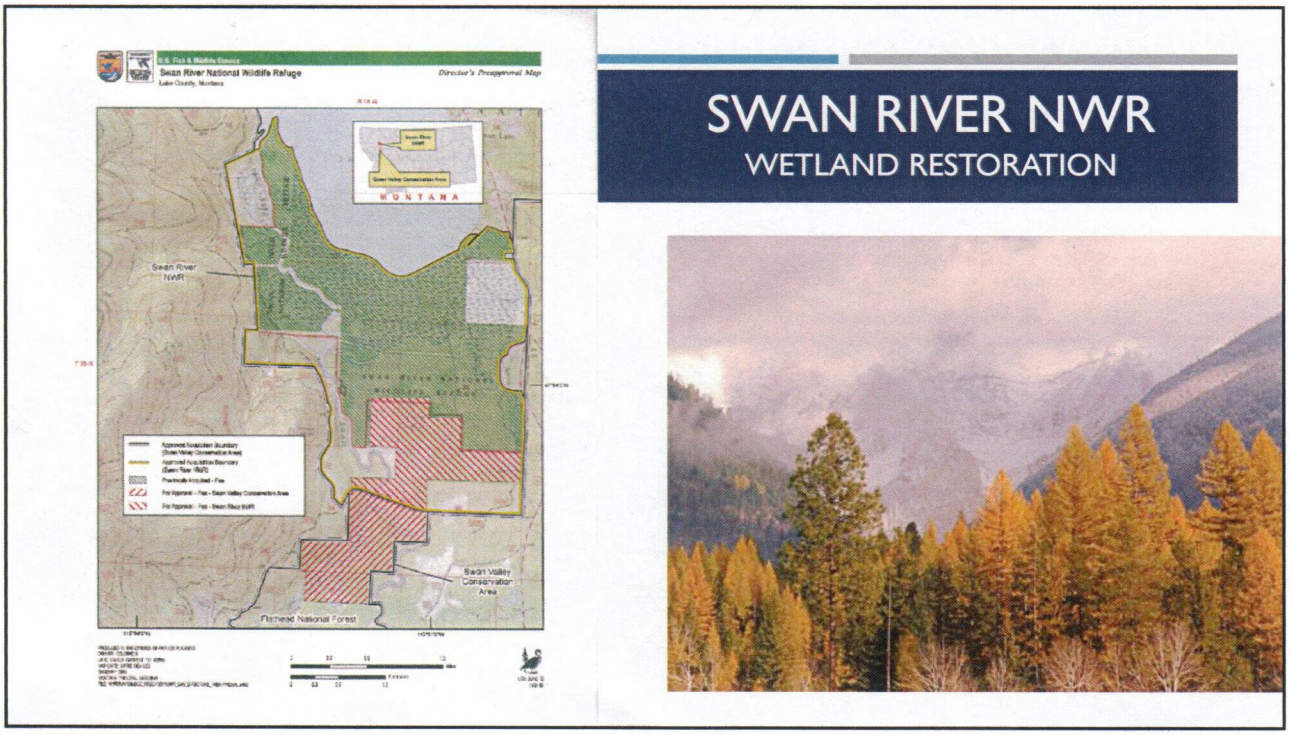
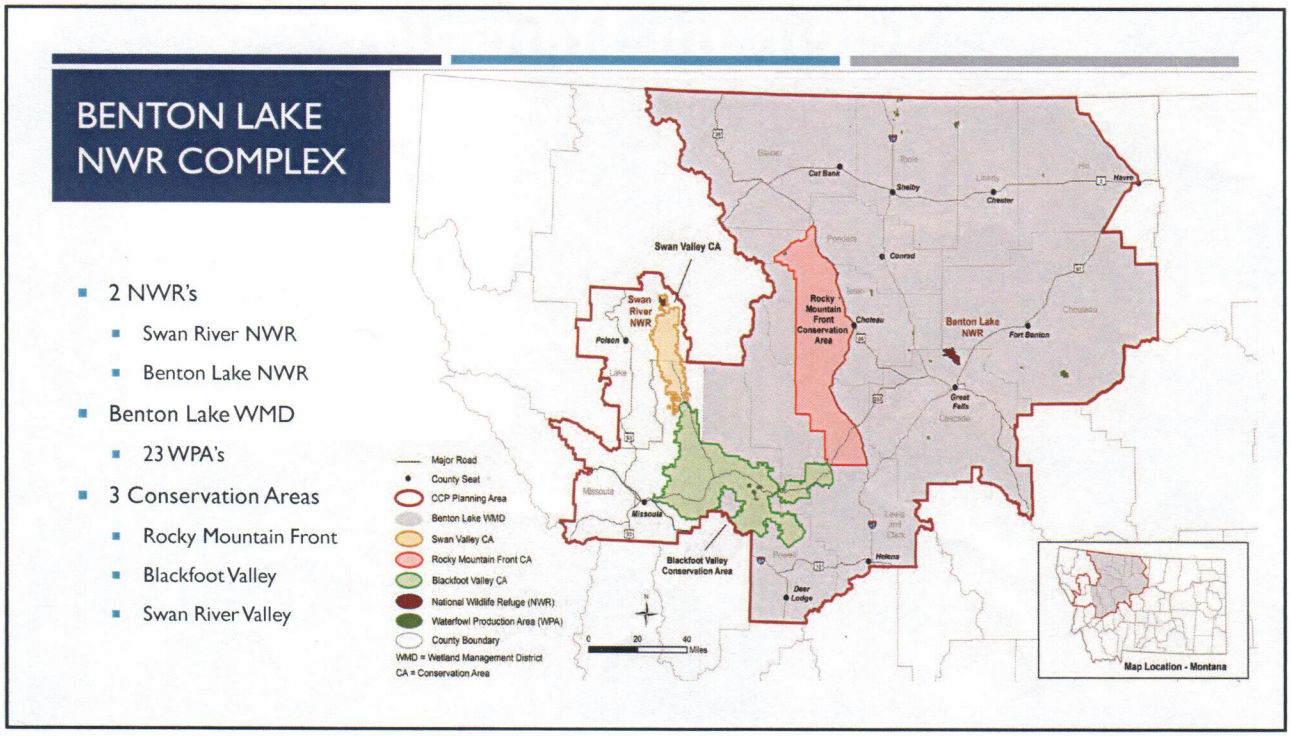

U.S. Fish & Wildlife Service
Swan River National Wildlife Refuge
Lake County, Montana
Director's Preapproval Map
MONTANA
Swan River NWR
Swan Valley Conservation Area
Flathead National Forest
SWAN RIVER NWR
WETLAND RESTORATION


BENTON LAKE NWR COMPLEX
2 NWR's
Swan River NWR
Benton Lake NWR
Benton Lake WMD
23 WPA's
3 Conservation Areas
Rocky Mountain Front
Blackfoot Valley
Swan River Valley
Swan Valley CA
Swan River NWR
Rocky Mountain Front Conservation Area
Benton Lake NWR
Blackfoot Valley Conservation Area
Cut Bank
Shelby
Chester
Havre
Conrad
Choteau
Fort Benton
Great Falls
Helena
Deer Lodge
Missoula
Polson
Major Road
County Seat
CCP Planning Area
Benton Lake WMD
Swan Valley CA
Rocky Mountain Front CA
Blackfoot Valley CA
National Wildlife Refuge (NWR)
Waterfowl Production Area (WPA)
County Boundary
WMD = Wetland Management District
CA = Conservation Area
0 20 40 Miles
Map Location - Montana

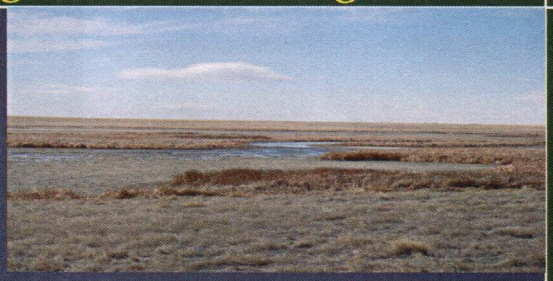
Benton Lake NWR Management Challenges

Elevated Selenium

- **Conventional Wisdom: Complete Drawdown required**
  - **Some evidence that fluctuation might be better (redox/microbial rxn)**
  - **Plants-may act as selenium pumps**
- Beginning Monitoring Program to evaluate effects of Management (water, fire, grazing)
- Need water mgmt. independence and flexibility to test

Existing Infrastructure

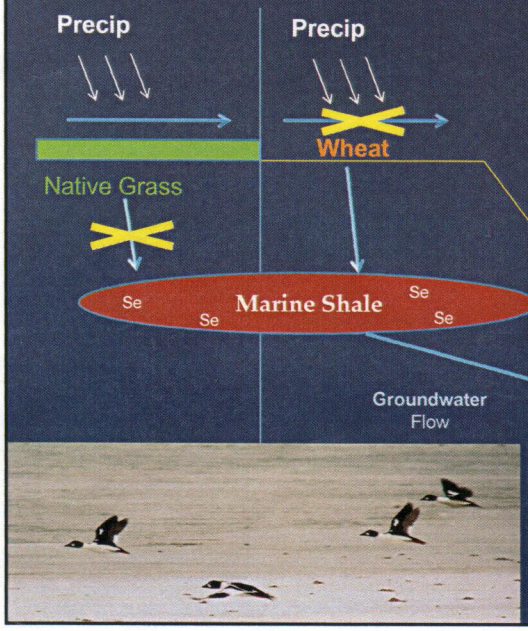
- Units are not Independent
- Doesn't follow historic pathway
- Excessive sediment deposition
- Structures are 55 years old



Unpredictable Budget

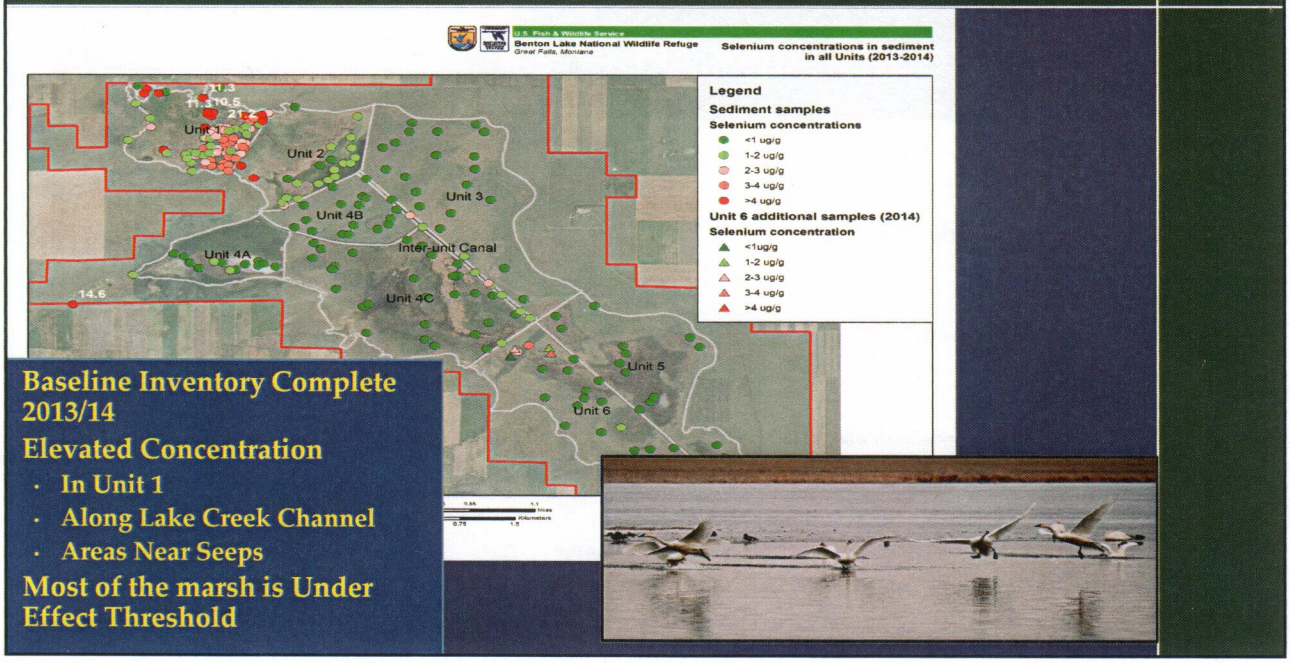
- Historically - 80K Line Item for Pumping
- Eliminated in 2008
- Pumping now part of Base Budget
  - $8,300 – Start-up
  - $1,100/day pump fee
  - $41,000 Yields approx. 2000 AF

