THE HISTORIC LEE METCALF ECOSYSTEM

GEOLOGY, SOILS, TOPOGRAPHY

Geology

The Bitterroot Valley, where the Lee Metcalf NWR is located, is a north-trending basin bounded by the Bitterroot Mountains on the west and the Sapphire Mountains on the east. The origin of these mountains, and the rich montane Bitterroot Valley, date to nearly 90 million years before the present (Hodges and Applegate 1993). The Bitterroot Valley extends about 120 miles from the confluence of the East and West Forks of the Bitterroot River south of Darby to its junction with the Missoula Valley and Clark Fork River five miles south of Missoula. The elevation of the valley floor ranges from about 3,900 feet above mean sea level (amsl) in the south to about 3,200 feet amsl near Missoula. Summit elevations of surrounding mountains range from 6-8,000 feet amsl in the Sapphire Range and exceed 9,500 feet amsl in the Bitterroot Range. Four general geomorphologic zones occur in the Bitterroot Valley and include: 1) the Holocene (geologic timeframe is provided in Appendix A) floodplain of the Bitterroot River, 2) low elevation alluvial fans that extend into the floodplain, 3) high elevation, mostly Quaternary-derived, terraces adjacent to the floodplain on the west side of the valley, and 4) high elevation Tertiary-derived outcrop benches/terraces on the east side of the valley (Lonn and Sears 1998, 2001). The floodplain contains highly heterogeneous vertical and horizontal bands of mostly sandy and gravelly alluvium about 3 miles wide.

The Bitterroot Valley is a structural trough formed during the late Cretaceous emplacement of the Idaho batholiths (Ross 1950, McMurtrey et al. 1972, Hyndman et al. 1975). The Bitterroot Mountains are composed of granitic rocks, metamorphic materials, and remnants of pre-Cambrian sediments of the Belt series. The Idaho batholiths, predominantly gray quartz monzonite with small amounts of grandodiorite and anorthite, form the core of the Bitterroot Range. A veneer of gneissic metamorphic material about 2,000 feet thick drapes the range's eastern front (McMurtrey et al. 1972). The Sapphire Mountains are mostly Belt rocks with localized occurrences of granitic stocks. Outcrops of Belt rock include dark-gray quartzite and argillaceous limestone and limy argillites of the Newland formation.

The unusually straight front of the Bitterroot Range is a zone of large-scale faulting (Langton 1935, Pardee 1950); however, the Bitterroot Valley shows little sign of recent tectonic activity (Hyndman et al. 1975). Undisturbed valley fill indicates that tectonic movement since the early Pliocene has been slight or that the entire valley floor has moved as a single unit. The structural basin of the Bitterroot Valley has accumulated a considerable thickness of Tertiary sediments capped in most places by a layer of Quaternary materials. Surficial geology evidence suggests Tertiary fill in the Bitterroot Valley may be up to 4,000 feet thick in some locations (Lankston 1975). This fill is highly variable in context with mostly Six-Mile gravelly formation and finer-grain Renova formation (Noble et al. 1982, Uthman 1988). Sediment is coarse colluviums near the fronts of mountains with finer-grain alluvial fill deposits that interfinger with floodplain silts and clays. Channel deposits of the ancestral Bitterroot River lie beneath the valley center. Tertiary sediments outcrop only on the high terraces of the east side of the valley. Average thickness of Quaternary sediments is about 40 feet of alluvium over the Tertiary strata. The ends of the high Tertiary terraces on the east and most of the west-side terrace surfaces are capped by early to mid-Pleistocene alluvium, while the low terraces and current floodplain are composed of late Pleistocene and Holocene alluvium.

Quaternary alluvium on high terraces in the valley is mostly unconsolidated sediments of fluvial, glaciofluvial, and glaciolacustrine origin. Low terrace alluvium occurs as outwash, or "alluvial fans", below the mouths of tributaries on both sides of the valley (Lonn and Sears 2001). Floodplain alluvium is mostly well-rounded gravel and sand with a minor amount of silt and clay derived from the edges of the adjacent terraces and fans. Most of Lee Metcalf NWR is mapped as "Qal" alluvial deposits of recently active channels and floodplains (Fig. 2). These deposits are well-rounded, and sorted gravel and sand with a minor amount of silt and clay. Clast lithologies represent rock types of the entire drainage including granitic, volcanic, metamorphic, and sedimentary rocks. Minor amounts of "Qaty" (younger alluvial outwash terrace and fan complex deposits from the late Pleistocene) occur adjacent to the Bitterroot Valley alluvium on the north end of the Lee Metcalf NWR. These surfaces are late Pleistocene alluvium of the Riverside and Hamilton terraces and rise 10-20 feet above the present floodplain and are approximately 10-30 feet thick. Materials in these terraces are well-rounded and sorted gravel of predominantly granitic, gneissic, and Belt sedimentary origin (Lonn and Sears 2001). "Qafy" surfaces extend along the Bitterroot Valley on both sides of Lee Metcalf NWR. These surfaces are younger (late Pleistocene) alluvial outwash terrace and fan complexes of well-rounded cobbles and boulders in a matrix of sand and gravel deposited in braided-stream environments that formed between and below the dissected remnants of older fans. These surfaces appear to have been at least partly shaped by glacial Lake Missoula that reached a maximum height at an elevation of 4,200 feet and covered the Bitterroot Valley near Lee Metcalf during the last glacial advance 15-20,000 years before the present (Weber 1972). Surfaces of these deposits are 5-25 feet above active channels. Some alluvial fans coalesce with younger alluvial terrace deposits; average thickness of fans is about 40 feet.

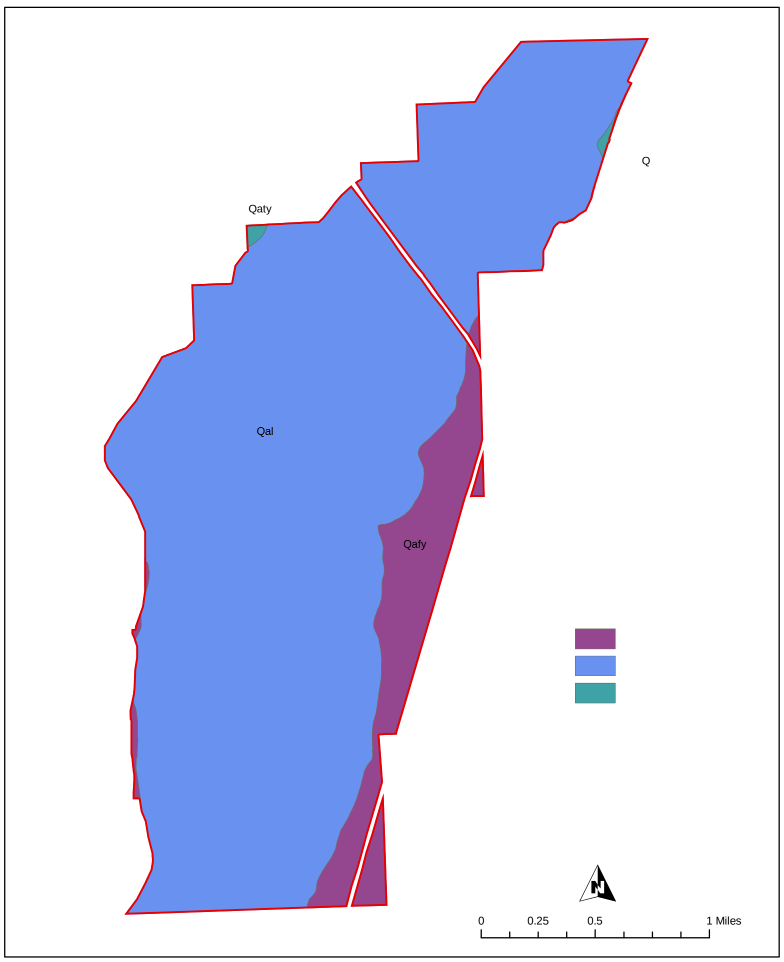


Figure 2. Geomorphic surfaces on Lee Metcalf National Wildlife Refuge (from Lonn and Sears 2001). "Qal" – Quaternary alluvial deposits. "Qafy" – Holocene alluvial outwash terraces and fan complexes. "Qaty" – Pleistocene alluvium of late Riverside and Hamilton terraces.

