Fen Mapping for the Salmon-Challis National Forest

COLORADO NATURAL HERITAGE PROGRAM

December 2017

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Executive Summary

The Salmon-Challis National Forest (SCNF) covers 4.3 million acres in five discontinuous units within east-central Idaho. Wetlands within the SCNF provide important ecological services to both the Forest and lands downstream. Organic soil wetlands, known as fens, are an irreplaceable resource that the U.S. Forest Service has determined should be managed for conservation and restoration. Fens are defined as groundwater-fed wetlands with organic soils that typically support sedges and low stature shrubs. In the arid west, organic soil formation can take thousands of years. Long-term maintenance of fens requires maintenance of both the hydrology and the plant communities that enable fen formation.

In 2012, the U.S. Forest Service released a new planning rule to guide all National Forests through the process of updating their Land Management Plans (also known as Forest Plans). A component of the new planning rule is that each National Forest must conduct an assessment of important biological resources within its boundaries. Through the biological assessment, biologists at the SCNF identified a need to better understand the distribution and extent of fen wetlands under their management. To this end, U.S. Forest Service contracted Colorado State University and the Colorado Natural Heritage Program (CNHP) to map all potential fens within the SCNF.

Potential fens in the SCNF were identified from digital aerial photography and topographic maps. Each potential fen polygon was hand-drawn in ArcGIS based on the best estimation of fen boundaries and attributed with a confidence value of 1 (low confidence), 3 (possible fen), or 5 (likely fen). The final map contained 3,401 potential fen locations (all confidence levels), covering 5,749 acres or 0.1% of the total land area. This total included 385 likely fens, 1,037 possible fens, and 1,979 low confidence fens. The average fen polygon is just 1.69 acres, but the largest likely fen polygon is over 140 acres.

Fen distribution was analyzed by elevation, bedrock geology, Land Type Association, and watershed. The vast majority of mapped potential fens occurred between 6,000 to 9,000 feet. This elevation range contained 78% of all potential fen locations and 74% of likely fen locations. The majority of likely fen locations occurred in the Strongly Glaciated Lands in Granite Land Type Association. Likely fens were concentrated in three particular watersheds: Upper Elk Creek had 24 likely fens, Swamp Creek-Marsh Creek had 18 likely fens and Cape Horn Creek had 16 likely fens.

This report and associated dataset provide the SCNF with a critical tool for conservation planning at both a local and Forest-wide scale. These data will be useful for the ongoing SCNF biological assessment required by the 2012 Forest Planning Rule, but can also be used for individual management actions, such as planning for timber sales, grazing allotments, and trail maintenance. Wherever possible, the Forest should avoid direct disturbance to the fens mapped through this project, and should also strive to protect the watersheds surrounding high concentrations of fens, thereby protecting their water sources.

ACKNOWLEDGMENTS

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We also thank colleagues at CNHP who have worked on previous projects mapping and surveying fen wetlands in the field, specifically Erick Carlson, Denise Culver, Laurie Gilligan, Peggy Lyon, and Dee Malone. Special thanks David Cooper, Rod Chimner, and Brad Johnson, each of whom has shared with us their great knowledge of fens over the years.

Finally, we would like to thank Tracey Trujillo and Carmen Morales with Colorado State University for logistical support and grant administration.

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1.0 INTRODUCTION

The Salmon-Challis National Forest (SCNF) covers over 4.3 million acres in five discontinuous units within east-central Idaho. The Forest spans a broad elevation range from 2,830 ft. to 12,659 ft. and is dominated by volcanic bedrock geology. Several types of wetlands occur within SCNF. Snowfall in the mountains percolates through shallow mountain soils and creates wet meadows, riparian shrublands, and a limited area of organic soil wetlands known as fens. All wetland habitats provide important ecological services to both SCNF and lands downstream (Mitsch & Gosselink 2007; Millennium Ecosystem Assessment 2005). Wetlands act as natural filters, helping to protect water quality by retaining sediments and removing excess nutrients. Wetlands help to regulate local and regional hydrology by stabilizing base flow, attenuating floods, and replenishing belowground aquifers. Wetlands also support habitat for numerous plant and animals species that depend on aquatic habitats for some portion of their life cycle (Redelfs 1980 as cited in McKinstry et al. 2004).

Organic soil wetlands, known as fens, are an irreplaceable resource. Fens are defined as groundwater-fed wetlands with organic soils that typically support sedges and low stature shrubs (Mitch & Gosselink 2007). The strict definition of an organic soil (peat) is one with 40 cm (16 in) or more of organic soil material in the upper 80 cm (31 in) of the soil profile (Soil Survey Staff 2014). Accumulation of organic material to this depth requires constant soil saturation and cold temperatures, which create anaerobic conditions that slow the decomposition of organic matter. By storing organic matter deep in their soils, fens act as a carbon sink. In the arid west, peat accumulation occurs very slowly; estimates are 20 cm (8 in) per 1,000 years in Colorado (Chimner 2000; Chimner and Cooper 2002). Long-term maintenance of fens requires maintenance of both the hydrology and the plant communities that enable fen formation.

In 2012, the U.S. Forest Service released a new planning rule that will guide all National Forests through the process of updating their Land Management Plans (also known as Forest Plans).[1] A component of the new planning rule is that each National Forest must conduct an assessment of important biological resources within its boundaries. Through the process of conducting the biological assessment, biologists at the SCNF identified a need to better understand the distribution and extent of fen wetlands and other groundwater dependent ecosystems under their management. To this end, U.S. Forest Service contracted Colorado State University and the Colorado Natural Heritage Program (CNHP) to map all potential fens within the SCNF. This project builds upon CNHP's previous projects mapping fens on the White River National Forest (Malone et al. 2011), the Rio Grande National Forest (Smith et al. 2016), the Ashley National Forest (Smith and Lemly 2017), and the Manti-La Sal National Forest (Smith and Lemly 2017).

[1] For more information on the 2012 Forest Planning Rule, visit the following website: http://www.fs.usda.gov/main/planningrule/home.

2.0 STUDY AREA

2.1 Geography

The fen mapping study area was the entire Salmon-Challis National Forest (SCNF), which is administered as five discontinuous units in east-central Idaho (Figure 1).

The SCNF includes portions of Butte, Custer, Lemhi and Valley counties, as well as small portions of Idaho, Blaine, Clark and Boise counties. The largest municipalities near the study area are Salmon, Stanley, Challis, and Sun Valley. Elevations in the study area range from 2,831 ft. (863 m) to 12,657 ft. (3,858 m) and the mean elevation is 7,493 ft. (2,284 m).

The Bitterroot Range and the Yellow Jacket Mountains run through the north part of SCNF, while the Salmon River Mountains cut through the center of the Forest. Borah Peak, the highest mountain in Idaho (12,667 ft; 3861 m), lies within the Lost River Range in the south east section of the SCNF.

The SCNF straddles two different HUC6 river basins: the Salmon River Basin, which flows out of the Salmon-Challis heading northwest, and the Upper Snake River Basin, which drains to the southwest (Figure 2). The Middle Fork of the Salmon River has its headwaters in SCNF and meets the main stem of the Salmon River inside the Forest.

2.2 Land Type Associations

The U.S. Forest Service has developed Land Type Associations for each National Forest to describe the major geomorphic landforms within the Forest. The SCNF LTA system contains 38 LTA Geology Groups (Figure 3), though portions are still in draft form. The most common LTA geology type in the study area is Mountain Slopelands in Volcanics, which make up 14% of the study area. The next most common type is the Cyric Uplands in Volcanics, which comprises 10% of the study area, followed by Mountain Slopelands in Quartzite (9%), Cryic Uplands in Quartzite (8%) and Mountain Slopelands in Granite (8%). The LTA maps and tables in this report are based on a draft LTA dataset for Salmon-Challis dated December 19, 2017.

2.3 Geology

The SCNF is underlain by rock types varying greatly in age. A large portion of the forest is underlain by Precambrian metamorphic features, while Paleozoic sedimentary rocks are common in the Salmon River and Lemhi Mountains. Tertiary volcanic rocks are widespread (Johnson et al. 1998). The most common geologic substrate in the fen mapping study area is quartzite, which covers 19% of the study area followed by rhyodacite (17%) (Figure 4). The next most common geology is granodiorite (12%). Trachyandesite (9%), granite (9%), and limestone (7%) are also common within the Forest.

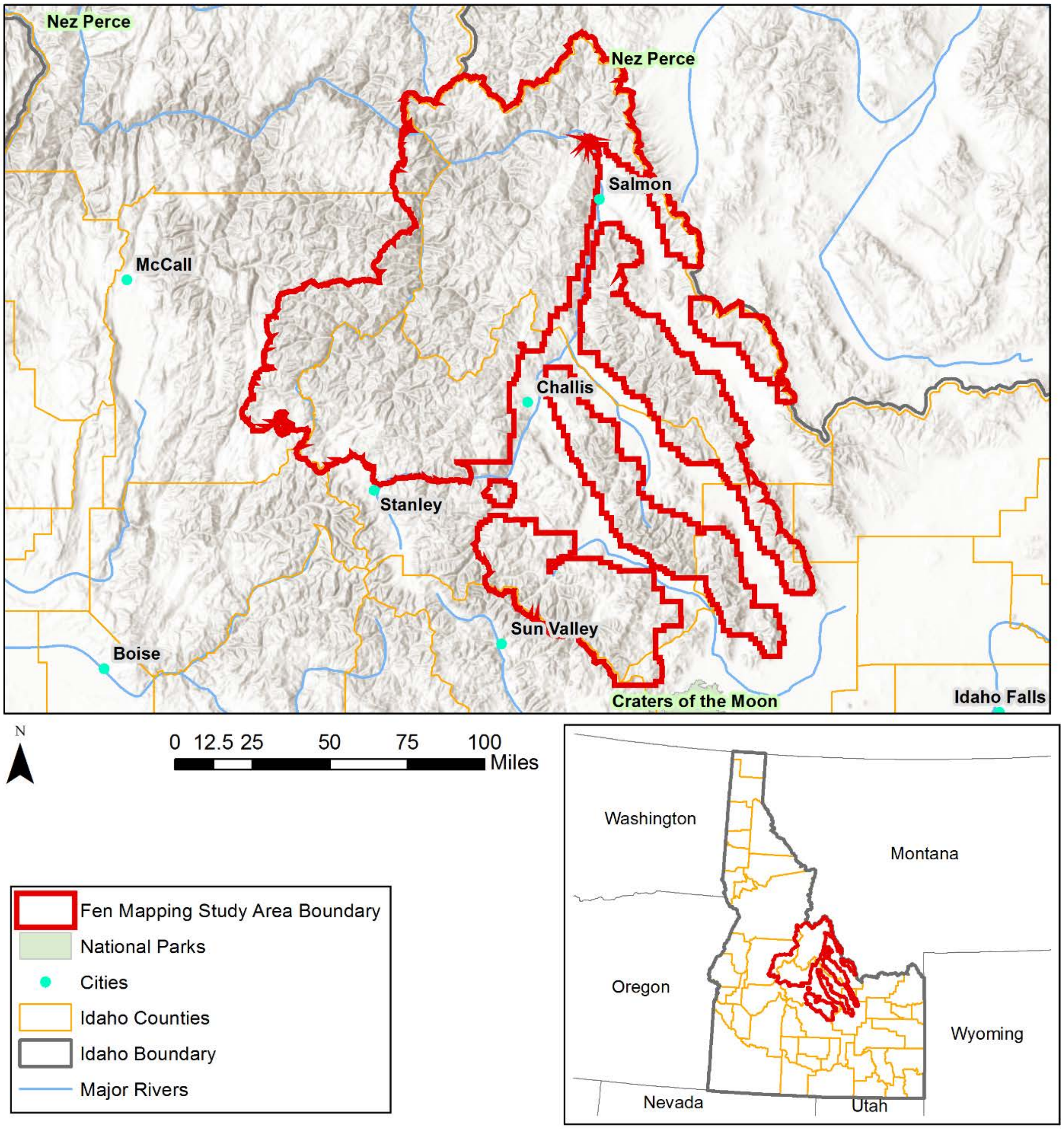

Figure 1. Location of the Salmon-Challis National Forest (fen mapping study area) within the state of Idaho.