Selenium Transport



- **Precip captured by grass roots**
- **Grass removed**
- **Conduit to Marine Shale**
- **Released to saline seeps**
- **Overland Flow to BL Marsh**

Selenium Distribution



Baseline Inventory Complete 2013/14

Elevated Concentration

- **In Unit 1**
- **Along Lake Creek Channel**
- **Areas Near Seeps**

Most of the marsh is Under Effect Threshold

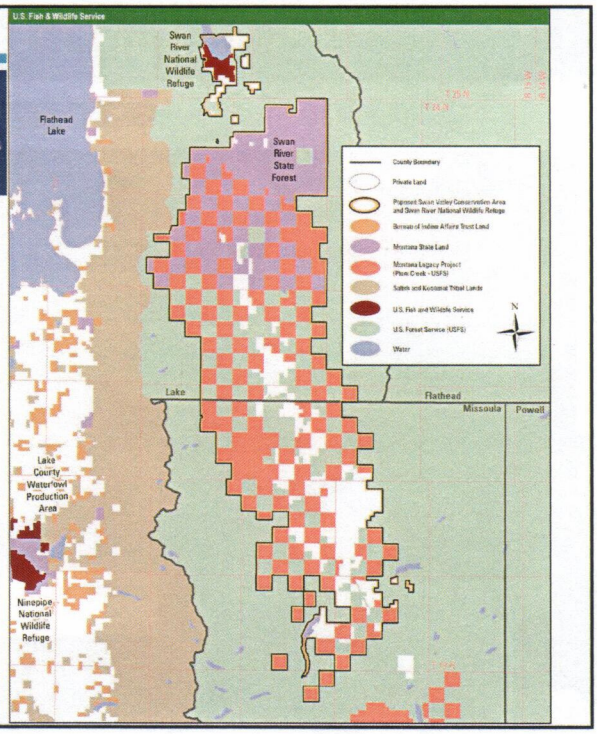
BENTON LAKE NWR COMPLEX EASEMENT HOLDINGS

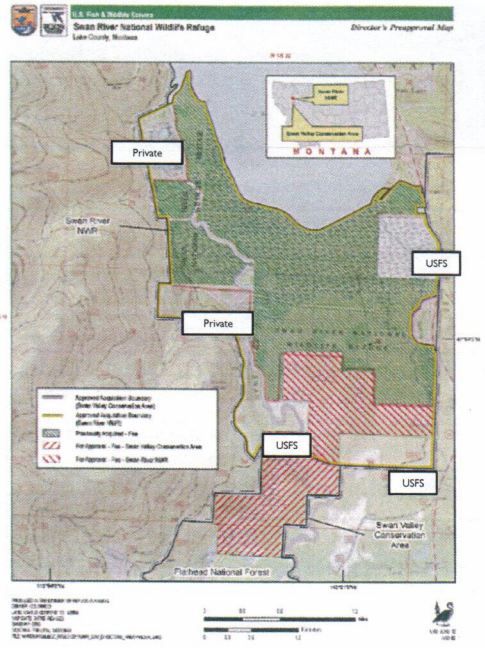
- WET (wetland)
  - Drain, burn, level, or fill
- GRA (grassland)
  - No development
  - No hay before July 15
- FmHA
  - All over the board
- Western MT CE
  - Positive Term Agreement
  - No Subdivision
  - Can graze, hay, harvest timber by SUP

Complex Unit	County(s)	Date Established	Acres	Contracts	Means of Acquisition
Benton Lake WMD	Cascade, Choteau, Gla-	1975	7,098	140	Wetland Easement (MBCF)
	cier, Hill, Lewis and Clark,		4,294	5	Grassland Easement (MBCF)
	Liberty, Pondera, Powell,		24,145	4	Western MT Conservation Easement
	Teton, Toole		628	3	Famers Home Administration easement
Blackfoot Valley Conservation	Lewis and Clark, Missoula,	1994	45,736	36	Migratory Bird Conservation Funds
Area	Powell		23,845	20	Land and Water Conservation Funds
			358	7	Donation
			474	2	North American Wetlands Conservation Act Grant
Rocky Mountain Front	Teton, Lewis and Clark	2005	83,380	30	Migratory Bird Conservation Funds
Conservation Area	Pondera		22,270	11	Land and Water Conservation Funds
Swan Valley Conservation Area	Lake	2011	80	1	Land and Water Conservation Funds
TOTAL			**212,308**	**259**	

SWAN VALLEY CONSERVATION AREA

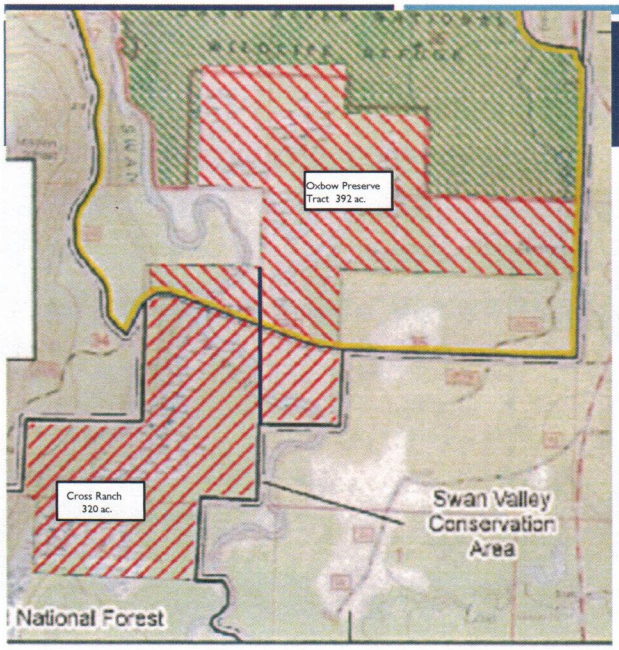
- Swan Valley Conservation Area Land Protection Plan (LPP)
  - Approved May 2011
  - Conservation Easements
    - Up to 10,000 acres
  - Fee Title Acquisition
    - Up to 1,000 acres immediately adjacent to Swan River NWR





SWAN RIVER NWR

- Established May 14, 1973
- MBCA – providing waterfowl habitat and production and habitat for other migratory birds.
- Three T&E Species
  - Grizzly bear
  - Bull Trout
  - Water howellia
- Multiple RD Priorities
  - Recover 2 or more populations of grizzlies
  - Ensure habitat connectivity for large carnivores
  - Endemic fisheries recovery
    - Bull trout
    - Westslope cutthroat

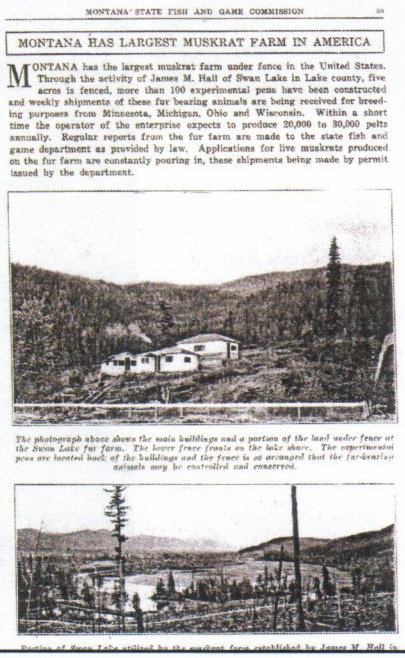


ACQUISITION OPPORTUNITIES

- Oxbow Preserve Tract
  - Formerly owned by TNC
  - Mostly within the SRNWR Acquisition Boundary (40 acres outside)
  - Can use MBCF inside
  - Limited to LWCF outside
- Acquisition Strategy
  - EA to modify acquisition boundary
  - Present to Mig Bird Commission to use MBCF
  - Access Necessary in current political setting
- Cross Ranch
  - 95% outside boundary
  - In CA so can use LWCF
  - Two Restorable Wetlands
    - Prime candidate for MBCF
    - Restoration would provide TRUS Habitat
  - NWR or WPA???

HISTORIC ALTERATION

- HydroGeomorphic Model
  - Historic documentation
  - Past Land Use
  - Way to look at what was, what is now, and what is reasonably restorable
- Two Major Findings
  - The Unit was extensively drained to facilitate hay production
  - Largest Muskrat Fur Farm in America



