-trampled, pitted soil. There appears to be little cover of moss or sedge in this highly disturbed area.
Photos: #2680.

2. 2700-110 rd.
Elevation: 3100 feet.
TRS: T35N, R43E, S4
Date: 8/14/2015
Rationale: NWI PEM1C
Examiner: Dewey
Plants: Graminoids – **JUEN**, PHAR3, CAUT, CAVE6
Forbs – EQAR, ANMA, HYPE, CIAR4, SPARG, MEAR4
Bryophytes – BRPS70
Soil probes: None
Notes: This wetland system consists of a small, marginally connected NW lobe and a main, 300m x 50m body. Overall the wetland appears to be rather plant species-poor, with very little diversity or cover of bryophytes. The NW lobe appears to be wetted by seasonal flow in a channel running lengthwise through the middle of the lobe. Flora of the lobe is dominated by sedges and grasses but plant cover is discontinuous and appears to reflect periodic disturbance. Lobe soil moisture was patchy, ranging from dry to damp. The northern portion of the main wetland is dominated by reed canarygrass. No channels were detected in the mid-section and southern portion of the wetland. Soil moisture ranged from dry in the central portion of the wetland, to damp and cracking in its lightly vegetated southern portion. At least

the central and southern portions of the wetland appear to regularly experience seasonal inundation. The water source for this wetland is clearly surface water, but the routes by which it enters the wetland were not obvious.
Photos: #s 2681-2682, 2683, 2684, 2685.

3. 2712 rd., upper Ruby Creek
Elevation: 3800 feet
TRS: T35N, R42E, S3
Date: 8/14/2015
Rationale: NWI PEM1C
Examiner: Dewey
Plants: Graminoids – PHAR3, CAUT, SCMI2, CASC12, **JUEN**, CADI6
Forbs – EQAR, ASTER, COPA28, **PLDI3**
Shrubs – **BEGL**
Bryophytes – **SPHAG2**

Soil probes: Single probe in squishy-wet portion of meadow-fen found pure organic soil to depth of 54+".
Notes: This is a largely herb-dominated meadow-fen flanking a 200m reach of upper Ruby Creek. The upper portion of this mapped wetland polygon is a grass and sedge-dominated meadow, dry-soiled at the time of visit, but apparently seasonally wetted by surface water. Much of the southern portion of the site, on the western side of the creek, is fen featuring squishy-wet or soppy-wet peaty soil that is wetted by groundwater persistently discharging along meadow-slope interface along the western edge of the meadow. The very small number of plant species, including fen indicator taxa detected within this fen so robustly wetted by groundwater is unexpected, although the small size of this fen habitat may be an important contributing factor. Sphagnum moss and beaked sedge (CAUT) account for a larger percentage of total plant cover within this fen.
Photos: # 2686.

4. 2712 road, Rufus Meadow (upper South Fork Lost Creek)
Elevation: 4100 feet
TRS: T36N, R42E, S26
Date: 8/18/2015
Rationale: Staff recommendation; NWI PEM1C
Examiner: Dewey
Plants: Graminoids – CASC12, **ERAN6**, CAUT, **CAMA12**, **ELQU2**, CALAA, ERCH7, **CAEC**, PHAR3, **SCPAA3**, CALAM, **JUEN**, CALE10
Forbs – EQAR, **PEGR2, DRRO**, COPA28, VIOLA, **UTMI**, ASTER, **PLATA2**, EPILO, SETR
Shrubs – **BEGL**, **KAMI**, VACCI, SALIX
Bryophytes – **SPHAG2**, AUPA70, **CAST70**, CACO70, PHFO6, **PLEL2**, PLSC70, MAPO16, **WAEX**
Soil probes: In short-statured fen on far-western edge of meadow-wetland system on DNR ownership, organic soil thicknesses from 34-54+"; probes along main E-W bottoms, at forest/meadow interface

midway along S edge of E-W bottoms, and upper portions of both main northern lobes of meadow-wetland system all found organic soil thickness of 50+-54+".
Notes: This is a long (1200m), generally narrow, but lobed meadow-wetland system occurring along the upper South Fork Lost Creek (SFLC) drainage, immediately east of the 2712 road. The two primary system lobes run N-S on the N side of the SFLC; the W-most lobe is approximately 285m in length; the E-most lobe is approximately 475m in length. Each of these lobes is associated with intermittent drainages into SFLC. Several small, actively maintained beaver dams are present in the lower part of SFLC within the meadow-wetland system. The upland on either side of this meadow-wetland system, which rises 200-400 feet above the SFLC bottoms, appears to supply both a largely seasonal surface drainage to the SFLC, as well as a complex pattern of both seasonal and persistent soil wetting by groundwater. Plant communities strongly influenced by either seasonal or persistent groundwater wetting were found a) on DNR land south of the SFLC at the far W edge of the meadow-wetland system, b) at points along the S side of the SFLC, including along the Creek edge, at the meadow-wetland/forest interface, and at points in between, and c) within each of the two major N lobes. Additionally, a relatively large area of persistent groundwater discharge occurs in alder and spruce woods adjacent at the far upper end of the smaller, W-most of these two lobes. While this meadow-wetland system is very notable for the relatively large number (16) of fen indicator taxa detected, these taxa for the most part were detected in small numbers within a large number of smallish, non-contiguous fen habitats occurring over much of the extent of the system. Perhaps the largest of these local fens, and likely the most species-rich, is the short-statured fen on DNR land at the far western edge of the meadow-wetland system. While not exclusively detected at this site, eight of the 16 fen indicator taxa found within the full meadow-wetland system, were seen here.
Photos: 2691, 2692, 2695, 2699, 2700, 2701, 2703, 2704, 2705, 2702, 2708, 2709

5. 3116-015 rd., Tacoma Creek drainage.
Elevation: 2800 feet
TRS: T34N, R43E, S21
Date: 8/14/2017
Rationale: NWI PEM1C
Examiner: Dewey
Plants: Graminoids – PHAR3, CAVE6, CAUT, CALAA, **CACU5**, AGSC5, CAPA14, **JUEN**, SCMI2, CACA11, **CAIN11**
Forbs – VIOLA, COPA28, EPILO, ASOC, EQFL, SPARG, POTAM
Shrubs – SPDO, ALNUS
Bryophytes – **SPHAG2**, AUPA70, **CAST70**
Soil probes: In middle of south meadow, probe found low-resistance, apparent organic soil to 51+; residue smooth, with no trace of grit. Probe at southern edge of inundation in north meadow found moderately low resistance to first notable, +/- gritty layer at 36", with firm base to follow at 38".
Notes: This site can be viewed as consisting of a pair of closely adjacent, very low gradient (essentially flat) interconnected shrub-meadows. The southern shrub-meadow consists of a damper southern half with stronger meadow character due to a lower density and lower general height of SPDO; waking through the less damp northern portion of this shrub-meadow is somewhat challenging due to the higher density and generally greater SPDO height (mostly 3-4

feet, but sometimes as much as 5 feet). The deep, apparent organic soil detected in mid-meadow suggest a history, if not present status, of persistent or prolonged seasonal soil wetness. The north shrub-meadow features a central pond/area of persistent inundation, with soil too soft, and water too high to permit exploration in 12" boots. This shrub-meadow system is mapped as the headwaters of a tributary to Tacoma Creek, although no well-developed channel was detected exiting the meadow system. The source of water wetting this meadow system is not obvious; groundwater discharge, even seasonal, is not evident at the edges or within the system.
Photos: #3575.

6. 3116-004 rd., Tacoma Creek drainage.
Elevation: 2700 feet
TRS: T34N, R43E, S28
Date: 8/14/2017
Rationale: NWI PEM1C
Examiner: Dewey
Plants: Graminoids – CAVE, CALAA
Forbs – COPA28, EQFL
Shrubs – SPDO
Soil probes: One probe in mid-meadow found low resistance, uniform, apparently organic soil to 51+"; little residue, no grit.
Notes: This is an apparently zero gradient meadow with extremely low plant diversity. Paucity of soil-dwelling bryophytes and common presence of a crisp, dry, parchment-like, compressed thatch soil surface indicate that this meadow experiences periodic, likely seasonal, inundation. Source of water that periodically wets this meadow is not obvious, but any significant contribution by groundwater discharge appears unlikely.
Photos: None.

