Manejo de humedales para técnicos en México
3-7 March 2014
Adonia R. Henry

USANDO INFORMACIÓN ABIÓTICA COMO FUNDAMENTO PARA LOGRAR UN EFECTIVO MANEJO Y RESTAURACIÓN DE HUMEDALES

Hydrogeomorphic Evaluations

(not the same as USACE HGM functional assessments)

1. Identify the historic ecosystem condition and ecological processes

2. Evaluate changes from the historic condition

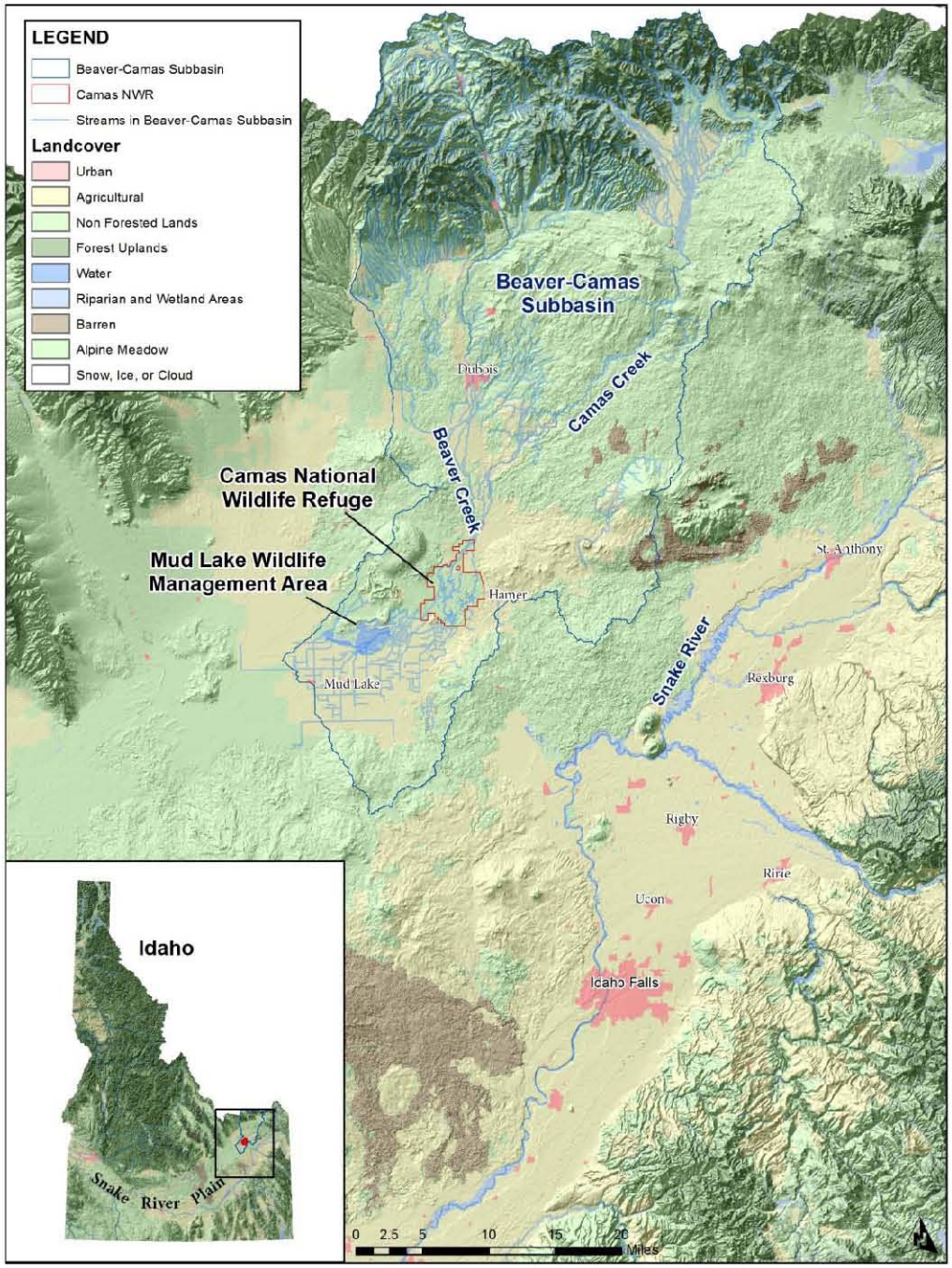
3. Identify restoration and management options and ecological attributes needed to restore and manage specific habitats

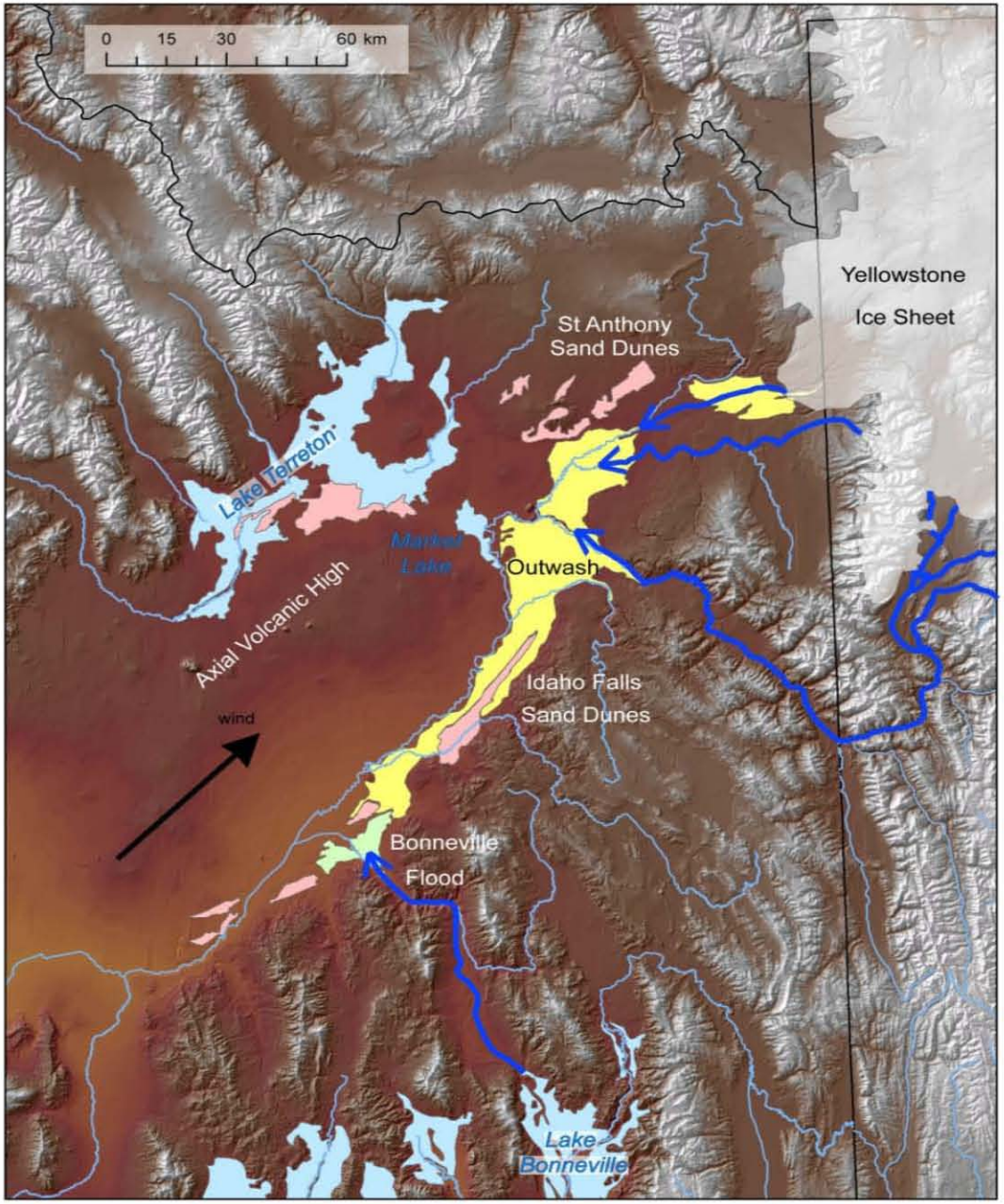
Obtain Historical Information on:

- Geomorphic surfaces
- Soils
- Topography
- Climate
- Hydrological "System"
- Plant and Animal Communities

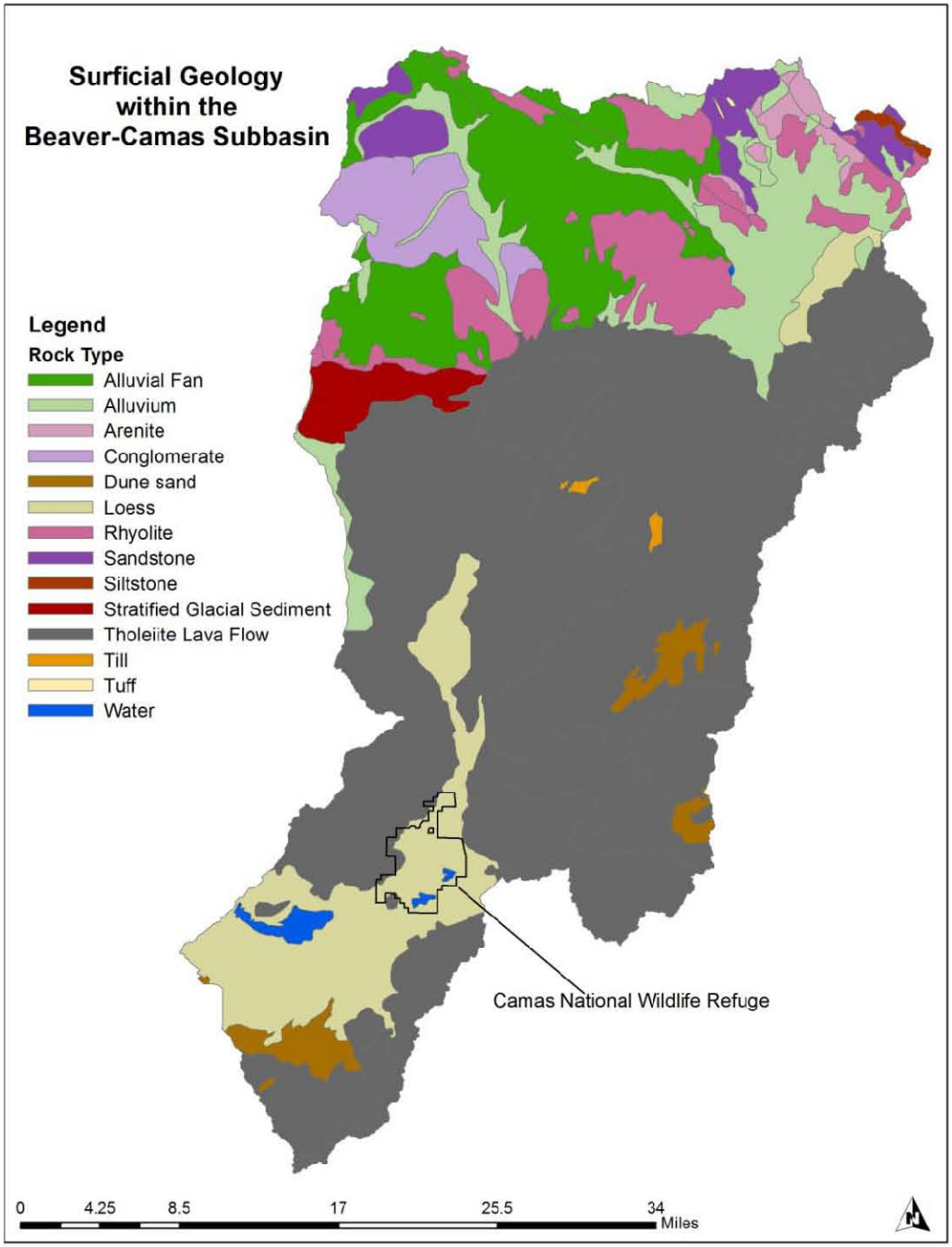
CAMAS NATIONAL WILDLIFE REFUGE

CAMAS NWR

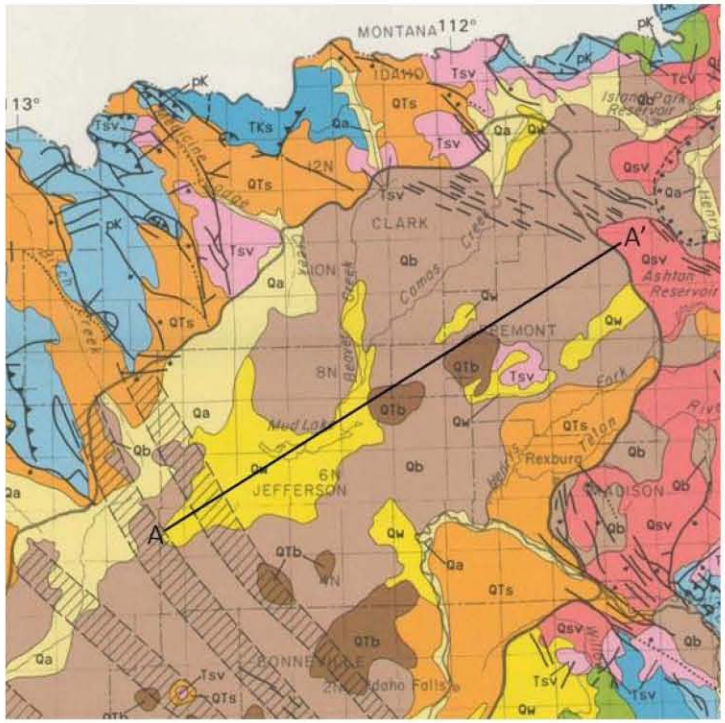

LEGEND
Beaver-Camas Subbasin
Camas NWR
Streams in Beaver-Camas Subbasin
Landcover
Urban
Agricultural
Non Forested Lands
Forest Uplands
Water
Riparian and Wetland Areas
Barren
Alpine Meadow
Snow, Ice, or Cloud
Beaver-Camas Subbasin
Camas Creek
Beaver Creek
Camas National Wildlife Refuge
Mud Lake Wildlife Management Area
Dubois
Hamer
Mud Lake
St. Anthony
Rexburg
Snake River
Rigby
Ririe
Ucon
Idaho Falls
Idaho
Snake River Plain
0 2.5 5 10 15 20
Miles

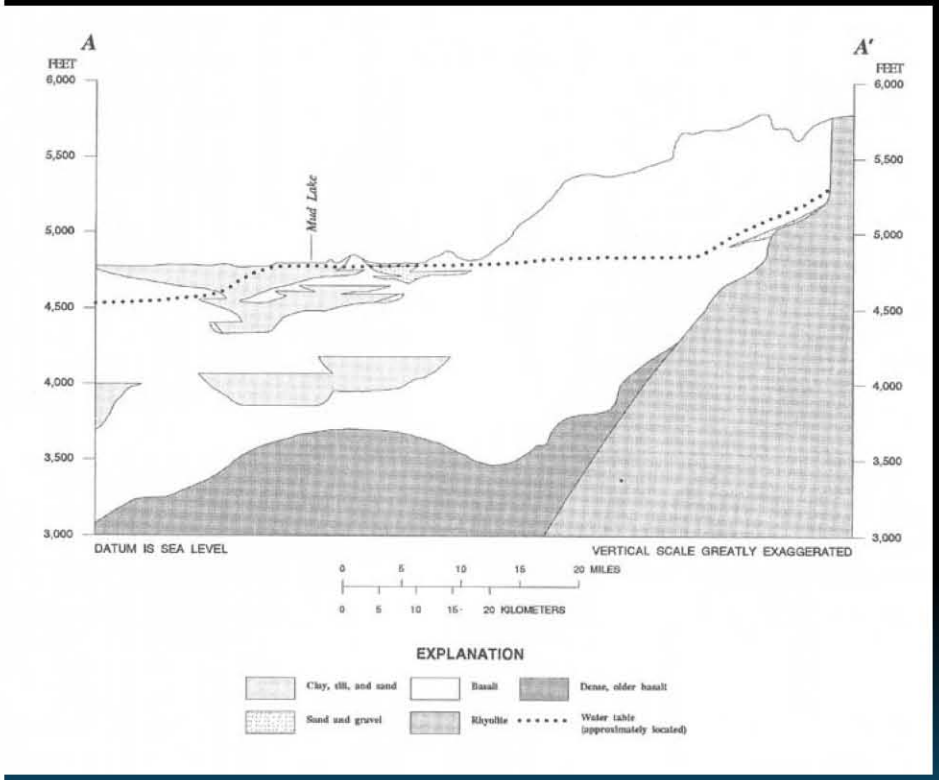

0 15 30 60 km
Yellowstone
Ice Sheet
St Anthony
Sand Dunes
Lake Terreton
Market
Lake
Outwash
Axial Volcanic High
wind
Idaho Falls
Sand Dunes
Bonneville
Flood
Lake
Bonneville