The Bitterroot River has an inherently unstable hydraulic configuration and high channel instability, particularly between the towns of Hamilton and Stevensville (Cartier 1984, Gaeuman 1997). The river reach immediately upstream from Lee Metcalf NWR has a complex multi-strand channel pattern that is characterized by numerous braided, or anastomosing, channels that spread over a wide area of the valley bottom. The zone of non-vegetated gravels associated with main braided channel system has widened and straightened since 1937 (Gaeuman 1997). In addition to this widening, severe bank erosion is common but numerous cut-off chutes counteract some lateral bend displacement. Chutes and other avenues of river overflow are encouraged by low river banks and natural levees, which were never highly accreted because of active river movements and a braided river channel configuration. Complex networks of minor channels occur in the valley floor including the floodplain lands on Lee Metcalf NWR (Fig. 3). These minor channels appear to have their genesis from ground-water discharge, which promotes basal sapping and headwater retreat of small channel head cuts on the floodplain. Channel multiplicity appears to be controlled by irregularities in the respective elevation gradients of the valley.

From Stevensville north about 10-15 miles, the Bitterroot River channel is more confined, compared to a highly braided form further south. Despite some river morphology change north of Stevensville, the river stretch along the Lee Metcalf NWR has maintained a highly dynamic, instable channel form due to its geological, topographic, and hydraulic position. The historic floodplain at Lee Metcalf NWR was characterized by: 1) multiple abandoned channels (e.g. Barn and Francois sloughs) that were connected with the main river channel during high flow events; 2) small "minor" within-floodplain channels (e.g., Rogmans and Spring Creek) that received water from groundwater discharge and occasional overbank backwater flooding during high flow events; 3) entry of two mountain/terrace derived major tributaries to the Bitterroot River (e.g. North Burnt Fork Creek and Three Mile Creek); 4) slightly higher elevation inter-drainage point bars, natural levees, and terraces; and 5) alluvial fans (Figs. 4,5).

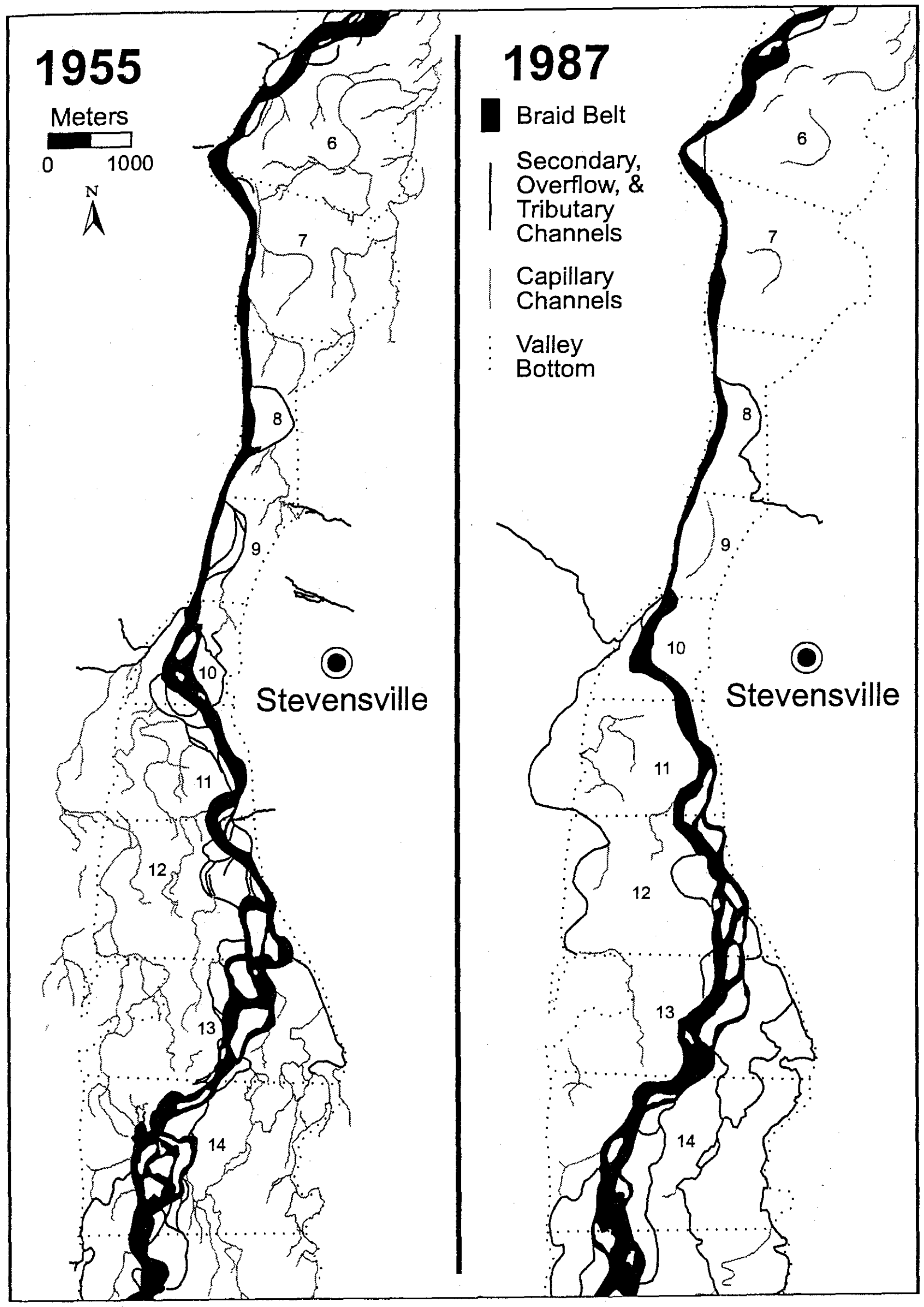


Figure 3. Bitterroot River floodplain channels and tributaries in the Lee Metcalf National Wildlife Refuge region, 1955 and 1987 (from Gaeuman 1997).

Soils

Nearly 25 soil types/groups currently identified by the U.S. Department of Agriculture SSURGO data bases are present on or adjacent to Lee Metcalf NWR (Fig. 6). The most extensive soils are Riverrun-Curlew-Gash complex, Ambrosecreek sandy loams, and Riverside-Tiechute-Curlew complexes. Current soil maps of Lee Metcalf NWR are constrained