7. 1921-055 rd.
Elevation: 2800 feet
TRS: T34N, R44E, R27
Date: 8/14/2017
Rationale: NWI PEM1C
Examiner: Dewey
Plants: Graminoids – **CACU5**, **JUEN**
Forbs – TYPHA, SPARG, MIGU
Shrubs – SPDO
Bryophytes – COCO38

Soil probes: None.
Notes: Site is a flat valley bottom, essentially a creek terrace. No groundwater-fed wetland habitat here.
Photos: #3577.

8. 5030-166 rd.
Elevation: 3400 feet
TRS: T34N, R44E, S23
Date: 8/14/2017
Rationale: NWI PEM1C
Examiner: Dewey
Plants: Graminoids – PHAR3, CASTS3, **JUEN**
Forbs – LEVU, HYPE, CEST8, MIGU
Bryophytes - AUPA70, PHFO6
Soil probes: Probe on soppy soil makes immediate contact with coarse grit.
Notes: Site appears to be a weedy, +/- flat riparian terrace with active and dry braided channels. Local soil soppiness apparently due to adjacency to active channels. Little reason to suppose any significant groundwater influence.
Photos: #3578.

9. 1200-250 rd.
Elevation: 4500 feet
TRS: T35N, R45E, S6
Date: 8/15/2017
Rationale: NWI PEM1C
Examiner: Dewey
Plants: Graminoids – **CAEC**, CACA11, CALE10, CAUT, **JUEN,** CACA4, AGROS2
Forbs – SETR, EQUIS, RAUN, **PEGR2**, ASFO, GEMA4, COPA28, EPILO, PAPS5, EQAR, **PLST4**, **SAOR2**
Bryophytes – BRFR70, BLTR2, **WAEX**, FONTI, **SPHAG2**, AUPA70, PHFO6, **CAST70**
Soil probes: Five probes up the middle of this wetland-meadow detected apparent organic soil thicknesses ranging from 24-50". All probes encountered moderately low resistance/low density soil.
Notes: This site is included within an isolated section of COL NF, accessible by roads through state and private lands to the south. The wetland slopes gently downward from NNW to SSE. The far SSE end of this wetland was soppy-wet/shallowly inundated at the time of visit. This wetness is due, apparently in large part, to spillage from a small creek that runs along the lower eastern side of the wetland before entering, and largely disappearing into this far end of the wetland. Moving north though mid-meadow, soil moisture quickly lessens, becoming no more than damp. Beyond midway up the meadow, the soil became gradually damper, then rather quickly turned soppy wet in the upper 30-40 m of the meadow. This wetness appears to be rather clearly and primarily due to persistent groundwater discharge, and forms a more or less central swath down the upper portion of the meadow. Underfoot, the meadow has much soft, low-density, matted thatch that frequently is melded together forming parchment-like sheets indicative of early season inundation.
Photos: #s 3579, 3580, 3581, 3584-3585, 3586.

Colville National Forest – Three Rivers Ranger District

1. Little Twin Lakes, C-4920 rd.
Elevation: 3720 feet
TRS: T35N, R41E, S4
Date: 8/17/2015
Rationale: NWI PEM1C
Examiner: Dewey
Plants: Graminoids – CAUT, SCMI2, CALAA, **JUEN**
Forbs – EQAR, ASTER, MEAR4, COPA28, PEFR5
Shrubs – ALNUS, SPDO
Bryophytes – AUPA70
Soil probes: Probe in northern half of south meadow found pure, uniform organic soil to firm base at 48"; probe in northern shrub-meadow found very dense moist-dry soil allowing probe to depth of only 1-2"; probe on damp soil along channel exiting southern end of northern meadow found organic soil to 52+" with thin inorganic stratum at 48".
Notes: Site consists of a northern shrub-meadow mapped as PEM1C, connected by a narrow riparian corridor to a southern meadow, also mapped as PEM1C. The northern and southern portions of this meadow system appear to intermittently drain into the connecting corridor where the confluent channels drain out of the system to the east. Mats of compressed, annealed thatch within the connecting corridor suggest that this portion of the meadow system is subject to seasonal inundation. Mosses are essentially absent from this 3-part meadow system, which shows no evidence of significant influence by groundwater.
Photos: None.

2. 7018-600 rd.
Elevation: 3290 feet
TRS: T37N, R42E, S34
Date: 8/17/2015
Rationale: Staff recommendation; NWI PEM1C
Examiner: Dewey
Plants: Graminoids – **ELQU2**, CAUT, CABU6, CALAA, PHAR3
Forbs – COPA28, **PEGR2**
Shrubs – ALNUS, **BEGL**, SPDO
Bryophytes – **SPHAG2**, AUPA70, CLDE70, **PLEL2**, CHPO14, **WAEX, HYPR70**
Soil probes: Probe midway along eastern edge of main meadow found very dense organic soil to firm base at 26"; in seepy, squishy-wet woods approximately 100m NNE of far north end of main meadow, low-density organic soil to coarse sand at 22"; in moist soil at far southern end of narrowed, sinuous, southern portion of meadow, moderately resistant, pure organic soil to apparent firm base at 54"; at +/- center of main meadow, dense, pure organic soil to 54+".
Notes: Hydrologically, this is a very interesting meadow. No evident surface water channels were detected entering or leaving this meadow along any edge. The meadow consists of a main meadow approximately 310m (N-S) by 90m (E-W) that continues south as a much narrowed, sinuous, lightly shrubby lobe. The meadow system initially appears to be slopeless, but more careful examination

indicates the presence of a very slight downward gradient from south to north. Seasonal groundwater discharge, along with seasonal inundation, is evident at the far southern end of this lobe. Active groundwater discharge was in progress in the woods adjacent to the far northern end of the main meadow. This discharge is initially very spatially diffuse and not associated with discernable channels; with travel NNE, this discharge becomes somewhat more spatially restricted and associated with weakly discernable, multiple, meandering channels. It's interesting that although these channels appear to eventually feed into a notable slope break and associated ravine, this drainage flattens out as it approaches an intersection with the 7020 (Rocky Creek) road, any seasonal surface water appears to recharge here, and no culvert is in place at this intersection. Soils in the main meadow and the southern lobe were little more than moist, at best, at the time of visit, but depth of organic soils detected here suggest that this meadow system has historically experienced persistent wetting, apparently largely due to groundwater discharge. It's possible the groundwater aquifer(s) serving this meadow system are fairly small and local, and their water delivery capacity is especially vulnerable to consecutive below average water years. A central N-S oriented, vegetated channel is discernable in the southern 1/3-1/2 of the main meadow, but can be seen running centrally through the full length of main meadow in aerial imagery. Aerial imagery indicates the presence of a second, shorter channel running along the eastern edge of the main meadow's northern half. This location corresponds to vegetative evidence (presence of the mosses *Sphagnum* and *Climacium dendroides*) of seasonal groundwater discharge along this same edge. The scarcely arcing courses of these features in an essentially flat meadow, strongly suggests that these are human-made drainage ditches, not natural channels. This interpretation would certainly agree with the observation that this meadow system is currently heavily grazed by cattle. Extreme soil pitting and de-vegetation are present everywhere current or seasonal groundwater discharge is evident. The high soil density at three of the four soil probe sites may in part owe to oxidation of the extensive peaty soils, but compaction by livestock use is likely an important causative factor as well. A late spring or early summer visit to this meadow system, particularly during an average or above average water year could be very informative with regard to extent and intensity of groundwater discharge and effectiveness of the ditches in meadow drainage. This meadow system very much deserves consideration for grazing relief and hydrologic restoration. Final note: A forest staff member recalled seeing the groundwater-loving sundew (*Drosera* sp.) within this meadow system. It was not detected during this visit, but this taxon can be quite cryptic late in the season of a below average water year.
Photos: #s 2688-2689, 2690.