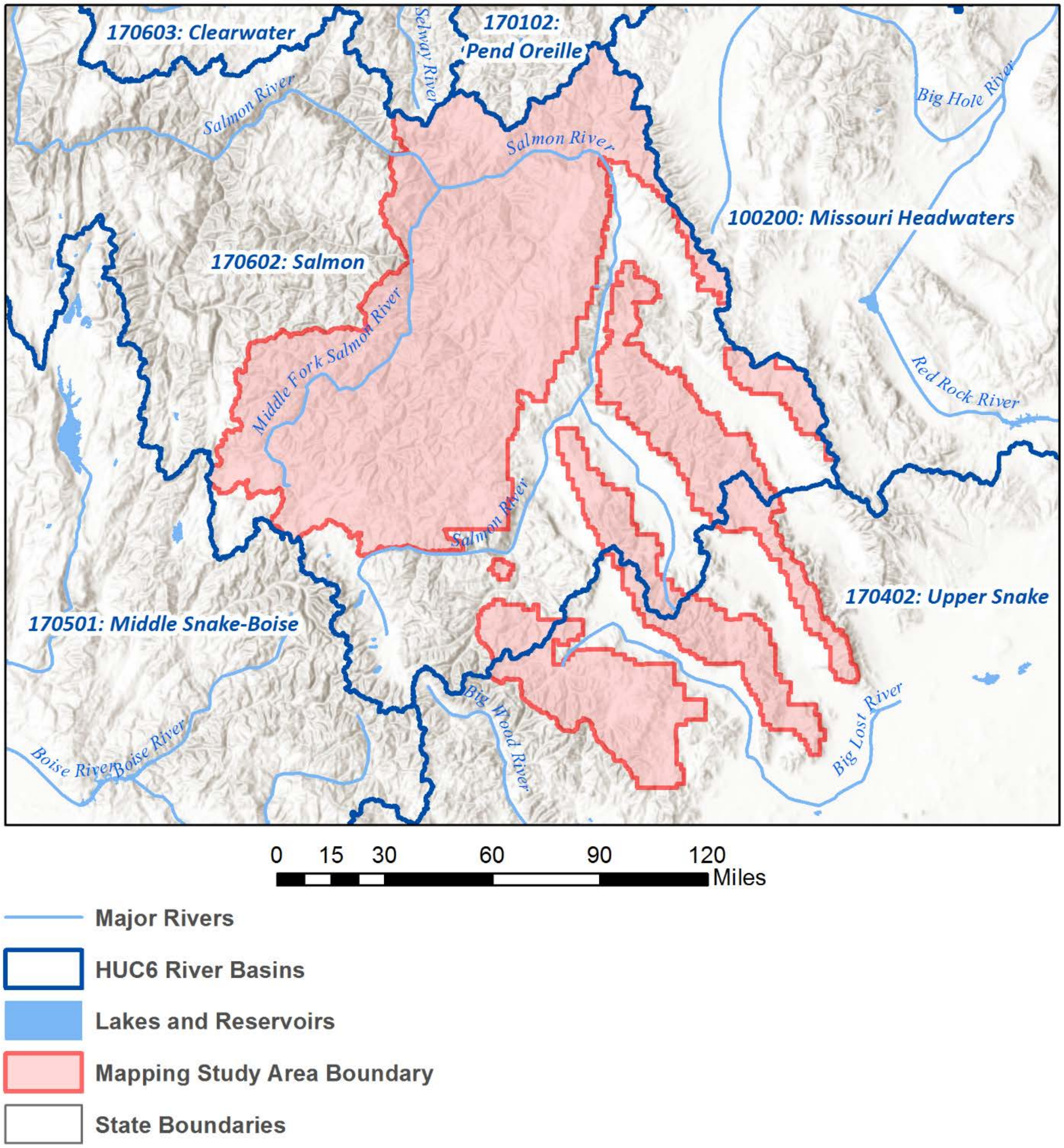

Figure 2. HUC6 river basins and major waterways in the fen mapping study area.

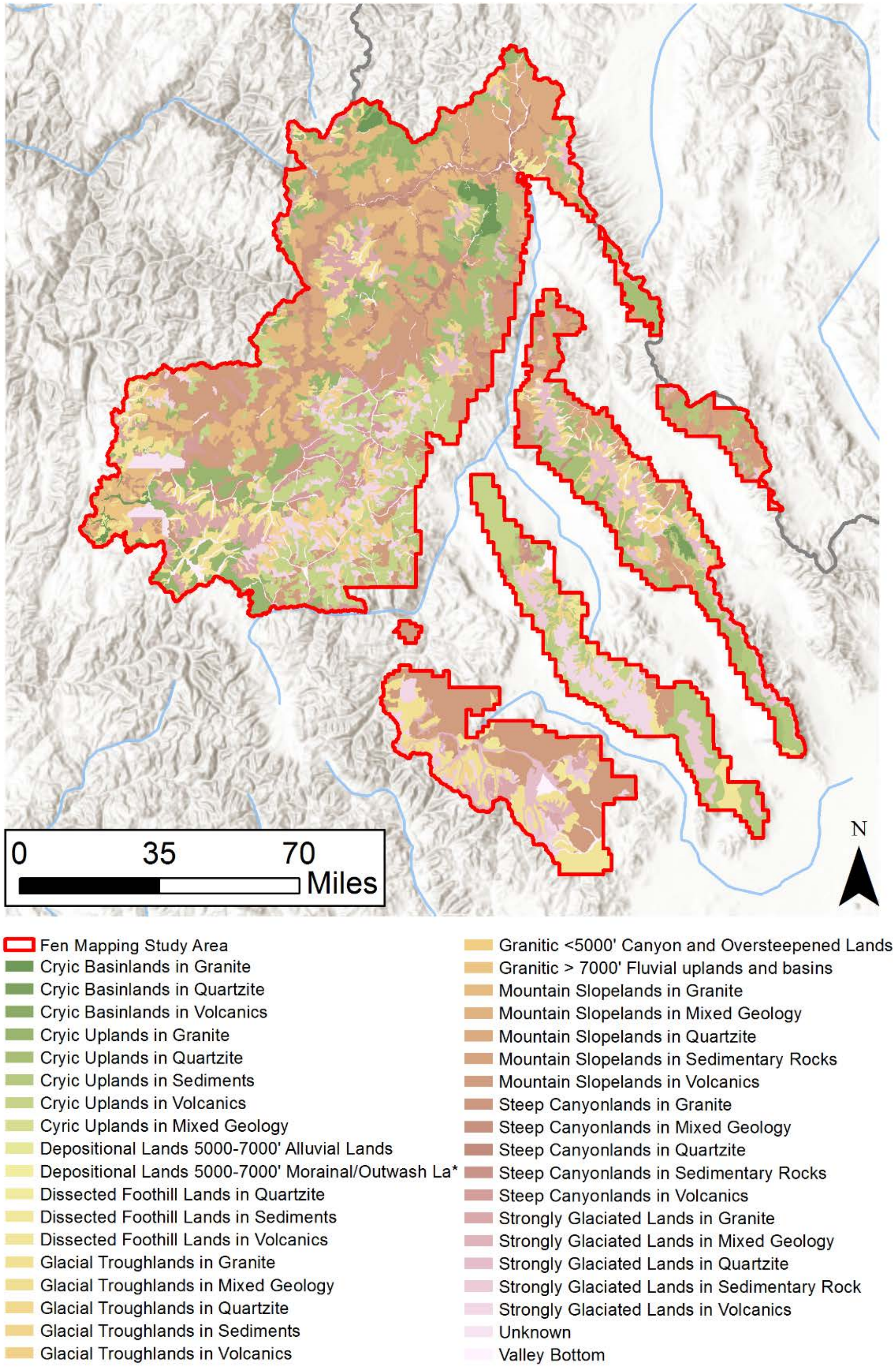

Figure 3. Land Type Associations of the fen mapping study area, symbolized by LTA Geology.

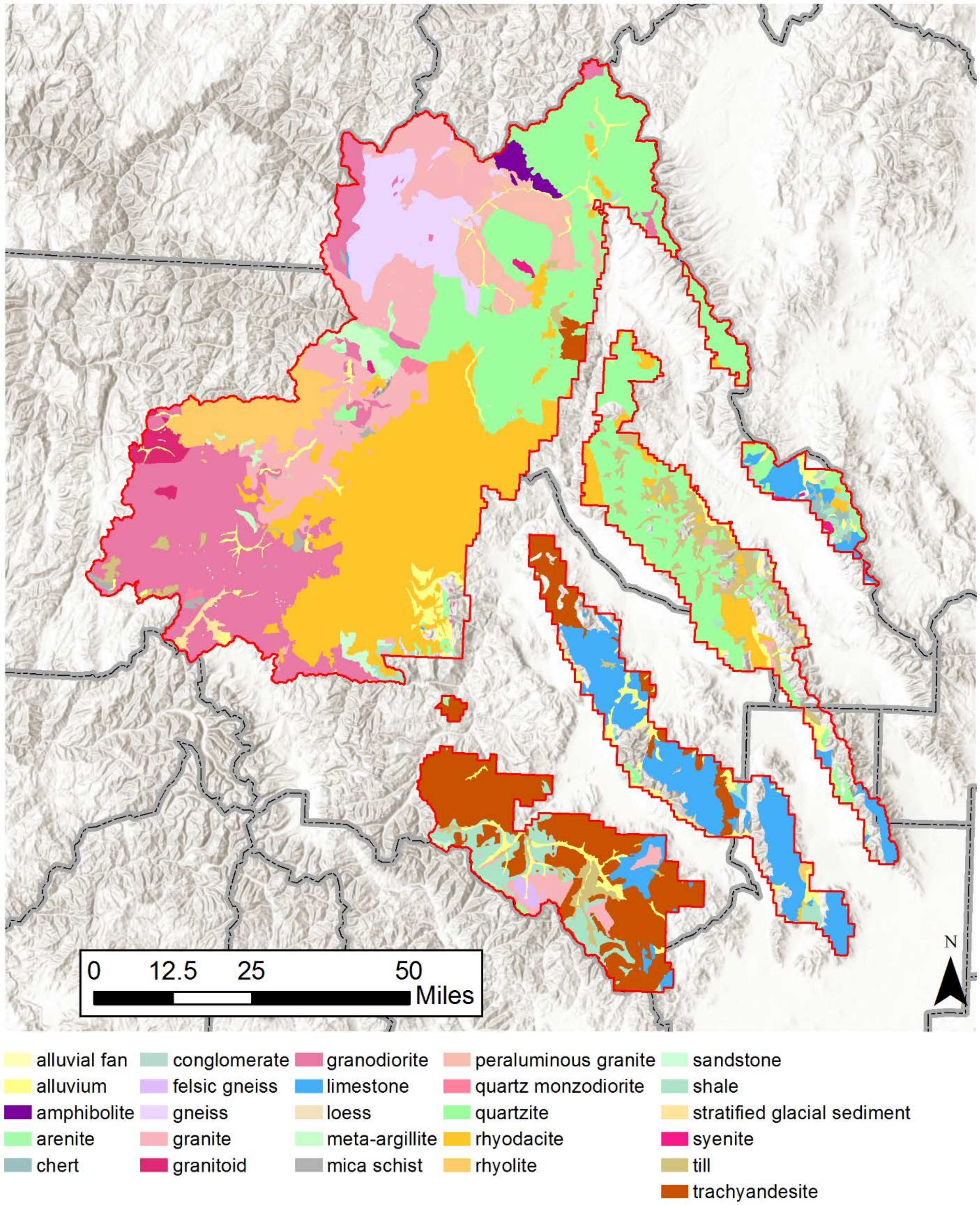

Figure 4. Geology within the fen mapping study area.