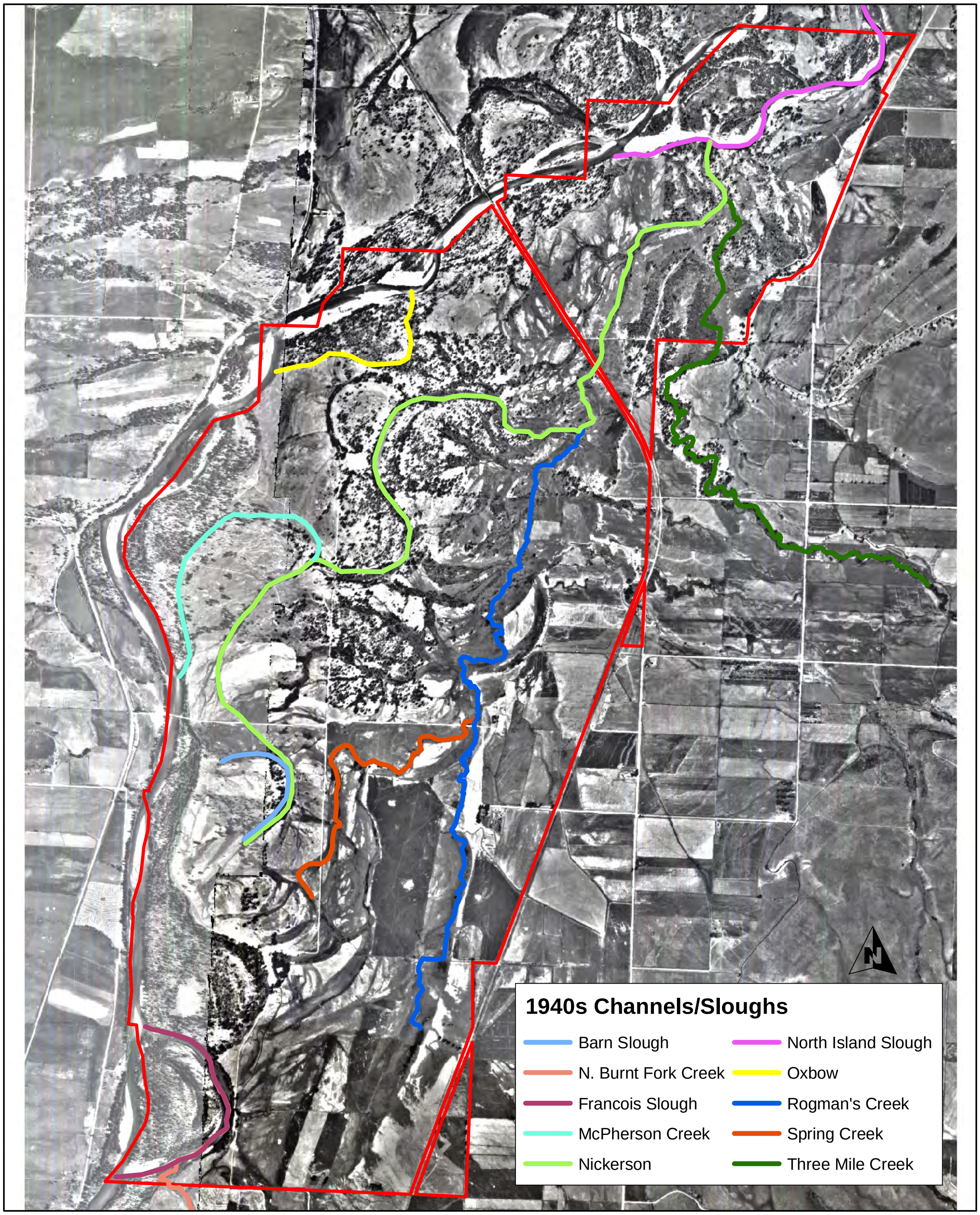


Figure 4. Aerial photograph of the Lee Metcalf National Wildlife Refuge region in 1940 showing major floodplain drainages and abandoned channels of the Bitterroot River.

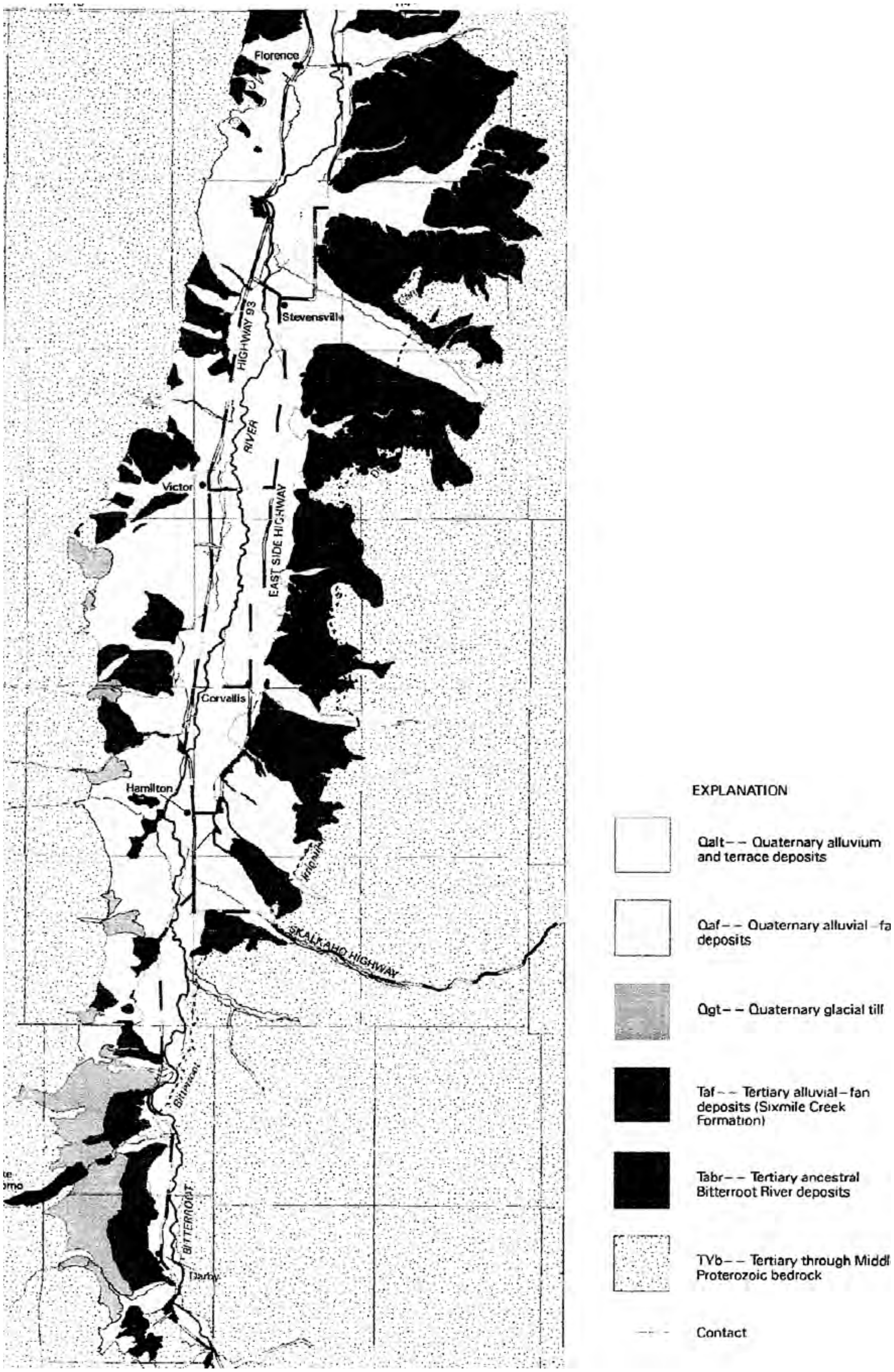


Figure 5. Location of major alluvial fans along the Bitterroot River Valley (modified from Lonn and Sears 1998).