GEOLOGY

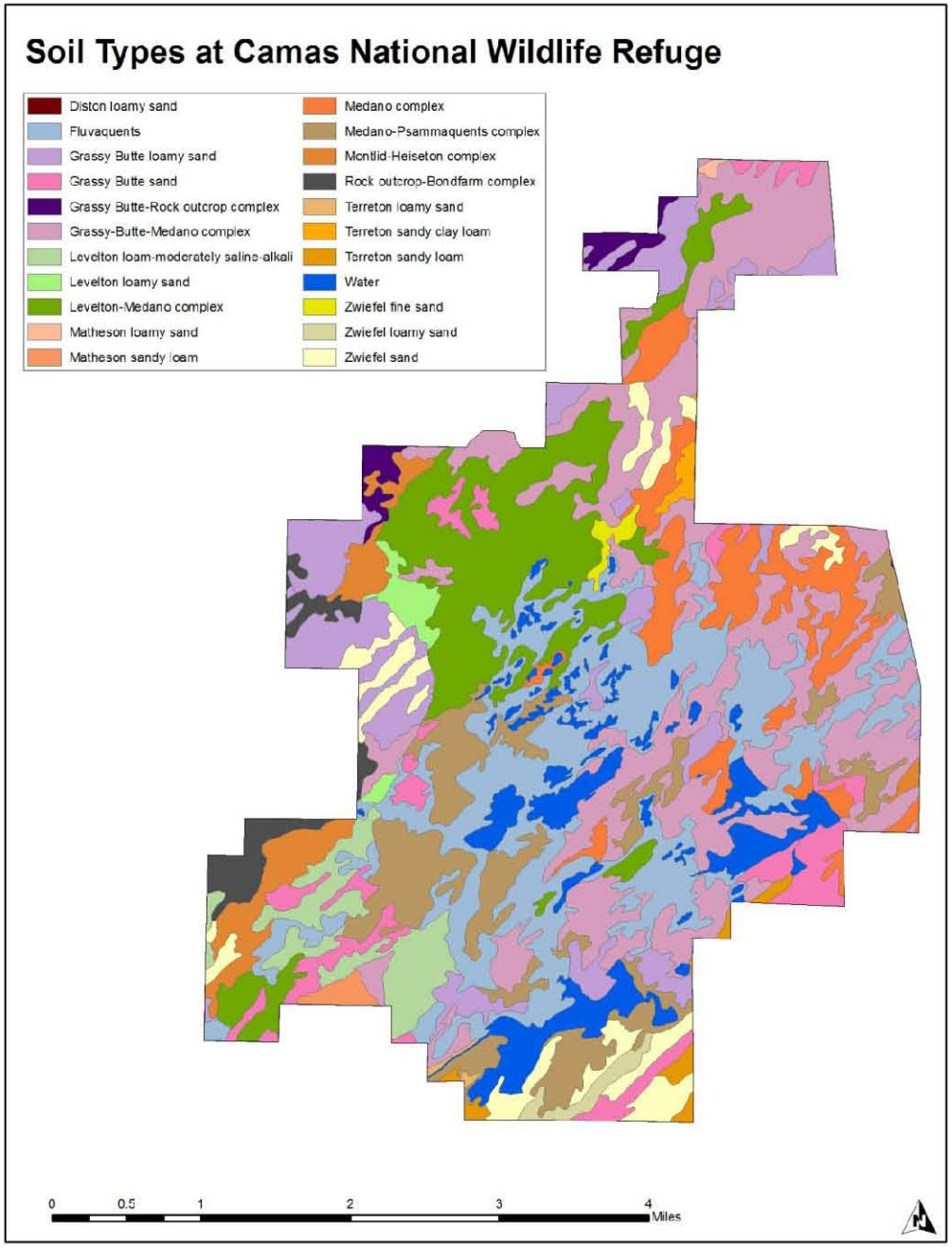

Surficial Geology
within the
Beaver-Camas Subbasin
Legend
Rock Type
Alluvial Fan
Alluvium
Arenite
Conglomerate
Dune sand
Loess
Rhyolite
Sandstone
Siltstone
Stratified Glacial Sediment
Tholeiite Lava Flow
Till
Tuff
Water
Camas National Wildlife Refuge
0
4.25
8.5
17
25.5
34
Miles

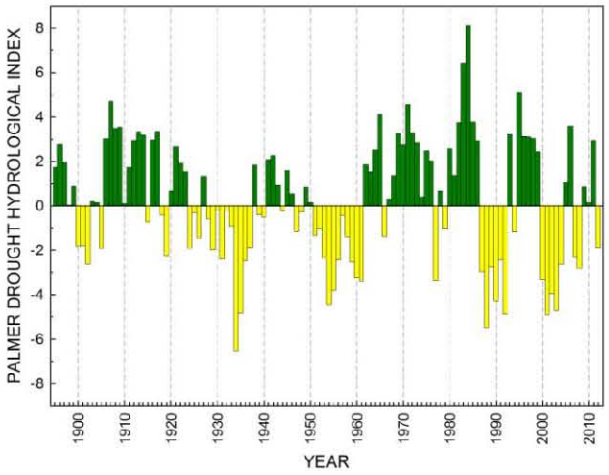
GEOLOGY

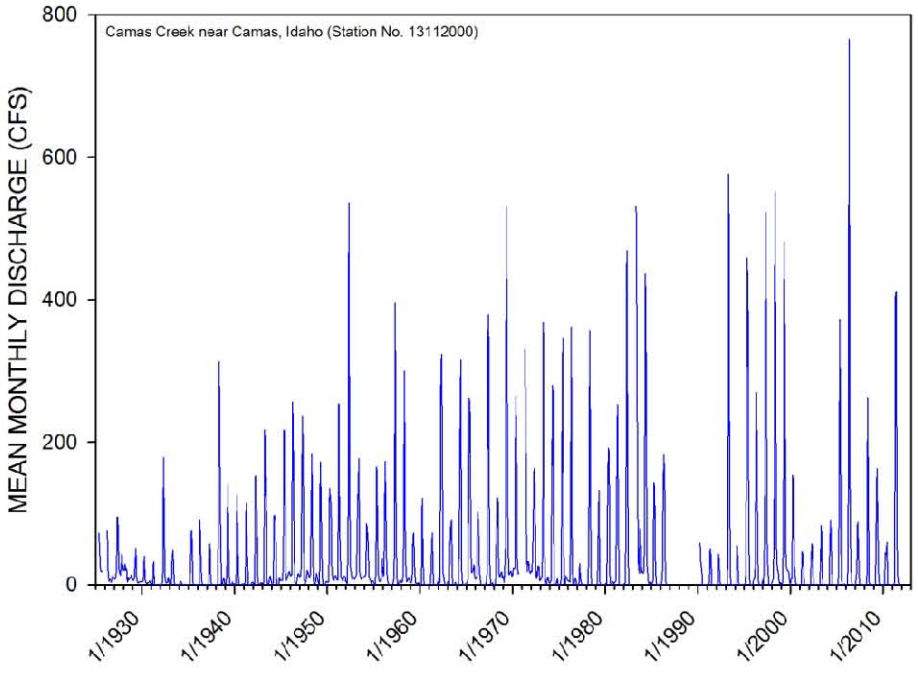

MONTANA
112°
113°
IDAHO
CLARK
JEFFERSON
MADISON
Rexburg
Idaho Falls
Mud Lake
Ashton Reservoir
A
A'

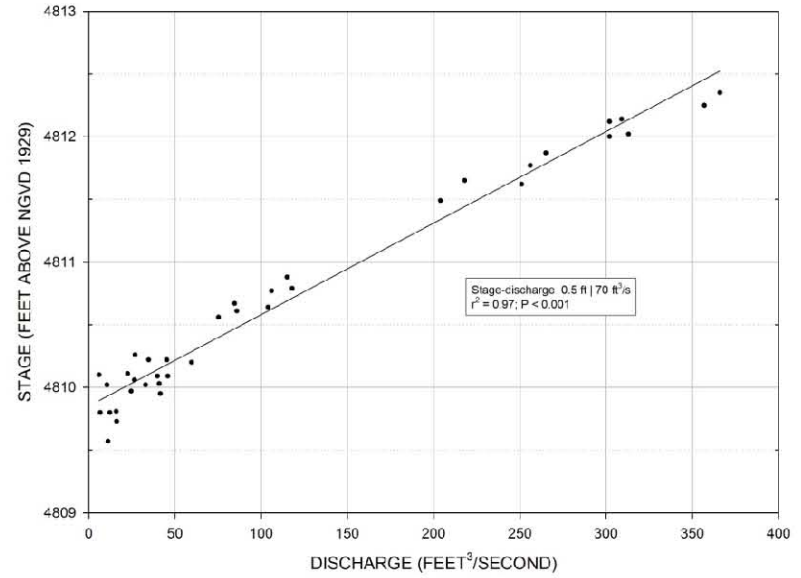

A
A'
FEET
6,000
5,500
5,000
4,500
4,000
3,500
3,000
Mud Lake
DATUM IS SEA LEVEL
VERTICAL SCALE GREATLY EXAGGERATED
0 5 10 15 20 MILES
0 5 10 15 20 KILOMETERS
EXPLANATION
Clay, silt, and sand
Basalt
Dense, older basalt
Sand and gravel
Rhyolite
Water table (approximately located)

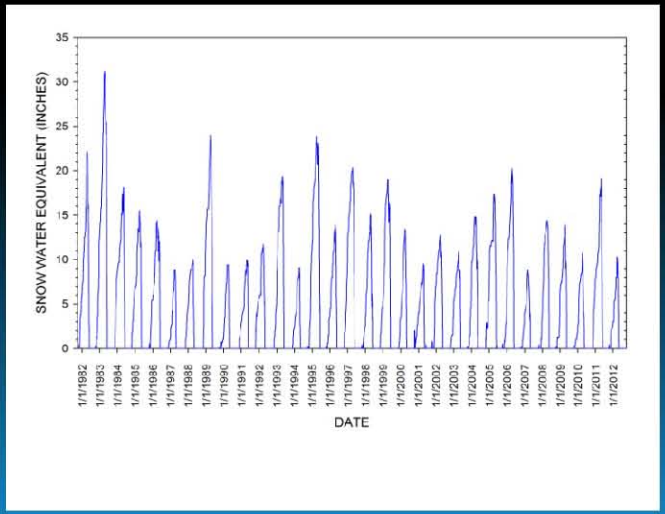
Soil Types at Camas National Wildlife Refuge




PALMER DROUGHT HYDROLOGICAL INDEX
8
6
4
2
0
-2
-4
-6
-8
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
YEAR

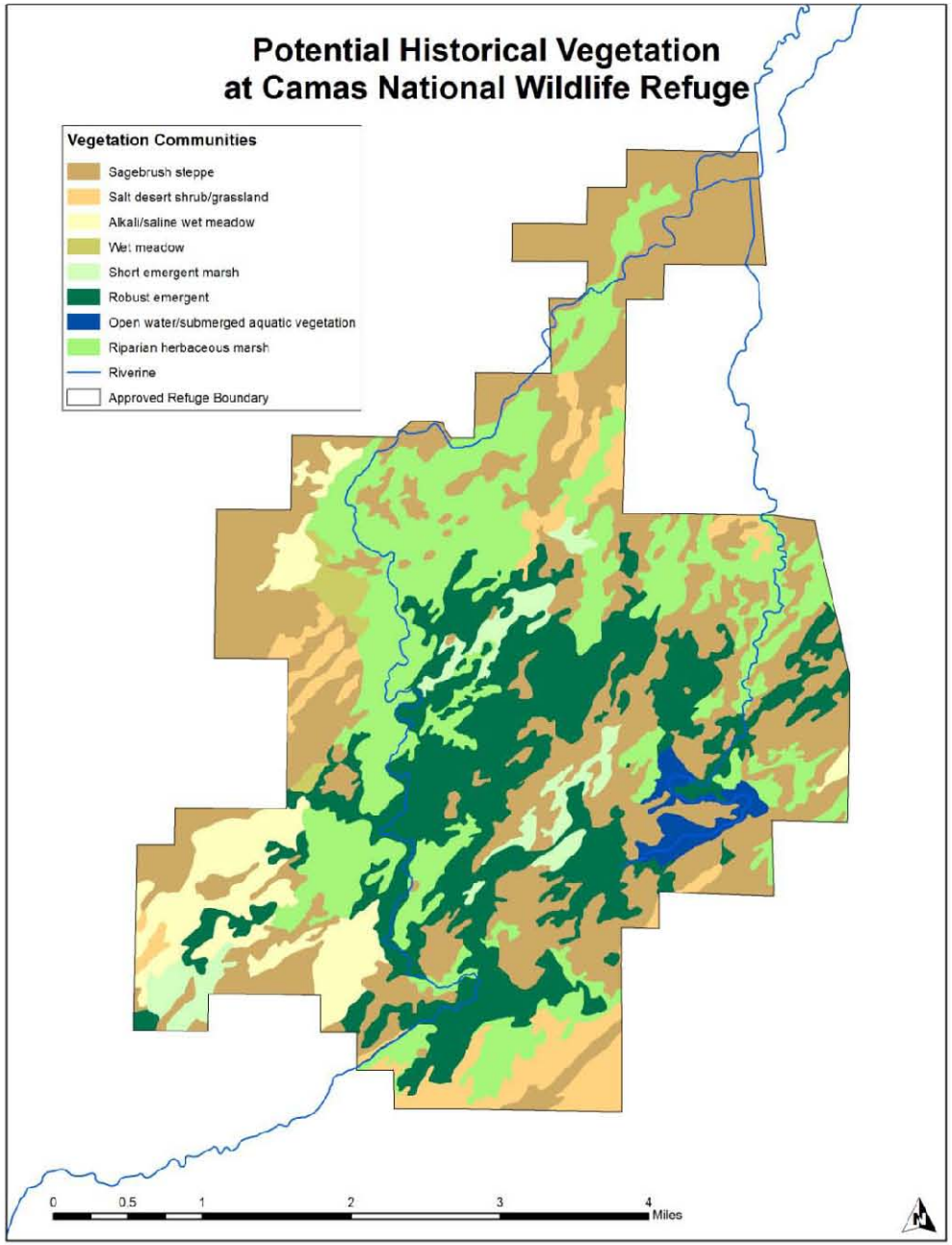

Camas Creek near Camas, Idaho (Station No. 13112000)
MEAN MONTHLY DISCHARGE (CFS)
800
600
400
200
0
1/1930
1/1940
1/1950
1/1960
1/1970
1/1980
1/1990
1/2000
1/2010