3. Elbow Lake, 1500-600 rd.
Elevation: 2880 feet.
TRS: T40, R38E, S21
Date: 9/9/2015
Rationale: Staff recommendation
Examiner: Dewey
Plants: Graminoids – CAUT, SCIRP, TYPHA
Forbs – EQUIS, LEMNA, ATFI, VERON, EPILO, SPARG, NUPHA, MIGU, ASTER, COPA28,
Shrubs – ALNUS
Bryophytes – CAGI70, **DRAD2**, SAUN8, BRFR70, BRACH10, AMBLY4
Soil probes: in soppy-wet band of vegetation separating northern and southern bodies of lake, mix of organic and inorganic soil to firm base at 36"; at CAGI70 site in wooded wetland mapped as PEM1F,

shortly above northern body of lake, mix of organic and inorganic soil to 52+"; at eastern edge of bull rush marsh immediately above northern body of lake, low-density pure organic soil to 52+".
Notes: Elbow Lake consists of northern and southern portions separated by a bridge of soppy-wet, vegetated soil only slightly elevated above the surface of the lake bodies on either side. No evidence of direct groundwater input to the either lake body was detected. The channel of an intermittent reach of the West Fork of Crown Creek flows from N to S through the Lake. A wetland lies adjacent to and immediately up-channel from the northern end of the Lake. The wetland is consists of bulrush marsh adjacent to the Lake, transitioning to woodland up-channel where soil moisture transitions from soppy-wet to merely damp. Multiple, weakly-defined channels occur within the wooded wetland, but none of these was actively carrying water at the time of visit. The source of water wetting the wooded wetland was not apparent, although groundwater input along the margins of the wooded wetland was not evident.
Photos: #s 2776-2777.

4. 9500-585 rd.
Elevation: 4200 feet
TRS: T36N, R37E, S8
Date: 8/21/2017
Rationale: NWI PEMC
Examiner: Dewey
Plants: Graminoids – **CAEC**, CAUT, ERCH7, CALE10, **JUEN**, **JUNE**, JUBA
Forbs – ASTER, LYAM3, **PLST4**, **PLDI3**, EQAR, COPA28
Shrubs – ALNUS
Bryophytes – AUPA70, **SPHAG2**, **CAST70**, BRPS, SCAPA
Soil probes: Single probe in southeast corner of wetland found resistant soil to apparent aquitard at 36" which was punched through to moderately resistant soil to 51+"; no inorganics evident anywhere along probe.
Notes: This site features a smallish wet meadow at its southern end, transitioning into a progressively drier, but obviously seasonally wet *Alnus* stand. A creeklet runs SE to NW along the eastern edge of this wetland. The southern and especially, SW edge of this wetland are very wet at the interface of a forested slope and the flat wetland. Groundwater discharging at this interface pools up forming an essentially impassibly wet-soiled band occupied by LYAM3. This free surface water makes its way into the main body of the flat wetland via surface and presumably, shallow subsurface flow. Most of the area of this wetland that was wet at the time of visit is then, apparently wetted by second-order groundwater, with the first-order groundwater wetting occurring only at the wetland/forest interface. This wetland is dominated by a *Carex* species of uncertain identity. With its very long inflorescence bracts, compact, closely spaced female spikes featuring trigonous achenes with persistent styles enclosed within small, inflated perigynia, it appear to be closely related to species such as *C. rostrata* and *C. retrorsa*, yet it does not readily match any species within this group as described by Wilson et al.(2008). This is an interesting wetland, but challenging to classify. Although groundwater discharge appears to ultimately account for most of the wetland's water supply, no part of this wetland appears to qualify as a sloping fen.
Photos: #3655.

5. 9565-260 rd.
Elevation: 4100 feet
TRS: T38N, R36E, S34
Date: 8/22/2017
Rationale: NWI PEMC
Examiner: Dewey
Plants: Graminoids – SCMI2, CAUT, **CACU5,** CACA4
Forbs – **PLST4**, **PLDI3**, COPA28, EPILO, GALIU, LEMNA, EQFL
Shrubs – ALNUS
Bryophytes – **PLEL2**, **DRAD2**, CAGI70, BRPS70, BRFR70, AUPA70, MAPO16
Soil probes: Single probe in middle of the southern wetland found resistant and then less resistant soil to apparent aquitard at 31"; this punched through at 36" and then low resistance passage to 51+"; apparent organic matter on extracted rod with evidence of sand or other inorganic matter. Single probe in northern wetland found moderate resistance through rooting zone and then moderate to low resistance to 51+"; no apparent aquitard encountered; extracted probe clean.
Notes: This site features two meadow-wetlands situated on bench/bowl-like, forested terrain at an upper slope, perennial creek headwaters. Structurally and hydrologically, the two wetlands appear to be very similar, bordered by alder and cedar, with a dominance of one or two tallish (30-36") sedge species on soppy wet or shallowly inundated soil with scant moss or herb soil cover. Portions of each wetland are relatively inaccessible because of softness of inundated soils. Each wetland appears to be essentially flat; a mapped an actual creeklet actively drains NE out of the southern wetland. Low-volume springs/seeps with short distance flows occur upslope on the west side of the northern wetland. The wetlands have a low count of detected fen indicator species, which supports a sense that first-order groundwater discharge is much less important in the wetting of these wetlands relative to second-order groundwater discharge/local surface inflow and snowpack.
Photos: #3658.

Colville National Forest – Republic Ranger District

1. Sherman Pass, State Hwy. 20
Elevation: 5900 feet.
TRS: T36N, R34E, S24
Date: 9/10/2015
Rationale: Staff recommendation.
Examiner: Dewey
Plants: Graminoids – CALAM, CAUT
Forbs – EQUIS, SETR, **PLATA2**, MAIAN
Shrubs – ALNUS, SALIX, LEGL
Bryophytes – AUPA70, BRFR70, MAPO16, RHIZO2, **WAEX**
Soil probes: In squishy-wet soil shortly downslope of northern edge of cirque lake, single probe found pure organic soil to 52+".
Notes: This site was of interest due to reports of persistent soil wetness shortly below (north) of an apparent small cirque lake above Sherman Pass. In visiting this site it became apparent that this wetness is due to seepage from the lake, likely through unconsolidated glacial debris forming the northern embankment of the lake. Three primary seepage zones out of this embankment were noted in walking along the northern edge of the lake. The central and western-most of these seepage zones were associated with small, low volume, active drainage channels. Even though deep peat was detected within one of these seepage zones, the flora of the broader seepage area, which includes very few detected fen indicator taxa, suggests that this seepage water may only weakly resemble the chemical character of water typically associated with groundwater seepages.
Photos: None.

2. South Fork O'Brien Creek tributary, Forest Road 99.
Elevation: 3650 feet
TRS: T36N, R34E, S32
Date: 9/10/2015
Rationale: Staff recommendation
Examiner: Dewey
Plants: Graminoids – CAUT, CALE10
Forbs – LEMNA, VIOLA, LYCOP2
Shrubs – ALNUS
Bryophytes – MAPO16, AUPA70, BRPS70, PHFO6, **PLEL2**, **DREPA3**, CLDE70, **TONI70**, **HEBL2**, THRE7, PLSC70, HYSP70
Soil probes: At eastern edge of northern opening in wetland complex, 6-8" organic soil over coarse sand continuing to firm base at 22"; shortly further west into northern opening at DREPA3 site, 23" organic soil over coarse sand; in channel of active creeklet near DREPA3 site, 40" organic soil over coarse sand; at eastern extent of HEBL2 at base of sloping short-statured fen community in SW corner of northern opening, 42" organic soil with minor inorganic component over sandy base extending to 52+"; at gentle upslope extent of HEBL2, pure organic soil to 52+"; in a active channel at northern edge of southern opening in this wetland complex, 18" organic soil over coarse sand; at THRE7 site in wooded western edge of southern opening, 33" organic soil over coarse sand.