3.0 Fen Mapping Methods

Potential fens in the SCNF were identified by analyzing digital aerial photography and topographic maps. True color aerial photography taken by the National Agricultural Imagery Program (NAIP) in 2004, 2009, 2011, 2013, and 2015 were used in conjunction with color-infrared imagery from 2013 and 2015. High (but variable) resolution World Imagery from Environmental Systems Research Institute (ESRI) was also used. To focus the initial search, all wetland polygons mapped by the U.S. Fish and Wildlife Service's National Wetland Inventory (NWI) program in the 1980s with a "B" (saturated) hydrologic regime were isolated from the full NWI dataset and examined.[2] However, hand delineated NWI mapping completed since the 1980s only covers about 10% of the Forest, which rendered the NWI mapping of limited use (Figure 5). NWI mapping for the remaining 90% of the Forest is a based on a model developed by NWI to fill areas of the country with no delineated mapping, called Scalable Model Output. This model does capture open bodies of water, but almost completely excludes vegetated wetlands and does not provide a comprehensive profile of the wetland resource. This unusual situation makes Salmon-Challis National Forest a good priority for future updated NWI mapping. Without the saturated NWI polygons to use as a guide for this project, the project area was split into 900 by 1500 meter grid cells which were all individually reviewed at a 1:3,000 scale.

Potential fen polygons were hand-drawn in ArcGIS 10.3/10.4 based on the best estimation of fen boundaries. Each potential fen polygon was attributed with a confidence value of 1, 3 or 5 (Table 1). In addition to the confidence rating, any justifications of the rating or interesting observations were noted, including iron fens, beaver influence, floating mats, and springs.

Table 1. Description of potential fen confidence levels.

Confidence	***Description***
5	***Likely fen.*** Strong photo signature of fen vegetation, fen hydrology, and good landscape position.
3	***Possible fen.*** Some fen indicators present (vegetation signature, topographic position, ponding, or visibly saturated substrate), but not all indicators present. Some may be weak or missing.
1	***Low confidence fen.*** At least one fen indicator present, but weak.

Because of the lack of NWI available for this Forest, the Forest Service will not receive an enhanced version of the 1980s original NWI mapping with a "Fen Potential" attribute for Salmon-Challis National Forest. There were some challenging circumstances in Salmon-Challis that were not present in the other Forests that have had fen mapping done as a part of this contract. The biggest challenge was the lack of traditional NWI data, but there are also many areas in the Forest that have snowpack or shadows from steep cliff sides present in every image year.

[2] For more information about the National Wetland Inventory and the coding system, please visit: http://www.fws.gov/wetlands/

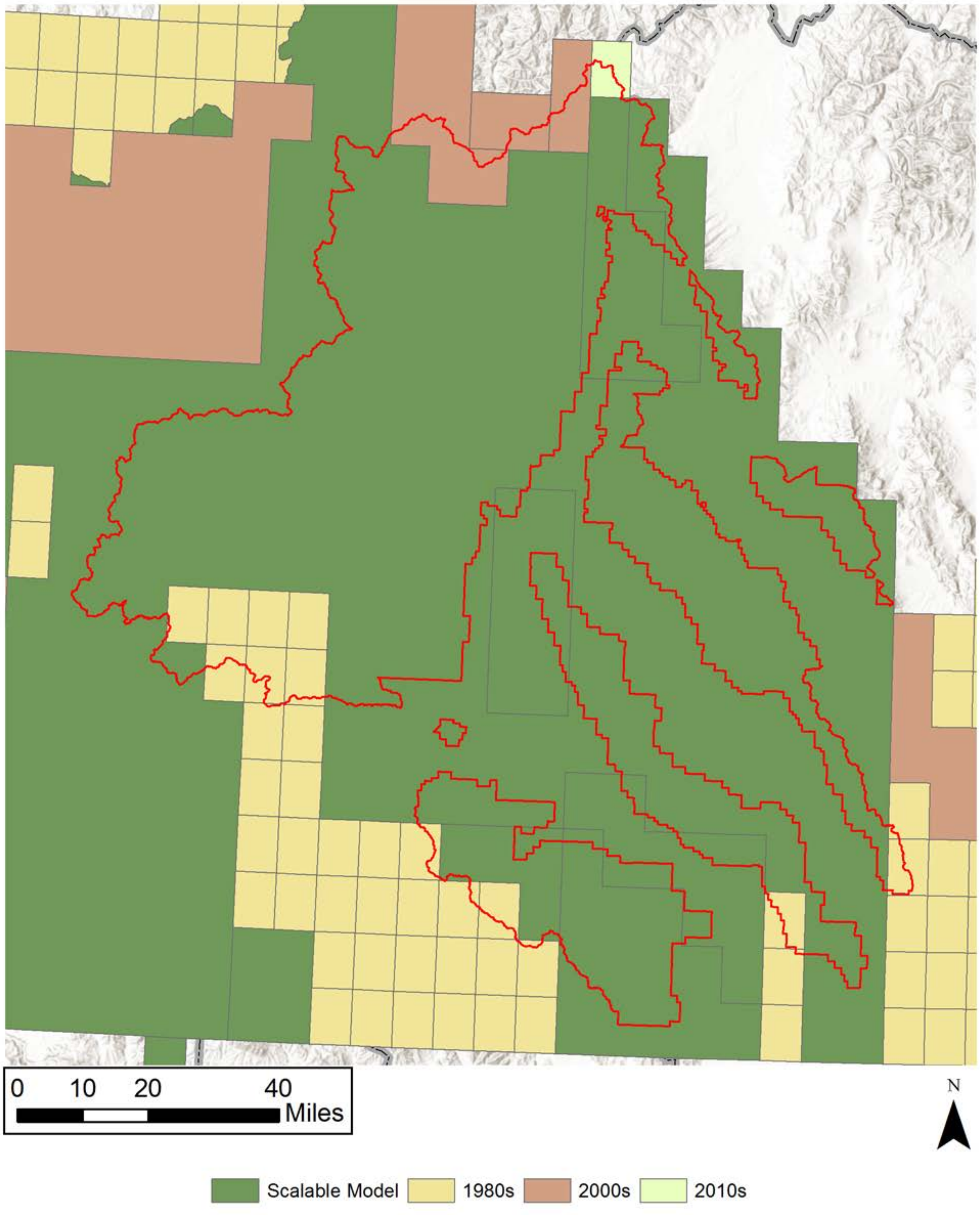

Figure 5. Availability of National Wetland Inventory (NWI) data in the Salmon-Challis National Forest, symbolized by grouped NWI Image Year, highlighting that the majority of the Forest does not have traditional NWI data.

4.0 RESULTS

4.1 Potential Fen Mapping Acreage

The final map of potential fens contained 3,401 potential fen locations (all confidence levels), covering 5,749 acres or 0.1% of the total land area (Table 2; Figures 8 and 9). This total included 385 likely fens (confidence level = 5), 1,037 possible fens, and 1,979 low confidence fens. While the count of likely fens was much less than the count of possible fens, on average the likely fens were considerably larger (2.92 acres vs. 1.69 acres), resulting in 1,126 acres of likely fens, 2,030 acres of possible fens, and 2,592 acres of low confidence fens. The size of individual potential fens ranged from 140 acres to 0.02 acres.

Table 2. Potential fen counts and acreage, by confidence levels.

Confidence	*Count*	*Acres*	*Average size (acres)*
5 – Likely Fen	385	1,126	2.92
3 – Possible Fen	1,037	2,030	1.95
1 – Low Confidence Fen	1,979	2,592	1.31
TOTAL	**3,401**	**5,749**	**1.69**

A comparison of potential or likely fen acreage to acreage mapped as saturated in the National Wetland Inventory is unfortunately not revealing due to the limited NWI mapping coverage for the SCNF.

The following sections break down the fen mapping by elevation range, bedrock geology, Land Type Associations (LTA), and HUC12 watershed. The last section summarizes observations made by the fen mappers during the mapping process, including potential iron fens.

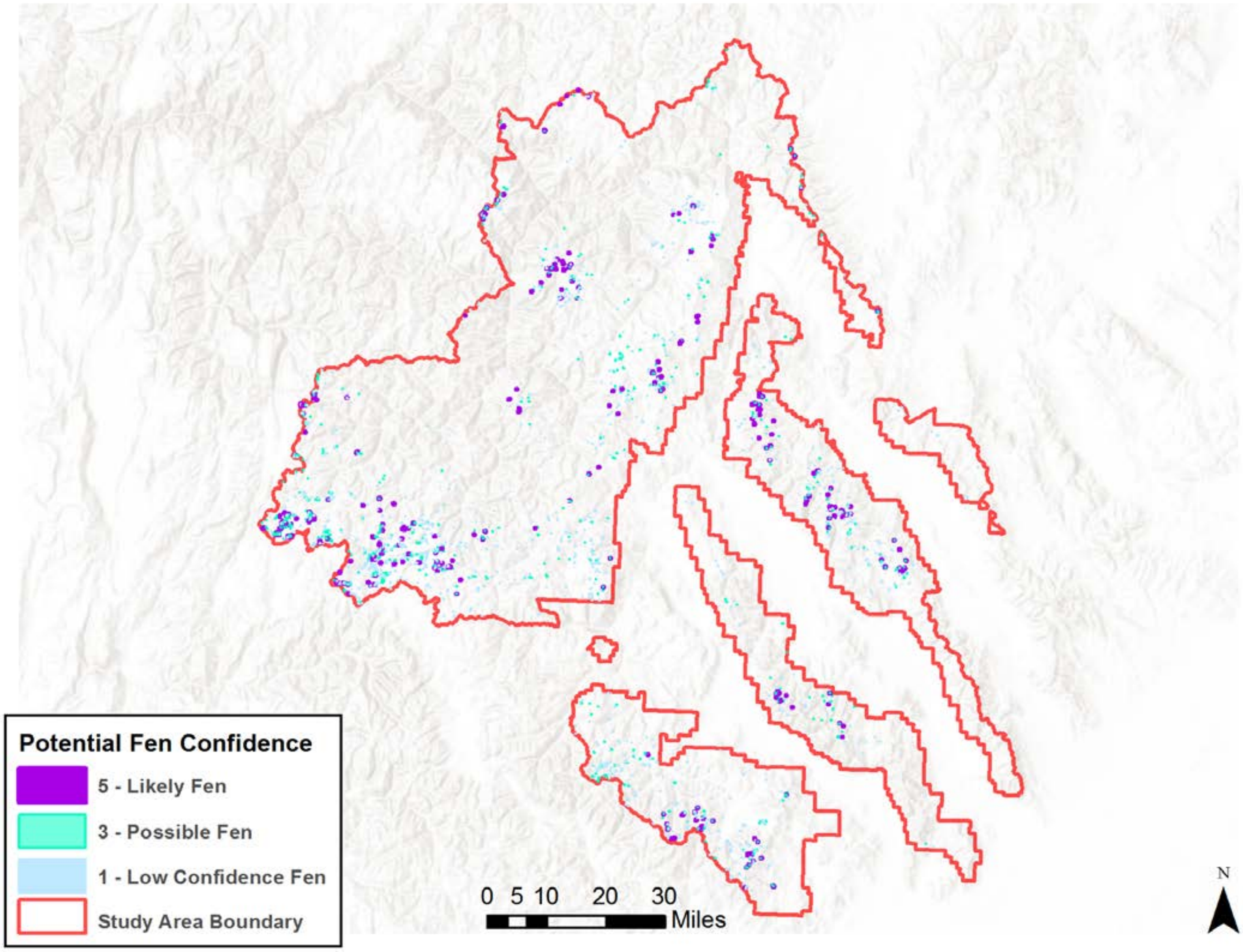

Figure 6. All potential fens within the fen mapping study area.