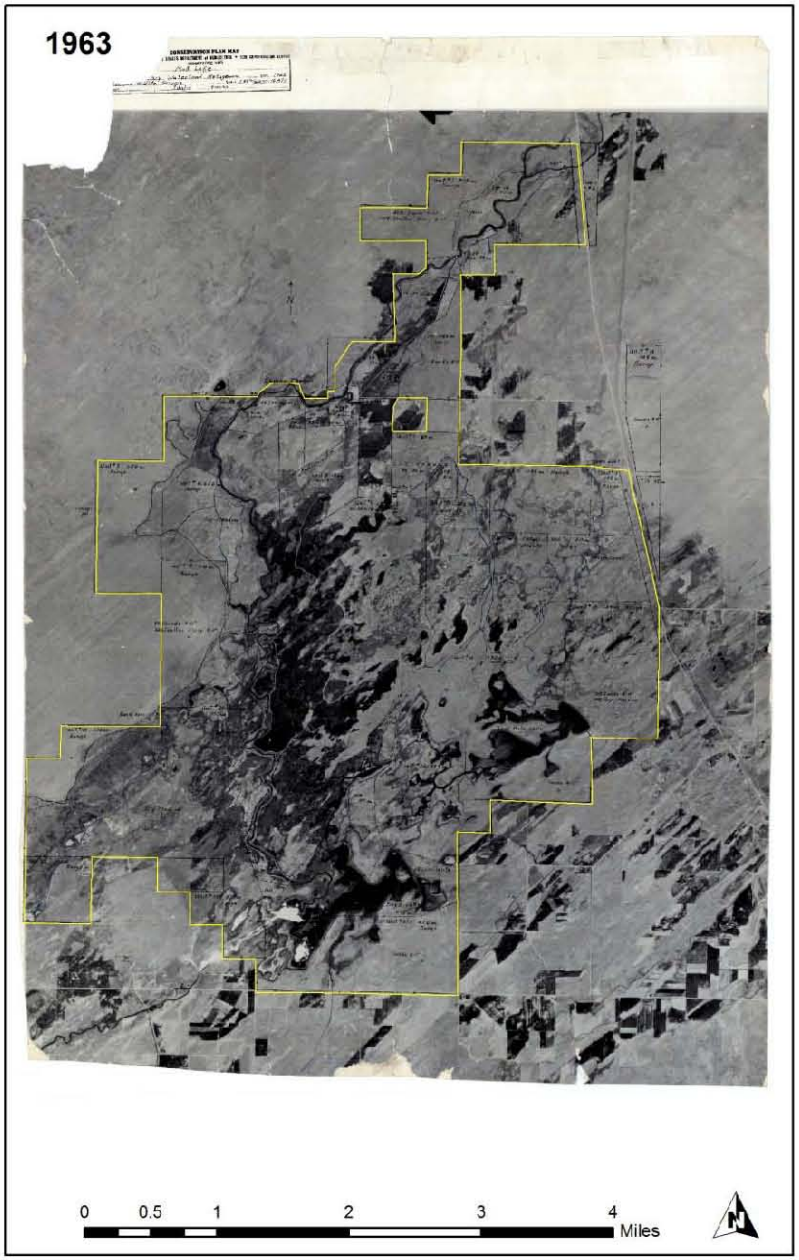

STAGE (FEET ABOVE NGVD 1929)
4813
4812
4811
4810
4809
0
50
100
150
200
250
300
350
400
DISCHARGE (FEET3/SECOND)
Stage-discharge 0.5 ft | 70 ft3/s
r2 = 0.97; P < 0.001

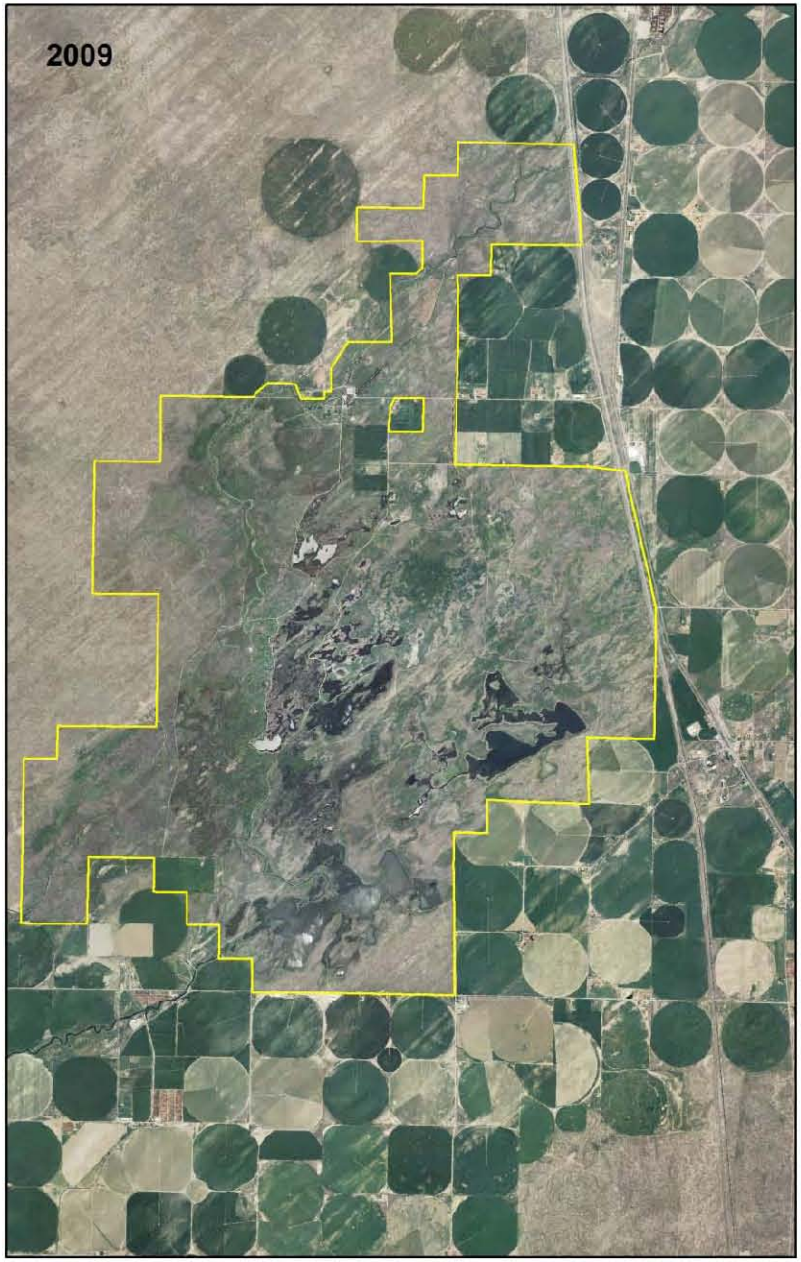

SNOW WATER EQUIVALENT (INCHES)
35
30
25
20
15
10
5
0
DATE

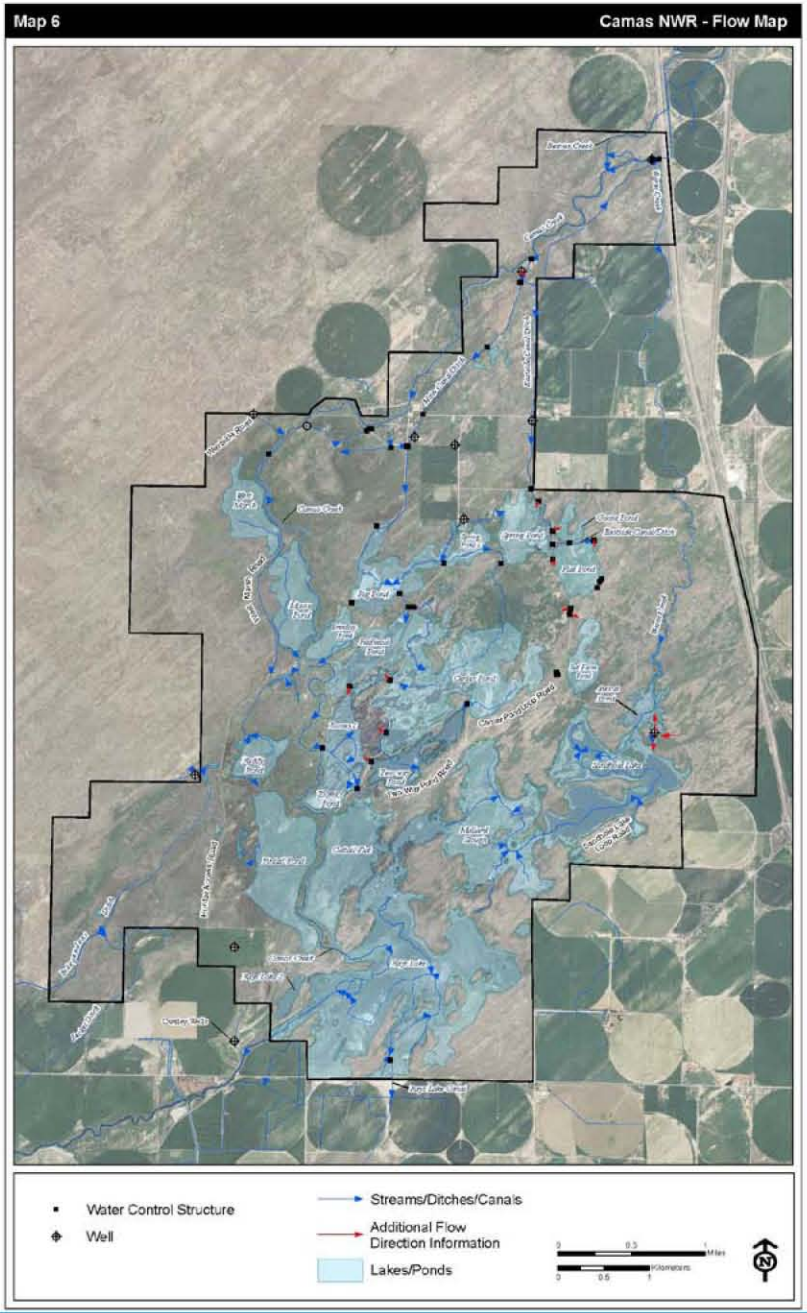
Compile Life-History Strategies of Plants that Historically Occurred at Site

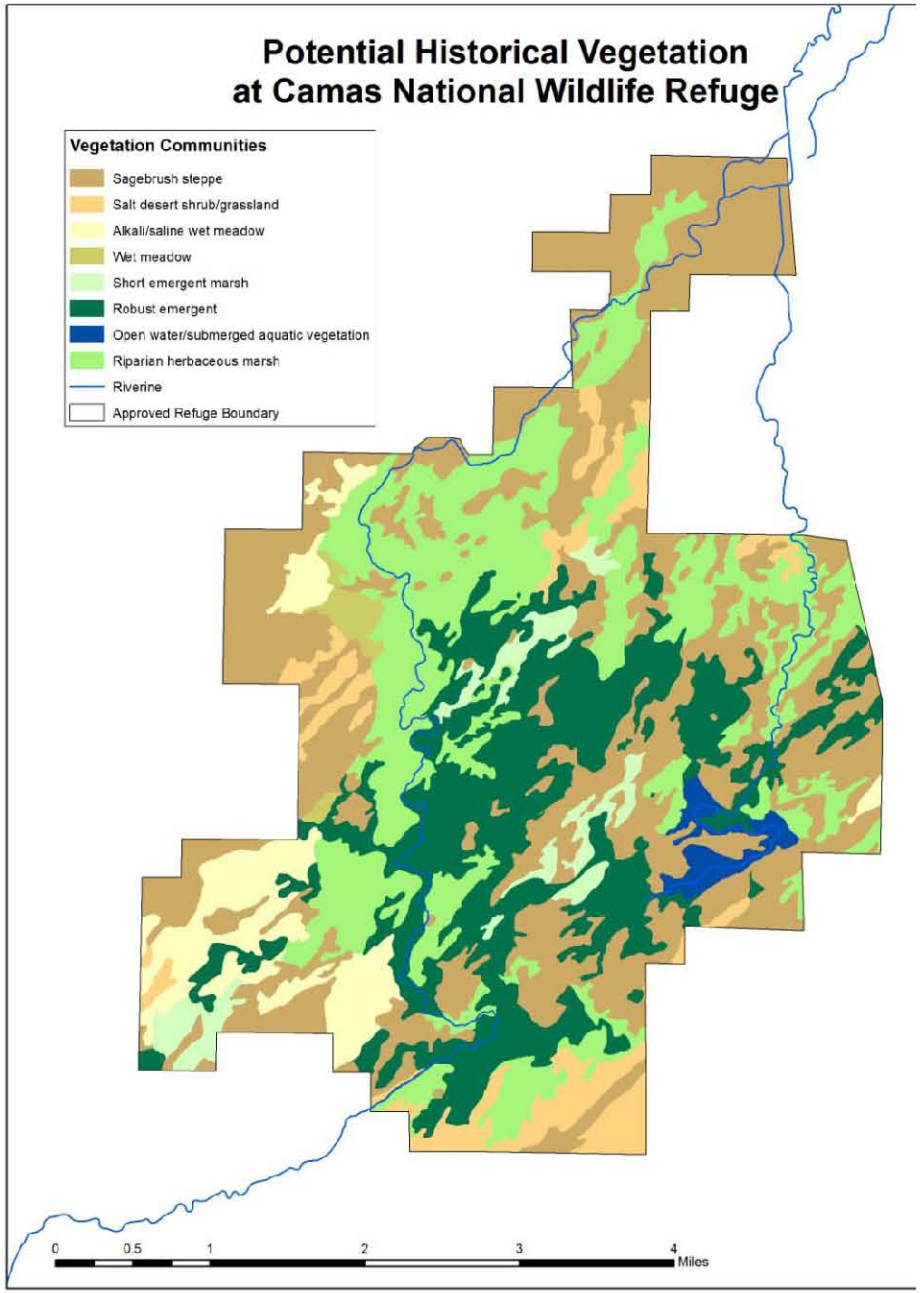
Habitat Type	Geologic surface	Landform	Parent Material	Soil Type(s)	Hydrologic regime
Sagebrush steppe	Tholeiite lava flow Loess	Lava plains	Eolian Mixed alluvium Bedrock	Diston loamy sand Grassy Butte sand Grassy Butte loamy sand Grassy Butte-Medano complex Grassy Butte-Rock outcrop complex Matheson loamy sand Matheson sandy loam Rock outcrop-Bondfarm complex	Dry
Salt desert shrub/ grassland	Loess	Relict lakebed	Lacustrine	Terreton loamy sand Terreton sandy loam Terreton sandy clay loam Zwiefel fine sand Zwiefel loamy sand	Ephemeral and/or Saturated subsurface soil
Alkali/saline wet meadow	Loess	Relict lakebed	Lacustrine	Levelton loam, moderately saline-alkaline Montlid-Heiseton complex	Temporary
Wet meadow	Loess	Depressions on lakebeds	Lacustrine	Levelton loamy sand	Temporary
Short emergent marsh	Loess	Relict lakebed	Lacustrine Mixed alluvium	Levelton-Medano complex Medano complex	Seasonal
Robust emergent/ submerged aquatic vegetation	Loess	Relict lakebed	Lacustrine	Fluvaquents Water (except Sandhole L)	Semi-permanent
Open water/ submerged aquatic vegetation	Loess	Relict lakebed	Lacutrine	Water (Sandhole L only)	Permanent
Riverine	Loess	Creek channel through relict lakebed	Mixed alluvium	Varies	Semi-pemanent
Riparian herbaceous marsh	Loess	Relict lakebed adjacent to creek channel	Primarily mixed alluvium	Poorly drained soils adjacent to creek channel: Medano-Psammaquents complex Medano complex Levelton-Medano complex	Seasonal


Potential Historical Vegetation
at Camas National Wildlife Refuge
Vegetation Communities
Sagebrush steppe
Salt desert shrub/grassland
Alkali/saline wet meadow
Wet meadow
Short emergent marsh
Robust emergent
Open water/submerged aquatic vegetation
Riparian herbaceous marsh
Riverine
Approved Refuge Boundary
0
0.5
1
2
3
4
Miles