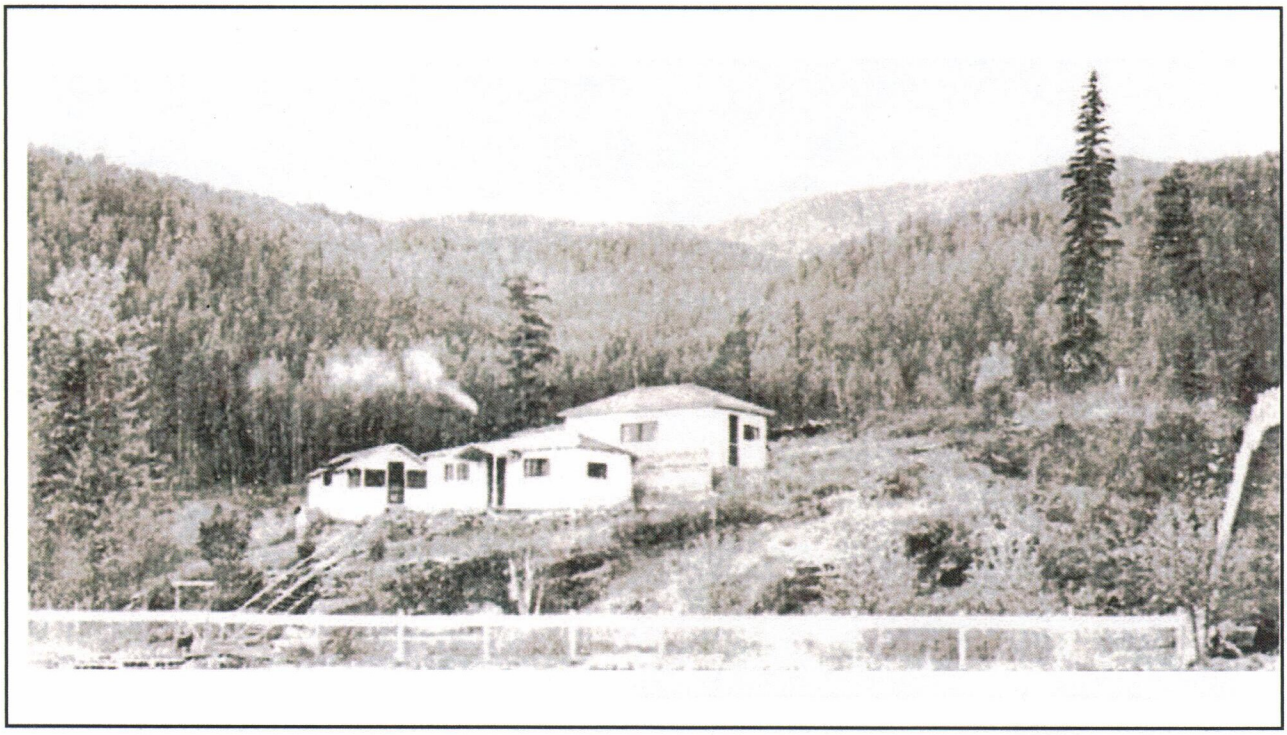
MONTANA STATE FISH AND GAME COMMISSION

MONTANA HAS LARGEST MUSKRAT FARM IN AMERICA

MONTANA has the largest muskrat farm under fence in the United States. Through the activity of James M. Hall of Swan Lake in Lake county, five acres is fenced, more than 100 experimental pens have been constructed and weekly shipments of these fur bearing animals are being received for breeding purposes from Minnesota, Michigan, Ohio and Wisconsin. Within a short time the operator of the enterprise expects to produce 20,000 to 30,000 pelts annually. Regular reports from the fur farm are made to the state fish and game department as provided by law. Applications for live muskrats produced on the fur farm are constantly pouring in, these shipments being made by permit issued by the department.

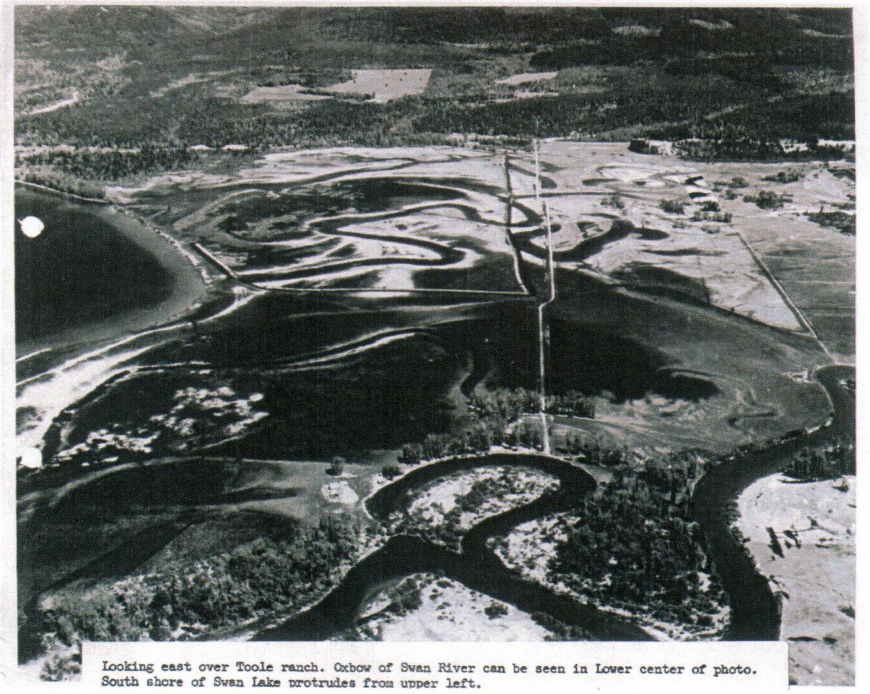
The photograph above shows the main buildings and a portion of the land under fence at the Swan Lake fur farm. The lower fence fronts on the lake shore. The experimental pens are located back of the buildings and the fence is so arranged that the far-wanderer animals may be controlled and conserved.

Portion of Swan Lake utilized by the muskrat farm established by James M. Hall in



ANTHROPOGENIC MODIFICATIONS

- How many can you see?
  - Bog Road
  - Main collector Ditch
  - Spoil to create drain and redirect flow
  - Laterals
  - Rectangular hay pastures
- How many can't you see?
  - Potholes and Islands
  - Spoil along river channel to prevent overflow
  - Other irrigation features
    - Rock wall on west bank of swan river



Looking east over Toole ranch. Oxbow of Swan River can be seen in Lower center of photo. South shore of Swan Lake protrudes from upper left.

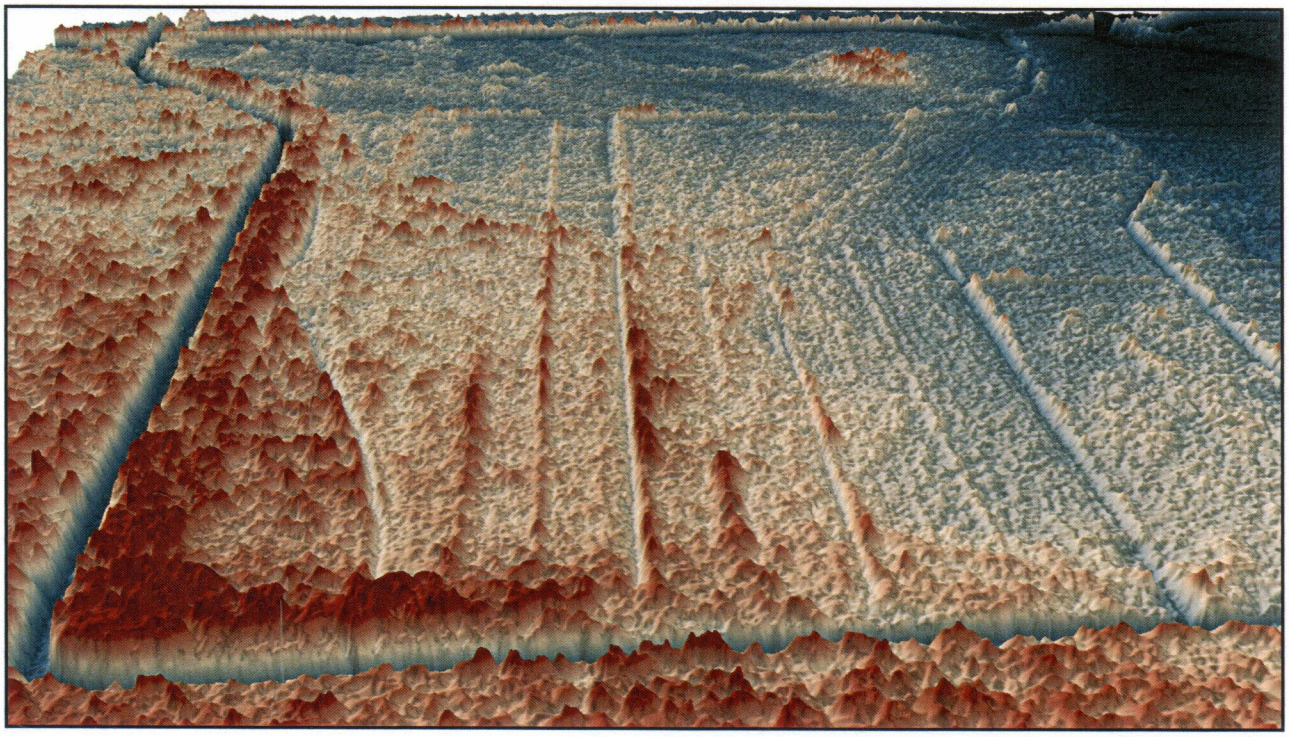


LIGHT DETECTION AND RANGING (LIDAR) DATA

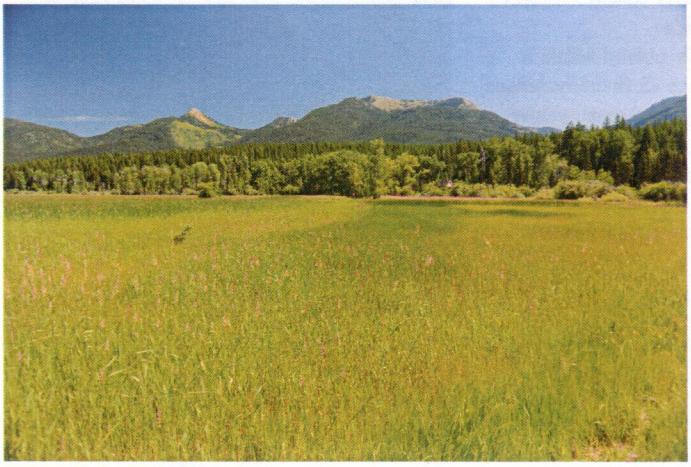
- How many can you see?
  - Bog Road
  - Main collector Ditch
  - Spoil to create drain and redirect flow
  - Laterals
  - Rectangular hay pastures
- How many can't you see?
  - Potholes and Islands
  - Farmstead Foundation
  - Spoil along river channel to prevent overflow
  - Other irrigation features
    - Rock wall on west bank of swan river

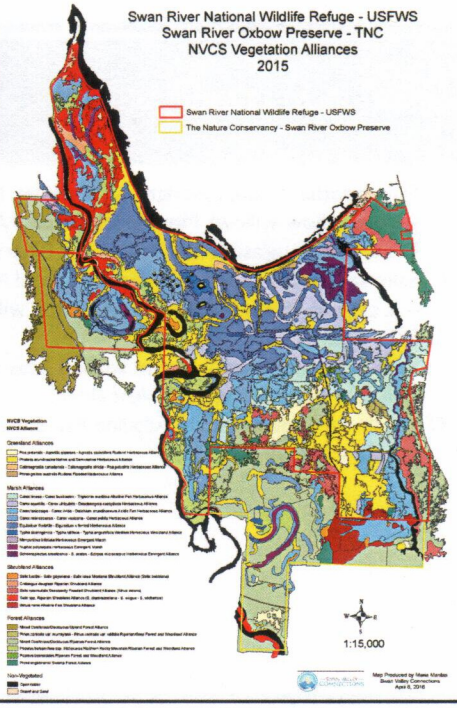



on Lake



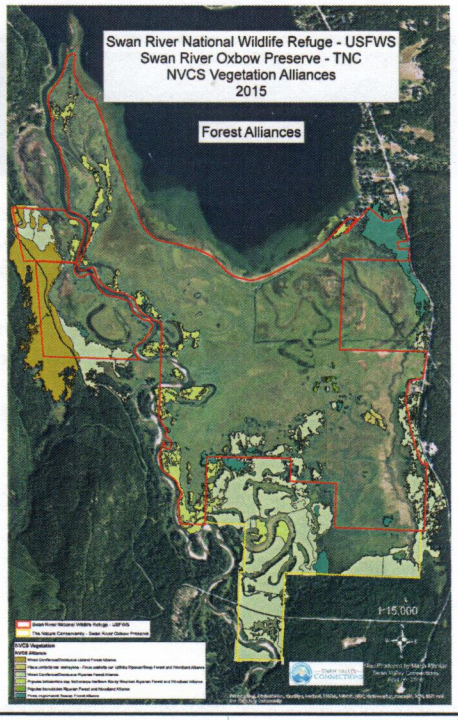
BASELINE VEGETATION MAPPING





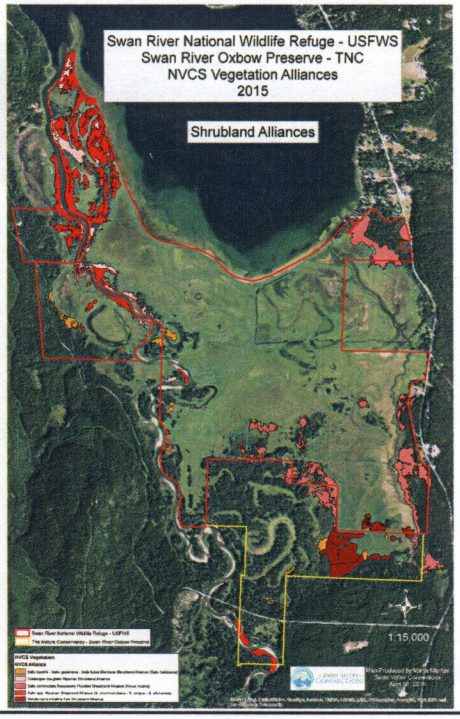
FOREST ALLIANCES

- Mixed Coniferous/Deciduous Upland Forest Alliance
- Pinus contorta var. murrayana – Pinus contorta var. latifolia (Sierra lodgepole pine – lodgepole pine) Riparian/Seep Forest & Woodland Alliance
- Mixed Coniferous/Deciduous Riparian Forest Alliance
- Populus balsamifera ssp. trichocarpa (black cottonwood) Northern Rocky Mountain Riparian Forest & Woodland Alliance
- Populus tremuloides (quaking aspen) Riparian Forest & Woodland Alliance
- Picea engelmanii (Engelmann spruce) Swamp Forest Alliance



