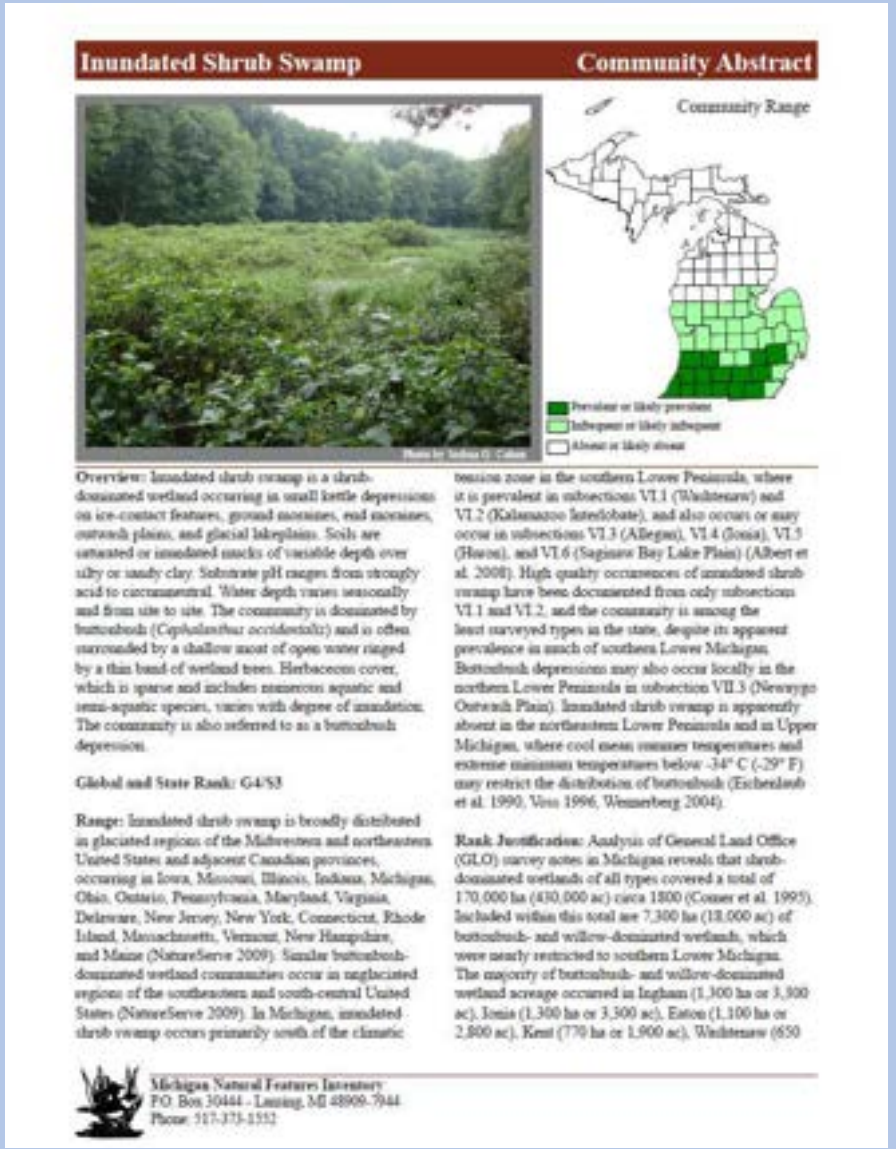
Hydrologic fluctuations of an inundated shrub swamp

Fort Custer Training Center – Kalamazoo County, Michigan

Brian Huggett – State of Michigan, Department of Military and Veterans Affairs

Inundated shrubs swamps are:

- A globally secure but State rare natural community
- Found in former ice-contact features (generally southern Michigan)
- Buttonbush dominated
- Driven by the hydrologic regime



Inundated Shrub Swamp — **Community Abstract**

Community Range

Prevalent or likely prevalent
Infrequent or likely infrequent
Absent or likely absent