1963
0
0.5
1
2
3
4
Miles
N


2009


Map 6
Camas NWR - Flow Map
Water Control Structure
Well
Streams/Ditches/Canals
Additional Flow Direction Information
Lakes/Ponds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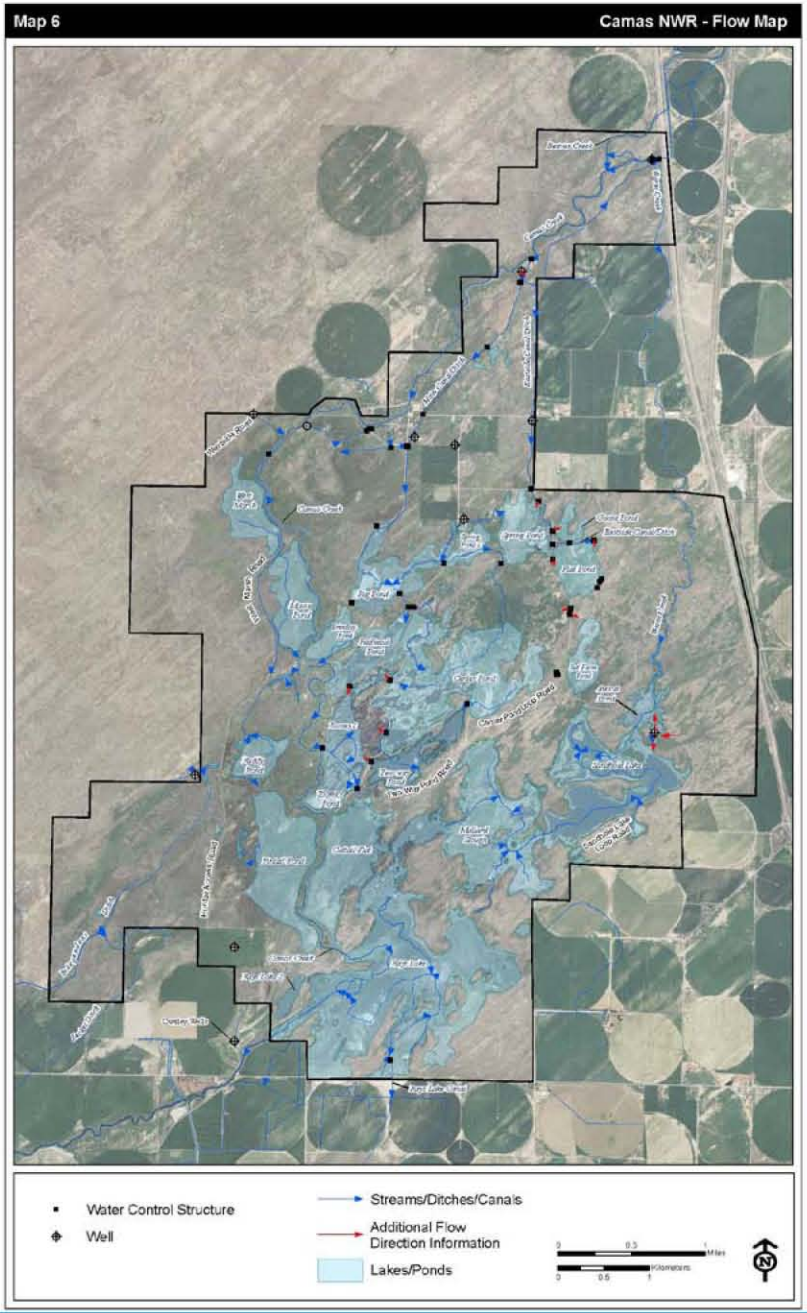
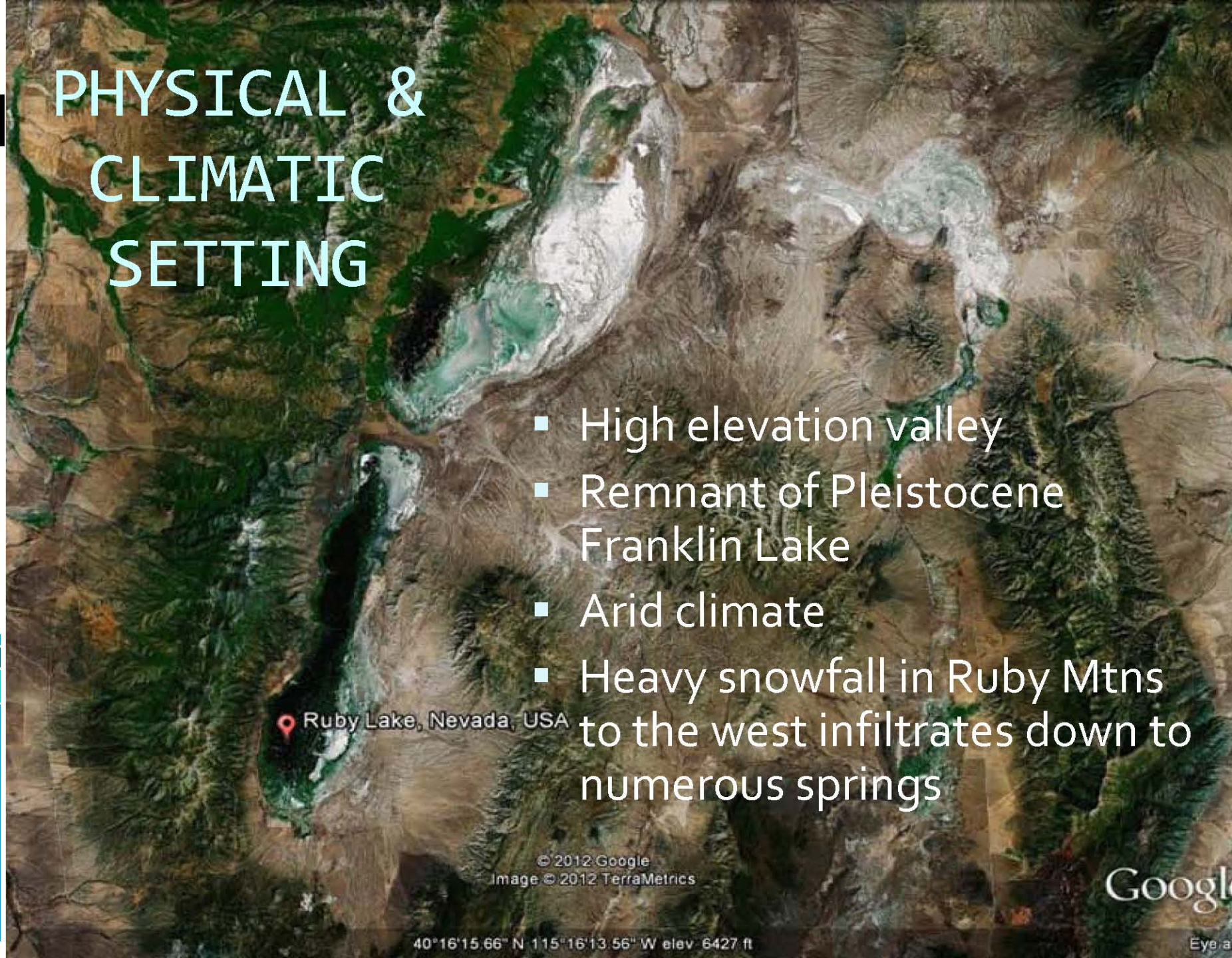
Wet meadow
Short emergent marsh
Robust emergent
Open water/submerged aquatic vegetation
Riparian herbaceous marsh
Riverine
Approved Refuge Boundary
0
0.5
1
2
3
4
Miles


Map 6
Camas NWR - Flow Map
Water Control Structure
Well
Streams/Ditches/Canals
Additional Flow
Direction Information
Lakes/Ponds

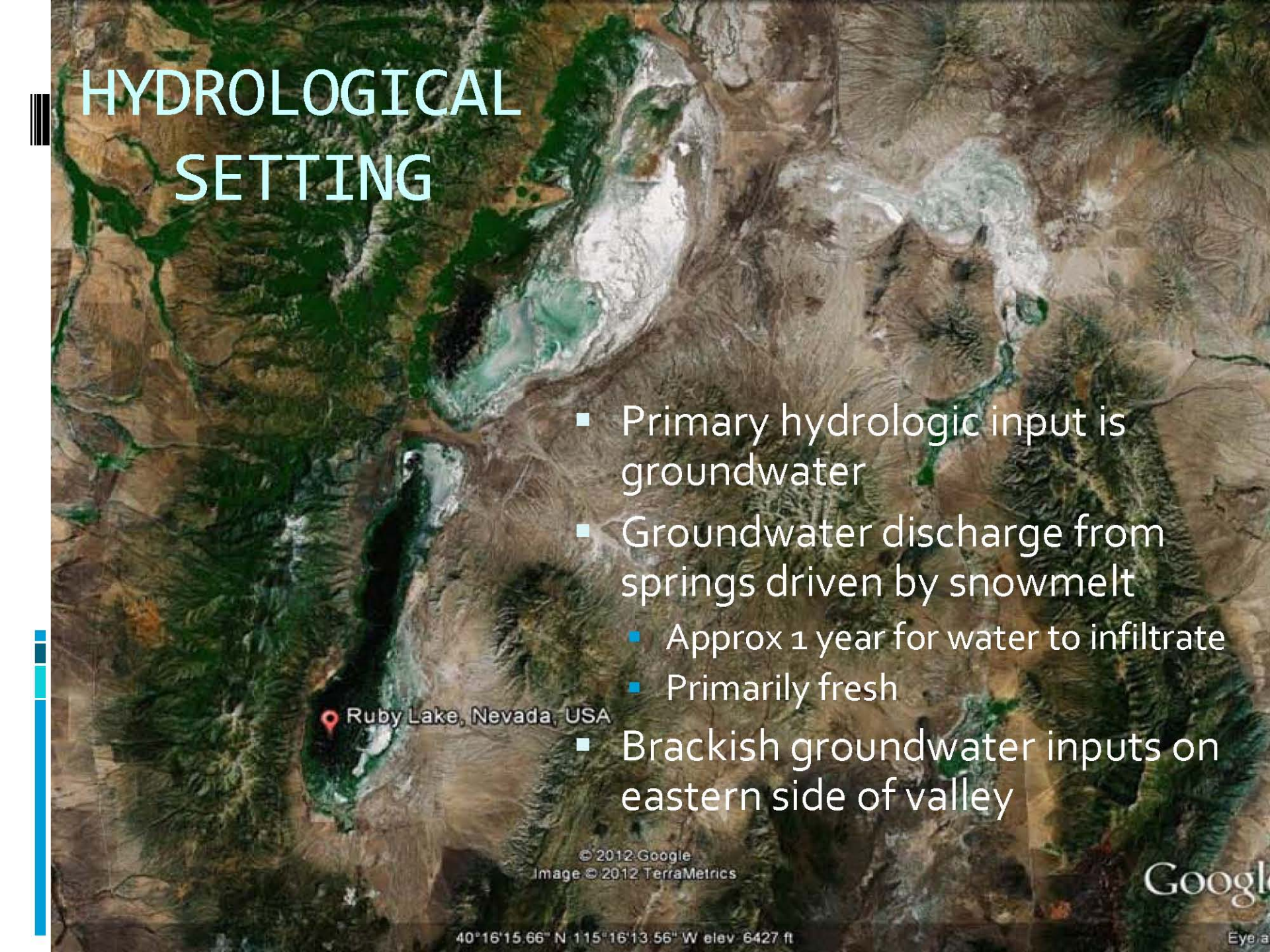
RUBY AND FRANKLIN LAKES, NV

PHYSICAL & CLIMATIC SETTING



- High elevation valley
- Remnant of Pleistocene Franklin Lake
- Arid climate
- Heavy snowfall in Ruby Mtns to the west infiltrates down to numerous springs

HYDROLOGICAL SETTING



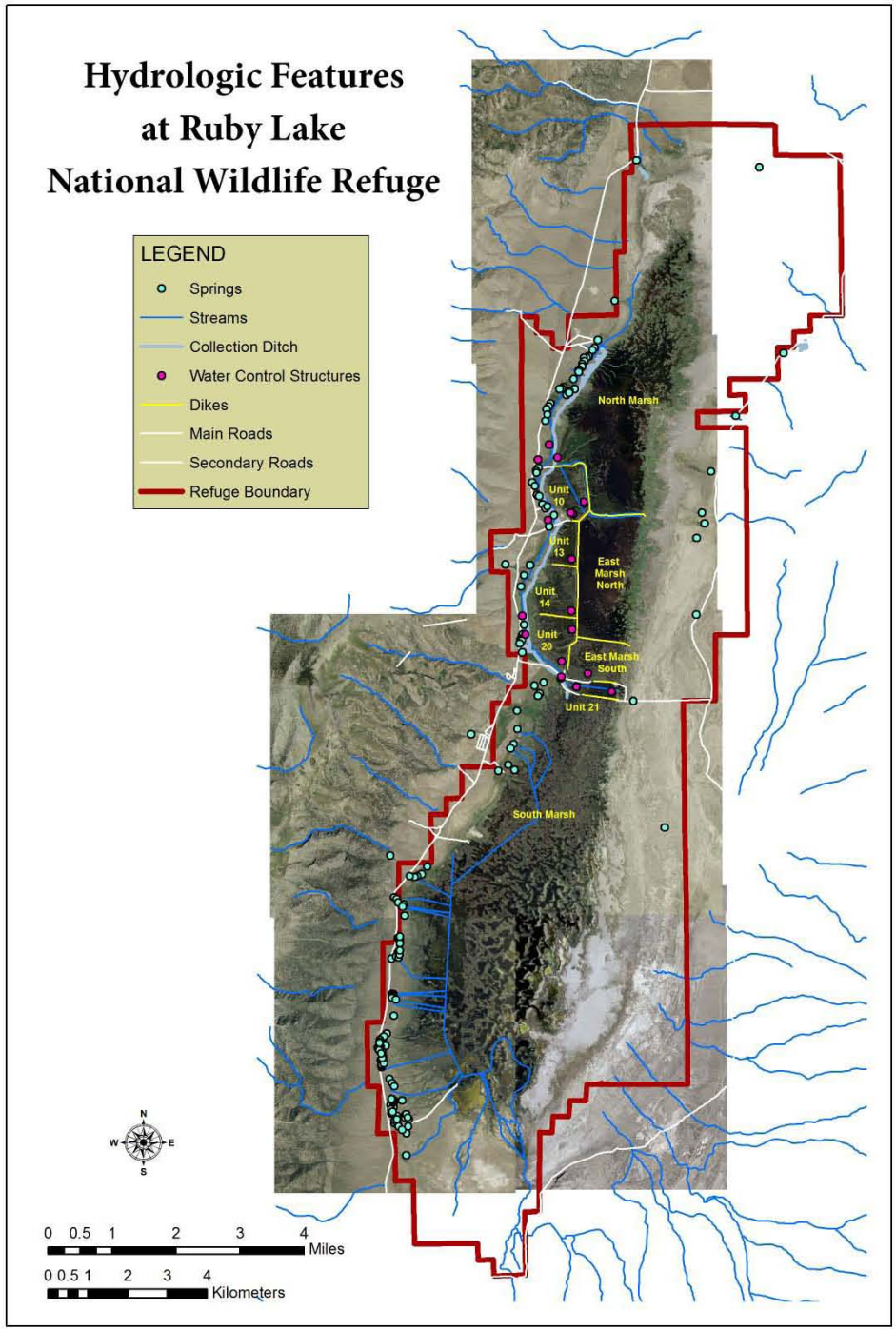
- Primary hydrologic input is groundwater
- Groundwater discharge from springs driven by snowmelt
  - Approx 1 year for water to infiltrate
  - Primarily fresh
- Brackish groundwater inputs on eastern side of valley

BIOLOGICAL SETTING

- Sago pondweed and hard stem bulrush were dominant vegetation species when refuge was established at Ruby Lake in 1938.
- Pondweeds, Ruppia, and Chara so thick that travel by boat is virtually impossible
- Important breeding area for canvasbacks, redheads, white-faced ibis, black terns, long-billed curlews, and sage grouse