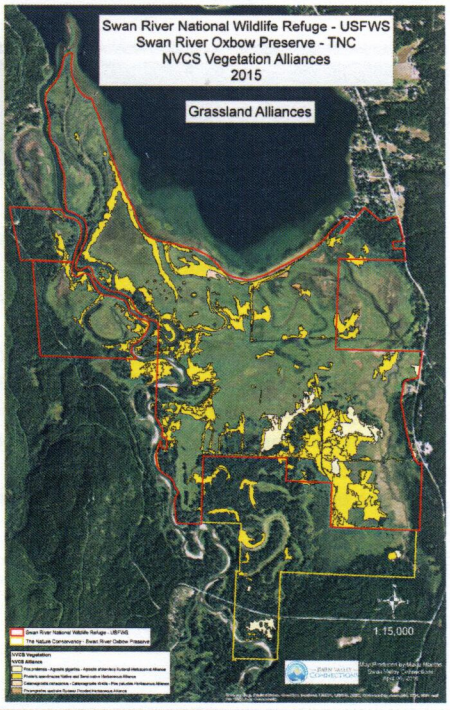
SHRUB ALLIANCES

- Salix boothii – Salix geyeriana – Salix lutea (Booth's willow – Geyer's willow, yellow willow) Montane Shrubland Alliance
- Crataegus douglasii (black hawthorn) Riparian Shrubland Alliance
- Salix spp. (willow spp.) Riparian Shrubland Alliance (S. drummondiana – S. exigua – S. sitchensis) (Drummond's willow, narrowleaf willow – Sitka willow)
- Salix commutata (undergreen willow) Seasonally Flooded Shrubland Alliance: (Alnus incana - thinleaf alder)
- Betula nana (dwarf birch) Alkaline Fen Shrubland Alliance: (Betula pumila – bog birch)



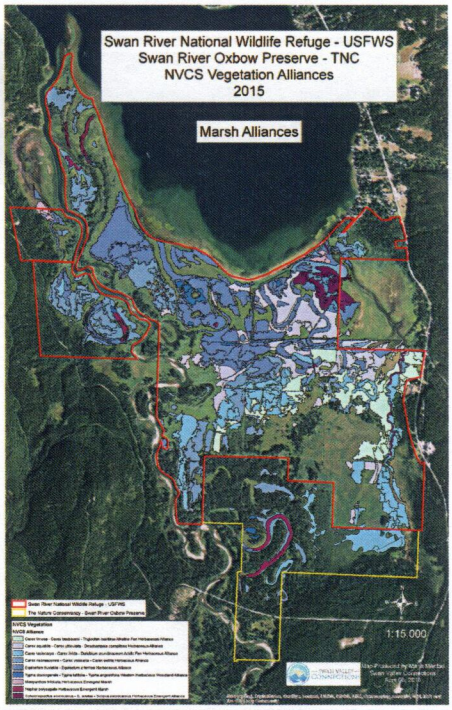
GRASSLAND ALLIANCES (4)

- Poa pratensis – Agrostis gigantea – Agrostis stolonifera (Kentucky bluegrass – redtop) Ruderal Herbaceous Alliance)
- Phalaris arundinacea (reed canarygrass) Native & Semi-native Herbaceous Alliance
- Calamagrostis canadensis – Calamagrostis stricta – Poa palustris (bluejoint – slimstem reedgrass – fowl bluegrass) Herbaceous Alliance
- Phragmites australis (common reedgrass) Ruderal Flooded Herbaceous Alliance



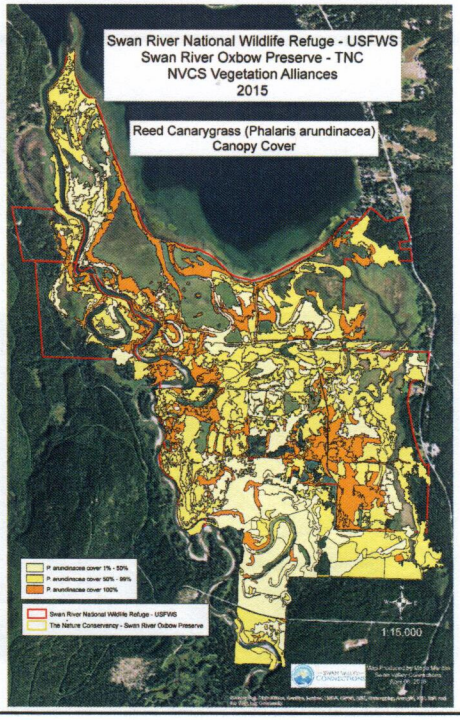
WETLAND ALLIANCES

- Carex limosa – Carex buxbaumii – Triglochin maritima (mud sedge – Buxbaum's sedge – seaside arrowgrass) Alkaline Fen Herbaceous Alliance
- Carex aquatilis – Carex utriculata – Deschampsia caespitosa (water sedge – Northwest Territory sedge – tufted hairgrass) Herbaceous Alliance
- Carex lasiocarpa – Carex livida – Dulichium arundinaceum (woollyfruit sedge – livid sedge – three-way sedge) Acidic Fen Herbaceous Alliance
- Carex nebraskensis – Carex vesicaria – Carex pellita (Nebraska sedge – western inflated sedge – woolly sedge) Herbaceous Alliance
- Equisetum fluviatile – Equisetum x ferrissii (water horsetail) Herbaceous Alliance
- Typha domingensis – Typha latifolia – Typha angustifolia (southern cattail – broadleaf cattail – narrowleaf cattail) Western Herbaceous Emergent Alliance
- Menyanthes trifoliata (buckbean) Herbaceous Emergent Alliance
- Nuphar polysepala (Rocky Mountain pond lily) Herbaceous Emergent Alliance
- Schoenoplectus americanus – S. acutus – Scirpus microcarpus (chairmaker's bulrush – hardstem bulrush – panicled bulrush) Herbaceous Emergent Alliance



REED CANARYGRASS

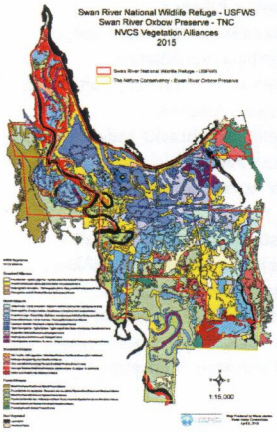
- 290 acres with >50% RCG Coverage
  - 80% of refuge has some level of coverage
- Heaviest infestation
  - East of the north south drain
  - South of Bog Road
  - North of the TNC Oxbow Preserve
  - Agricultural Drainage Area
- Falls out in perennial wetlands to the north
- Timing, depth, and duration of flooding
- Phragmites Australis??? (need to remain vigilant)



PIECES OF THE PUZZLE

- History
  - Fur Farm
  - Agricultural Drainage
  - Recreational Access
- Topography
  - LiDAR
- Biology
  - Vegetation
  - TRUS