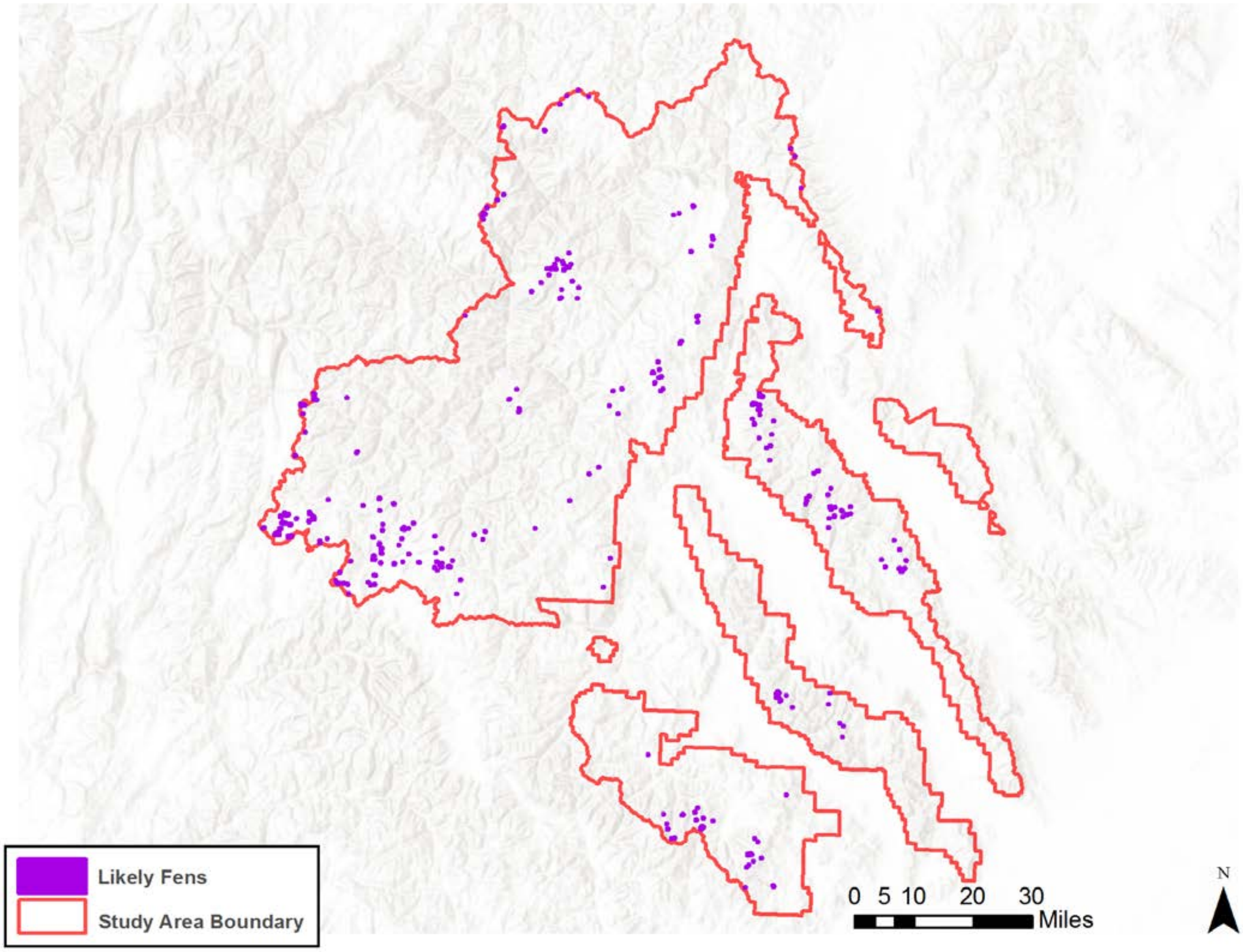

Figure 7. Likely fens (confidence rating = 5) within the fen mapping study area.

Likely fen area exaggerated for map visibility.

4.2 Mapped Potential Fens by Elevation

Elevation is an important factor in the location of fens. Fen formation occurs where there is sufficient groundwater discharge to maintain permanent saturation. This is most often at higher elevations, closer to the zone where slow melting snowpack can percolate into subsurface groundwater.

Of all potential fens, 1,301 polygons (698 acres) were mapped between 8,000 to 9,000 feet, which represents 38% of potential fen locations and 20% of potential fen acres (Table 4; Figure 11). Of the 385 total likely fens mapped, 174 polygons (45%) and 220 acres (23%) were located between 8,000 to 9,000 feet (Table 4; Figures 10 and 12). This is likely the zone of maximum fen formation for the SCNF.

The elevation band of 6,000 to 7,000 feet was the next most numerous in terms of potential and likely fen acreage. There were 532 mapped potential fens (2,575 acres) in that elevation range, which represent 16% of potential fen locations and 33% of potential fen acres. In addition, there were 47 likely fens (590 acres) mapped in that elevation range, which represent 12% of likely fen locations and 52% of likely fen acres. These two elevation bands combined (8,000 to 9,000 and 6,000 to 7,000) contain 62% of potential fen locations and 57% of likely fen locations.

Table 3. Potential and likely fens by elevation within the fen mapping study area.

Elevation Range (ft)	*# of All Potential Fens*	*All Potential Fen Acres*	*# of Likely Fens*	*Likely Fen Acres*
< 4,500	5	4	--	
> 4,500 – 5,000	1	<1	--	
> 5,000 – 5,500	1	<1	--	
> 5,500 – 6,000	32	120	1	1
> 6,000 – 6,500	102	678	3	74
> 6,500 – 7,000	430	1,897	43	516
> 7,000 – 7,500	381	713	28	105
> 7,500 – 8,000	533	760	38	70
> 8,000 – 8,500	796	698	94	137
> 8,500 – 9,000	505	397	80	83
> 9,000 – 9,500	388	308	61	81
> 9,500 – 10,000	204	158	34	57
> 10,000 – 10,500	23	13	5	4
Total	**3,401**	**5,749**	**385**	**1,126**

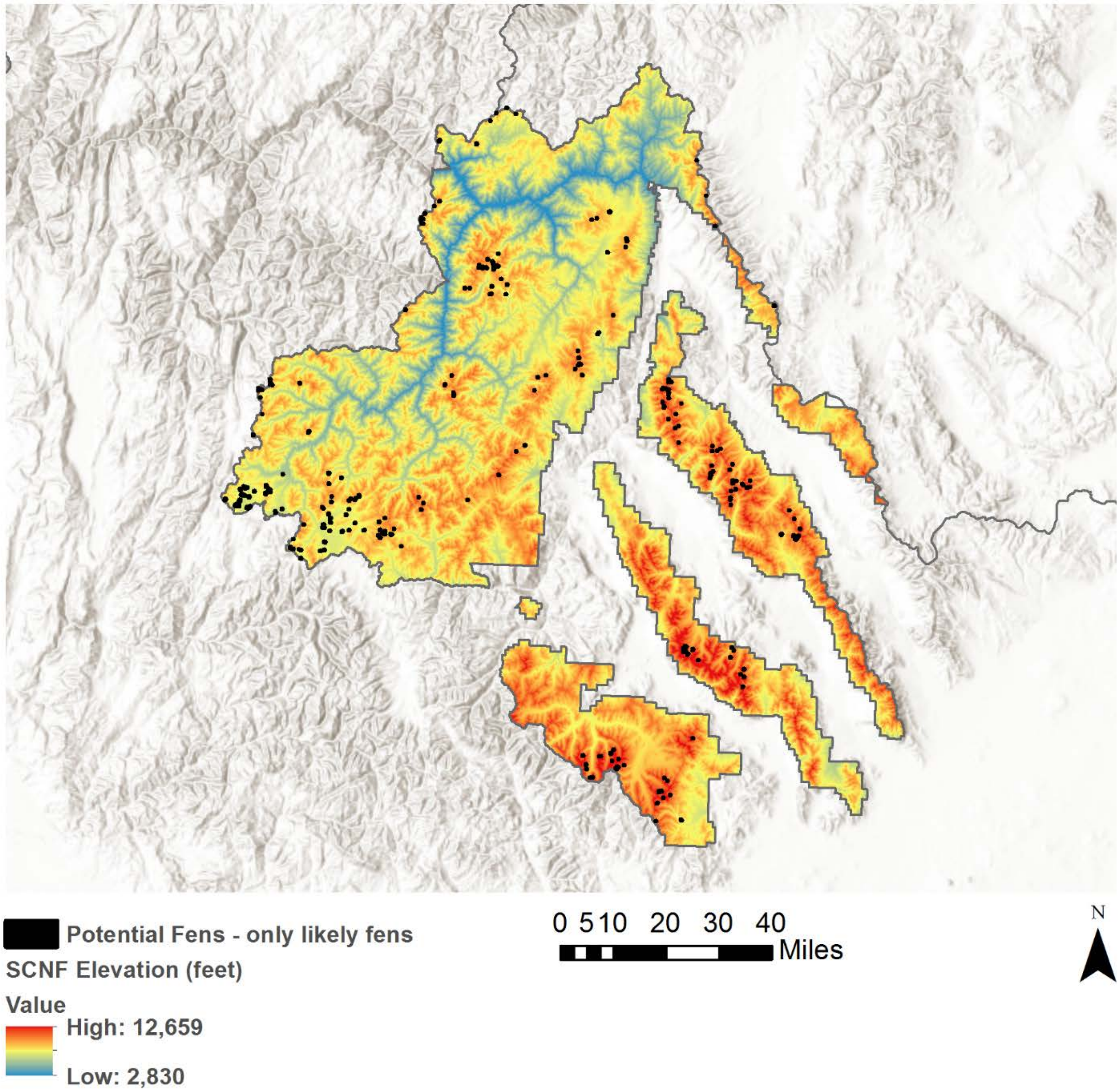

Figure 8. Likely fens (confidence rating = 5) and elevation within the fen mapping study area. Likely fen area exaggerated to visually highlight the locations.