EARLY REFUGE MANAGEMENT

- Marsh "development" began in the 1950s
- Diked impoundments to hold water
- Collection ditch collected water discharged from springs
- Impoundments designed to hold STABLE water at FULL POOL throughout breeding season


Hydrologic Features
at Ruby Lake
National Wildlife Refuge
LEGEND
Springs
Streams
Collection Ditch
Water Control Structures
Dikes
Main Roads
Secondary Roads
Refuge Boundary
North Marsh
Unit 10
Unit 13
East Marsh North
Unit 14
Unit 20
East Marsh South
Unit 21
South Marsh
N
W
E
S
0 0.5 1 2 3 4 Miles
0 0.5 1 2 3 4 Kilometers

CHANGES IN THE BIOLOGICAL SETTING

- Submerged aquatic vegetation shifted to coontail, milfoil, & bladderwort; all of which have lower nutritional value.
- Marsh choking itself out with emergent vegetation, primarily bulrush
- Cattail increasing
- Reduced productivity

IMPACTS OF EARLY MANAGEMENT

RUBY LAKE

- By 1957-58
  - Vegetation shifts
  - Decreased duck productivity
- 50+ years of stable water
- Management headache to reverse impacts
  - Controlled burns, dredged accumulated peat into islands

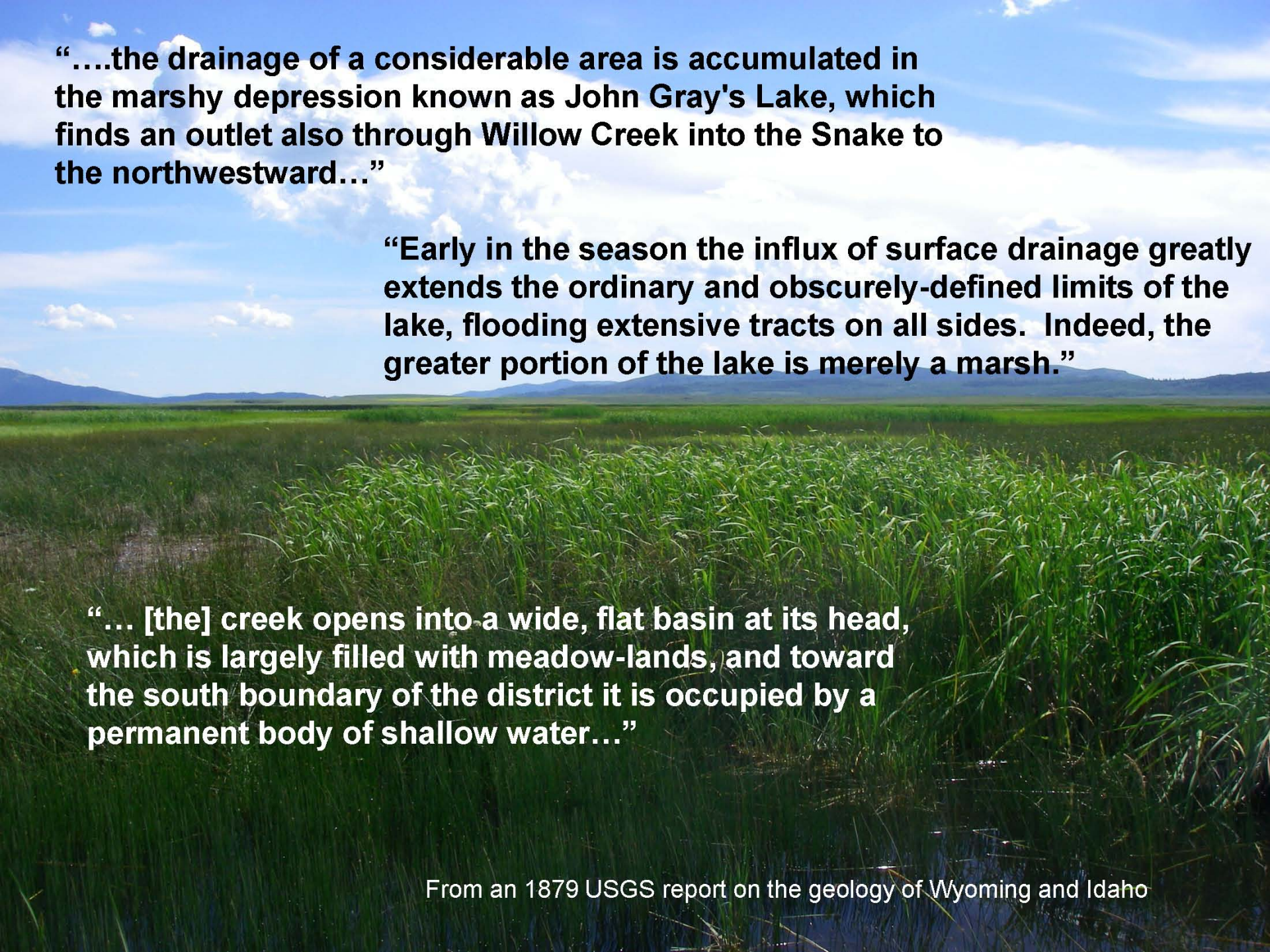
FRANKLIN LAKE

- No active management
- Fluctuated naturally
- Sago pondweed remained dominant SAV
- During wet years, 90% of diving ducks at Franklin Lake, NOT on the refuge.

GRAYS LAKE, ID

PHYSICAL SETTING

- Large montane wetland valley
- Arid climate
- Primary hydrologic input is snowmelt & spring rains
- Groundwater inputs from springs along fault lines



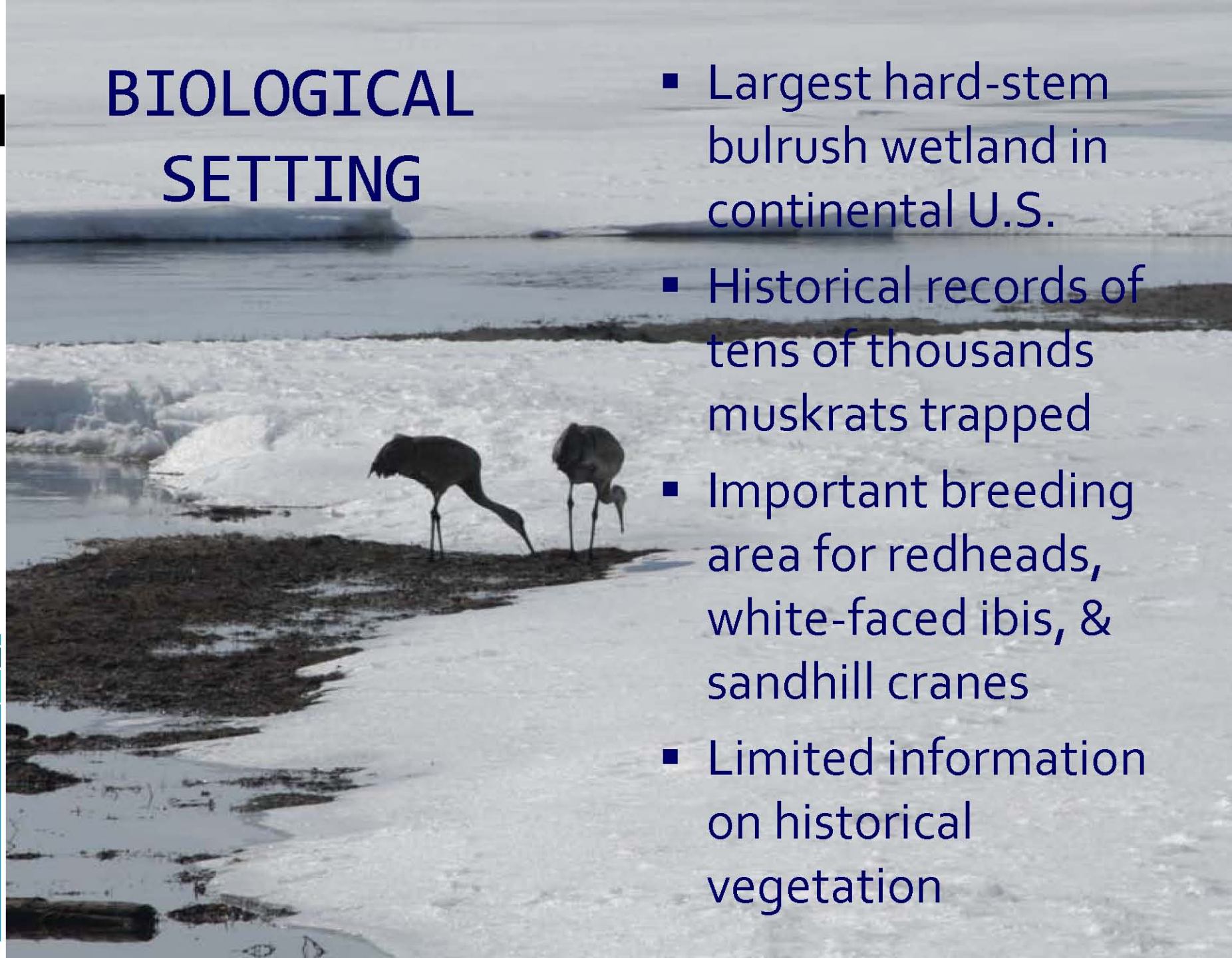
"….the drainage of a considerable area is accumulated in the marshy depression known as John Gray's Lake, which finds an outlet also through Willow Creek into the Snake to the northwestward…"

"Early in the season the influx of surface drainage greatly extends the ordinary and obscurely-defined limits of the lake, flooding extensive tracts on all sides. Indeed, the greater portion of the lake is merely a marsh."

"… [the] creek opens into a wide, flat basin at its head, which is largely filled with meadow-lands, and toward the south boundary of the district it is occupied by a permanent body of shallow water…"

From an 1879 USGS report on the geology of Wyoming and Idaho

BIOLOGICAL SETTING

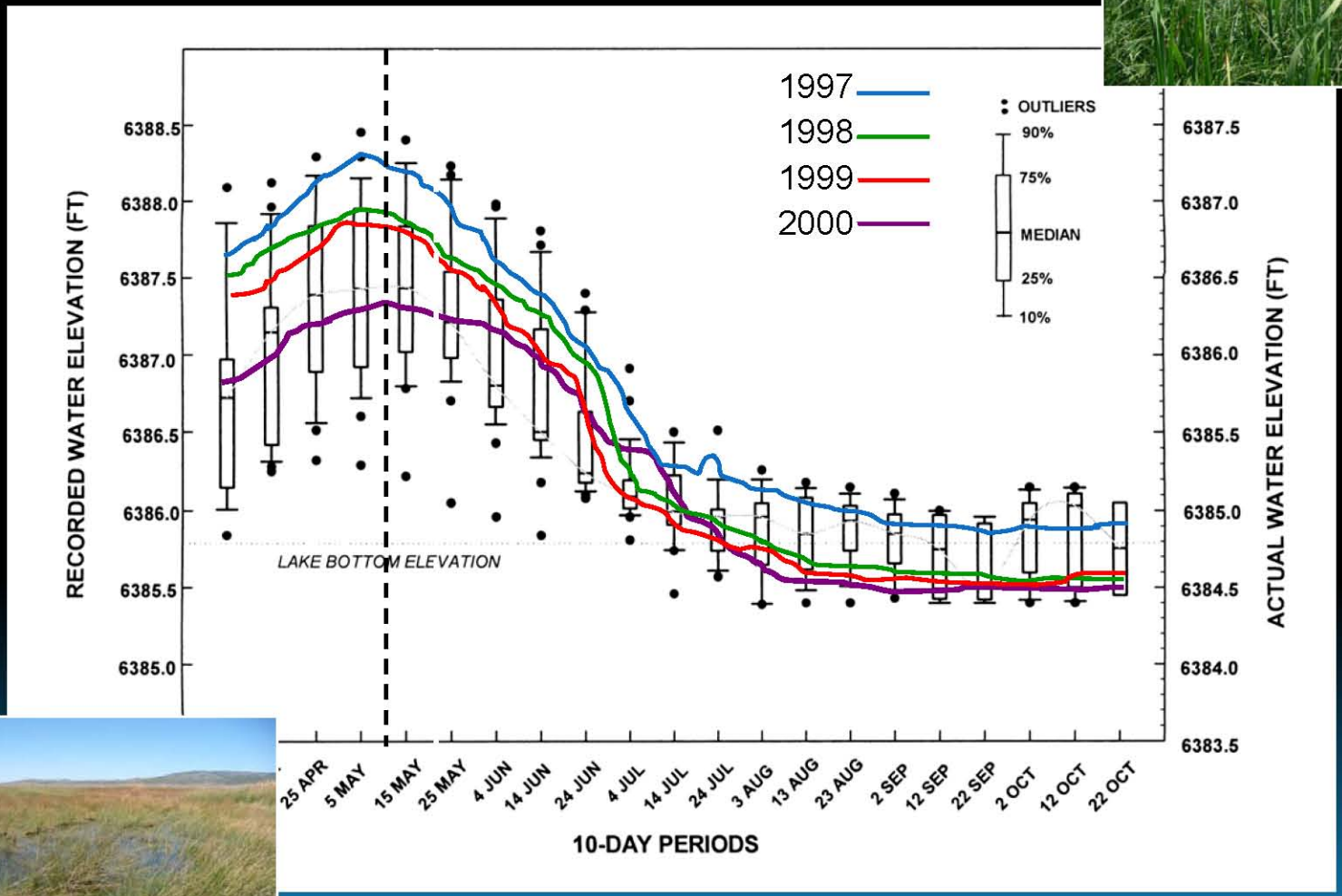


- Largest hard-stem bulrush wetland in continental U.S.
- Historical records of tens of thousands muskrats trapped
- Important breeding area for redheads, white-faced ibis, & sandhill cranes
- Limited information on historical vegetation

EARLY MODIFICATIONS

- Natural outlet dammed
- Clarks Cut built in early 1900s to convey water
- BIA has water rights for Fort Hall Irrigation project
  - Withdraw water to same target elevation every year
- Most of planned refuge impoundments never built

MODIFIED HYDROLOGY



IMPACTS OF WATER DEVELOPMENT

PROCESSES

- HIGHLY MODIFIED hydrology
  - Shortened hydroperiod
  - Stabilized summer water levels compared to historical
  - Natural drainage is "backwards"