Notes: This site is a hydrologically and structurally complex valley bottom wetland consisting of a network of small, active channels and patches of open, shrubby, and wooded fen. It is mapped in the NWI system as a larger polygon (470m long) enclosing two much smaller polygons. The smaller polygons are classified as PUBHb and the enclosing, larger polygon is identified as PSSCB. Without the recommendation of Forest staff ("it's always wet there"), this combination of NWI codes by itself would not have drawn the project lead to this site. This is the only mapped wetland along this tributary to the South Fork O'Brien Creek which originates approximately 1200m south of the wetland along the eastern base and flank of Iron Mountain. The source of wetness in the relatively short stretch of valley bottom wetland explored (approximately 150m), clearly appears to be groundwater discharging at the NE base of Iron Mountain, which rises 1000 feet above the wetland's southwestern edge. It seems likely that much of the water within these numerous small channels is derived via local, subsurface groundwater interception. Soil along the wooded southwestern edge of the wetland is damp to soppy-wet, while soil shortly into the wooded northeastern edge of the wetland was moist to dry at the time of visit. Where sampled, soil along the northeastern edge of the wetland features relatively shallow organic layers over coarse sand; the thickness of this organic layer increases markedly southwestward across the wetland, with the thickest layers detected along the gently upward sloping southwestern edge of the wetland. The uncommon to rare mosses detected during this visit, including TONI70, HEBL2, and THRE7, were all found along this southwestern edge. Current land management practices at this site very much need review. The persistently wet, peaty soils associated with groundwater-rich ecosystems are highly susceptible to degradation by livestock use, and the degradation due to such use is painfully evident at this site. Bare peat in the wettest areas of the wetland and pit and pedestal formation elsewhere, is extensive and intensive. Very rotten, down, wet tree boles which are currently colonized by a variety leafy liverwort species are regularly being kicked apart by cattle.
Photos: #s 2781-2782, 2783, 2784-2786, 2787-2788, 2789.

3. Hall Creek Ponds, 2050-600 rd.
Elevation: 4650 feet
TRS: T35N, R34E, S16
Date: 9/11/2015
Rationale: Staff recommendation
Examiner: Dewey
Plants: Graminoids – CALAM, AGROS2, **CAIN11**, CAUT, CALAA, **SCPAA3**, **CALI7**
Forbs – COPA28, NUPHA
Shrubs – ALNUS
Bryophytes – AUPA70, **SPHAG2**, CALLI10, **WAEX**
Soil probes: In northern lobe of this dumbbell-shaped wetland, a) in bare-soiled tall sedge community in northern portion of this lobe, highly resistant organic soil to +/- firm base at 38"; b) at edge of quaking CAUT patch, very low density (single-handed insertion of probe) organic soil to 52+" (quaking and easy probe insertion suggests organic soil layer of undetermined thickness overtopping a body of free water); c) at edge of quaking CALAA patch, very low density organic soil to 52+"; In southern lobe, a) in SPHAG2 carpet along W edge of lobe, resistant, +/- organic soil with a thin, included, sandy layer or two to coarse sandy base at 52"; b) multiple probes in quaking CALAA-CAUT community along pond margin found very low density organic soil to 52+".

Notes: This site occupies an interesting geomorphologic feature, namely, a N-S oriented, 400mx≤100m two-parted terrace tucked into a SE aspect slope approximately 100 feet below that slope's ridgeline. The northern portion of this terrace averages approximately 5 feet higher than the southern portion of the terrace with the two portions separated by a narrow, low bridge of land. A large pond is centrally located in the southern portion of this terrace; a pond appears to have also existed in the northern part of the terrace, but likely has been overtopped by peat-forming herbaceous vegetation, and is detectable now primarily by quaking soil above its overtopped water. Quaking peat around the margin of the pond in the southern portion of the terrace indicates that it is in the midst of being overtopped as well. The southern half of the northern portion of the terrace features sparse NUPHA plants lying on bare peat, and indication of regular seasonal inundation of this area. Indeed, the relatively flat topography and scarce cover of bryophytes at both northern and southern portions of the terrace suggests that seasonal inundation may be a frequent occurrence throughout the terrace. In walking the edges of each terrace portion, no compelling evidence of groundwater contribution to wetness across the terrace, even seasonally, was detected. At the same time, no well-developed surface water input channels were noted at any point along the terrace periphery. While no output channels were noted along the edges of the northern portion of the terrace, a weakly developed output channel was found along the central eastern edge of the southern portion of the terrace. This channel appears to primarily serve to drain periodic high water levels in the adjacent pond.
Photos: #s 2790, 2792, 2793, 2794, 2795, 2796, 2796.

4. 2149 rd.
Elevation: 3800 feet
TRS: T38N, R32E, S10
Date: 9/12/2015
Rationale: NWI PEMC
Examiner: Dewey
Plants: Graminoids – CAUT, **ERGR8**, AGROS2, **CATE5**, CALAA
Forbs – SPARG, COPA28, VIOLA, **DRAN**
Shrubs – **BEGL**
Bryophytes – AUPA70, **SPHAG2**, **CAST70**, CLDE70
Soil probes: At far N end of meadow, in seasonally inundated, largely bare soil, sandy organic soil to firm base at 22"; shortly S of above site, in SPARG patch, variable density organic soil to coarse sandy organic soil at 52"; at mid-meadow (N-S) in CAUT/COPA28, pure organic soil to 52+"; within short-statured SPHAG2-CAST70-AUPA70/CATE5/COPA28 community in southern 1/3 of wetland, pure organic soil to 52+"; in quaking CAUT community in southern 1/3 of wetland, very low density pure organic soil to 52+".
Notes: This is an elongate (N-S) wetland with narrow northern and southern portions and a relatively broad central portion. The elongate southern portion of the wetland was not explored, because brief entry into its northern portion indicated generally drier soils and a dominance of tall sedge and grass species. Over its full length (approximately 600m), the wetland is essentially slopeless; along the midsection (N-S) of the full length of the wetland, R6 Digital Elevation Modeling indicates elevations almost entirely within the range of 3812.0 – 3812.9. The far northern end of the wetland appears to sit at topographic saddle in a narrow valley between tall ridges to both the west and east. Although soil moisture was patchy at the time of visit, wetland soils were generally at least damp and especially in the southern half of the central portion, often wet. The source of water responsible for wetting the wetland's soils is not

obvious. No well-developed surface water input channels were detected at any point along the edges of the wetland; no well-developed channels were observed within the wetland. Groundwater discharge along the wetland edges was evident only along the edges southern half of the central portion; discharge appears to be primarily seasonal. Occasional sampling suggests the soil within the wetland typically includes an upper layer of 52+" peat. Matted thatch and scarce moss cover over soil in much of the wetland indicates frequent seasonal inundation of the narrow northern portion of the wetland. Much of the southern half of the central portion of the wetland features the highest plant diversity within the wetland, including a wet-soiled, short-statured BEGL/CATE5-CAUT-CALAA/DRAN-COPA28/SPHAG2-CAST70-AUPA70 plant community. Immediately adjacent along the eastern edge of the short-statured community is a narrow, elongate (N-S) CAUT community on quaking peat. During a revisit to this wetland on 10/16/2015, probes within this area of quaking soil, and with portions of the short-statured community found very low density soil with no base reached with a 20 foot probe. This strongly suggests that a pond, overtopped by peat-forming vegetation, lies beneath this local portion of the wetland. Less dramatically quaking soil noted at the northern end of the wetland suggest that an overtopped pond may exist here as well. This is biophysically a very interesting wetland. Additional effort to better understand water source(s) for the wetland promise to be very informative. Additional efforts to document the existence of an overtopped pond within the wetland's south-central portion promise to be very informative as well. The presence of essentially a short-statured fen community within the central portion of the wetland is the most notable botanical feature of this wetland. Along with the presence of the groundwater-loving plant species BEGL, ERGR8, DRAN and CAST70, this community includes a robust population of the very rare Washington sedge, CATE5. This wetland needs a review of current management practices. Current use by cattle is causing intense soil impacts along portions of the wetland margin. Cattle use appears to be currently light within the short-statured community, but the community, with its rare or uncommon plants species on saturated peat soils, is very susceptible to damage by any increase in rates of visitation by cattle.
Photos: #s 2798, 2800, 2801, 2802, 2803-2804, 2805-2806, 2807, 2808.