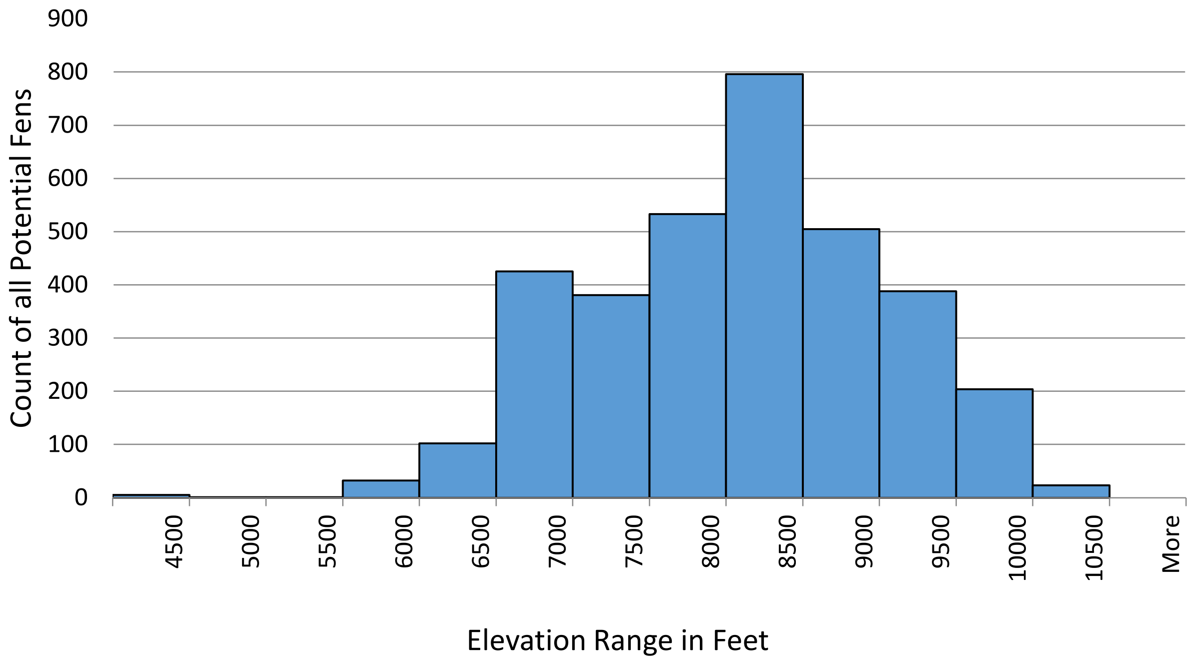

Figure 9. Histogram of all potential fens by elevation within the fen mapping study area.

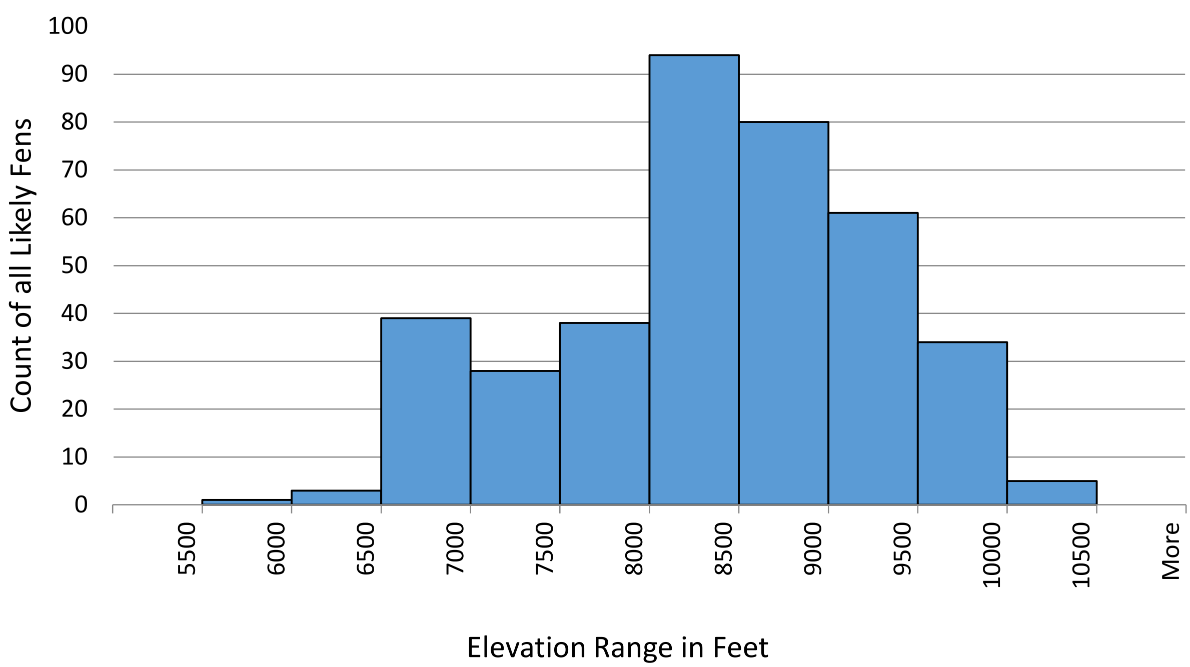

Figure 10. Histogram of the most likely fens by elevation within the fen mapping study area.

4.3 Mapped Potential Fens by Geology

The most common geologic substrate under potential fens was granodiorite, which had 785 mapped potential fens (1,615 acres) (Table 5). This represents 23% of potential fen locations. Granodiorite was also the most common substrate for likely fens, with 82 mapped likely fens (272 acres, 21% of likely fen locations). Quartzite, the geologic substrate covering the greatest area in the SCNF (19% of the National Forest), underlies 16% of all potential fens (560 locations) and 20% of likely fens (75 locations). Mica schist underlied a relatively small proportion of all potential fens acres (5%), however represents a disproportionate 11% of likely fen acres. 9 fens were mapped as occurring on water substrate; the majority of these are adjacent to a standing body of water. While present in the SCNF in small amounts, no likely fens were mapped on amphibolite, sandstone, or quartz monzodiorite substrates (0.5%, 0.3%, and 0.2% of SCNF, respectively).

Table 4. Potential and likely fens by geologic substrate within the fen mapping study area

Geology	Acres of Geologic Substrate Within SCNF[1]	# of All Potential Fens	All Potential Fen Acres	# of Likely Fens	Likely Fen Acres
Granodiorite	538,483	785	1,615	82	272
Quartzite	842,885	560	395	75	93
Rhyodacite	766,242	521	522	33	67
Granite	384,720	331	354	71	105
Trachyandesite	386,803	213	232	8	13
Till	121,210	203	742	34	179
Alluvium	154,130	120	168	7	201
Shale	105,501	112	404	6	11
Limestone	302,545	109	76	9	7
Stratified glacial sediment	11,706	111	548	8	67
Dolostone (dolomite)	209,378	105	72	15	24
Granitoid	27,335	62	58	14	12
Peraluminous granite	124,537	56	43	2	2
Mica schist	11,807	30	248	8	101
Felsic gneiss	7,312	19	13	4	4
Rhyolite	123,288	14	8	2	3
Sandstone	13,269	14	14	--	--
Arenite	7,312	13	9	1	1
Water	1,695	9	11	5	9
Gneiss	176,171	6	12	1	10
Quartz monzodiorite	8,026	3	2	--	--
Amphibolite	20,297	2	2	--	--
Meta-argillite	33,692	2	3	1	1
Total		**3,401**	**5,749**	**385**	**1,126**

[1] Acres of geologic substrate shown are only for those substrates where fens were mapped. The total acreage is not shown because it does not equal the total acreage of the SCNF.

4.4 Mapped Potential Fens by Land Type Association

Land Type Associations in SCNF combine landform and geomorphology. These LTAs are still in draft form, but an analysis of fens by LTA is provided for continuity with other Forest planning documents.

The greatest number of fens were mapped within the Strongly Glaciated Lands in Granite LTA, which occurs at high elevations in the River of No Return Wilderness Area of the Forest. Though this LTA covers only 3.5% of the SCNF, it represents 16% of all potential fen locations and 28% of likely fen locations. In the SCNF, fens mapped within higher elevation, more-constricted landscapes were generally smaller, while fens mapped in the less constricted valley bottoms were considerably larger.

While only representing a small area within the SCNF (0.08%), the Depositional Lands 5000-7000' Morainal/Outwash Lands LTA accounted for a notable 26% of likely fen acres (241 acres) and 13% of all potential fen acres. Like the Valley Bottom LTA, this land type represents low gradient depositional areas where groundwater is expressed at the bottom of slopes.

In contrast, the Mountain Slopelands in Volcanics LTA covers the greatest proportion of the SCNF (14%). But this LTA contained only 302 mapped potential fens (285 acres) and 8 likely fens (8 acres) (Table 6), representing 9% of potential fen locations and 2% of likely fen locations.

Table 5. Potential and likely fens by Land Type Association within the fen mapping study area.

Land Type Association Groups	*Acres within SCNF[1]*	*# of All Potential Fens*	*All Potential Fen Acres*	*# of Likely Fens*	*Likely Fen Acres*
Strongly Glaciated Lands in Granite	154,072	545	511	107	172
Strongly Glaciated Lands in Quartzite	167,729	434	631	74	87
Glacial Troughlands in Granite	236,801	332	568	33	147
Strongly Glaciated Lands in Volcanics	217,759	305	231	30	40
Mountain Slopelands in Volcanics	599,465	302	285	8	8
Valley Bottom	101,909	293	1,206	23	231
Cryic Uplands in Granite	240,927	258	314	30	40
Cryic Uplands in Volcanics	433,238	164	112	9	9
Cryic Uplands in Quartzite	337,764	115	103	13	21
Strongly Glaciated Lands in Sedimentary Rock	103,742	87	78	3	9
Cryic Basinlands in Granite	38,116	86	367	5	62
Glacial Troughlands in Volcanics	98,559	78	78	6	9
Glacial Troughlands in Quartzite	90,513	48	39	5	10
Depositional Lands 5000-7000' Morainal/Outwash Lands	3,543	45	708	12	241

Mountain Slopelands in Quartzite	405,990	43	37	1	<1
Cryic Basinlands in Quartzite	7,417	41	50	8	18
Unknown	25,604	35	38	7	8
Dissected Foothill Lands in Volcanics	75,731	34	17	1	<1
Granitic > 7000' Fluvial uplands and basins	30,806	26	47	1	4
Cryic Uplands in Sediments	170,838	25	11	--	--
Steep Canyonlands in Granite	170,929	22	33	3	6
Mountain Slopelands in Granite	331,561	15	14	--	--
Glacial Troughlands in Sediments	36,421	14	12	--	--
Mountain Slopelands in Sedimentary Rocks	51,783	14	44	--	--
Strongly Glaciated Lands in Mixed Geology	13,247	13	8	1	2
Dissected Foothill Lands in Sediments	43,036	9	7	1	<1
Cryic Basinlands in Volcanics	4,198	8	10	2	1
Depositional Lands 5000-7000' Alluvial Lands	980	3	17	--	--
Steep Canyonlands in Volcanics	104,676	2	1	--	--
Cyric Uplands in Mixed Geology	2,276	1	1	--	--
Dissected Foothill Lands in Quartzite	9,764	1	<1	--	--
Steep Canyonlands in Quartzite	65,313	1	2	--	--
Steep Canyonlands in Sedimentary Rocks	15,055	1	<1	--	--
		3,401	**5,749**	**385**	**1,126**

[1] Acres of Land Type Associations shown are only for those LTAs where fens were mapped. The total acreage is not shown because it does not equal the total acreage of the SCNF.

4.5 Mapped Likely Fens by Watershed

An analysis of likely fens in HUC 12 watersheds revealed interesting patterns. Three watersheds in particular had high numbers of likely fens (Figure 13). Upper Elk Creek (HUC12: 170602050101) had 24 likely fens, which covered 0.01% of the landscape in this watershed. Swamp Creek- Marsh Creek (HUC12: 170602050305) had 18 likely fens and Cape Horn Creek (HUC12: 170602050302) had 16 likely fens. All of the watersheds with more than 15 likely fens were on the southwest border of the Middle Fork Ranger District. See Appendix A for the full HUC12 watershed and likely fens table.