PHYSICAL ENV'T

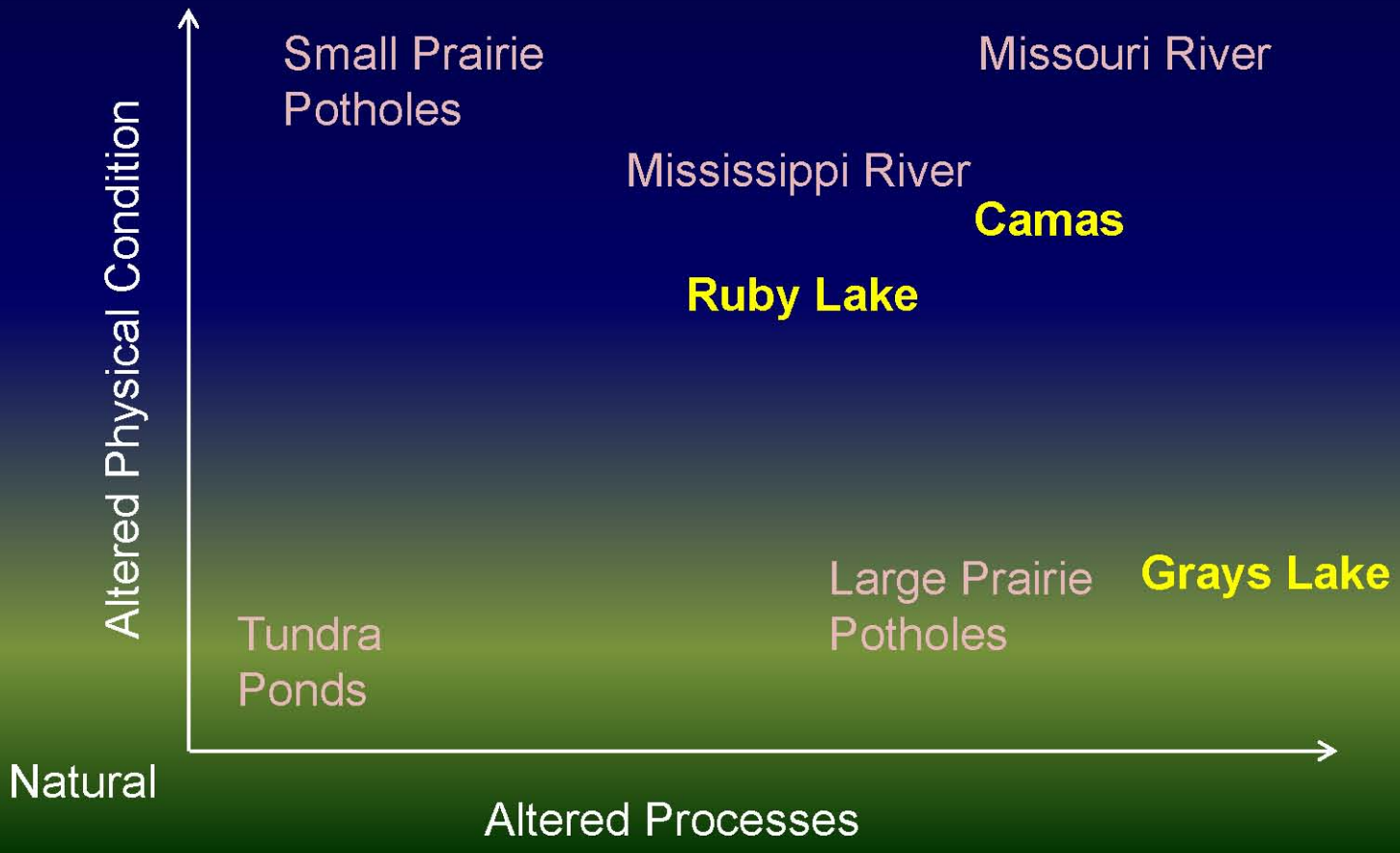
- Not as highly modified as natural processes
  - Some canals; old dikes built from peat (relatively non-functional)
  - Access road to Bear Island
  - Disrupted sheetflow

CHANGES IN THE BIOLOGICAL SETTING

- Suggested decrease in abundance, diversity, & quality of SAV
- Cattail expanding
- Reduced productivity of redheads from historical #'s (and recent?)
- Dramatic decline in muskrat abundance
- Cutthroat trout disconnected from spawning habitats & overwintering areas

HOW DO WE IMPROVE THESE WETLANDS?

To provide increased food resources, habitat interspersion, nesting structure, etc?



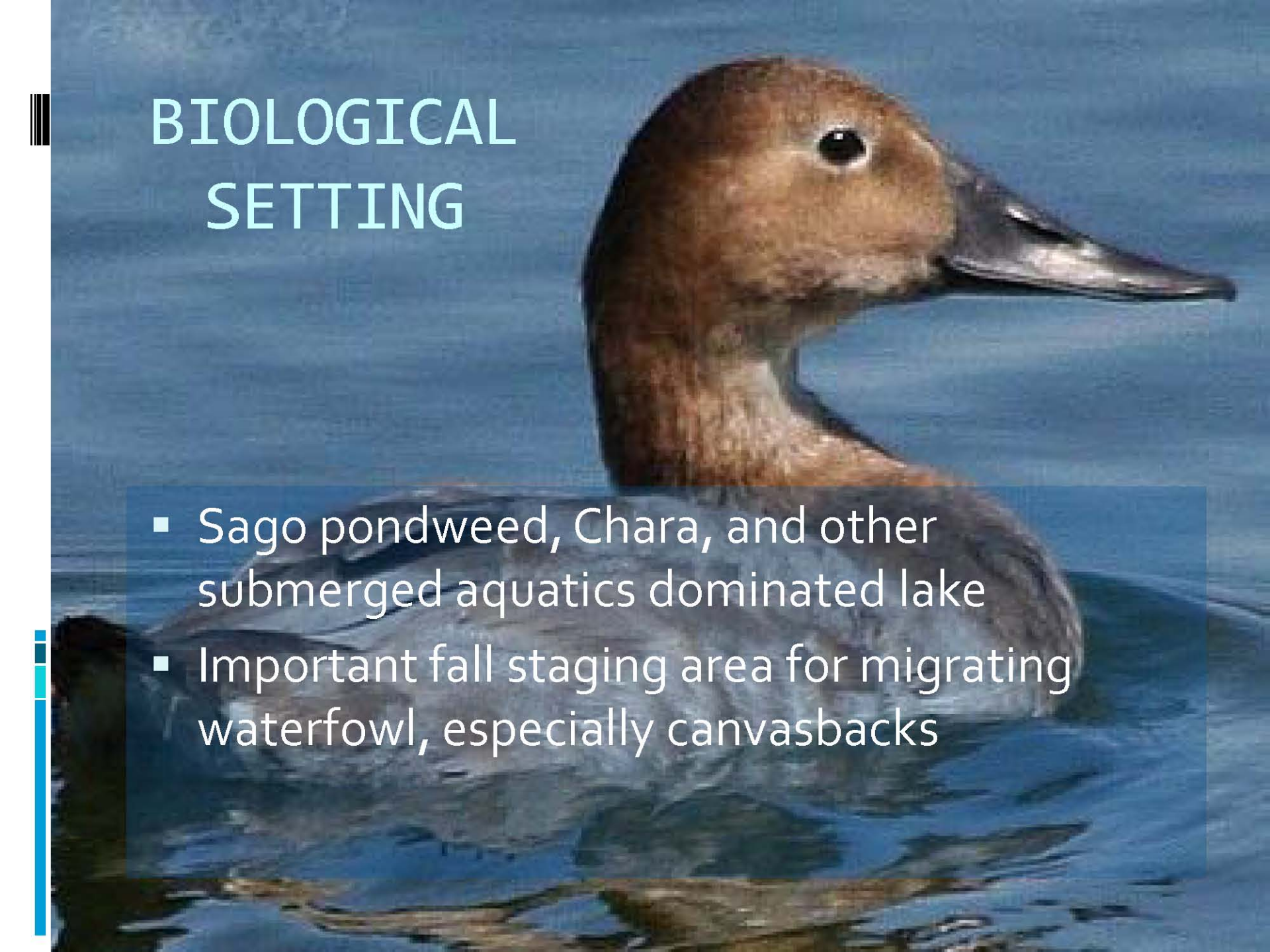
Northern Fall Migration Staging Habitat

CHRISTINA LAKE, WI

PHYSICAL & HYDROLOGICAL SETTING

- Glaciated west-central Minnesota
- At junction between deciduous transition & prairie zones
- Large, shallow lake
  - 3,900 acres
- Surface & groundwater inflows

BIOLOGICAL SETTING



- Sago pondweed, Chara, and other submerged aquatics dominated lake
- Important fall staging area for migrating waterfowl, especially canvasbacks

MODIFICATIONS

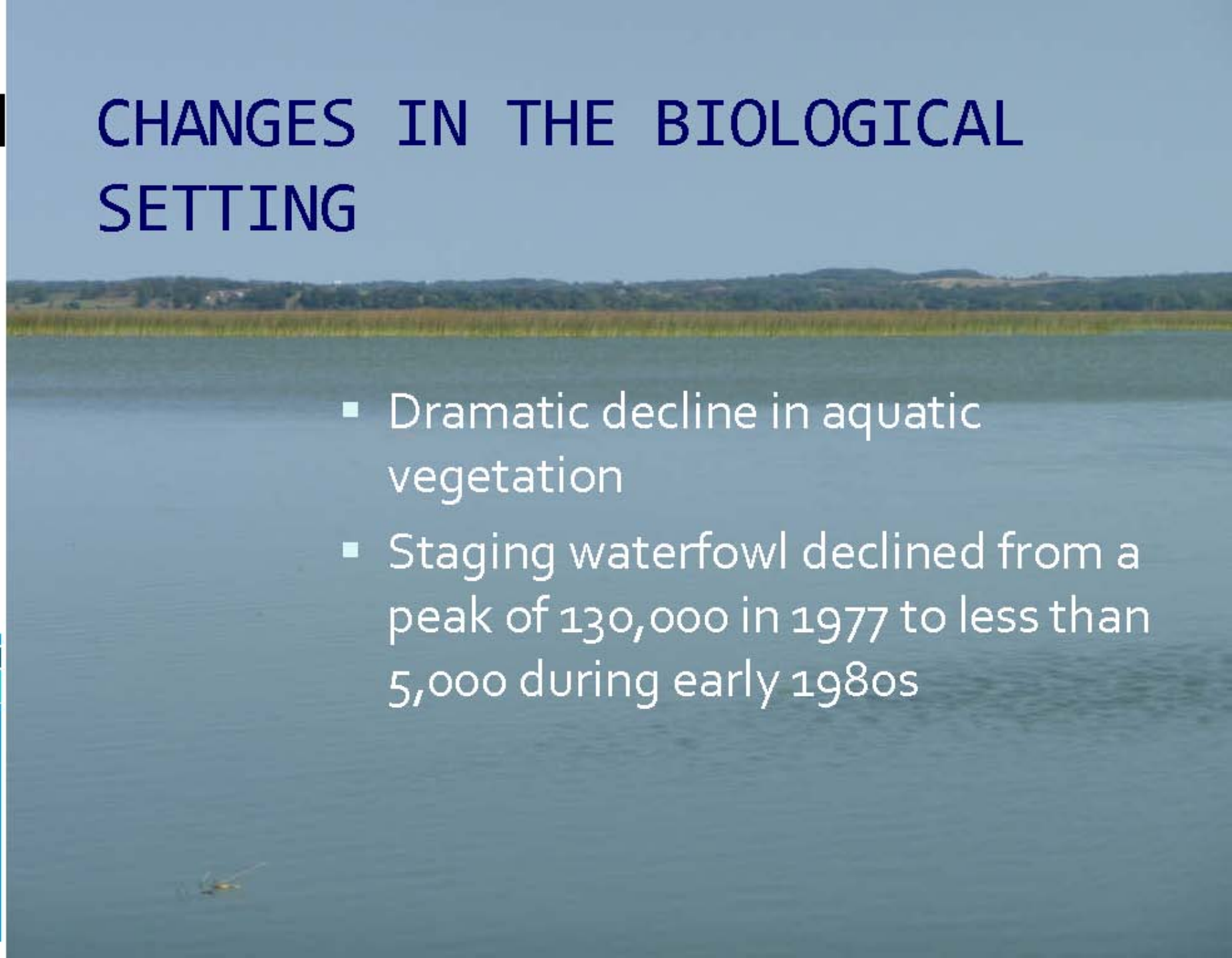
- Surrounding landscape not intensively farmed
- Railroad crossing "impounded" lake
- Highway also built across natural outlet
- Invasive species

IMPACTS OF MODIFICATIONS

PROCESSES

- Extended hydroperiod
- Deeper water that rarely freezes to the bottom
  - Therefore supports higher fish population
- Introduced carp responsible for shifting lake from clear state with abundant vegetation to turbid state with limited wildlife value

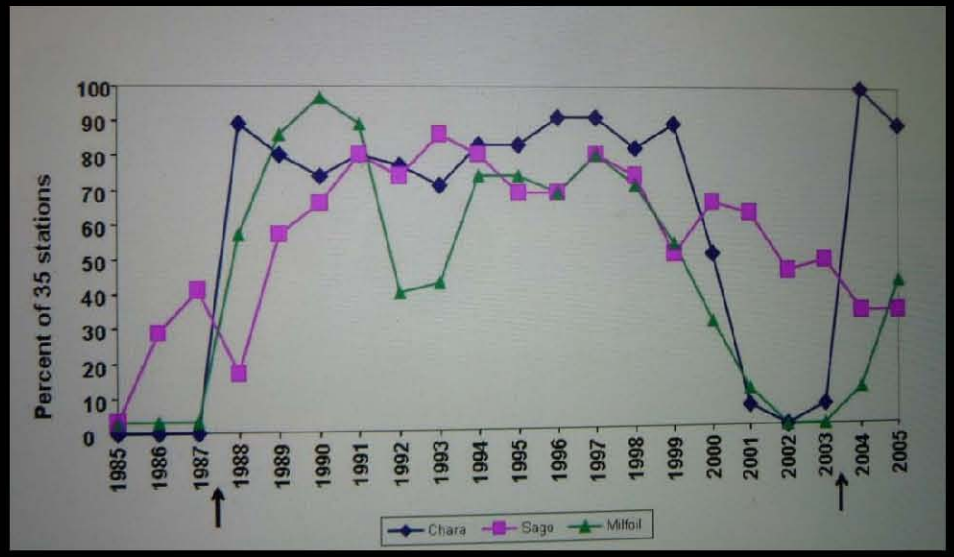
CHANGES IN THE BIOLOGICAL SETTING

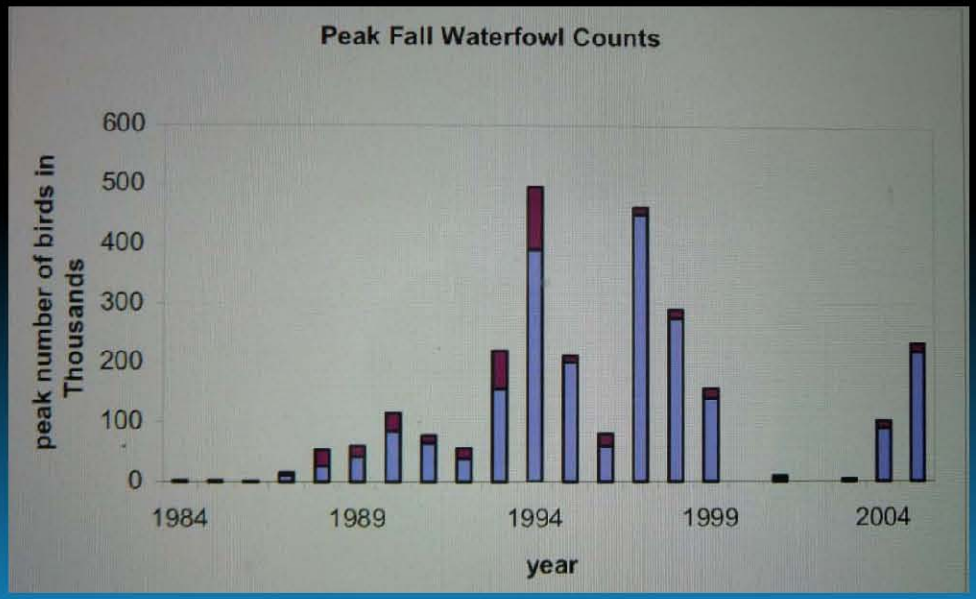


- Dramatic decline in aquatic vegetation
- Staging waterfowl declined from a peak of 130,000 in 1977 to less than 5,000 during early 1980s

MANAGEMENT

- Rotenone treatments
  - Expensive, logistically time consuming
  - Immediate response of vegetation
  - Increasing waterfowl population





FUTURE MANAGEMENT

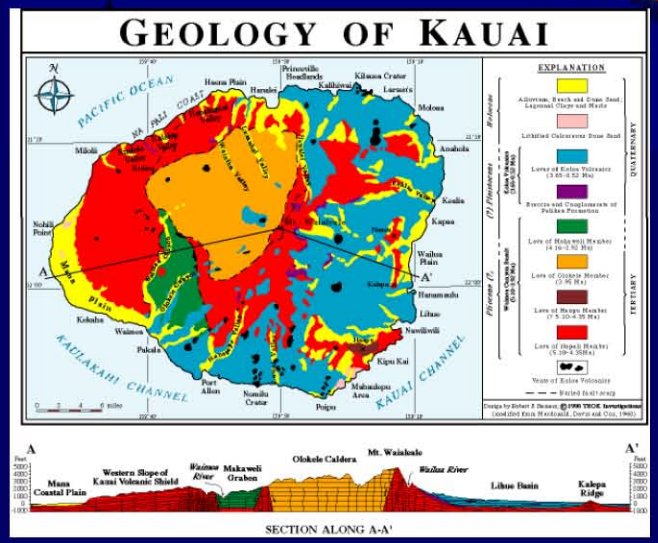
- Pump station with downstream aerator installed
  - Operation will be less expensive and less time consuming than rotenone treatments
  - Periodically lower lake water levels by 3 feet (e.g., when Chara is reduced to less than 50%)

HOW DO WE RESTORE HIGHLY ALTERED WETLANDS?