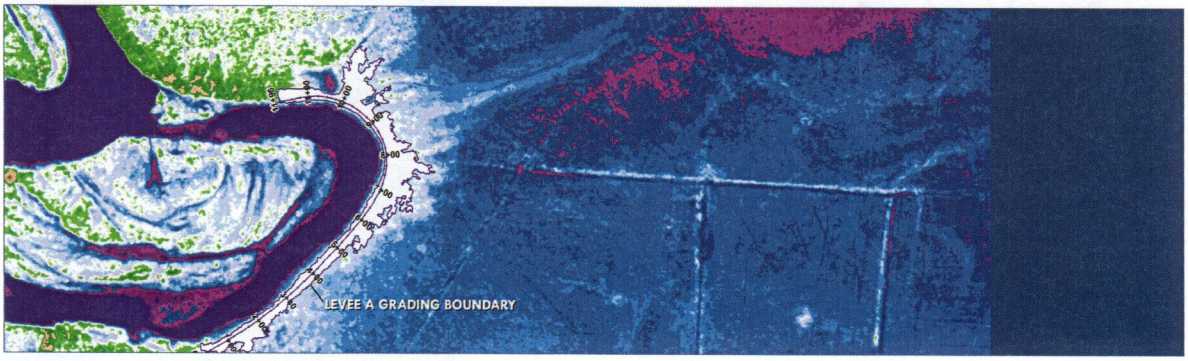




RDG RIVER DESIGN GROUP

SWAN RIVER NATIONAL WILDLIFE REFUGE

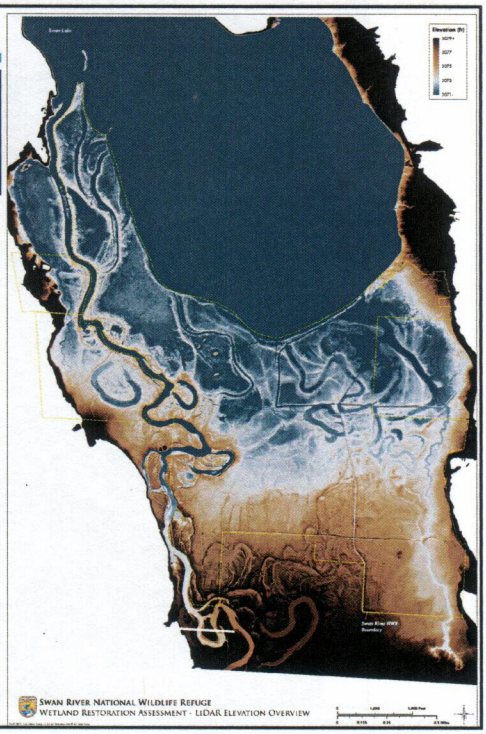
WETLAND RESTORATION ASSESSMENT

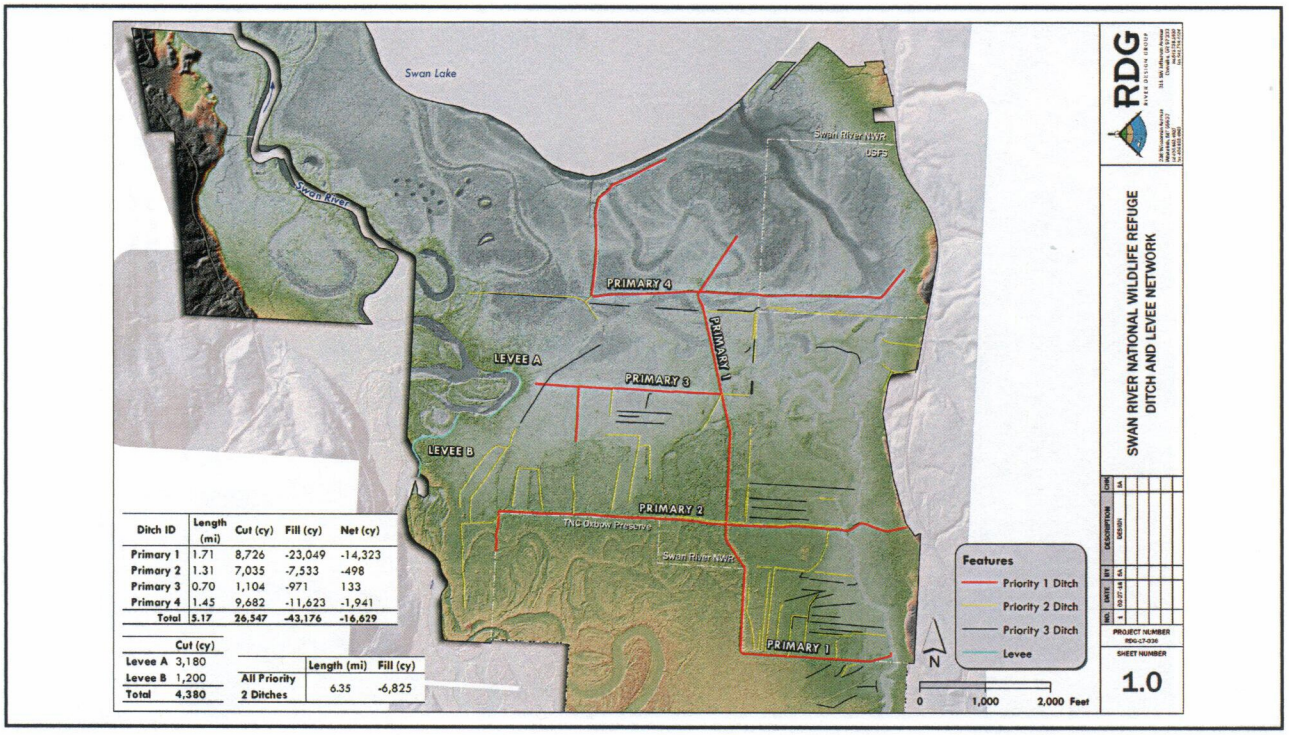




OBJECTIVES

- Assessment of wetland restoration potential
- Identification of opportunities for restoration of
  - Wetland hydrology
  - Non-invasive native vegetation

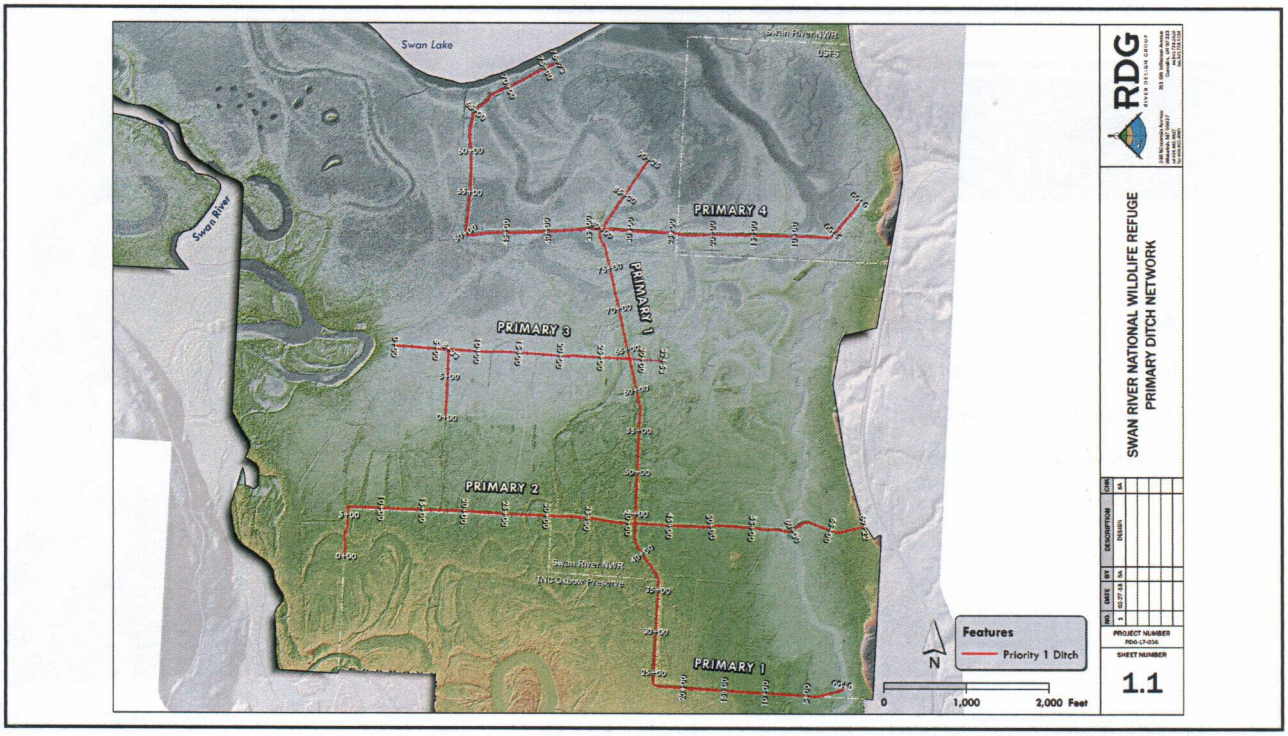


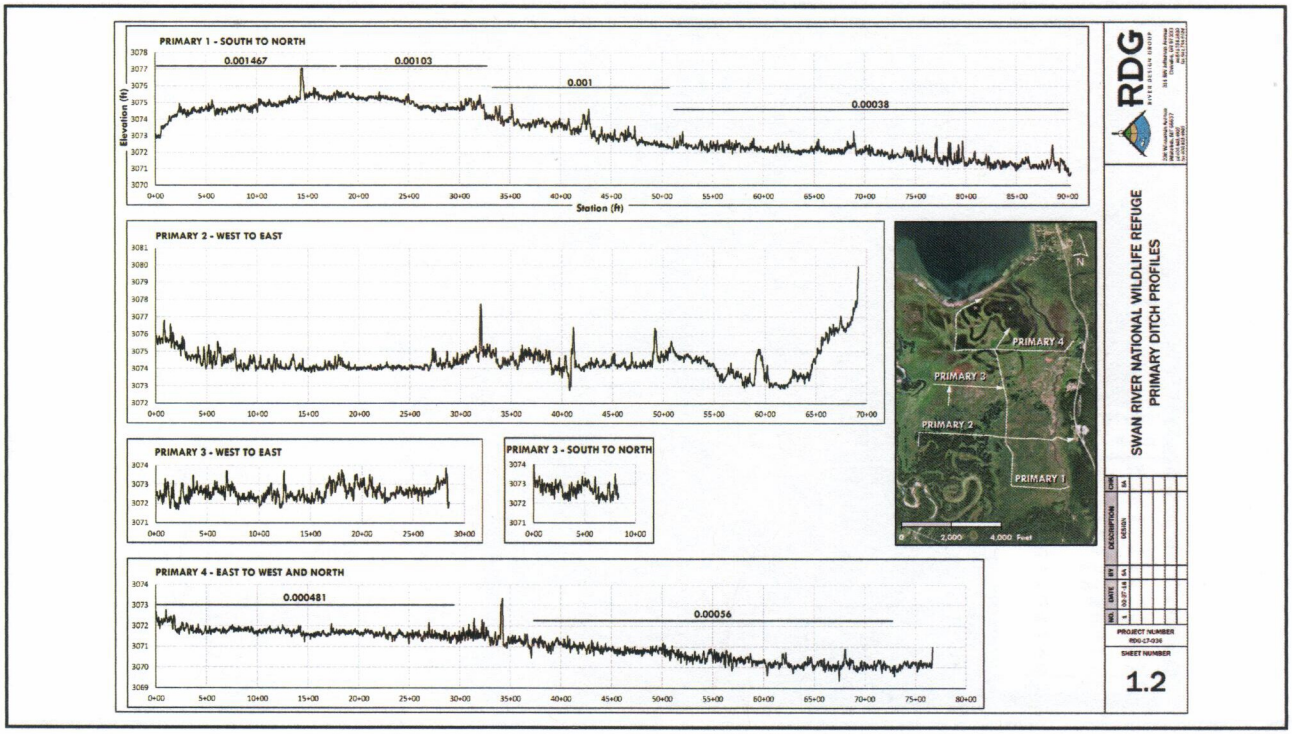


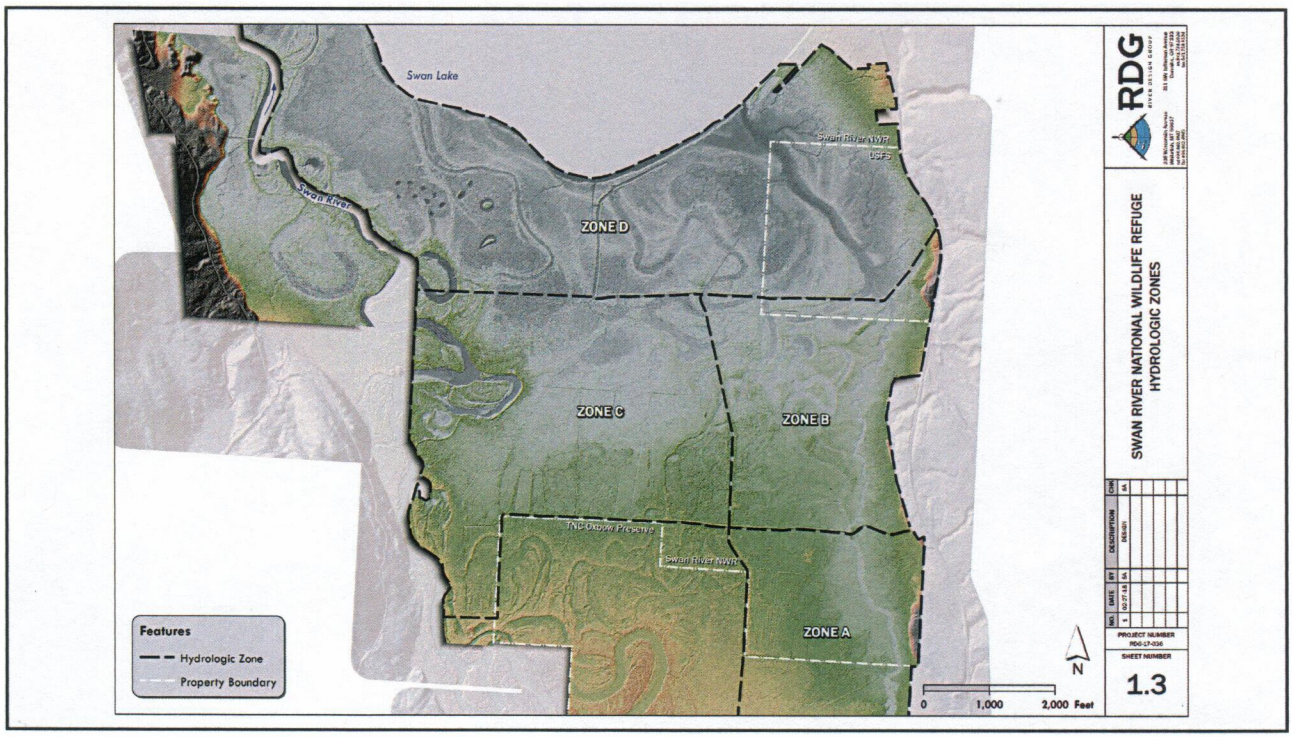
Ditch ID	Length (mi)	Cut (cy)	Fill (cy)	Net (cy)
Primary 1	1.71	8,726	-23,049	-14,323
Primary 2	1.31	7,035	-7,533	-498
Primary 3	0.70	1,104	-971	133
Primary 4	1.45	9,682	-11,623	-1,941
Total	5.17	26,547	-43,176	-16,629