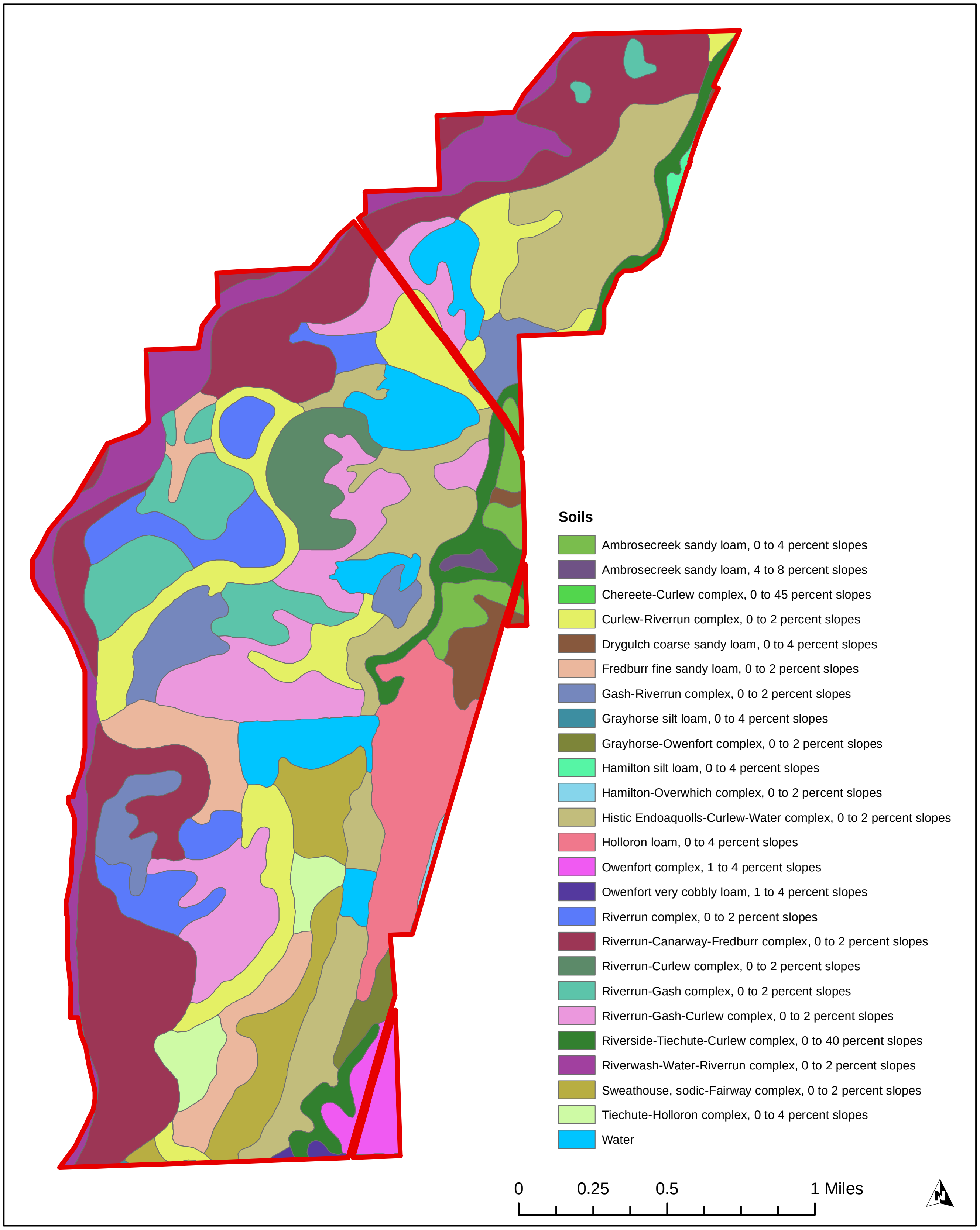


Figure 6. Soils on Lee Metcalf National Wildlife Refuge (from U.S. Department of Agriculture SSURGO data bases).

by numerous water impoundments where no soil type is identified and the impoundment areas are listed as "water." Consequently, older soil surveys (e.g., Bourne et al. 1959), despite using different soil taxonomy names, are more useful to understand soil types and distribution on the refuge prior to major floodplain developments and impoundment construction and are used in this report to construct HGM matrices of historic distribution of plant communities. The juxtaposition of soils on the NWR is complex, highly interspersed, and reflects the numerous channel migration events across this floodplain, introduction of mixed-erosion sediments from surrounding Quaternary and Tertiary terraces, and alluvial deposition of Bitterroot Valley parent materials. Most soils on the NWR are shallow, with thin veneers of silts and clays overlying deeper sands and gravels. In many places sandy outcrops occur, especially near the Bitterroot River.

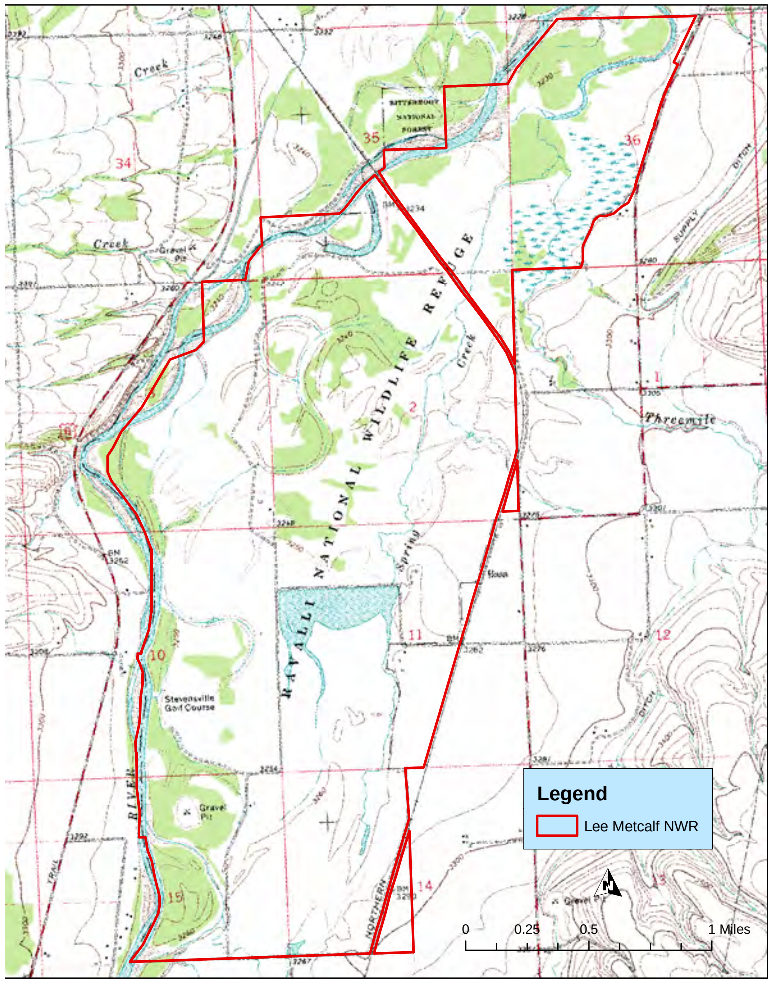


Figure 7. U.S. Geological Survey 7.5-minute topographic quadrangle map of the Lee Metcalf National Wildlife Refuge region.

Topography and Elevation

Elevations on Lee Metcalf NWR range from about 3,230 on the north end to about 3,260 on the south end of the refuge (Figs. 7, 8). Much topographic heterogeneity occurs within the refuge related to historic Bitterroot River channel and tributary channel migrations, scouring and natural levee deposition along minor floodplain channels, and alluvial deposition. A large portion of the southeast part of the refuge contains higher, more uniform, elevations while north and west parts of the refuge have lower, more diverse, elevations. Alluvial fans are present in many locations along the "Qafy" geomorphic surfaces on the east side of the refuge. A larger "tributary fan" is present where North Burnt Fort Creek enters the Bitterroot River floodplain and is much larger than the alluvial fans along the floodplain margin that grade into the Sapphire Mountain Range (Fig. 5).