KAUA`I

Mānā Plain

Mānā Unit

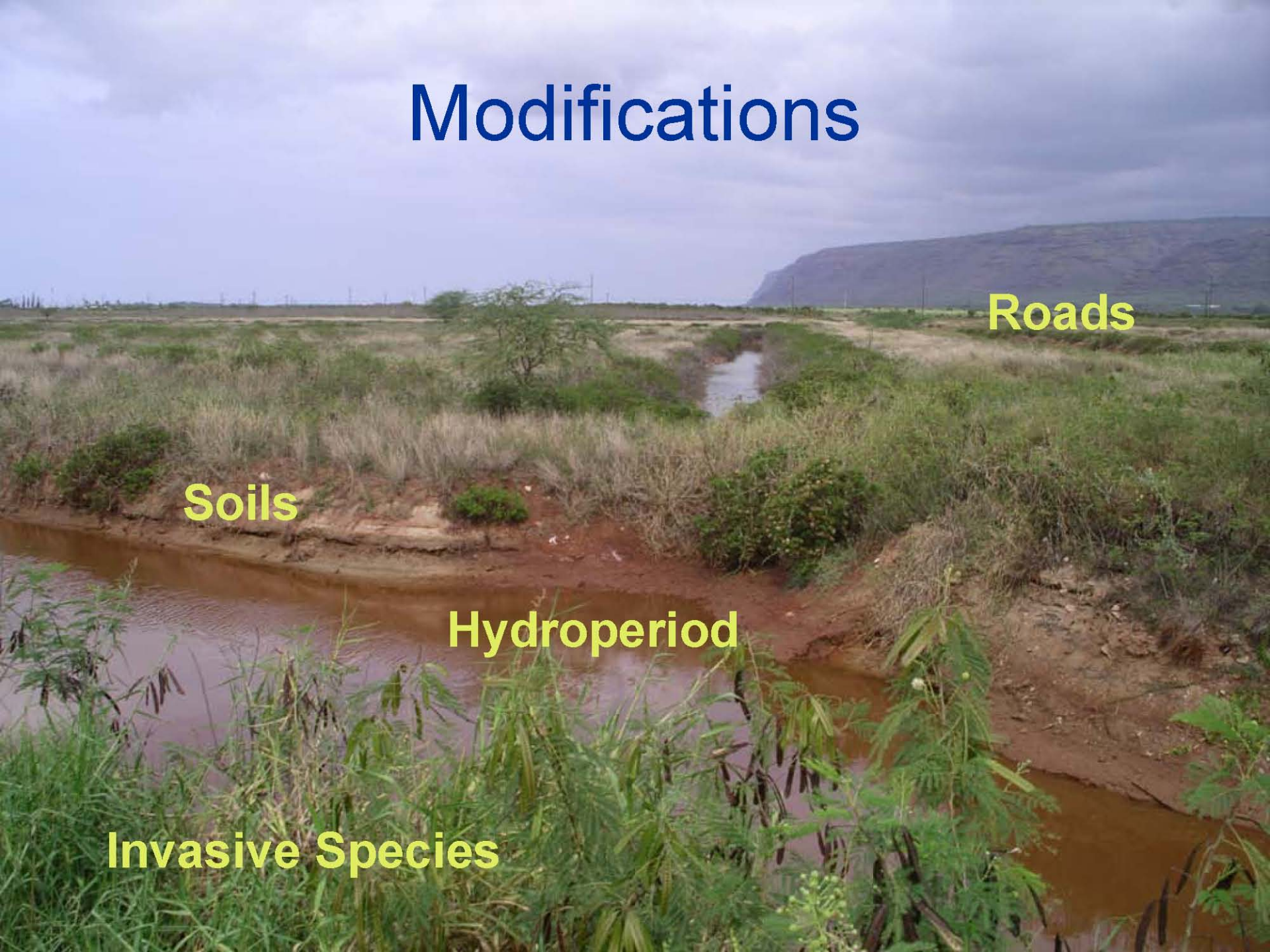


Kawaiele Waterbird Sanctuary

1910

2000

Modifications



PRELIMINARY INFORMATION

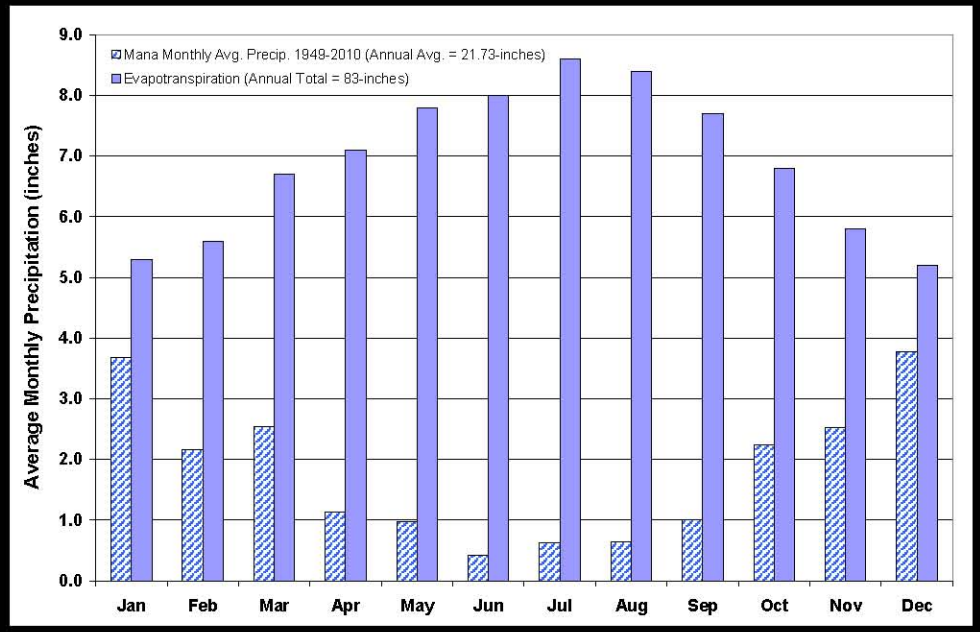
Hydrology
Climate
Geomorphology
Soils

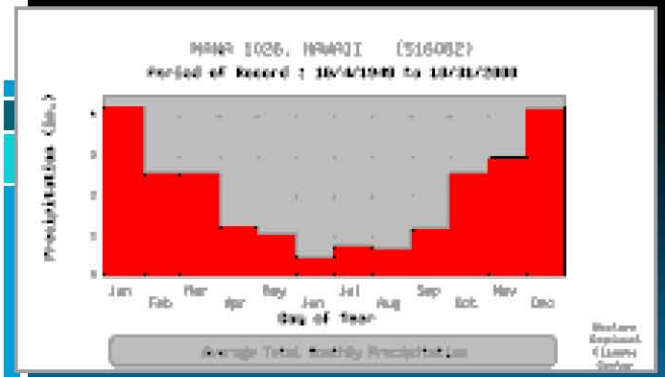
- Historical & current pump records
- Groundwater levels
- Surface water (hydroperiod)
- Historical and current precipitation data
  - On site
  - Upper watershed
- Position in landscape
- Engineering grade topographic survey
- NRCS soil survey information
- 20 soils pits part of archeological survey

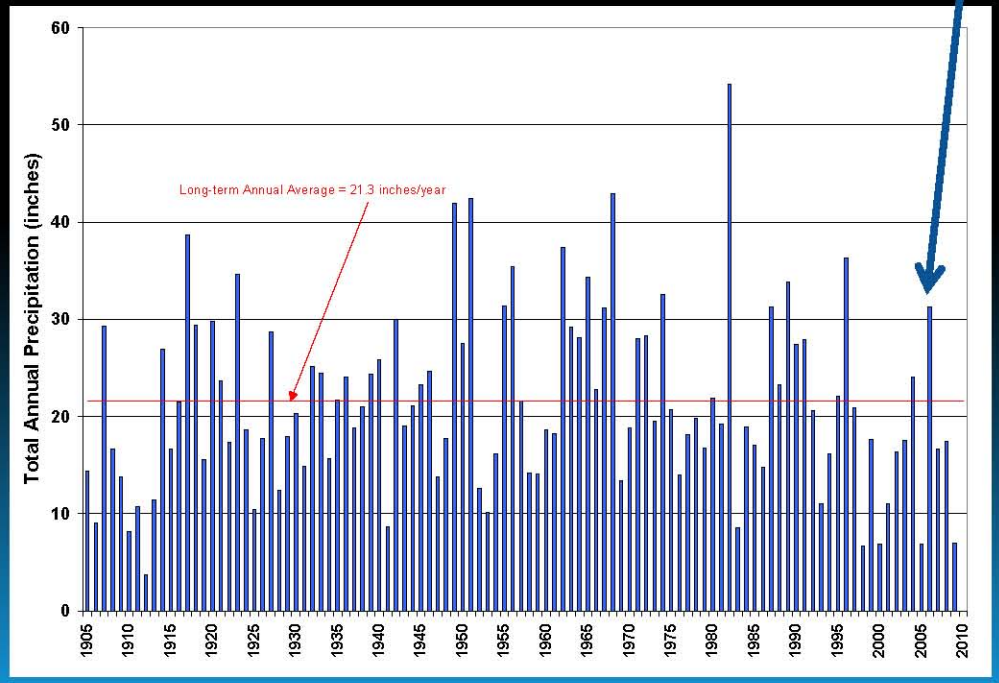
Biological
Historical

- Vegetation surveys
- Waterbird & habitat use surveys
- Invasive fish/plant interactions
- Historical or cultural artifacts and uses
- Paleo-ecological study

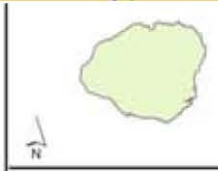
Precip, Temp, & Evapo-transpiration







Topographic Survey & Soils



0 0.2 0.4 Kilometers

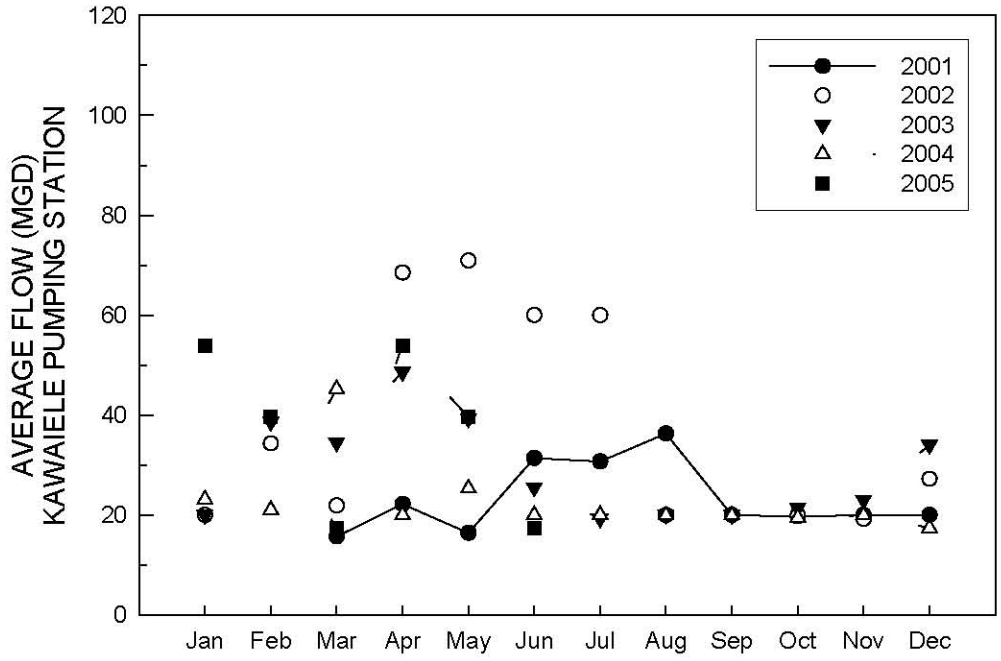
0 0.060.12 Miles

1:21,657

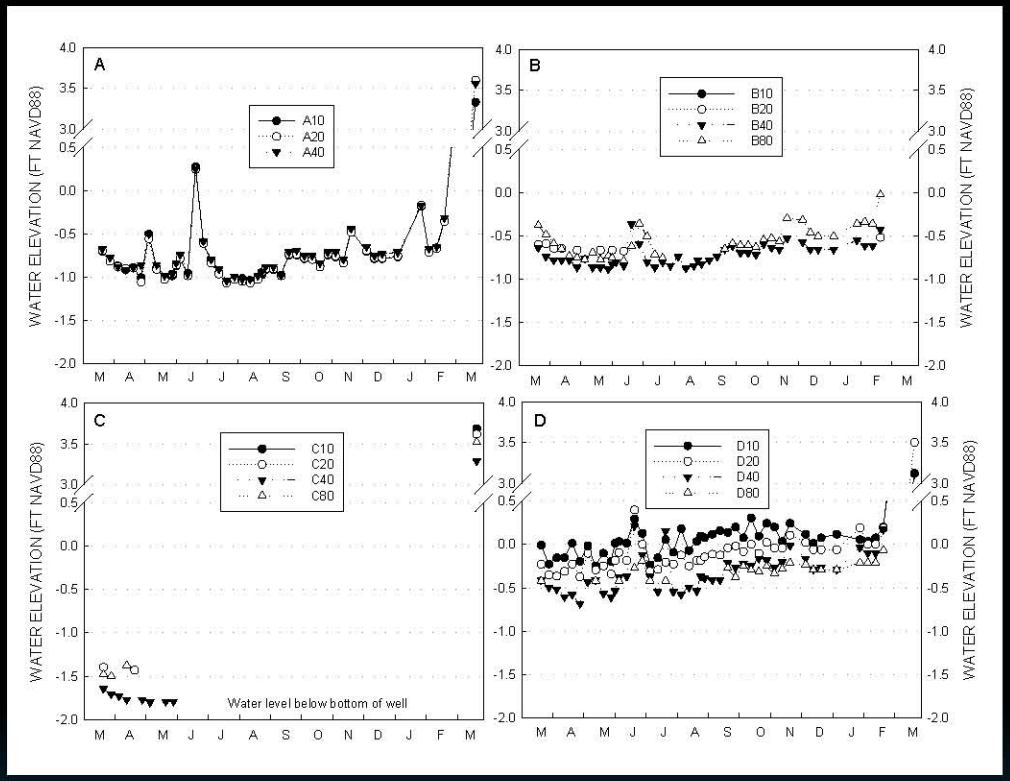
UTM Zone4, NAD83

Map produced July 2008.

PUMPING RECORDS



GROUNDWATER DATA



WHAT'S MISSING?

WHAT'S MISSING?

- Sub-surface soil profiles
- Hydrology
  - Infiltration
  - Water budget
  - SALTS!!!