5. 5330-100 rd.
Elevation: 3300 feet
TRS: T35N, R32E, S9/16
Date: 8/22/2017
Rationale: NWI PEMC
Examiner: Dewey
Plants: Graminoids – CAUT, **CADI4**, **CAAQ**
Forbs – COPA28, EPILO
Bryophytes – **DRAD2**, AMBLY4
Soil probes: Single probe in NE quadrant of southern meadow-wetland moderately low resistance to possible, 1-2" thick aquitard at 40"; below this, low resistance to 51+"; no evidence of sand or other inorganic matter in residue on extracted probe. Single probe in southern end of northern meadow-wetland found moderately low resistance to likely, 1" thick aquitard at 37"; below this, low resistance to 51+"; no evidence of sand or other inorganic matter in residue on extracted probe.
Notes: This site features two adjacent, essentially flat, wetland-meadows within a broad swail on a gentle east-aspect forested slope. Large portions of each of these wetlands are too wet to

access in 12” bog boots. Soils are very soft, even when not shallowly inundated. A festering goop was present on the soil in the middle of the southern wetland. The may have been the remains of a thick growth of filamentous algae earlier in the season. Each wetland is dominated by tall (36-48”) sedges and has a generally sparse soil cover of forbs and mosses. Plant species diversity is very low. These wetlands are much too large to be primarily wetted by first-order groundwater discharge. Snowmelt and second-order groundwater discharge/local surface water catchment appear to be the primary sources of wetness within these wetlands. The northern wetland has some notably mixed micro-topography. Ducks were heard on likely shallow ponds in the northern half of the northern wetland. *Carex diandra* was detected on a very minor rise within the southern portion of the northern wetland. It is notable the Wilson et al. describe this species as inhabiting “diverse wetlands with relatively stable water levels dependent on groundwater rather than surface runoff, usually on peat soils.”
Photos: #s 3659, 3660.

Appendix C

Plant taxa noted during course of field site visits on Naches and Tonasket Ranger Districts and Colville National Forest.

Naches Ranger District		
	Taxon	**Code**
Graminoids		
	Agrostis sp.	AGROS2
	Carex aquatilis	CAAQ
	Carex buxbaumii	CABU6
	Carex canescens	CACA11
	Carex cusickii	CACU5
	Carex echinata	CAEC
	Carex jonesii	CAJO
	Carex leptalea	CALE10
	Carex luzulina	CALU7
	Carex neurophora	CANE6
	Carex nigricans	CANI2
	Carex retrorsa	CARE4
	Carex simulata	CASI2
	Carex scopulorum	CASC12
	Carex utriculata	CAUT
	Carex vesicaria	CAVE6
	Eleocharis quinqueflora	ELQU2
	Eriophorum angustifolium	ERAN6
	Eriophorum gracile	ERGR8
	Juncus balitcus	JUBA
	Juncus ensifolius	JUEN
	Phleum sp.	PHLEU
	Scirpus sp.	SCIRP
	Scirpus microcarpus	SCMI2
Forbs		
	Aster sp.	ASTER
	Athyrium sp.	ATHYR
	Dulichium arundinaceum	DUAR3
	Epilobium sp.	EPILO
	Epilobium brachycarpum	EPBR3
	Equisetum arvense	EQAR
	Equisetum sp.	EQUIS
	Galium sp.	GALIU
	Gentiana sp.	GENTI
	Geum macrophullum	GEMA4
	Hypericum anagalloides	HYAN2
	Lysichiton americanus	LYAM3
	Menyanthes trifoliata	METR3
	Mimulus guttatus	MIGU
	Mimulus primuloides	MIPR
	Nuphar sp.	NUPHA
	Pedicularis groenlandica	PEGR2
	Platanthera sp.	PLATA2
	Platanthera dilitata	PLDI3
	Polemonium occidentale	POOC2

	Potamogeton sp.	POTAM
	Saxifraga oregana	SAOR2
	Scheuchzeria palustris ssp. *americana*	SCPAA3
	Sparganium sp.	SPARG
	Spiranthes romanzoffiana	SPRO
	Triantha glutinosa	TRGL5
	Utricularia minor	UTMI
	Veronica sp.	VERON
	Veratrum sp.	VERAT
	Viola sp.	VIOLA
Shrubs		
	Alnus incana	ALIN2
	Alnus sp.	ALNUS
	Cassiope sp.	CASSI3
	Kalmia microphylla	KAMI
	Ledum sp.	LEDUM
	Luetkea pectinata	LUPE
	Phyllodoce sp.	PHYLL3
	Salix sp.	SALIX
	Spiraea douglasii	SPDO
	Vaccinium sp.	VACCI
	Vacciniium uliginosum	VAUL
Bryophytes		
	Aulacomnium palustre	AUPA70
	Brachythecium frigidum	BRFR70
	Bryum pseudotriquetrum	BRPS70
	Calliergon cordifolium	CACO70
	Calliergon stramineum	CAST70
	Calliergonella cuspidata	CACU18
	Calypogeia fissa	CAFI12
	Chiloscyphus polyanthos	CHPO14
	Drepanocladus aduncus	DRAD2
	Drepanocladus capillifolius	DRCA12
	Hamatocaulis vernicosus	HAVE70
	Harpanthus flotovianus	HAFL9
	Helodium blandowii	HEBL2
	Hypnum pratense	HYPR70
	Marchantia polymorpha	MAPO16
	Meesia triquetra	METR70
	Philonotis fontana	PHFO6
	Plagiomnium ellipticum	PLEL2
	Rhizomnium sp.	RHIZO2
	Rhytidiadelphus squarrosus	RHSQ70
	Sanionia uncinata	SAUN8
	Scapania irrigua	SCIR
	Scapania paludosa	SCPA24
	Sphagnum sp.	SPHAG2
	Warnstorfia exannulata	WAEX

Tonasket Ranger District		
	Taxon	**Code**
Graminoids		
	Carex aquatilis	CAAQ
	Carex aurea	CAAU3
	Carex buxbaumii	CABU6
	Carex canescens	CACA11
	Carex capillaris	CACA12
	Carex disperma	CADI6
	Carex interior	CAIN11
	Carex leptalea	CALE10
	Carex magellanica	CAMA12
	Carex scopulorum	CASC12
	Carex tenuiflora	CATE5
	Carex utriculata	CAUT
	Danthonia sp.	DANTH
	Eleocharis palustris	ELPA3
	Eleocharis quinqueflora	ELQU2
	Eriophorum gracile	ERGR8
	Eriophorum sp.	ERIOP
	Juncus ensifolius	JUEN
Forbs		
	Achillea millefolium	ACMI2
	Allium vallidum	ALVA
	Arnica sp.	ARNIC
	Aster sp.	ASTER
	Caltha sp.	CALTH
	Castilleja sp.	CASTI2
	Epilobium angustifolium	EPAN2
	Equisetum arvense	EQAR
	Galium sp.	GALIU
	Geum macrophyllum	GEMA4
	Lonicera sp.	LONIC
	Lupinus sp.	LUPIN
	Lycopodium sp.	LYCOP2
	Menyanthes trifoliata	METR3
	Parnassia fimbriata	PAFI3
	Pedicularis groenlandica	PEGR2
	Petasites sp.	PETAS
	Platanthera dilitata	PLDI3
	Platanthera sp.	PLATA2
	Potentilla sp.	POTEN
	Pyrolla sp.	PYROL
	Ranunculus sp.	RANUN
	Senecio triangularis	SETR
	Taraxacum sp.	TARAX
	Utricularia minor	UTMI
	Valeriana sp.	VALER
	Zigadenus sp.	ZIGAD
Shrubs		
	Alnus sp.	ALNUS
	Betula glandulosa	BEGL