CLIMATE AND HYDROLOGY

The climate of the Bitterroot Valley is characterized by cool summers, generally light precipitation, little wind, and relatively mild winters. Annual precipitation averages about 13 inches but is variable related to position in the valley (Fig. 9). Precipitation increases with elevation along the valley margins and ranges from < 13 inches in the Bitterroot Valley floor to nearly 60 inches near Bitterroot Mountain summits on the west side of the valley. In contrast, precipitation along the crest of the Sapphire Mountains on the eastern margin of the Valley is about 25-35 inches/year. The growing season in the Valley averages about 103 days; the average last occurrence of freezing temperatures is 30 May and average first frost is 10 September. Spring is the wettest period of the year, with about 25% of annual precipitation falling in May and June (Fig. 10). Runoff in the Bitterroot River is highest in spring, with about 55% of the river's discharge occurring in May and June following snowmelt and local rainfall (McMurtrey et al. 1972). Natural flows in the Bitterroot River

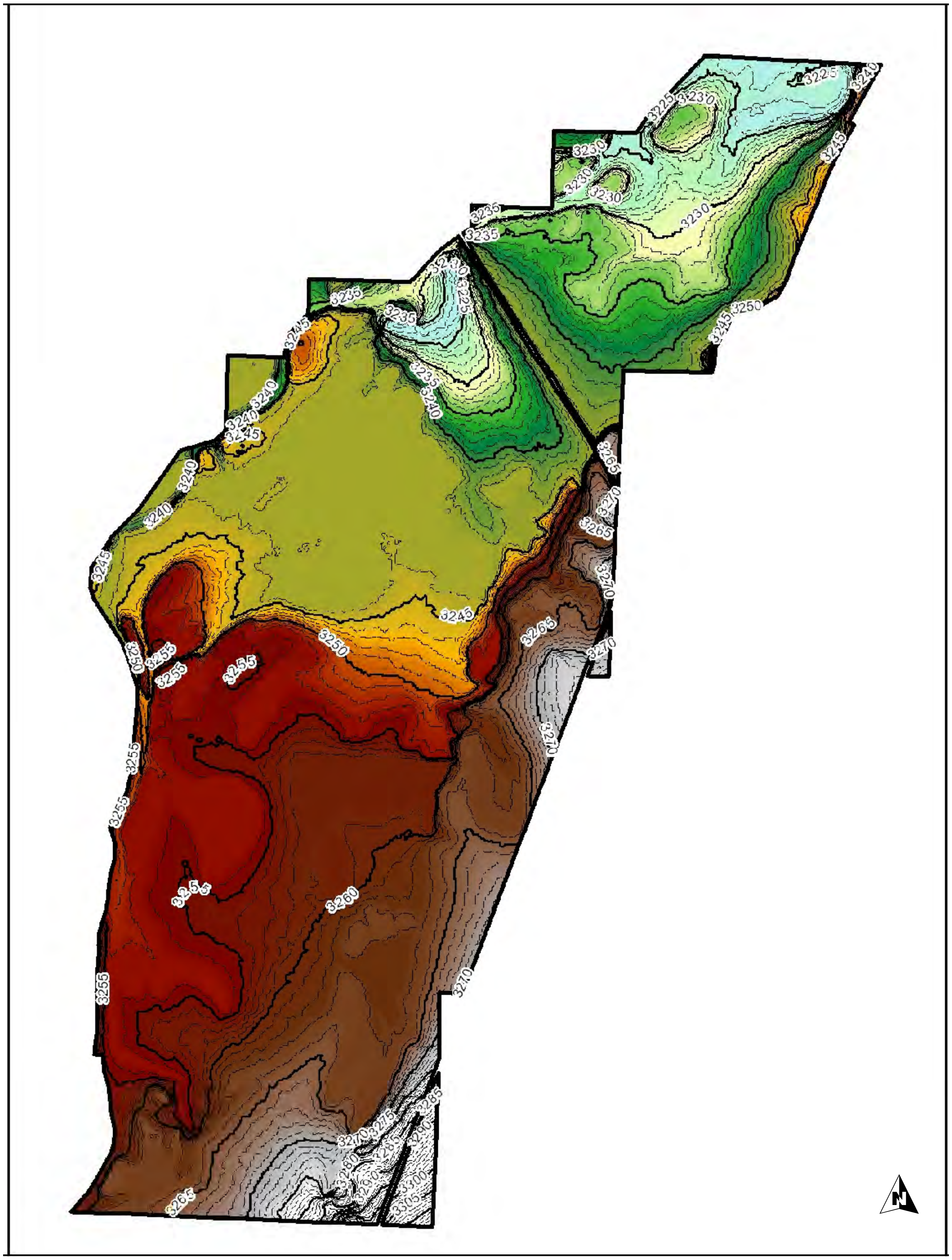
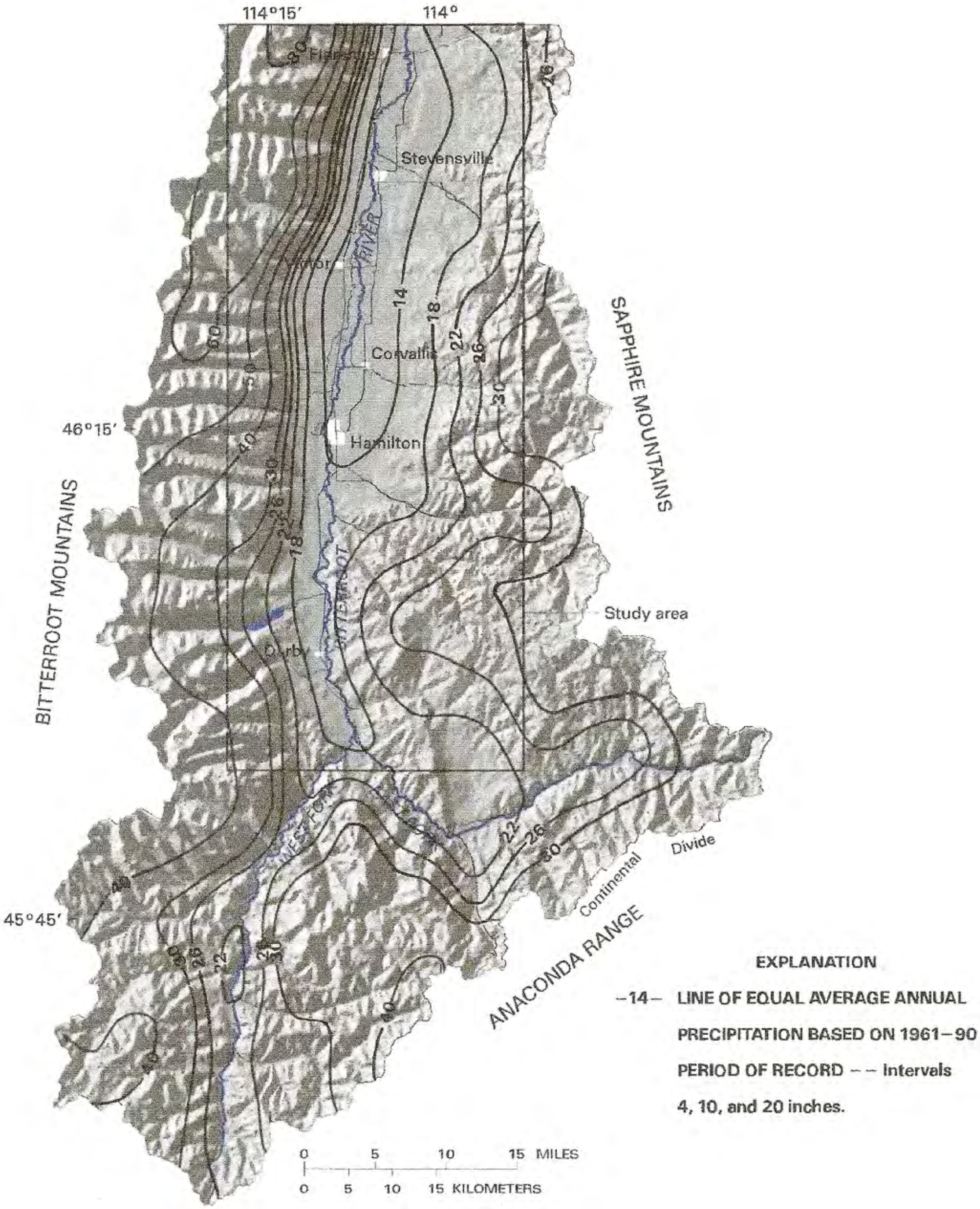


Figure 8. Digital elevation (10 m) model of Lee Metcalf National Wildlife Refuge, showing one-foot contour intervals.