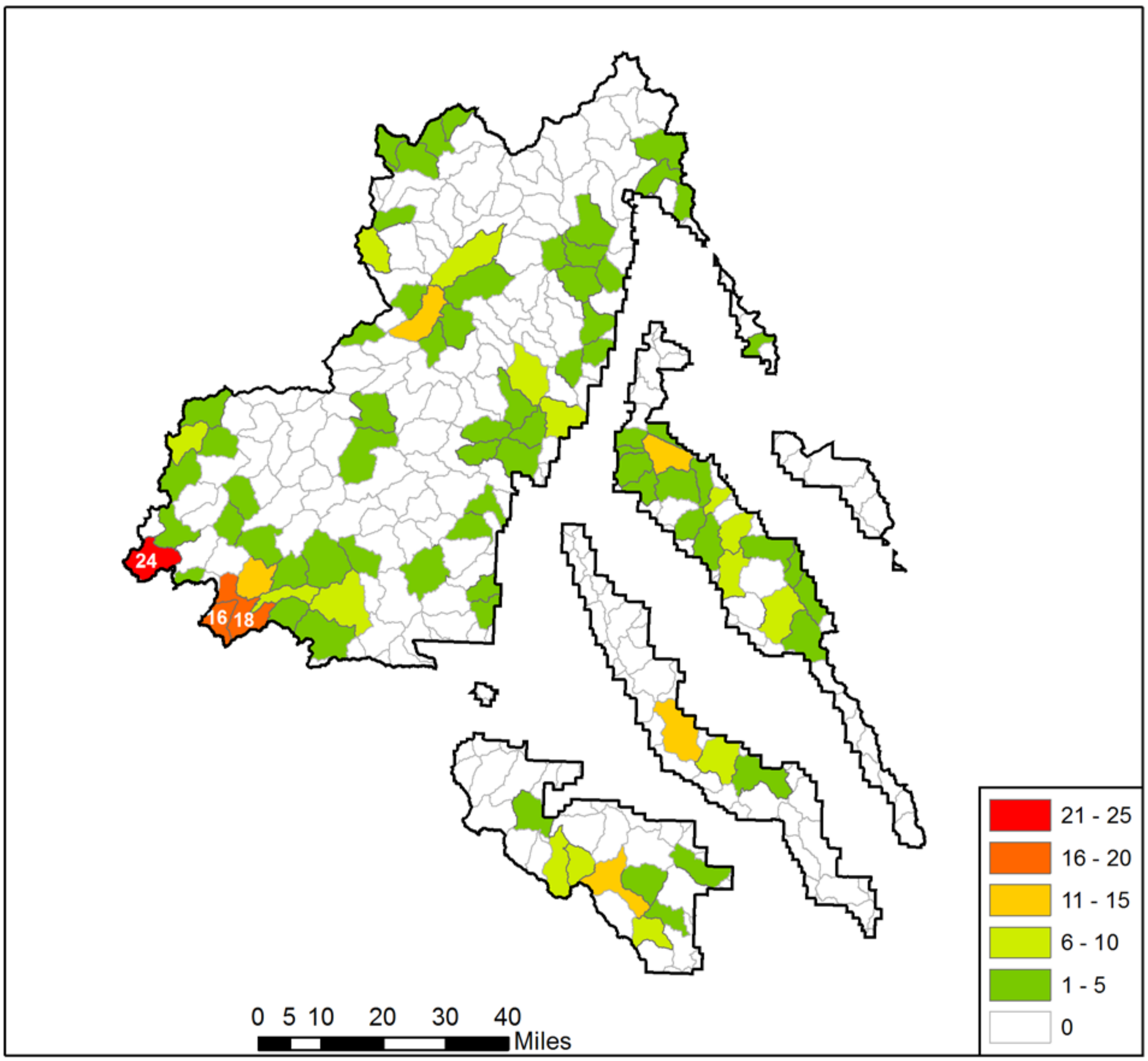

Figure 11. Likely fens by HUC12 watershed within the fen mapping study area.

4.6 Notable Mapped Potential Fens

Several characteristics related to fens were noted by photo-interpreters when observed throughout the fen mapping process (Table 7). Springs and fens are both important components of groundwater-dependent ecosystems (GDEs) and are of particular interest to the U.S. Forest Service (USDA 2012). Springs were noted when observed on either the topographic map, aerial imagery or when a NHD spring point was present. However, this was not a comprehensive investigation of springs or even springs within fens. One hundred and sixty-one potential fens were observed in proximity to springs including ten likely fens. A large complex of likely and potential fens influenced by multiple springs in the Crane Meadows area of Upper Elk Creek watershed is shown in Figure 14. This is not an exhaustive examination of springs, but does indicate their connection to fen formation. The second largest likely fen (Figure16) was also located in the Upper Elk Creek watershed. This watershed is clearly an important area for fen resources on the SCNF.

The largest mapped likely fen is the Blind Summit Fen, located in the Swamp Creek-Marsh Creek watershed between the headwaters of the Marsh Creek and Valley Creek (Figure 14). This fen extends beyond the Salmon-Challis Forest border, but the portion contained within the Forest is 140 acres.

Beaver influence is a potentially confounding variable in fen mapping because longstanding beaver complexes can cause persistent saturation that looks very similar to fen vegetation signatures. Beavers also build dams in fens, so areas influenced by beavers cannot be excluded from the mapping. Twenty-seven potential fens (288 acres) showed some evidence of beaver influence.

Three likely fens were noted as being possible iron fens (Figures 15 and 16), both of these locations are located in the Iron Bog Creek watershed in south Custer County. Iron fens are notable because of their highly acidic groundwater (as low as 4.0) and their potential to support rare Sphagnum moss species (Cooper et al. 2002).

Table 6. Potential and likely fens with distinctive characteristics within the fen mapping study area.

Observation	*# of Potential Fens*	*Potential Fen Acres*	*# of Likely Fens*	*Likely Fen Acres*
Beaver Influence	27	288	1	6
Spring	161	150	10	68
Iron Fen	6	18	3	7
Floating Mat	26	24	6	6
Total	**217**	**469**	**19**	**87**

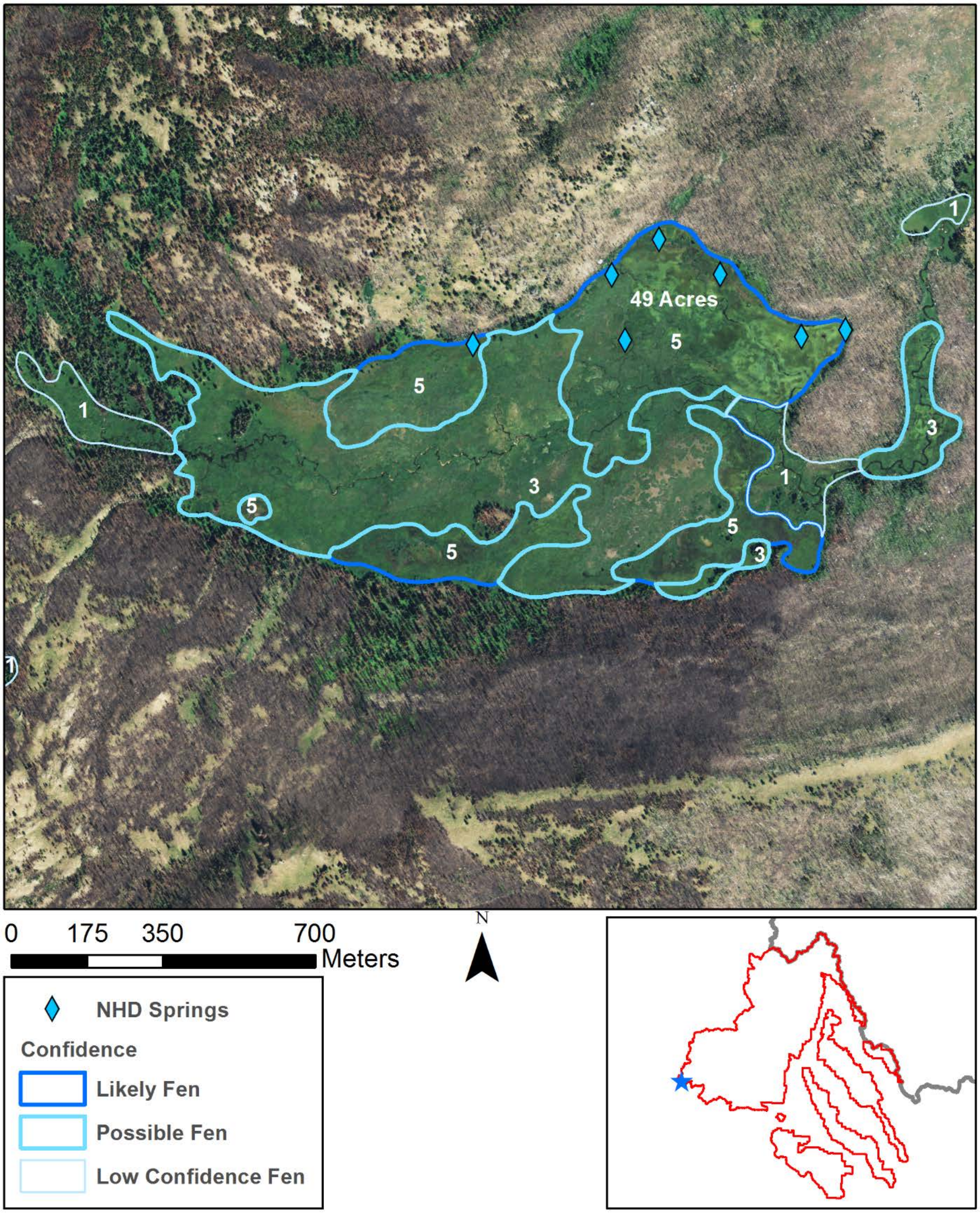

Figure 12. A large complex of likely and potential fens fed by numerous springs. This fen complex is located in the Crane Meadow area of the Upper Elk Creek watershed, within Valley County.