	Dasiphora fruticosa	DAFR6
	Salix brachycarpa	SABR
	Salix sp.	SALIX
	Symphoricarpos sp.	SYMPH
Bryophytes		
	Aulacomniium palustre	AUPA70
	Brachythecium frigidum	BRFR70
	Bryum pseudotriquetrum	BRPS70
	Bryum weigelii	BRWE70
	Calliergon giganteum	CAGI70
	Calliergon richardsonii	CARI70
	Calliergon stramineum	CAST70
	Campylium polygamum	CAPO17
	Campylium stellatum	CAST51
	Cephalozia pleniceps	CEPL3
	Drepanocladus aduncus	DRAD2
	Drepanocladus sp.	DREPA3
	Fissidens osmundioides	FIOS70
	Geocalyx graveolens	GEGR8
	Harpanthus flotovianus	HAFL9
	Helodium blandowii	HEBL2
	Hypnum pratense	HYPR70
	Lophozia gillmanii	LOGI3
	Marchantia polymorpha	MAPO16
	Paludella squarrosa	PASQ70
	Palustriella commutata	PACO47
	Philonotis fontana	PHFO6
	Plagiochila asplenioides	PLAS6
	Plagiomnium ellipticum	PLEL2
	Pleurozium schreberi	PLSC70
	Rhizomnium gracile	RHGR5
	Rhizomnium sp.	RHIZO2
	Sanionia uncinata	SAUN8
	Scapania sp.	SCAPA
	Scorpidium cossonii	SCCO18
	Scorpidium scorpioides	SCSC70
	Sphagnum compactum	SPCO70
	Sphagnum fuscum	SPFU70
	Sphagnum sp.	SPHAG2
	Sphagnum warnstorfii	SPWA70
	Splachnum sphaericum	SPSP70
	Thuidium recognitum	THRE7
	Tomentypnum nitens	TONI70
	Warnstorfia exannulata	WAEX

Colville National Forest		
	Taxon	**Code**
Graminoids		
	Agrostis sp.	AGROS2
	Agrostis scabra	AGSC5
	Calamagrostis canadensis	CACA4
	Calamagrostis sp.	CALAM
	Carex buxbaumii	CABU6
	Carex canescens	CACA11
	Carex cusickii	CACU5
	Carex diandra	CADI4
	Carex disperma	CADI6
	Carex echinata	CAEC
	Carex flava	CAFL4
	Carex illota	CAIL
	Carex interior	CAIN11
	Carex lasiocarpa var. *americana*	CALAA
	Carex lenticularis	CALE8
	Carex leptalea	CALE10
	Carex limosa	CALI7
	Carex magellanica	CAMA12
	Carex nebrascensis	CANE2
	Carex pachystachya	CAPA14
	Carex scopulorum	CASC12
	Carex stipata var. stipata	CASTS3
	Carex tenuiflora	CATE5
	Carex utriculata	CAUT
	Carex vesicaria	CAVE6
	Danthonia intermedia	DAIN
	Deschampsia cespitosa	DECE
	Eleocharis quinqueflora	ELQU2
	Eriophorum angustifolium	ERAN6
	Eriophorum chamissonis	ERCH7
	Eriophorum gracile	ERGR8
	Eriophorum sp.	ERIOP
	Juncus sp.	JUNCU
	Juncus ensifolius	JUEN
	Phalaris arundinaceae	PHAR3
	Scheuchzeria palustris ssp. *americana*	SCPAA3
	Schoenoplectus acutus var. *acutus*	SCACA
	Schoenoplectus acutus var. *occidentalis*	SCACO
	Scirpus microcarpus	SCMI2
	Scirpus sp.	SCIRP
	Typha sp.	TYPHA
Forbs		
	Anaphalis margaritacea	ANMA
	Aster foliaceus	
	Aster occidentalis	ASOC
	Aster sp.	ASTER
	Athyrium filix-femina	ATFI
	Botrychium sp.	BOTRY
	Castilleja sp.	CASTI2

	Centaurea stoebe	CEST8
	Cirsium arvense	CIAR4
	Comarum palustre	COPA28
	Drosera anglica	DRAN
	Drosera rotundifolia	DRRO
	Epilobium sp.	EPILO
	Equisetum arvense	EQAR
	Equisetum fluviatile	EQFL
	Equisetum sp.	EQUIS
	Geum macrophyllum	GEMA4
	Hieracium caespitosum	HICA10
	Hypericum perforatum	HYPE
	Lemna sp.	LEMNA
	Leucanthemum vulgare	LEVU
	Ligusticum canbyi	LICA2
	Lycopodium sp.	LYCOP2
	Lysichiton americanus	LYAM3
	Lupinus sp.	LUPIN
	Maianthemum sp.	MAIAN
	Mentha arvensis	MEAR4
	Menyanthes trifoliata	METR3
	Mimulus guttatus	MIGU
	Nuphar sp.	NUPHA
	Packera pseudaurea	PAPS5
	Pedicularis groenlandica	PEGR2
	Petasites frigidus	PEFR5
	Platanthera dilitata	PLDI3
	Platanthera sp.	PLATA2
	Platanthera stricta	PLST4
	Polemonium occidentale	POOC2
	Potamogeton sp.	POTAM
	Ranunculus uncinatus	RAUN
	Rumex sp.	RUMEX
	Saxifraga rhomboidea	SARH2
	Saxifraga oregana	SAOR2
	Saxifraga sp.	SAXIF
	Scheuchzeria palustris ssp. americana	SCPAA3
	Senecio triangularis	SETR
	Solidago sp.	SOLID
	Spaganium sp.	SPARG
	Spiranthes romanzoffiana	SPRO
	Utricularia minor	UTMI
	Verbascum thapsis	VETH
	Veronica sp.	VERON
	Viola sp.	VIOLA
Shrubs		
	Alnus sp.	ALNUS
	Betula glandulosa	BEGL
	Cornus sericea	COSE16
	Kalmia microphylla	KAMI
	Ledum glandulosum	LEGL
	Salix sp.	SALIX

	Spiraea douglasii	SPDO
	Vaccinium sp.	VACCI
Bryophytes		
	Amblystegium sp.	AMBLY4
	Aulacomnium palustre	AUPA70
	Blepharostoma trichophyllum	BLTR2
	Brachythecium frigidum	BRFR70
	Brachythecium sp.	BRACH10
	Bryum pseudotriquetrum	BRPS70
	Bryum weigelii	BRWE70
	Calliergon cordifolium	CACO70
	Calliergon giganteum	CAGI70
	Calliergon richardsonii	CARI70
	Calliergon sp.	CALLI10
	Calliergon stramineum	CAST70
	Calliergonella cuspidata	CACU18
	Campylium polygamum	CAPO17
	Campylium stellatum	CAST51
	Chiloscyphus polyanthos	CHPO14
	Climacium dendroides	CLDE70
	Conocephalum conicum	COCO38
	Dicranella palustris	DIPA20
	Drepanocladus aduncus	DRAD2
	Drepanocladus sp.	DREPA3
	Fontinalis sp.	FONTI
	Hamatocaulis vernicosus	HAVE70
	Harpanthus flotovianus	HAFL9
	Helodium blandowii	HEBL2
	Hylocomium splendens	HYSP70
	Hypnum pratense	HYPR70
	Marchantia polymorpha	MAPO16
	Meesia triquetra	METR70
	Pellia sp.	PELLI
	Philonotis fontana	PHFO6
	Plagiochila asplenioides	PLAS6
	Plagiomnium ellipticum	PLEL2
	Pleurozium schreberi	PLSC70
	Rhizomnium sp.	RHIZO2
	Sanionia uncinata	SAUN8
	Scapania paludosa	SCPA24
	Scapania sp.	SCAPA
	Scapania undulata	SCUN6
	Scorpidium cossonii	SCCO18
	Sphagnum sp.	SPHAG2
	Thuidium recognitum	THRE7
	Tomentypnum nitens	TONI70
	Warnstorfia exannulatus	WAEX