Overview: Inundated shrub swamp is a shrub-dominated wetland occurring in small kettle depressions on ice-contact features, ground moraines, end moraines, outwash plains, and glacial lakeplains. Soils are saturated or inundated muck of variable depth over silty or sandy clay. Substrate pH ranges from strongly acid to circumneutral. Water depth varies seasonally and from site to site. The community is dominated by buttonbush (*Cephalanthus occidentalis*) and is often surrounded by a shallow moat of open water ringed by a thin band of wetland trees. Herbaceous cover, which is sparse and includes numerous aquatic and semi-aquatic species, varies with degree of inundation. The community is also referred to as a buttonbush depression.

Global and State Rank: G4/S3

Range: Inundated shrub swamp is broadly distributed in glaciated regions of the Midwestern and northeastern United States and adjacent Canadian provinces, occurring in Iowa, Missouri, Illinois, Indiana, Michigan, Ohio, Ontario, Pennsylvania, Maryland, Virginia, Delaware, New Jersey, New York, Connecticut, Rhode Island, Massachusetts, Vermont, New Hampshire, and Maine (NatureServe 2009). Similar buttonbush-dominated wetland communities occur in unglaciated regions of the southeastern and south-central United States (NatureServe 2009). In Michigan, inundated shrub swamp occurs primarily south of the climatic tension zone in the southern Lower Peninsula, where it is prevalent in subsections VI.1 (Washtenaw) and VI.2 (Kalamazoo lateclobate), and also occurs or may occur in subsections VI.3 (Allegan), VI.4 (Ionia), VI.5 (Huron), and VI.6 (Saginaw Bay Lake Plain) (Albert et al. 2008). High quality occurrences of inundated shrub swamp have been documented from only subsections VI.1 and VI.2, and the community is among the least surveyed types in the state, despite its apparent prevalence in much of southern Lower Michigan. Buttonbush depressions may also occur locally in the northern Lower Peninsula in subsection VII.3 (Newaygo Outwash Plain). Inundated shrub swamp is apparently absent in the northeastern Lower Peninsula and in Upper Michigan, where cool mean summer temperatures and extreme minimum temperatures below -34° C (-29° F) may restrict the distribution of buttonbush (Eschenbach et al. 1990, Voss 1996, Wennerberg 2004).

Rank Justification: Analysis of General Land Office (GLO) survey notes in Michigan reveals that shrub-dominated wetlands of all types covered a total of 170,000 ha (430,000 ac) circa 1800 (Comer et al. 1995). Included within this total are 7,300 ha (18,000 ac) of buttonbush- and willow-dominated wetlands, which were nearly restricted to southern Lower Michigan. The majority of buttonbush- and willow-dominated wetland acreage occurred in Ingham (1,300 ha or 3,300 ac), Ionia (1,300 ha or 3,300 ac), Eaton (1,100 ha or 2,800 ac), Kent (770 ha or 1,900 ac), Washtenaw (650

Michigan Natural Features Inventory
P.O. Box 30444 - Lansing, MI 48909-7944
Phone: 517-373-1552

What are the characteristics that describe the hydrologic regime in shrub swamps?

- Frequency
- Duration
- Intensity
- Seasonality
- Variability

- Applies to thermal regime too!
- Research Needs: relative contributions of precipitation vs. groundwater

How are we going to measure the hydrologic (and thermal) regimes?

- Commercial, off-the-shelf datalogger
- Onset MX2001 water level logger
- $750

Water level datalogger

- Measures:
  - Water temperature
  - Pressure of water + pressure of atmosphere (submerged end)
  - Pressure of the atmosphere (not submerged end)

  - Water height equals:
    - Pressure (water & atmosphere) minus Pressure (atmosphere)
  - Water Temperature to 1/100s of degree
  - Water Height to 1/100s of foot

Datalogger site

- PVC tube – vented to atmosphere
- Sensor submerged in water
- Staff gage as independent check on water level reading
- Periodic check-ins to ensure battery levels, memory usage, insect / wildlife damage
- 1.6 acre shrub swamp on military installation