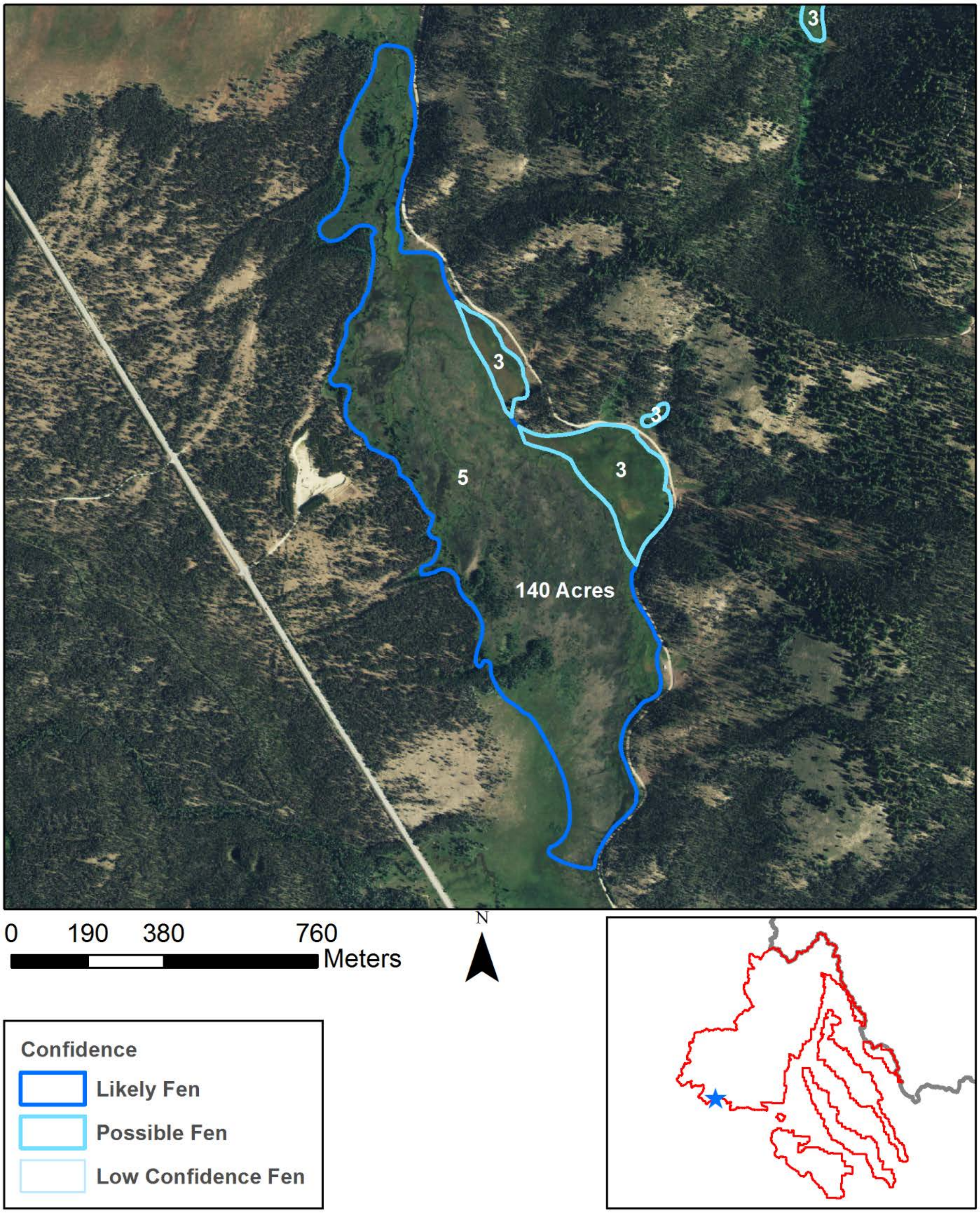

Figure 13. The largest mapped likely fen, Blind Summit Fen (140 acres) is located in the Swamp Creek-Marsh Creek watershed in Custer County.

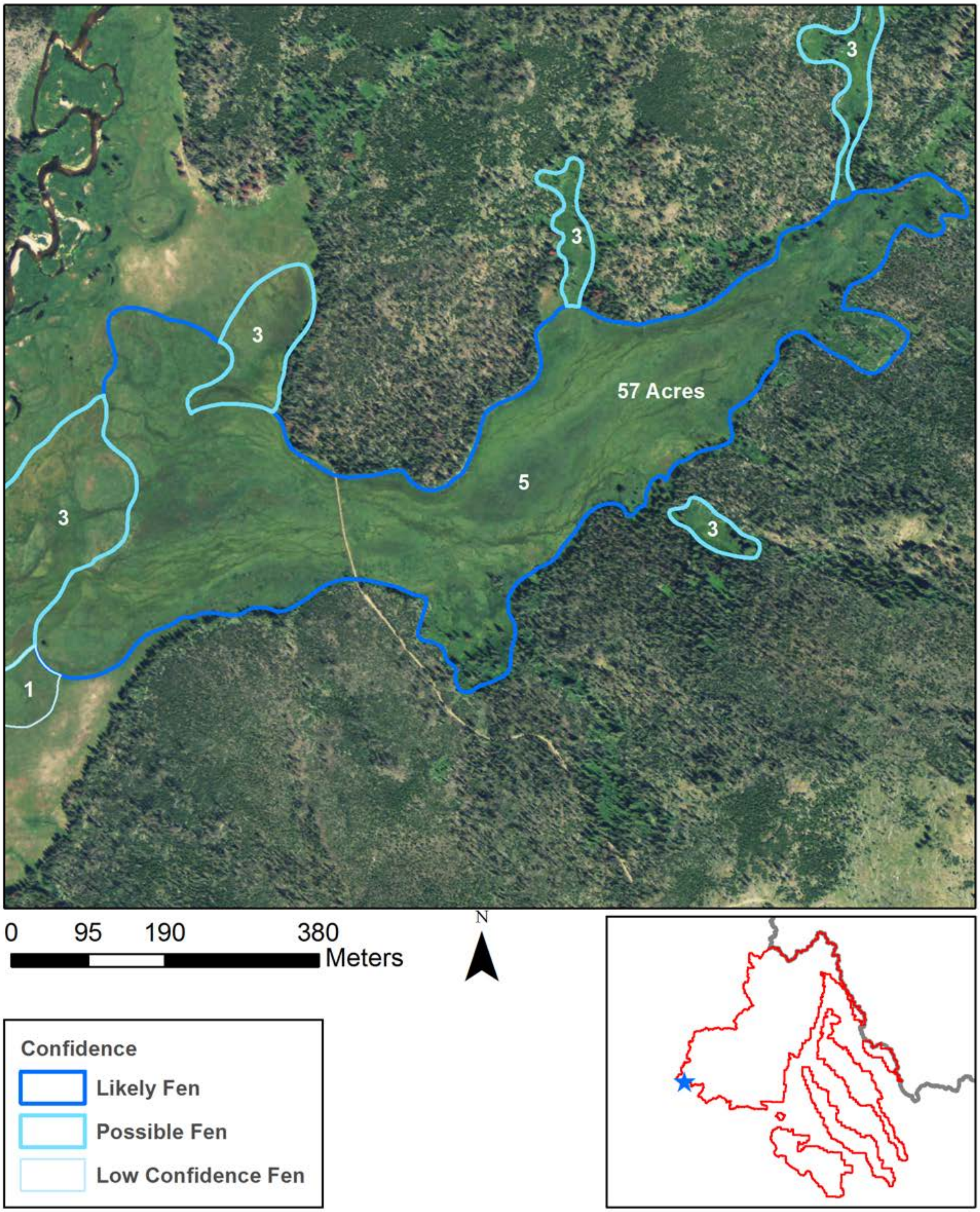

Figure 14. The second largest mapped likely fen at 57 acres, this likely fen is located near Elk Creek in the Upper Elk Creek watershed, in Valley County.

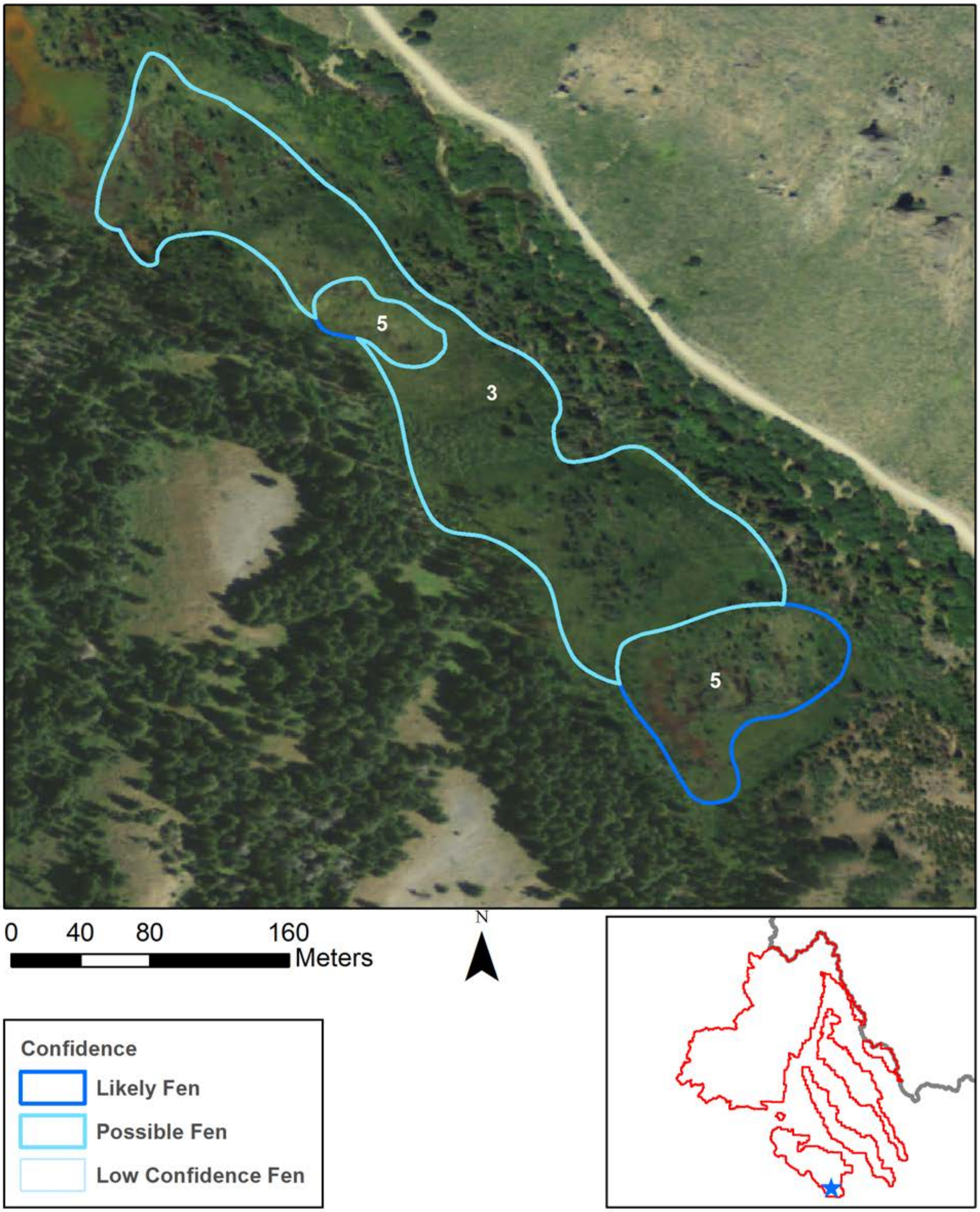

Figure 15: Iron Bog Fen, located along Iron Bog Creek in the Iron Bog Creek watershed in Custer County, near the Custer/Butte County border.