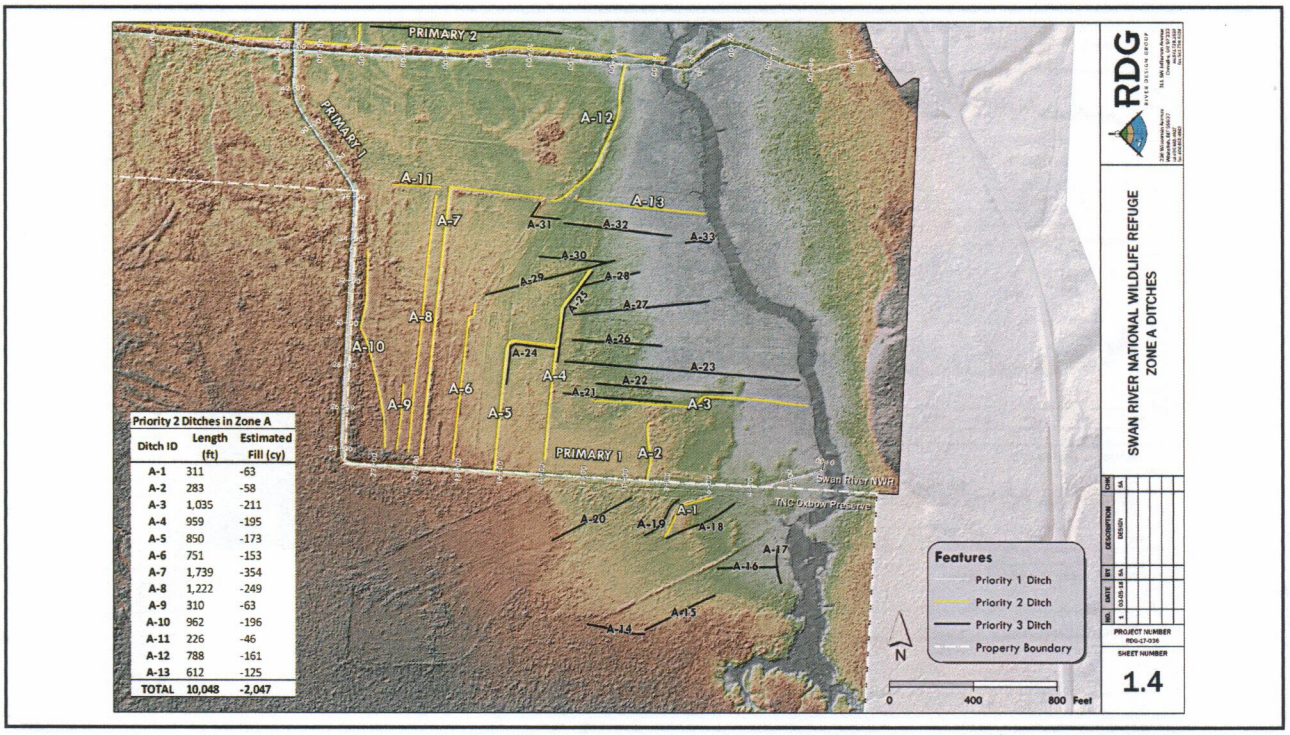
	Cut (cy)
Levee A	3,180
Levee B	1,200
Total	4,380

	Length (mi)	Fill (cy)
All Priority 2 Ditches	6.35	-6,825

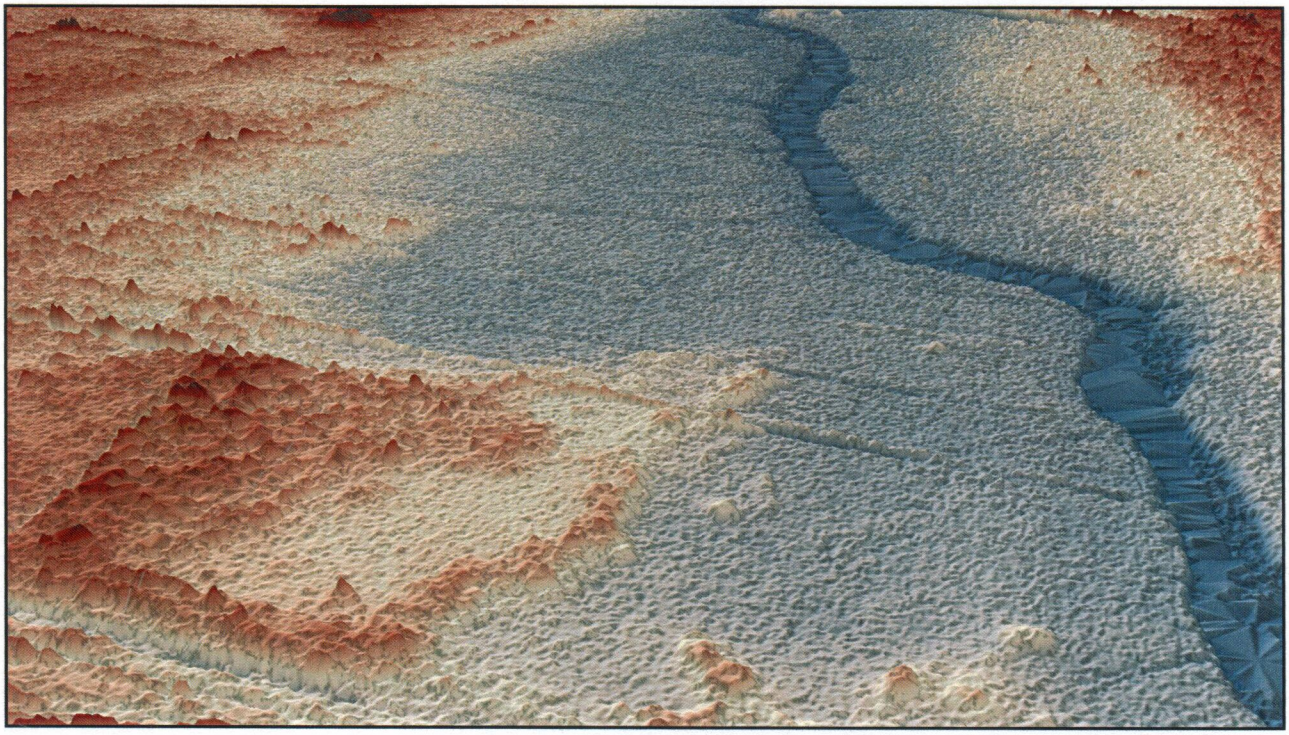


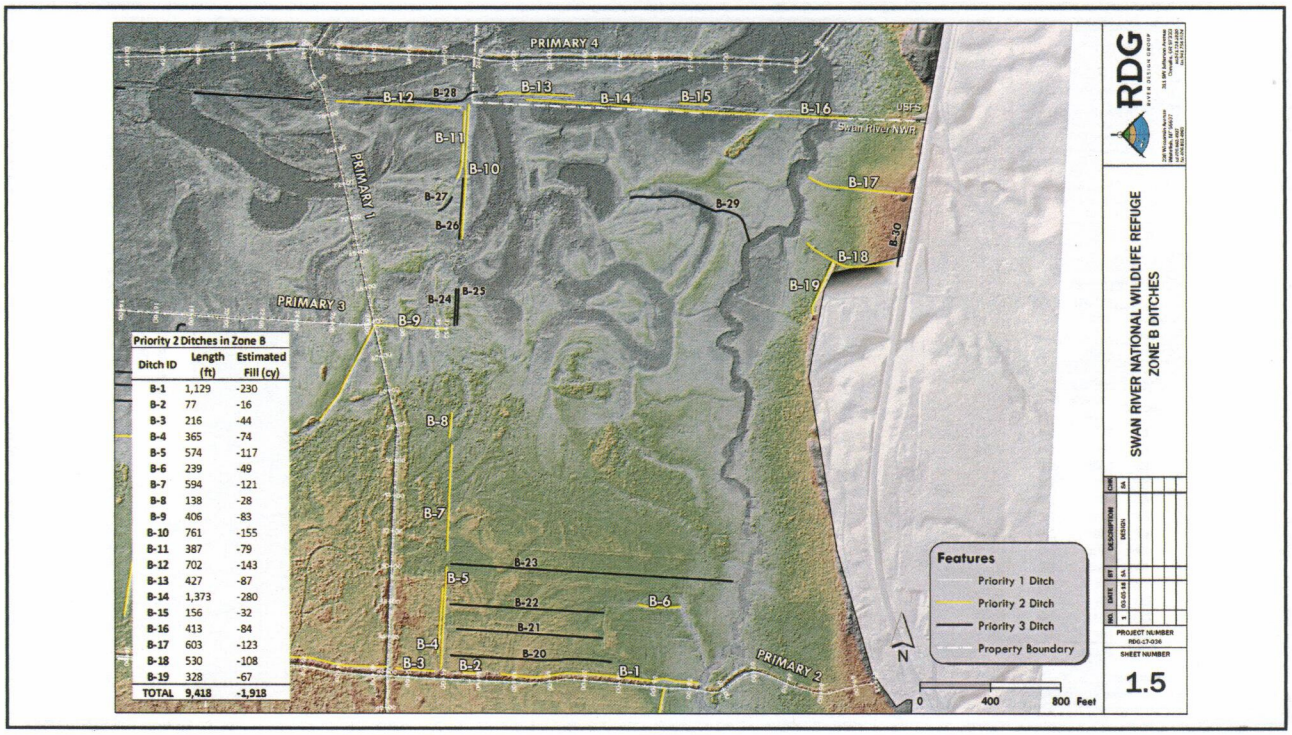

PRIMARY 1 - SOUTH TO NORTH
0.001467
0.00103
0.001
0.00038
Elevation (ft)
Station (ft)
PRIMARY 2 - WEST TO EAST
PRIMARY 3 - WEST TO EAST
PRIMARY 3 - SOUTH TO NORTH
PRIMARY 4 - EAST TO WEST AND NORTH
0.000481
0.00056
PRIMARY 4
PRIMARY 3
PRIMARY 2
PRIMARY 1
0 2,000 4,000 Feet
RDG
SWAN RIVER NATIONAL WILDLIFE REFUGE
PRIMARY DITCH PROFILES
PROJECT NUMBER
SHEET NUMBER
1.2