Base from Defense Mapping Agency digital data, 1:250,000, 1975, and
U.S. Geological Survey digital data, 1:100,000, 1983. Albers Equal Area
Conic Projection Standard parallels 44° 00′, and 48° 00′, central meridian -114° 00′.

Figure 9. Average annual precipitation in Ravalli County, Montana (from Briar and Dutton 2000).

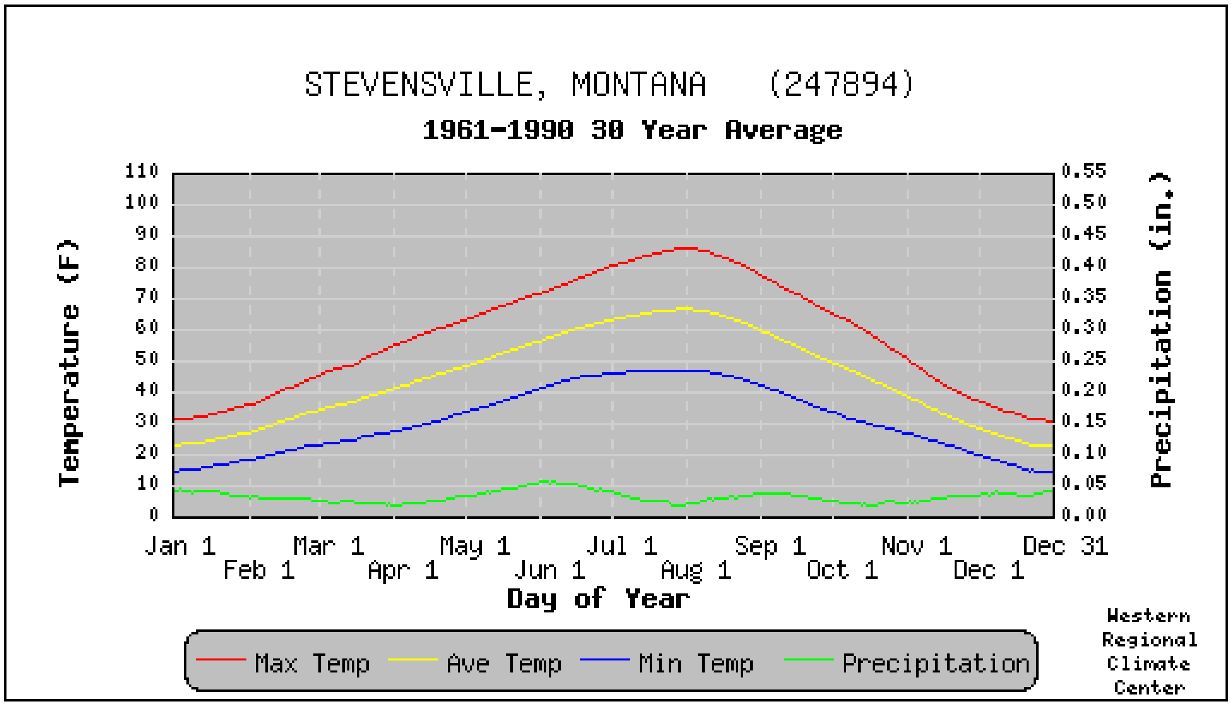


Figure 10. Mean annual temperature and precipitation at Stevensville, Montana 1961-1998.

Figure 11. Aerial photograph of flooding on Lee Metcalf National Wildlife Refuge in summer 1974.

decline from spring peaks throughout summer and remain relatively stable through winter. On average about 1.772 million acre-feet of water flows into the Bitterroot basin via the Bitterroot River each year. Of this total entry, 52% is from the west, 37% is from the south, and 11% is from the east (Briar and Dutton 2000).

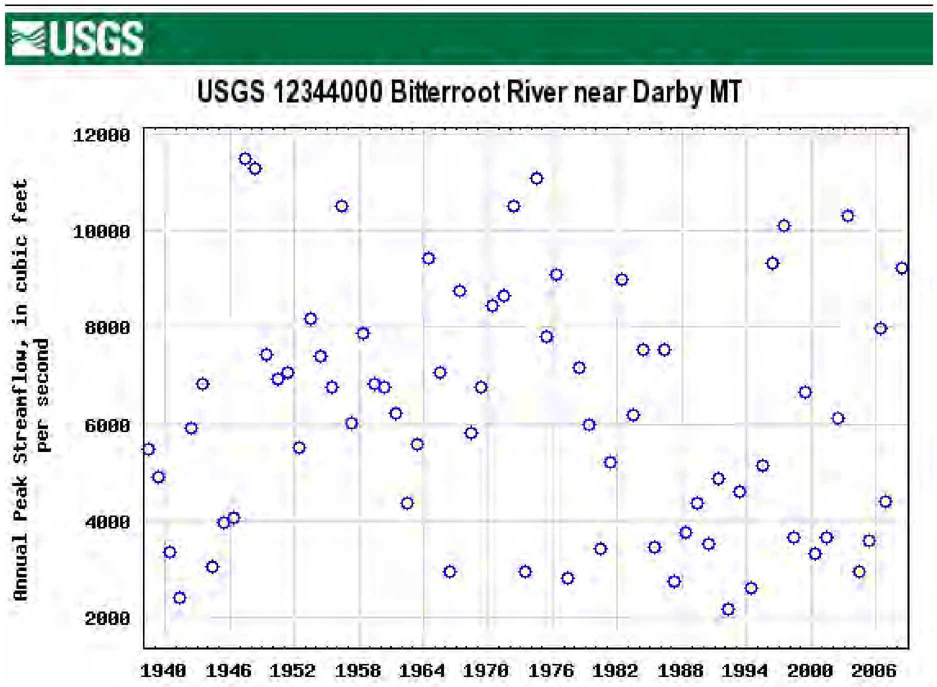


Figure 12. Peak discharge (cfs) of the Bitterroot River near Darby, Montana 1940-2007.

Numerous tributaries enter the Bitterroot Valley from mountain canyons. North Burnt Fork Creek and Three-mile Creek are major tributaries flowing across Lee Metcalf NWR into Francois Slough and North Island Slough, respectively (Fig. 4). Other minor, within flood-plain, drainages that historically crossed Lee Metcalf and ultimately emptied into the Bitterroot River included Spring Creek, Rogmans Creek, and the currently modified McPherson and Nickerson creeks (now called "ditches"). Valley-wide, about four times as many tributaries join the river from the Bitterroot Mountains on the west compared to the drier Sapphire Mountains on the east.

Flow and flood frequency relationships are available for the Bitterroot River near Florence since 1950 (Table 1). For this period of record, the river exceeded 1,050 cubic feet/second (cfs) at a 50% recurrence interval, or every other year frequency. Bankfull discharge at Florence is about 13,000 cfs; some modest backwater flooding on Lee Metcalf NWR occurs at > 10,000 cfs with a > seven-foot stage height (USFWS 1974). This high flooding discharge occurs very infrequently at a > 50-year recurrence interval, yet it causes extensive flooding throughout higher floodplain areas (e.g., Fig. 11). In contrast, spring backwater flooding into connected floodplain sloughs and oxbows occurs regularly, at a 5-10 year recurrence interval. The Darby gauge station, upstream from Lee Metcalf NWR, has the longest period of record for discharge on the Bitterroot River. Discharges on the Bitterroot River at Darby have less influence from irrigation return flow, so this gauge station represents the best location to evaluate relatively natural long-term patterns in river flow. Peak discharge at Darby, dating to the 1940s suggests periodic high discharge (> 10,000 cfs) at about 20-25 year intervals with intervening years of moderate to low flows (Fig. 12). During the period of record, more very low flow (< 4,000 cfs) years (20) occurred than did high flow (> 8,000) years (16). In summary, river gauge data suggest the floodplain at Lee Metcalf was seldom extensively flooded historically (e.g., 1974, Fig. 11), but that some backwater flooding into primary sloughs and tributaries occurred at a > 50% recurrence interval in spring.