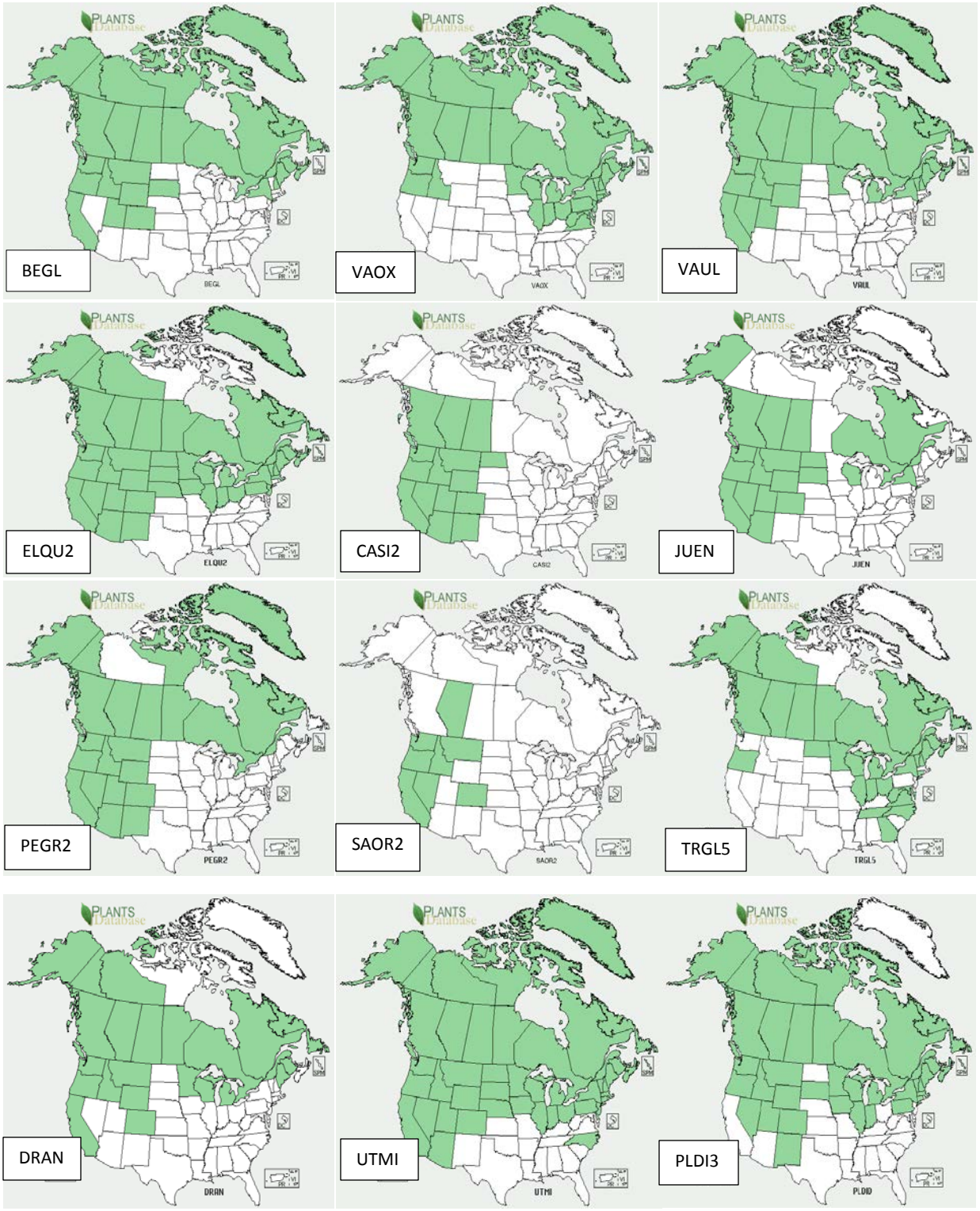
Appendix D

Current list of fen indicator taxa for Oregon and Washington developed by project lead. See Discussion section of report for more information about this group of species.

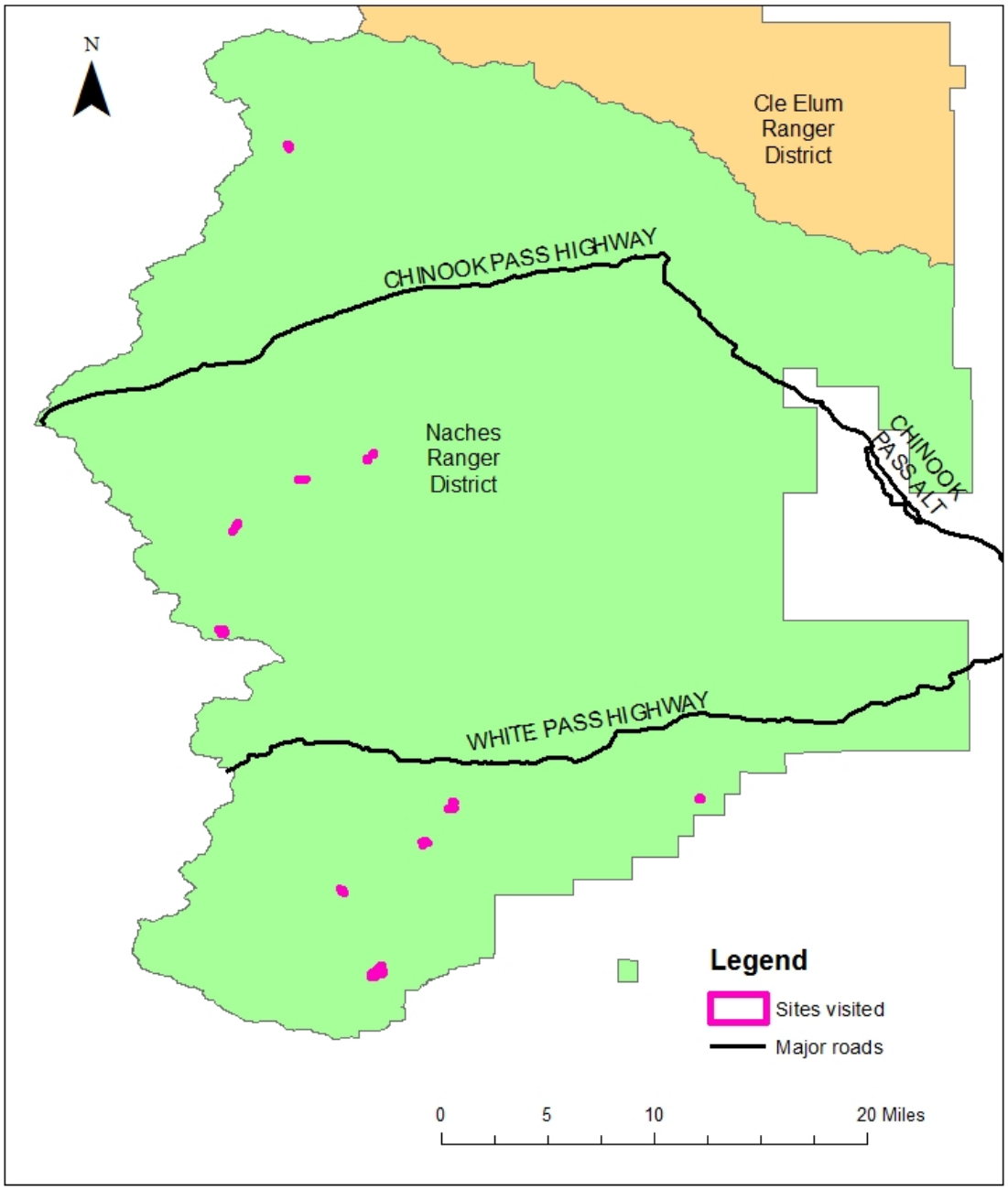
Taxon Group	Taxon Code	Scientific Name
Graminoids	CAAQ	*Carex aquatilis*
	CACU5	*Carex cusickii*
	CAEC	*Carex echinata*
	CAGY2	*Carex gynocrates*
	CAIN11	*Carex interior*
	CAJO	*Carex jonesii*
	CALI7	*Carex limosa*
	CALU7	*Carex luzulina*
	CAMA12	*Carex magellanica ssp. irrigua*
	CASI2	*Carex simulata*
	CATE5	*Carex tenuiflora*
	ELQU2	*Eleocharis quinqueflora*
	ERIOP	*Eriophorum* spp.(especially *E. gracile* and/or *E. angustifolium*)
	JUEN	*Juncus ensifolius*
	JUNE	*Juncus nevadensis*
Forbs	DODEC	*Dodecatheon* spp. (especially *D. jeffreyi*)
	DROSE	*Drosera* spp. (*D. anglica* and/or *D. rotundifolia*)
	HYAN2	*Hypericum anagalloides*
	METR3	*Menyanthes trifoliata*
	MIPR	*Mimulus primuloides*
	PEGR2	*Pedicularis groenlandica*
	PLATA2	*Platanthera* spp. (especially *P. dilatata* or *P. stricta*)
	SAOR2	*Saxifraga oregana*
	SCPAA3	*Scheuchzeria palustris* ssp. *americana*
	SPRO	*Spiranthes romanzoffiana*
	TRGL5	*Triantha glutinosa*
	UTRIC	*Utricularia* spp. (*U. minor* and/or *U. intermedia*)
Shrubs	BEGL	*Betula glandulosa*
	KAMI	*Kalmia microphylla*
	SAPE	*Salix pedicellaris*
	VAOX	*Vaccinium oxycoccos*
	VAUL	*Vaccinium uliginosum*
Mosses	CACU18	*Calliergonella cuspidata*
	CAST51	*Campylium stellatum*
	CARI70	*Calliergon richardsonii*