Swan Lake
Swan River
Swan River NWR
USFS
ZONE D
ZONE C
ZONE B
ZONE A
TNC Oxbow Preserve
Swan River NWR
Features
Hydrologic Zone
Property Boundary
N
0 1,000 2,000 Feet
RDG
SWAN RIVER NATIONAL WILDLIFE REFUGE
HYDROLOGIC ZONES
PROJECT NUMBER
SHEET NUMBER
1.3



Priority 2 Ditches in Zone A		
Ditch ID	Length (ft)	Estimated Fill (cy)
A-1	311	-63
A-2	283	-58
A-3	1,035	-211
A-4	959	-195
A-5	850	-173
A-6	751	-153
A-7	1,739	-354
A-8	1,222	-249
A-9	310	-63
A-10	962	-196
A-11	226	-46
A-12	788	-161
A-13	612	-125
TOTAL	10,048	-2,047





Priority 2 Ditches in Zone B

Ditch ID	Length (ft)	Estimated Fill (cy)
B-1	1,129	-230
B-2	77	-16
B-3	216	-44
B-4	365	-74
B-5	574	-117
B-6	239	-49
B-7	594	-121
B-8	138	-28
B-9	406	-83
B-10	761	-155
B-11	387	-79
B-12	702	-143
B-13	427	-87
B-14	1,373	-280
B-15	156	-32
B-16	413	-84
B-17	603	-123
B-18	530	-108
B-19	328	-67
TOTAL	9,418	-1,918

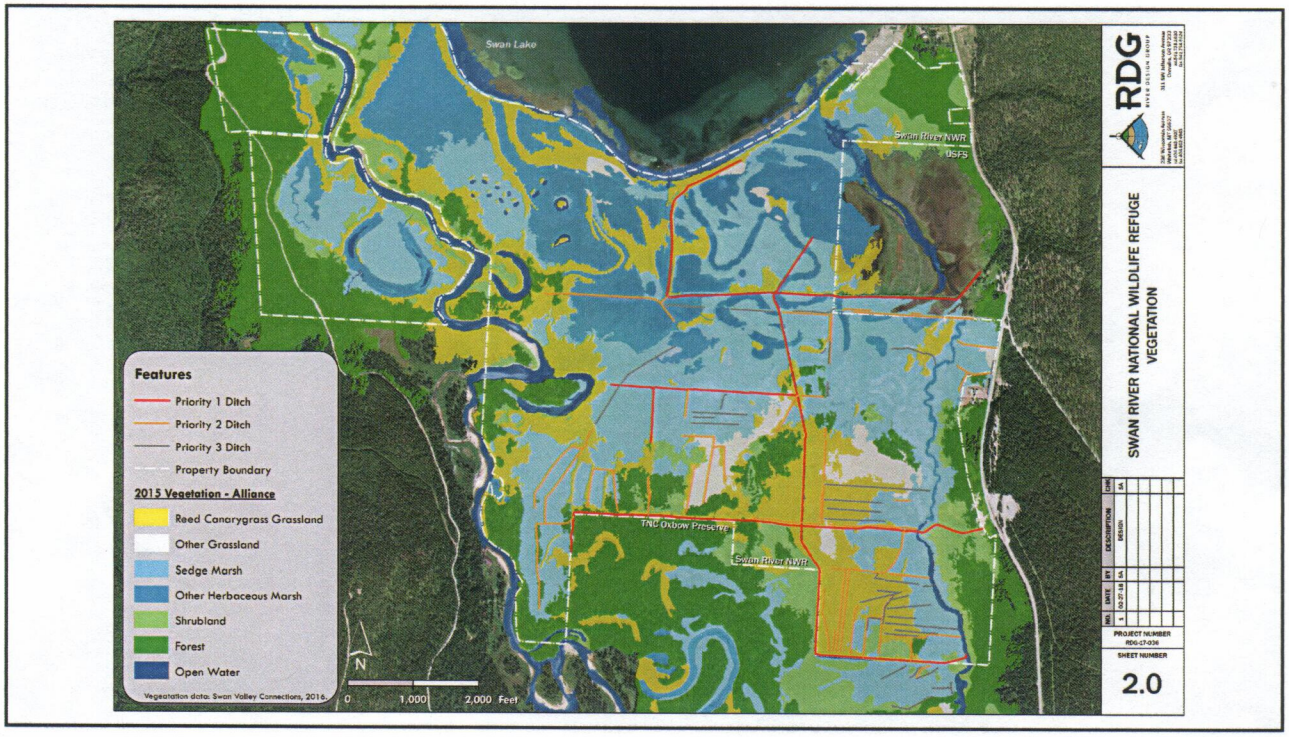


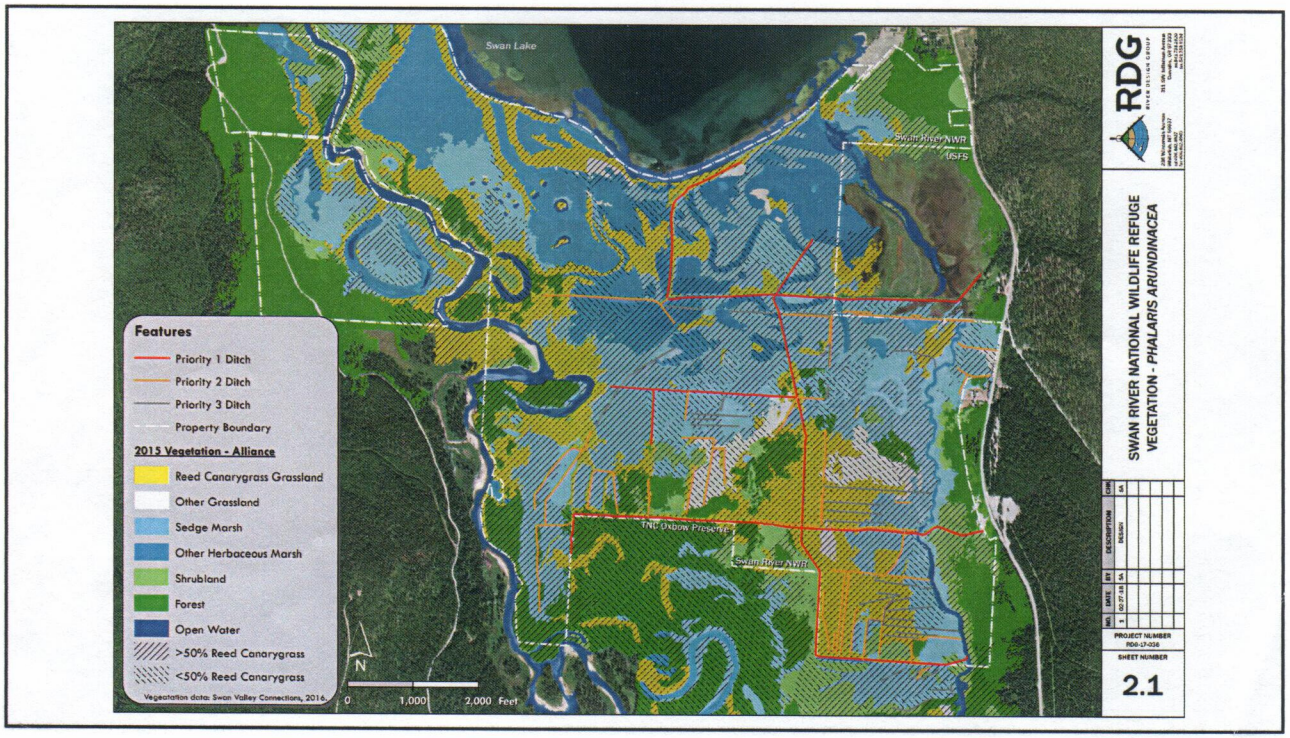

Features
Priority 1 Ditch
Priority 2 Ditch
Priority 3 Ditch
Property Boundary
Swan River Levees
Cut (cy)
Levee A 3,180
Levee B 1,200
TOTAL 4,380
Priority 2 Ditches in Zone C
Ditch ID Length (ft) Estimated Fill (cy)
C1 757 -154
C2 705 -144
C3 1,520 -310
C4 705 -144
C5 586 -119
C6 1,523 -310
C7 1,913 -390
C8 1,336 -272
C9 1,643 -335
C10 627 -128
C11 425 -87
C12 2,151 -438
C13 147 -30
TOTAL 14,038 -2,860
0 400 800 Feet
N
PRIMARY 4
PRIMARY 1
PRIMARY 3
PRIMARY 2
LEVEE A
LEVEE B
C-12
C-13
C-19
C-20
C-21
C-18
C-11
C-17
C-16
C-15
C-14
C-10
C-9
C-6
C-8
C-3
C-2
C-4
C-5
C-7
C-1
USFS
Swan River NWR
TNC Oxbow Preserve
RDG
SWAN RIVER NATIONAL WILDLIFE REFUGE
ZONE C DITCHES
PROJECT NUMBER
RDG-17-036
SHEET NUMBER
1.6