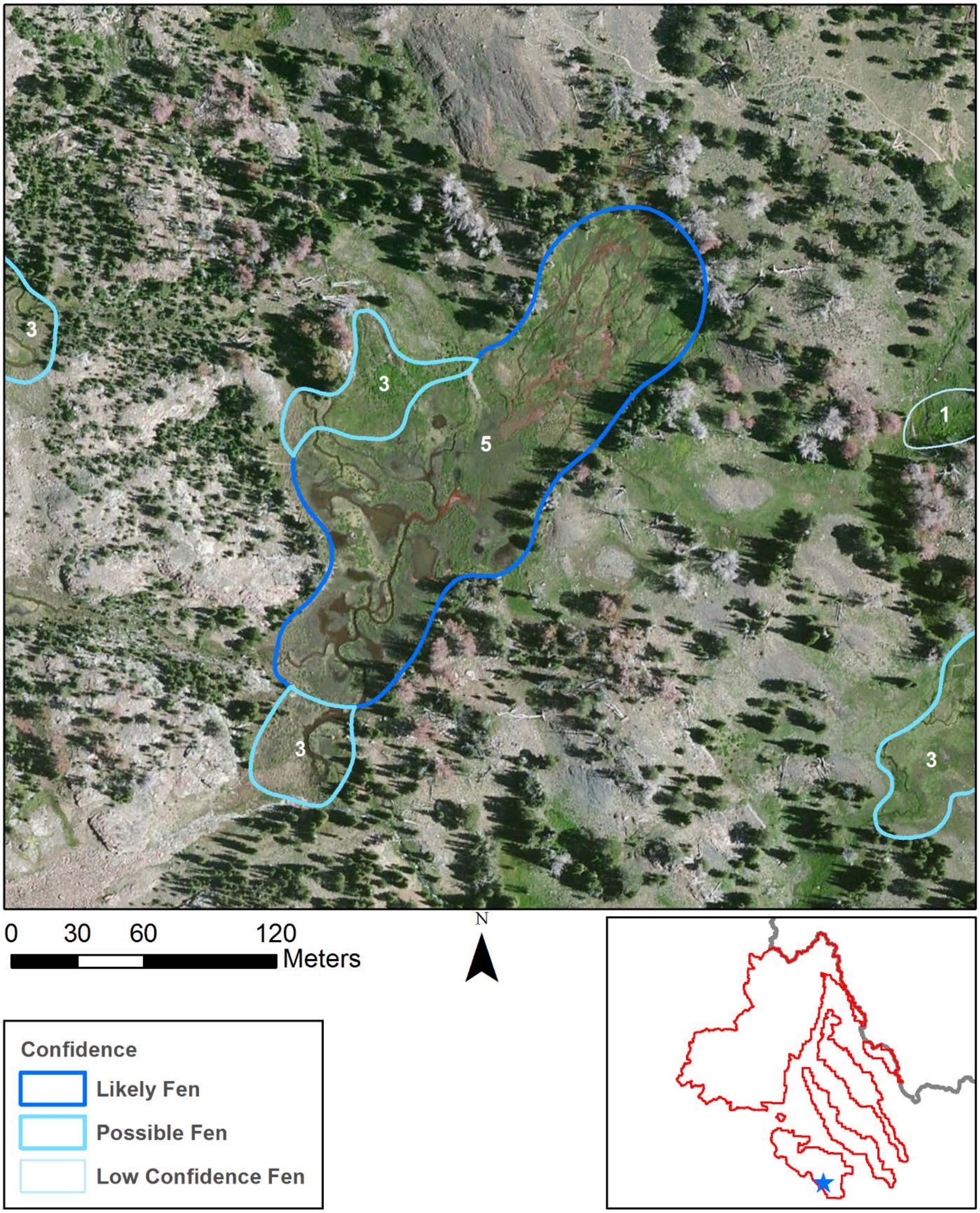

Figure 16: A likely iron fen located just downstream from Brockie Lake, in Iron Bog Creek watershed in Custer County.

5.0 DISCUSSION

The Salmon-Challis National Forest contains relatively few potential fen wetlands, covering only 5,749 acres or 0.1% of its jurisdiction. Some of the landforms in SCNF are not conducive to fen formation, particularly the hot dry canyons of the Idaho Batholith. However the LTA of Strongly Glaciated Lands in Granite shows numerous likely fens and the Valley Bottom LTA has several large acre likely fens. While the potential fen resource represents only a very small portion of the entire landscape, these fen wetlands are an irreplaceable resource for the Forest and the citizens of Idaho. Fens throughout the Rocky Mountains support numerous rare plant species that are often disjunct from their main populations (Cooper 1996; Cooper et al. 2002; Johnson & Stiengraeber 2003; Lemly et al. 2007). Studies specific to floristic diversity of fens in Idaho and the larger northern Rockies highlight the significance of these ecosystems (Moseley & Bursik 1994; Bursik & Henderson 1995; Chadde et al. 1998).

Along with habitat for rare plant species, fens also play a pivotal role in regional hydrologic processes. By slowly releasing groundwater, they help maintain stream flows throughout the growing season. With a predicted warmer future climate, in which snow pack may be less and spring melt may occur sooner, maintaining groundwater storage high in the mountains is imperative. Intact fens also sequester carbon in their deep organic soils, however, disturbing fen hydrology can lead to rapid decomposition of peat and associated carbon emissions (Chimner 2000).

Analysis of the potential fen data showed some interesting patterns in fen distribution within the SCNF. Unlike other National Forests where CNHP has mapped fens, the elevation range containing the majority of likely fen acres (986 acres) was < 9,000 feet, which is lower than most zones of fen formation in the Southern Rocky Mountains. However, this is not unexpected, as the elevation of subalpine vegetation, where fens are often found, is lower at northern latitudes. In addition, Idaho is known to contain numerous fens in lower elevation valley bottoms (Bursik & Henderson 1995).

Three HUC12 Basins stand out as likely fen hotspots in SCNF: Upper Elk Creek, Swamp Creek-Marsh Creek, and Cape Horn Creek. The Swamp Creek-Marsh Creek watershed includes the Blind Summit Fen which, along with the Iron Bog Fen in Iron Bog Creek watershed, were identified as a candidates for Research Natural Area (RNA) designation (Chadde et al 1998). These areas should be actively conserved. Human stressors were observed in some of these sites, including foot trails, ditches and canals. Limiting the impacts of these activities would be beneficial to SCNF fens.

In total, 3,401 potential fens were mapped throughout the SCNF, of which only 385 were most likely to be fens. It is not possible to compare mapped potential fen acreage to acreage mapped as saturated in the National Wetland Inventory with only 10% mapping coverage for the Salmon-Challis National Forest. However even in the areas where NWI does exist, there was not a strong relationship between NWI saturated areas and potential fens. Salmon-Challis stands out as good priority for future updated NWI mapping.

This report and associated dataset provide the SCNF with a critical tool for conservation planning at both a local and Forest-wide scale. Hopefully these 385 likely fen locations can serve as good starting point for field based verification and biological assessment. These data will be useful for the ongoing SCNF biological assessment required by the 2012 Forest Planning Rule, but can also be used to establish buffers around fens for individual management actions, such as timber sales, grazing allotments, and trail maintenance. Wherever possible, the Forest should avoid direct disturbance to the fens mapped through this project, and should also strive to protect the watersheds surrounding high concentrations of fens, thereby protecting their water sources.

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APPENDIX A: LIKELY FENS BY HUC12 WATERSHED, SORTED BY FEN DENSITY

HUC 12 Code	HUC 12 Name	Watershed Acres	Likely Fen Count	Likely Fen Acres
170602050101	Upper Elk Creek	26,052	24	349
170602050305	Swamp Creek-Marsh Creek	29,511	18	250
170602050302	Cape Horn Creek	17,492	16	15
170402180102	Lower Star Hope Creek	27,279	14	26
170602050304	Lower Beaver Creek	19,183	13	34
170602040603	Bear Valley Creek	19,724	13	8
170602060407	Wilson Creek	24,158	12	20
170602020101	Headwaters Pahsimeroi River	36,211	11	15
170602030103	Hat Creek	29,700	9	6
170602050601	Upper Little Pistol Creek	17,422	9	8
170602040505	Big Eightmile Creek	21,111	9	12
170402180204	Fall Creek	14,191	9	11
170402180205	Wildhorse Creek	22,175	8	9
170602020206	North Fork Big Creek	17,978	8	16
170402180602	Iron Bog Creek	15,049	8	12
170602031203	Clear Creek	32,303	8	8
170602010504	West Fork Yankee Fork	36,956	7	30
170602040507	Mill Creek	11,547	7	2
170602061002	Papoose Creek	18,860	7	11
170602030905	Moyer Creek	26,574	6	6
170402170201	Upper Sawmill Creek	25,816	6	13
170602050301	Knapp Creek	12,898	6	10
170402170301	Upper Dry Creek	25,726	6	3
170602050303	Upper Beaver Creek	16,259	5	8
170602050701	Upper Indian Creek	21,819	5	4
170602020304	East Fork Patterson Creek-Patterson Creek	19,987	5	3
170602031107	Big Deer Creek	29,377	5	9
170602051202	Cache Creek-Loon Creek	31,888	4	7
170602011701	Upper Morgan Creek	14,210	4	3
170602031001	Upper Napias Creek	14,055	4	4
170602030201	McKim Creek	10,123	4	10
170602060408	Waterfall Creek	13,215	4	5
170602060201	Upper Yellowjacket Creek	18,053	4	6
170602040704	Pattee Creek	15,853	4	2
170602040604	Basin Creek	28,169	4	8

170602070102	Reynolds Creek	11,166	4	4
170602030402	Jesse Creek	12,908	3	4
170602050502	Upper Rapid River	20,441	3	18
170602070105	West Fork Horse Creek	13,595	3	3
170602040601	Upper Hayden Creek	20,167	3	2
170602050408	Greyhound Creek-Middle Fork Salmon River	16,227	3	5
170402170401	Upper Wet Creek	27,785	3	3
170602010602	Basin Creek	33,701	3	4
170602030101	Cow Creek	17,370	3	4
170602051003	Mayfield Creek	15,586	3	3
170402170202	Middle Sawmill Creek	25,253	3	5
170602050603	Upper Pistol Creek	21,635	2	1
170602060203	Hoodoo Creek	11,336	2	5
170602070103	Middle Horse Creek	13,925	2	1
170602050203	Wyoming Creek-Bear Valley Creek	16,509	2	16
170602010102	Upper Valley Creek	17,354	2	10
170602011603	Eddy Creek	13,495	2	5
170602080106	Trapper Creek-Johnson Creek	12,590	2	6
170602070201	Kitchen Creek	12,173	2	5
170602040402	Lower Big Timber Creek	28,869	2	2
170602080101	Headwaters Johnson Creek	23,682	2	1
170602011403	Bayhorse Creek	15,357	2	1
170602030401	Williams Creek	18,005	2	2
170402180201	Headwaters East Fork Big Lost River	20,172	2	5
170602060402	Grouse Creek-Middle Fork Salmon River	21,782	2	5
170602030205	North Fork Iron Creek	11,857	2	3
170602060104	Castle Creek	15,361	2	3
170602031003	Middle Napias Creek	19,020	2	1
170602030702	Moose Creek	25,360	2	15
170602020306	Falls Creek	12,231	2	2
170602040101	Upper Texas Creek	30,528	2	3
170602011602	Middle Challis Creek	14,404	1	3
170402180603	Bear Creek	12,077	1	3
170602030501	Upper Carmen Creek	11,904	1	0
170602050602	Lower Little Pistol Creek	15,496	1	1
170602031002	Arnett Creek	12,059	1	1
170402180702	Alder Creek	24,556	1	2
170602030302	Lake Creek	12,903	1	1
170602050407	Soldier Creek	13,485	1	0
170602030604	Sheep Creek	24,537	1	1
170602040602	Middle Hayden Creek	11,565	1	1
170602050404	Lower Sulphur Creek	18,022	1	1
170602051001	Headwaters Loon Creek	32,241	1	1

170402180304	Lower North Fork Big Lost River	20,331	1	2
170602060103	Furnace Creek	11,879	1	0
170602060406	Soldier Creek	12,066	1	2
170602010501	Upper Yankee Fork	27,253	1	1
170602070106	Lower Horse Creek	19,672	1	10
170602011802	Garden Creek	21,441	1	1
170602020312	Morgan Creek	14,171	1	1
170602011702	Middle Morgan Creek	24,973	1	0
170602030901	Headwaters Panther Creek	17,672	1	1
170602030104	Allison Creek-Salmon River	22,003	1	2
170602030506	Fourth of July Creek	14,921	1	0
170602040808	Kirtley Creek	13,808	1	0
170602040102	Lower Texas Creek	31,793	1	1

Only watersheds containing potential fens are shown.