Our Interdisciplinary Team

Everyone involved with on-the-ground sampling

Everyone has equal say

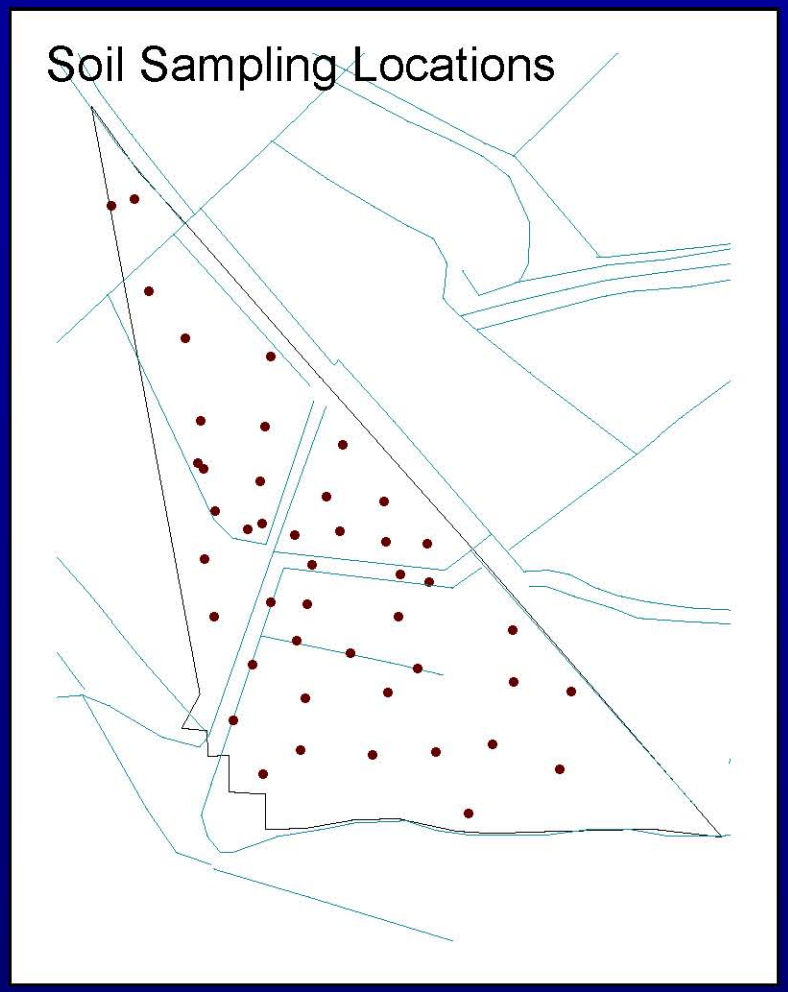
June 2009











Generalized Soil Profile

Clay Loam
range 16–58 in deep
avg 30 in deep

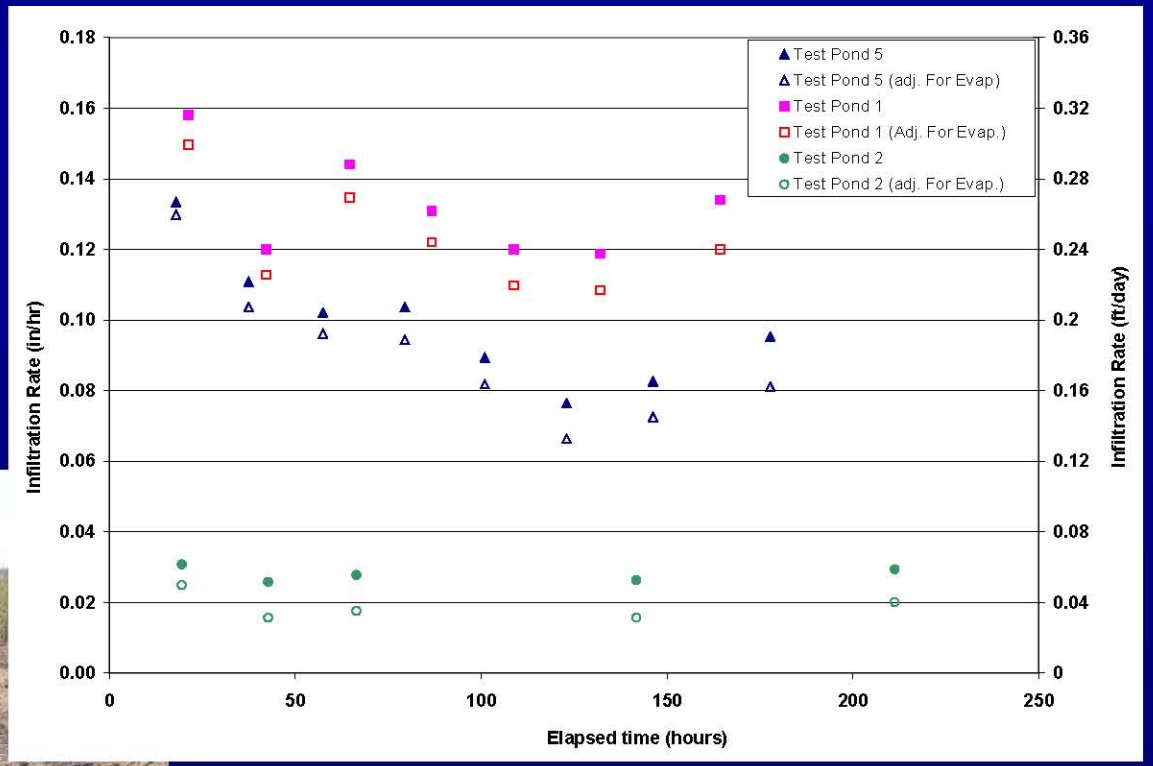
Sandy Clay Loam
or Silty Loam

Sandy
Loam

Silty Clay Loam or Clay
Calcium carbonate hard pan

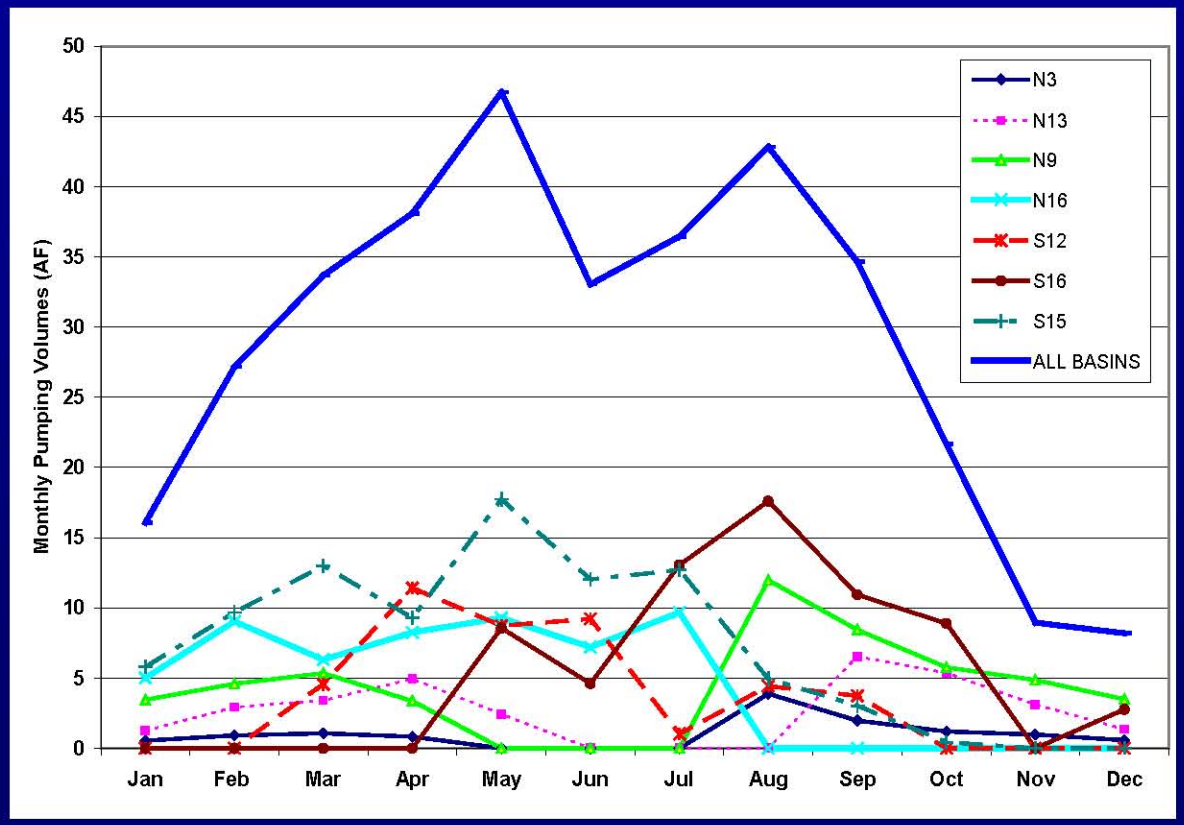
Water Table
avg 40 in below surface
(range 24 – 58 in)

Infiltration Data for Water Budget



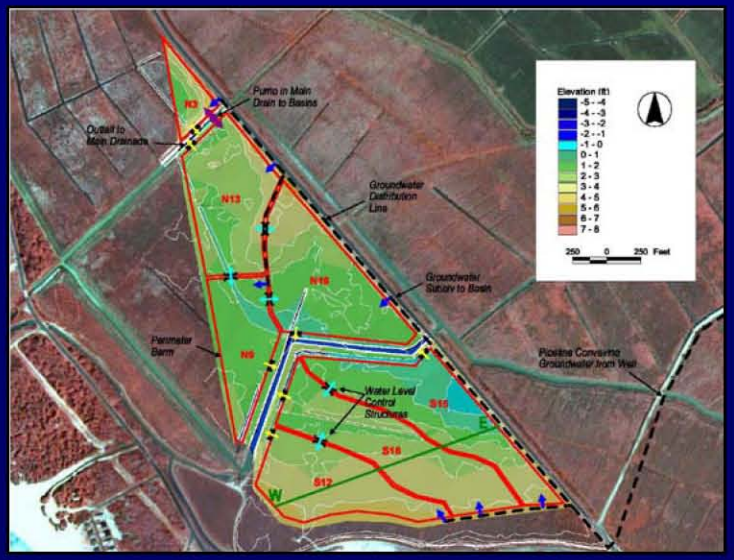
Water Budget

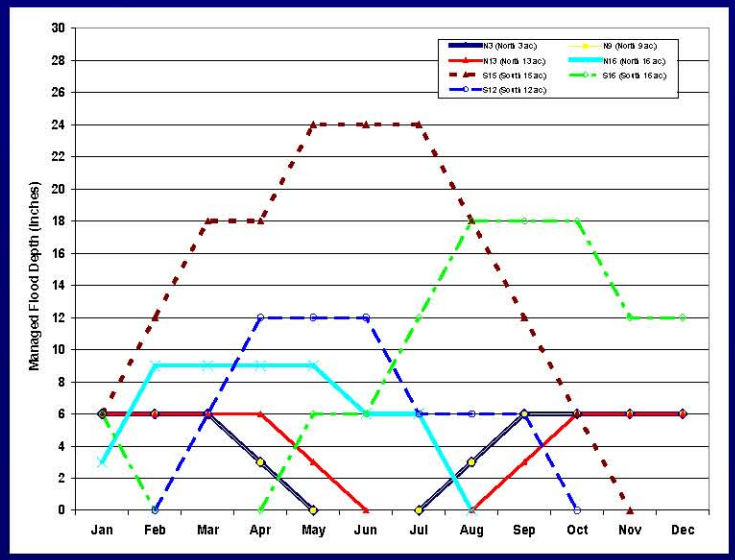
How much do we need?
Is it available?



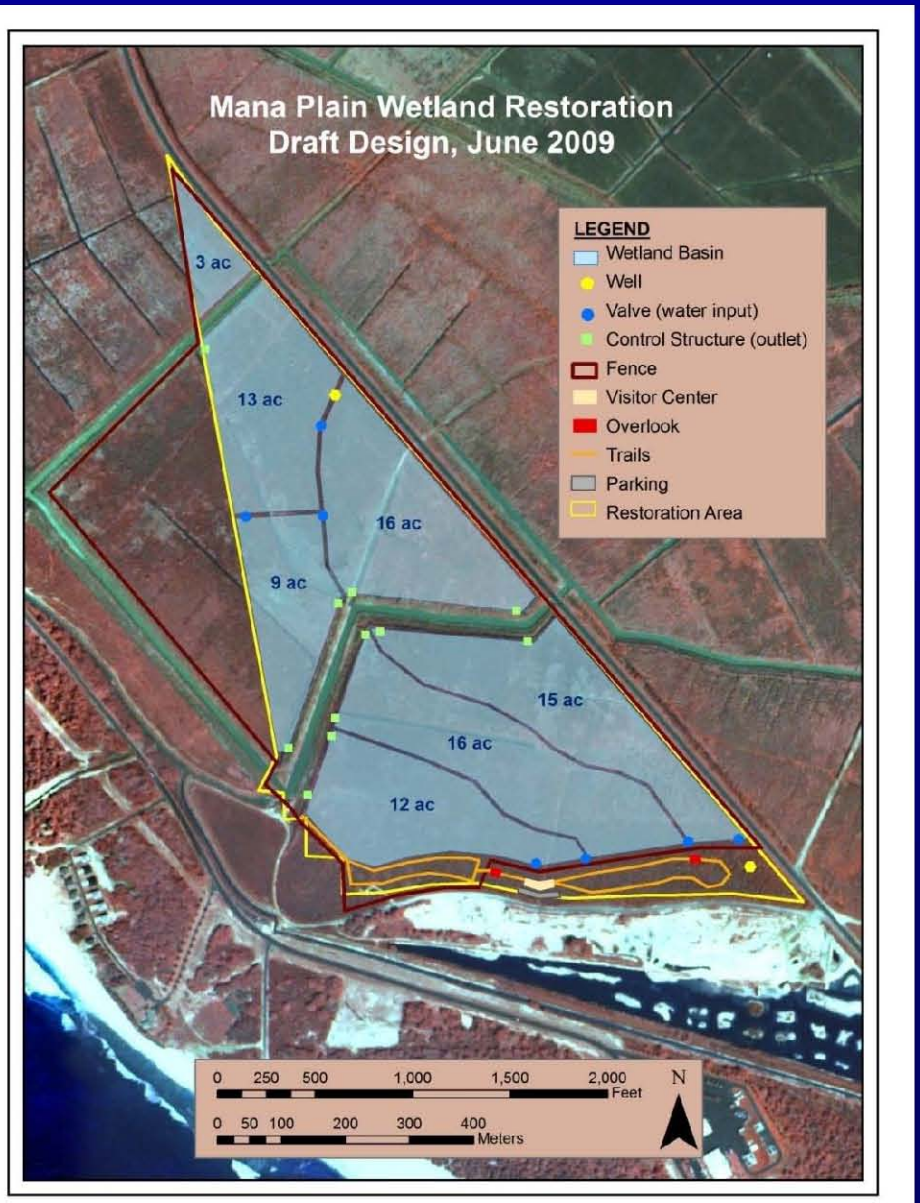
Next Steps for Design

- Have technical hydrology information
- Refined design & construction steps
  - Most engineers don't have management expertise
  - MAINTENANCE STAFF work with engineer and review designs
  - Can it be constructed with available resources?
  - Will it allow for cost effective management?





New Conceptual Design



- Redesign wetland basins to minimize excavation and soil needed for berms
- Plug/cap abandoned field ditches
- Water delivery
  - Outlets: 2-3x3 concrete riser
  - 1 or 2 in. boards
  - 2 Inputs per basin with 12” pipe

TAKE HOME MESSAGES

Take the time to collect the data to do it right

Restoration
Management
Infrastructure Improvements

TAKE HOME MESSAGES

Collaboration between:

refuges

regions

agencies

disciplines

EVERYONE IS IN THE FIELD TOGETHER

EVERYONE HAS EQUAL SAY

What is it that you are trying to restore and manage for?

- Structure: What communities were present and where?
- Functions: What were basic functions and resources?
- Species/Populations: What was present, when, and what resources did they use to meet annual cycle events?
- Ecological Processes: What processes sustained the system, short- and long-term?