Many of the morphological characteristics of "capillary" or "secondary" channels of the Bitterroot River floodplain, including those at Lee Metcalf NWR (such as Three-Mile, Rogmans, McPherson, and Nickerson creeks and Francois Slough) are indicative of an intimate connection with groundwater discharge (Gaeuman 1997). Lack of connectivity within secondary channel networks, large upstream and downstream variations in discharge within individual channels, and observed springs along the margins of floodplain terraces indicate a substantial subsurface flow. Many of these channels are probably remnants of formerly large channels (including past abandoned channels of the Bitterroot River) that have filled incompletely, perhaps because of the maintenance of a base groundwater flow. In other cases, groundwater discharge may be actively

Table 1. Flow duration record for the Bitterroot River near Florence, Montana, 1950-79 (from Cartier 1984).

BITTERROOT RIVER NEAR FLORENCE
(USGS 123512.00)

FLOW DURATION RECORD
1950-1979*

PERCENT EXCEEDENCE	DISCHARGE (CMS)	DISCHARGE (CFS)
0.1	546	19300
0.2	521	18400
0.5	464	16400
1.0	416	14700
2.0	362	12800
5.0	275	9700
10.0	184	6500
15.0	126	4450
20.0	87.8	3100
25.0	65.1	2300
30.0	51.2	1810
35.0	43.9	1550
40.0	38.2	1350
45.0	34.0	1200
50.0	29.7	1050
55.0	27.7	980
60.0	25.2	890
65.0	23.2	820
70.0	21.8	770
75.0	20.4	720
80.0	19.3	680
85.0	17.8	630
90.0	16.7	590
95.0	15.0	530

excavating channels that seem to be growing by head cuts.

Alluvial aquifers in the Bitterroot Valley are generally unconfined and interconnected, although the configuration of water-bearing layers in the heterogeneous valley fill is highly variable (Briar and Dutton 2000). Permeability is highest in alluvium of the low Quaternary terraces and floodplain and hydraulic conductivity of up to 75 feet/day has been calculated in low terrace alluvium. Groundwater circulation is predominantly away from the valley margins toward the Bitterroot River. The basin-fill aquifers are recharged by infiltration of tributary streams into coarse terrace alluvium, subsurface inflow from bedrock, and direct infiltration of precipitation and snowmelt. High amounts of precipitation on the western side of the valley cause greater recharge there than on the east side of the valley. Groundwater recharge is by seepage to springs and streams, evapotranspiration, and now by withdrawals from wells. Water in basin-fill aquifers is primarily a calcium bicarbonate type. Median specific conductance is about 250 microsiemens/centimeter at 25o C and median nitrate concentration is relatively low (0.63 mg/L) within the aquifer. Nitrate concentration in surface waters may reach 6 mg/L (Briar and Dutton 2000).

LAND COVER AND VEGETATION COMMUNITIES

Historic vegetation in the Bitterroot River floodplain near Lee Metcalf NWR included seven distinct habitat/community types: 1) Riparian/Riverfront-type Forest, 2) floodplain "Gallery-type" forest, 3) Persistent Emergent wetland, 4) Wet Meadow Herbaceous, 5) floodplain and terrace Grassland, 6) Saline Grassland, and 7) Grassland-Sagebrush (Table 2). The relatively low precipitation in the Bitterroot Valley prohibits the establishment of expansive areas of densely wooded or herbaceous wetland vegetation communities that require larger amounts of water each year. Consequently, the distribution of woody or wetland-type species is restricted to areas of greater soil moisture – primarily sites adjacent to the Bitterroot River and in floodplain drainages/depressions (Hansen et al. 1995 and indirect observations in various historical accounts including Leiberg 1899, Browman 1989, Cappious 1939, Clary et al. 2005, Stevensville Historical Society 1971, Chaffin 1971, Popham 1998, Losensky 1993).

Riverfront Forest includes early succession tree species such as cottonwood and willow (Appendix B) that are present on newly deposited and scoured gravelly-sand, sand, and fine sandy-loams near the active channel of the Bitterroot River and in sand-outcrop sites adjacent to floodplain drainages (Table 2). These sites have high water tables for most of the year and are inundated for short periods during high spring river flows almost annually. Regularly scoured soils provide bare soil sites for seed deposition and subsequent germination and growth of willow and cottonwood (e.g., Cooper et al. 1999).

Gallery Forest at Lee Metcalf NWR is dominated by cottonwood and ponderosa pine and is present on higher floodplain elevations with veneers of Chamokane loams over underlying sands along natural levees and point bar terraces adjacent to

Table 2. Hydrogeomorphic (HGM) matrix of historic distribution of vegetation communities/habitat types on Lee Metcalf National Wildlife Refuge. Relationships were determined from old aerial photographs, geomorphology maps (Lonn and Sears 2001), soil maps and survey publications (Eckmann and Harrington 1917, Bourne et al. 1959), U.S. Geological Survey 7.5-minute quadrangle topographic maps, river gauge data from the Bitterroot River (from Cartier 1984), various historical accounts of the region (e.g., Stevensville Historical Society 1971), botanical relationships (Hansen et al. 1995), and land cover maps prepared by the U.S. Fish and Wildlife Service.

Habitat type	Geomorphic surface[a]	Soil Type	Flood frequency[b]
Riverfront Forest	Qal, Qaty	Riverside, Riverwash, Chamokane gravelly-sand, sand, fine sand-loam	1YR-I
Gallery Forest	Qal	Chamokane loam and loamy sand	2-5YR
Persistent Emergent	Qal	Slocum poorly drained loam	1YR-P
Wet Meadow	Qal	Slocum deep loams	2-5YR
Grassland	Qal, Qafy	Corvallis, Hamilton, Grantsdale silt loam	> 5YR
Grassland-saline	Qal	Corvallis saline silt loam	> 5YR
Grassland-sage	Qafy	Lone Rock mixed erosional alluvial fan	> 10YR

[a] Qal – Quaternary alluvial deposits, Qafy – Quaternary younger alluvial fan and outwash terrace complex, Qaty – late Riverside and Hamilton terraces.

[b] 1YR-I – annually flooded for intermittent periods, primarily during high water periods of the Bitterroot River, 2-5YR – surface inundation at a 2-5 year recurrence interval, 1YR-P – annually flooded primarily for most of the year, > 5YR – surface inundation at a greater than 5 year recurrence interval, > 10YR – surface inundation rare except for lower elevations during extreme flood events.

minor floodplain tributaries. Gallery Forest areas often have woody shrubs such as alder, hawthorn, dogwood and wood's rose in the understory and mixed grass species such as bluebunch wheatgrass and Idaho fescue under and between trees and shrubs. Gallery Forests historically were flooded occasionally by overbank or high backwater floods from the Bitterroot River and secondary floodplain channels, but when flooding did occur, it was for short durations during spring. Fire and grazing by native ungulates probably sustained the savanna nature of these sites and encouraged a mix of grass, shrubs, and overstory trees (Fischer and Bradley 1987, Burkhardt 1996).

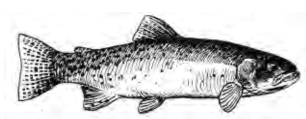
Low elevation oxbows, depressions, and tributary off-channel areas contained more permanent water regimes and supported water tolerant wetland vegetation species dominated by Persistent Emergent species such as cattail. Certain of these low elevation sites with extended water regimes may have been periodically created, and then abandoned during dry periods, by beaver activity (Kudrey and Schemm 2008). Sites immediately adjacent to Persistent Emergent communities grade into diverse Wet Meadow communities dominated by annual and perennial sedges, rushes, herbaceous species, and water tolerant grasses. Historic Persistent Emergent habitats appear to have had predominantly poorly drained Slocum loams, while historic Wet Meadow areas had deeper, better drained, loam-type soils.