	CAST70	*Calliergon stramineum*
	DIPA20	*Dicranella palustris*
	DRAD2	*Drepanocladus aduncus*
	HAVE70	*Hamatocaulis vernicosus*
	HEBL2	*Helodium blandowii*
	HYPR70	*Hypnum pratense*
	METR70	*Meesia triquetra*
	MEUL70	*Meesia uliginosa*
	PASQ70	*Paludella squarrosa*
	PLEL2	*Plagiomnium ellipticum*
	SCCO18	*Scorpidium cossonii*
	SCSC70	*Scorpidium scorpioides*
	SPAM5	*Splachum ampullaceum*
	SPSP70	*Splachnum sphaericum*
	SPHAG2	*Sphagnum* spp.
	TONI70	*Tomentypnum nitens*
	WAEX	*Warnstorfia exannulata*

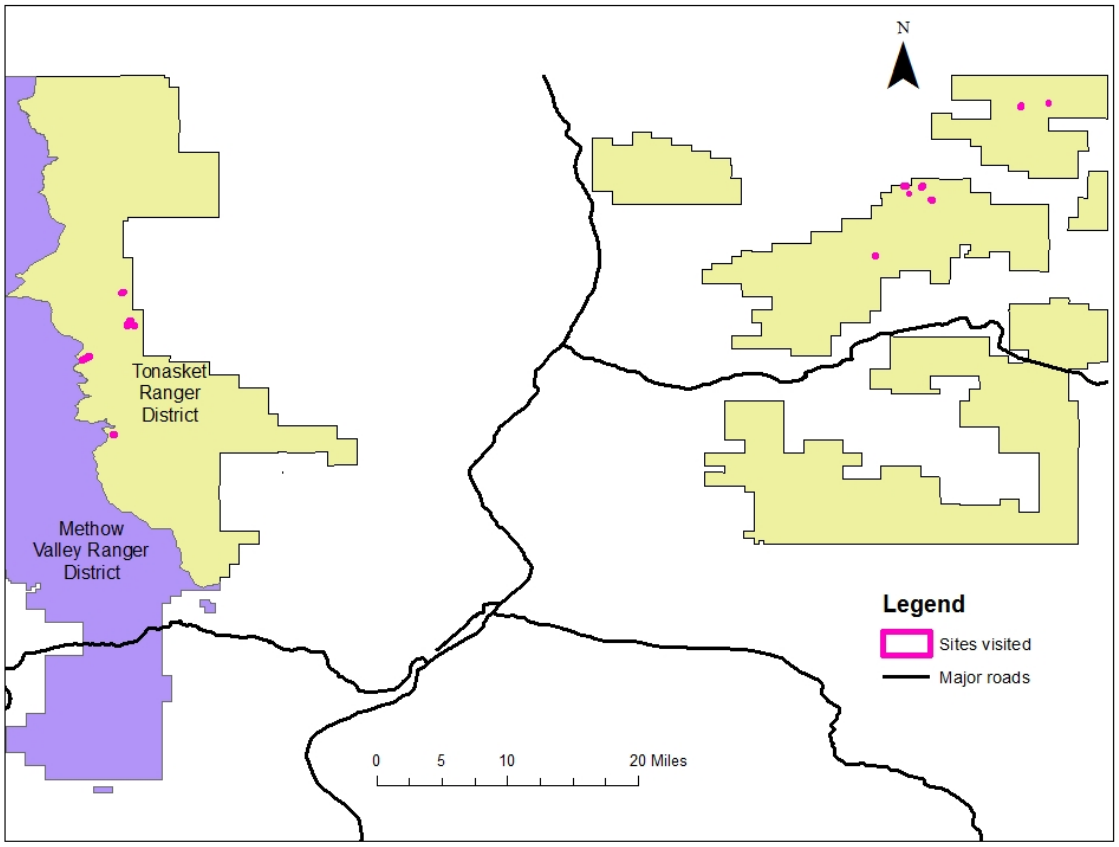
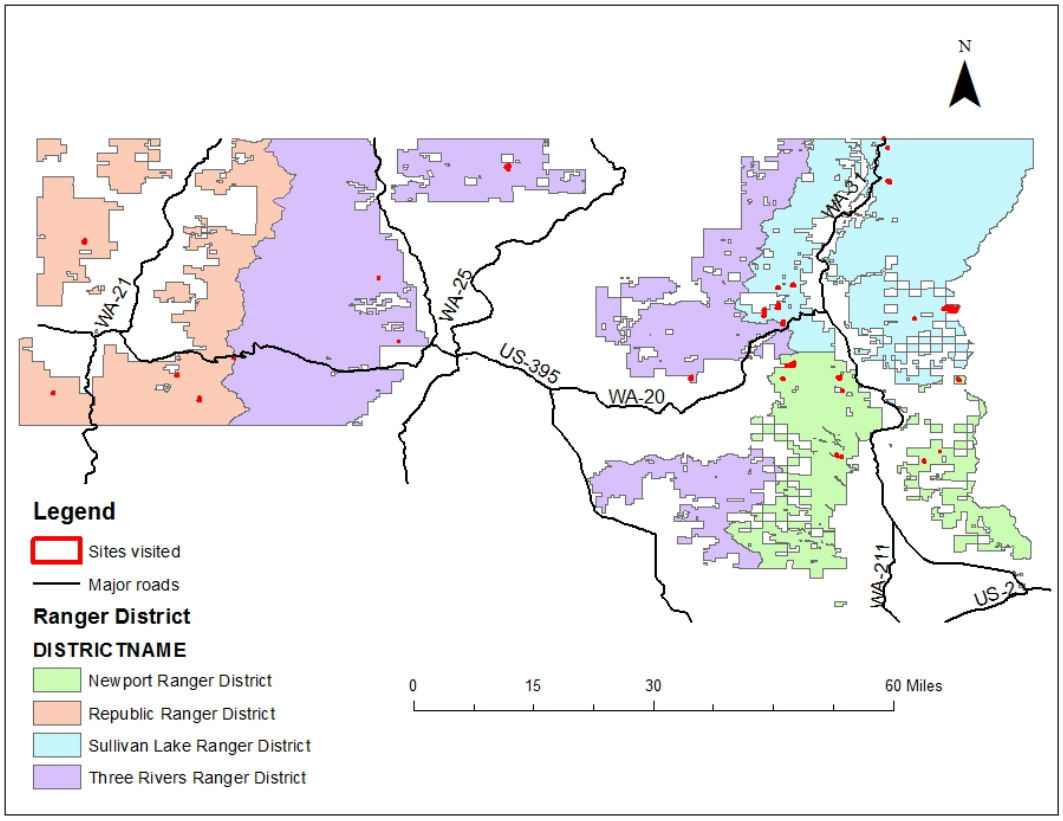
Appendix E – Biogeography of selected fen indicator taxa.



Appendix F.1. – Wetland sites visited on Naches Ranger District



Appendix F.2. Wetland sites visited on Tonasket Ranger District



Appendix F.3. Wetland sites visited on Colville National Forest