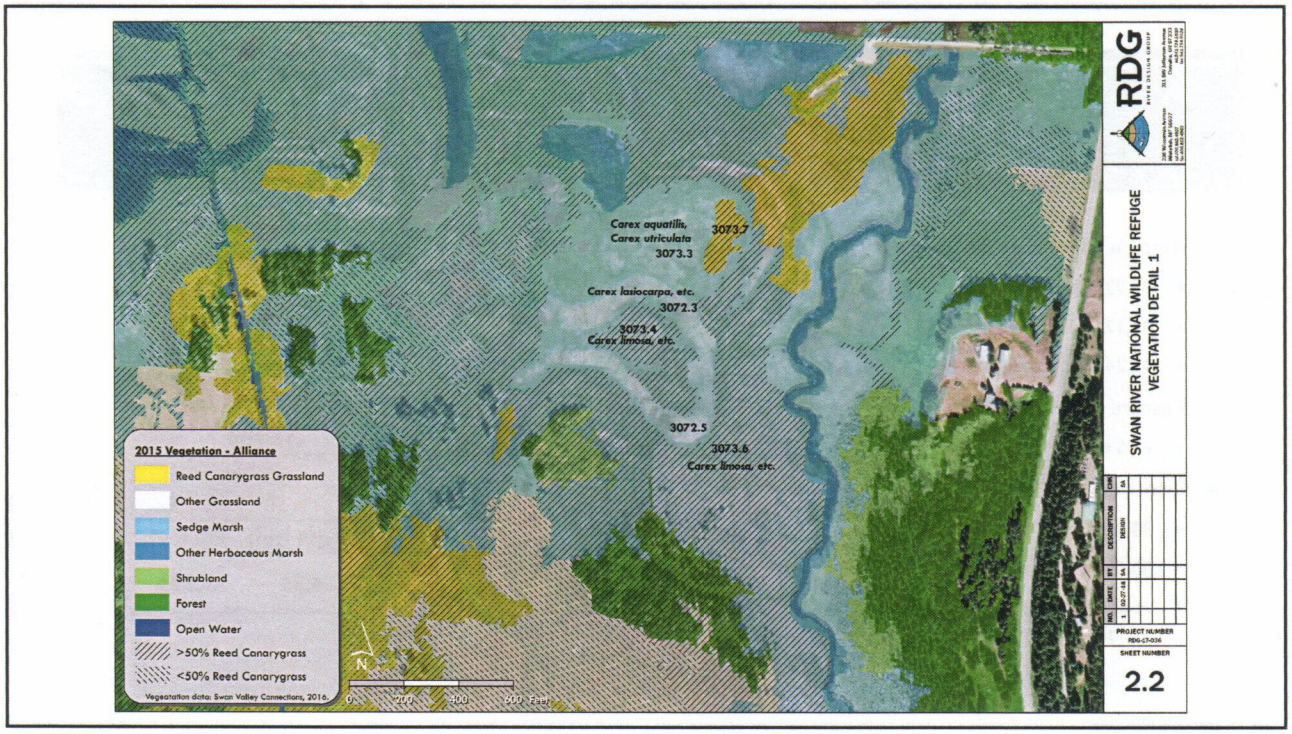


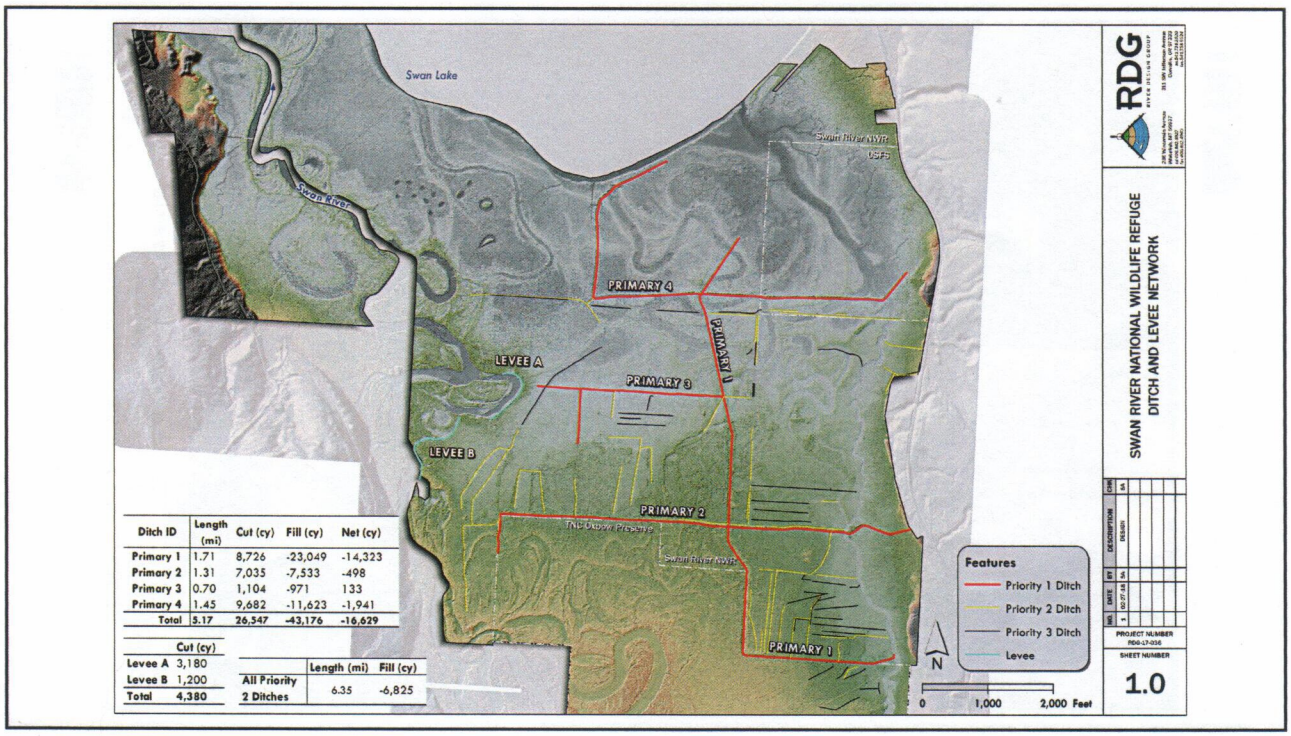





Swan Lake
Swan River NWR
USFS
TNC Oxbow Preserve
Swan River NWR
Features
Priority 1 Ditch
Priority 2 Ditch
Priority 3 Ditch
Property Boundary
2015 Vegetation - Alliance
Reed Canarygrass Grassland
Other Grassland
Sedge Marsh
Other Herbaceous Marsh
Shrubland
Forest
Open Water
Vegetation data: Swan Valley Connections, 2016
N
0
1,000
2,000 Feet
RDG
SWAN RIVER NATIONAL WILDLIFE REFUGE
VEGETATION
PROJECT NUMBER
SHEET NUMBER
2.0


Swan Lake
Swan River NWR
USFS
TNC Oxbow Preserve
Swan River NWR
Features
Priority 1 Ditch
Priority 2 Ditch
Priority 3 Ditch
Property Boundary
2015 Vegetation - Alliance
Reed Canarygrass Grassland
Other Grassland
Sedge Marsh
Other Herbaceous Marsh
Shrubland
Forest
Open Water
>50% Reed Canarygrass
<50% Reed Canarygrass
Vegetation data: Swan Valley Connections, 2016
N
0
1,000
2,000 Feet
RDG
SWAN RIVER NATIONAL WILDLIFE REFUGE
VEGETATION - PHALARIS ARUNDINACEA
PROJECT NUMBER
SHEET NUMBER
2.1





Ditch ID	Length (mi)	Cut (cy)	Fill (cy)	Net (cy)
Primary 1	1.71	8,726	-23,049	-14,323
Primary 2	1.31	7,035	-7,533	-498
Primary 3	0.70	1,104	-971	133
Primary 4	1.45	9,682	-11,623	-1,941
Total	5.17	26,547	-43,176	-16,629

	Cut (cy)
Levee A	3,180
Levee B	1,200
Total	4,380

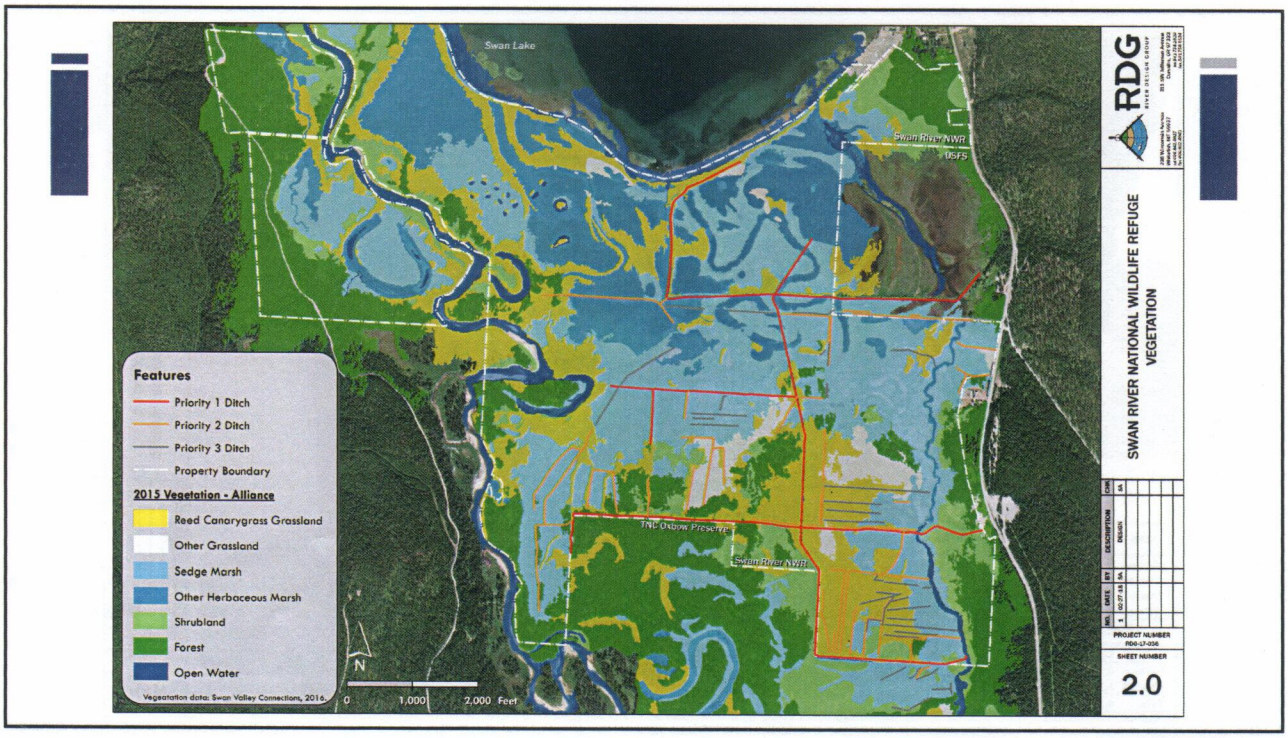
	Length (mi)	Fill (cy)
All Priority 2 Ditches	6.35	-6,825

- Restore all primary ditches
  - 30,927 CY Fill material
  - 43,176 CY fill needed
  - 12,249 CY needed
- Restore all priority 2 ditches
  - 6.35 miles – 6,825 CY Needed
- Contractor charges
  - 3$ - 6$ per CY moved
  - 50,001 CY to be moved
  - 150K – 300K project just for the dirt work

Ditch ID	Length (mi)	Cut (cy)	Fill (cy)	Net (cy)
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Total	4,380

	Length (mi)	Fill (cy)
All Priority 2 Ditches	6.35	-6,825



BENTON LAKE NATIONAL WILDLIFE REFUGE COMPLEX ACQUISITION HISTORY AND ASSETS

- Fee Title
  - Two NWR's
  - 23 WPA's
- Facilities
  - 3 Administrative Offices
  - 4 GOV Quarters
  - 12 shop/support bldg's
  - 1 Really Nice Guest Lodge
- Maintenance Costs
  - 130 Assets
  - $58,271,003
- Public Use Opportunities
  - NWR's – all over the board
  - WPA's – Hunting, fishing and trapping unless deed restricted

Complex Unit	County(s)	Date Aquired or Established	Acres	Contracts	Means of Acquisition
Benton Lake NWR	Cascade, Teton, and Choteau	1929	12,235		Primary Withdrawal
		1958-62	148		Fee Title
		1958-62	77		Right-of-way Easement
Benton Lake WMD	Cascade, Choteau, Glacier, Hill, Lewis and Clark, Liberty, Pondera, Powell, Teton, Toole	1975	16,337		Fee Title
			280		State Leased Land
			7,098	140	Wetland Easement (MBCF)
			4,294	5	Grassland Easement (MBCF)
			24,145	4	Western MT Conservation Easement
			628	3	Famers Home Administration easement
Blackfoot Valley Conservation Area	Lewis and Clark, Missoula, Powell	1994	45,736	36	Migratory Bird Conservation Funds
			23,845	20	Land and Water Conservation Funds
			358	7	Donation
			474	2	North American Wetlands Conservation Act Grant
Rocky Mountain Front Conservation Area	Teton, Lewis and Clark Pondera	2005	83,380	30	Migratory Bird Conservation Funds
			22,270	11	Land and Water Conservation Funds
Swan Valley Conservation Area	Lake	2011	80	1	Land and Water Conservation Funds
Swan Lake NWR	Lake	1973	1,569		Fee Title
		2017	392		Fee Title (Oxbow Preserve Tract)
TOTAL			**243,345**	**259**	