The majority of higher elevations within the Lee Metcalf NWR floodplain region were covered with grasses and some scattered shrubs (Eckmann and Harrington 1917, Cappious 1939, Chaffin 1971, Popham 1998). Sites that had occasional surface flooding contained more wet Grassland communities with interspersed herbaceous plants such as smartweed and sedges while higher floodplain terraces, slopes and alluvial fans included mixed wet- and upland-type grasses and shrubs such as rabbit brush, sage, needle and thread, and june grass. Most floodplain grassland areas have Corvallis, Hamilton, and Grantsdale silt loam and loam soils. Certain sites in the Lee Metcalf NWR region have saline soils that supported more salt tolerant species. Larger alluvial fans, such as near Three Mile Creek, are present on "Qafy" surfaces with Lone Rock mixed erosion soils, and these sites historically had a mixed Grassland-Sagebrush community (e.g., Browman 1989, Clary et al. 2005). A composite model of potential historic vegetation communities, based on HGM attributes (Table 2); present on Lee Metcalf NWR prior to significant alteration and development beginning in the late 1800s is presented in Fig. 13.

KEY ANIMAL COMMUNITIES

The Bitterroot River floodplain at Lee Metcalf NWR historically supported a wide diversity of vertebrate and invertebrate animal species associated with the interspersed riverine, riparian, floodplain wetland, and grassland habitats Appendices C, D). Migratory birds are especially abundant at Lee Metcalf during fall and spring migration. About 267 native species of birds are present in the Bitterroot River watershed and 242 species have been documented at Lee Metcalf NWR (USFWS, unpublished refuge files). Key species groups include grebes, bitterns, herons, egrets, waterfowl, raptors, shorebirds, flycatchers, swallows, chickadees, warblers, wrens, sparrows, and blackbirds. Additionally, many bird species nest in forest, wetland, and grassland areas; the most common species are dabbling ducks, warblers, flycatchers, swallows, blackbirds, sparrows, wading birds, and raptors. Over 40 mammal species also are present in the region; the most common species are marmots, chipmunks, northern pocket gopher, woodrat, voles, silver-haired bat, red squirrel, striped skunk, mule deer, moose, and elk in upland and riparian areas and muskrat, otter, mink, and raccoon in wetland and riverine areas. At least twelve species of reptiles and amphibians apparently used the area including 6 snakes, 3 turtles, and 3 frogs. Several species of native fish historically were present in the Bitterroot River and many moved into floodplain drainages, oxbows, and wetlands during high flow periods. Native species included bull trout, mountain whitefish, northern pikeminnow, large scale sucker, longnose sucker, redside shiner, and mottled sculpin. The bull trout, a federally listed threatened species, was native to North Burnt Fork Creek.

Resources used by animal species within the Bitterroot River floodplain were seasonally dynamic and also annually variable depending on long-term climate and river flow/flooding patterns. Most bird species exploited seasonal resources during migration and summer in the Lee Metcalf region, but a few species overwintered in the area. Many waterbirds likely stayed in the Bitterroot Valley during wet summers to breed when floodplain wetlands had more extensive and prolonged water regimes. In contrast, limited numbers of species and individuals probably bred in the Valley during dry years. Similarly, wet springs and carryover water to fall likely encouraged larger numbers of waterbirds to stopover in the Valley during fall migration in these years. In average or dry years, however, little wetland habitat would have been available in fall. Cold winter temperatures freeze most wetlands in the floodplain, but the river remains open throughout winter in most years and provides refuge, loafing, and some foraging resources for some species. Amphibian and reptile annual emergence and life cycle events coincide with spring thaw and flooding and the availability of key arthropod and other prey species. Larger mammals move in and out of the floodplain to forage and take advantage of cover during winter and in other seasons when nutritious grassland forage and carnivorous prey are present.



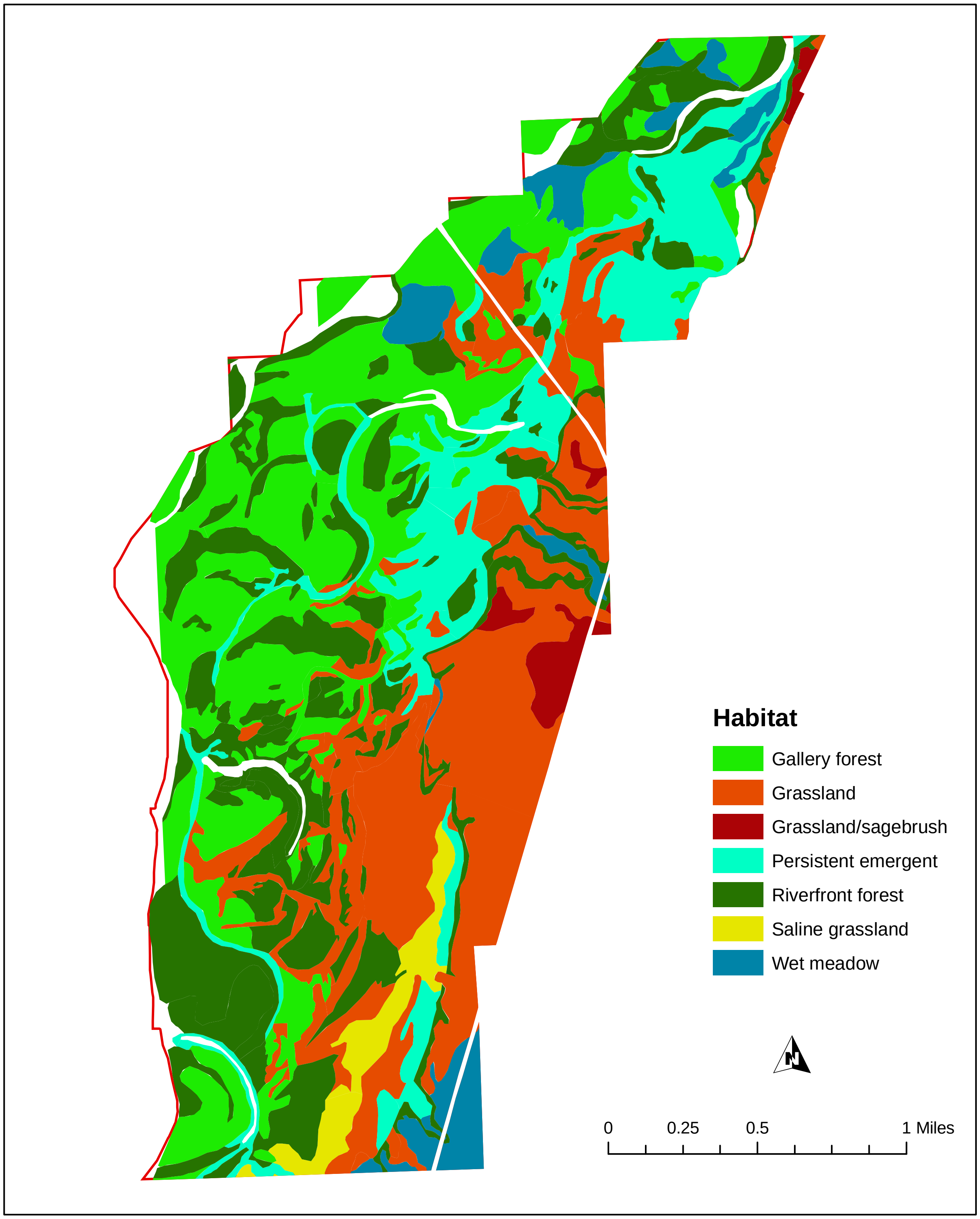


Figure 13. HGM-derived model map of potential vegetation communities present on Lee Metcalf National Wildlife Refuge prior to European settlement in the mid 1800s (mapped from data in Table 2).

http://etc.usf.edu/clipart

Left:
Old Bill Williams ca 1839, Rocky Mountain trapper

Below:
Salish men, 1903

Wikipedia.org