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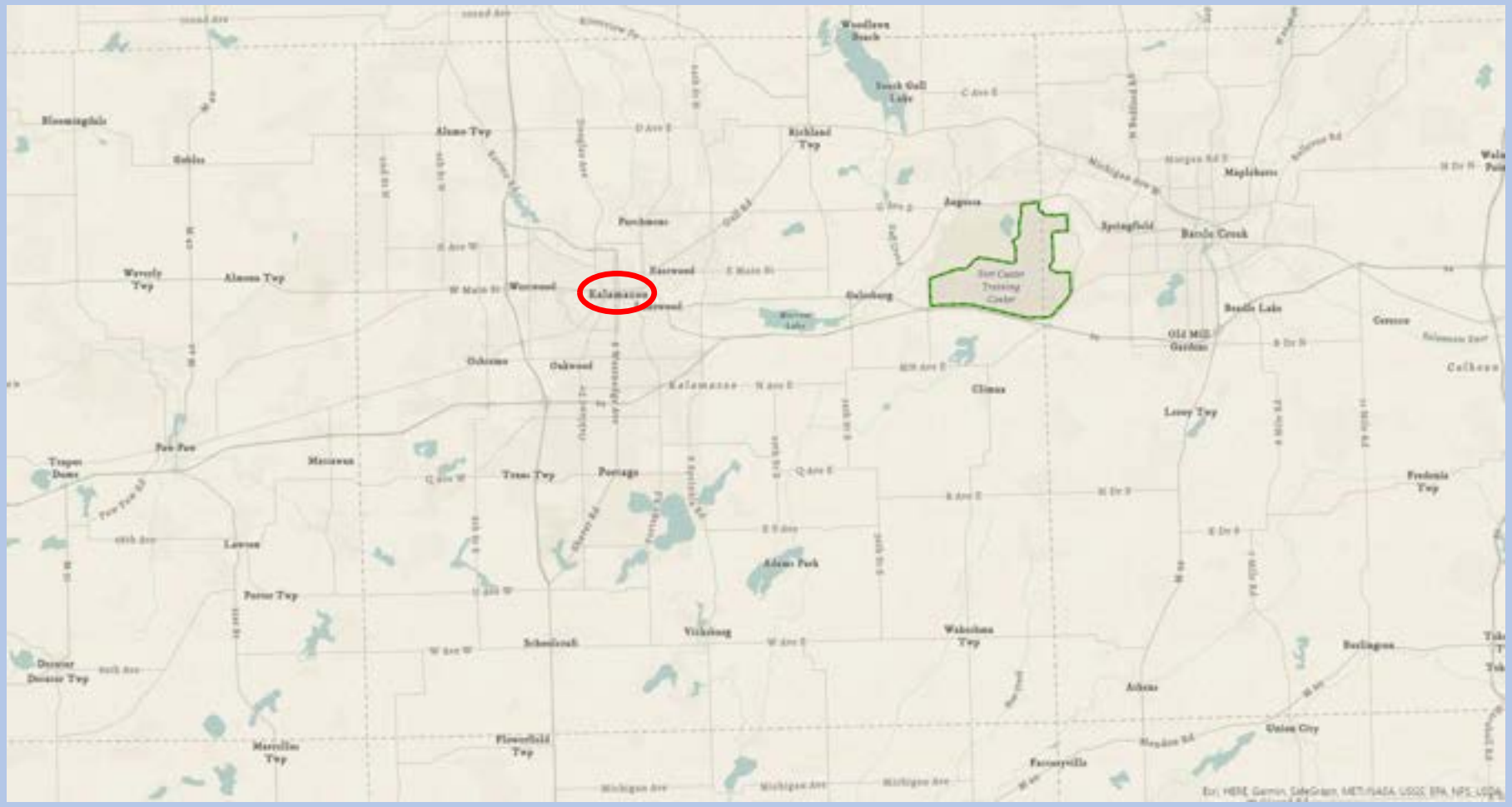

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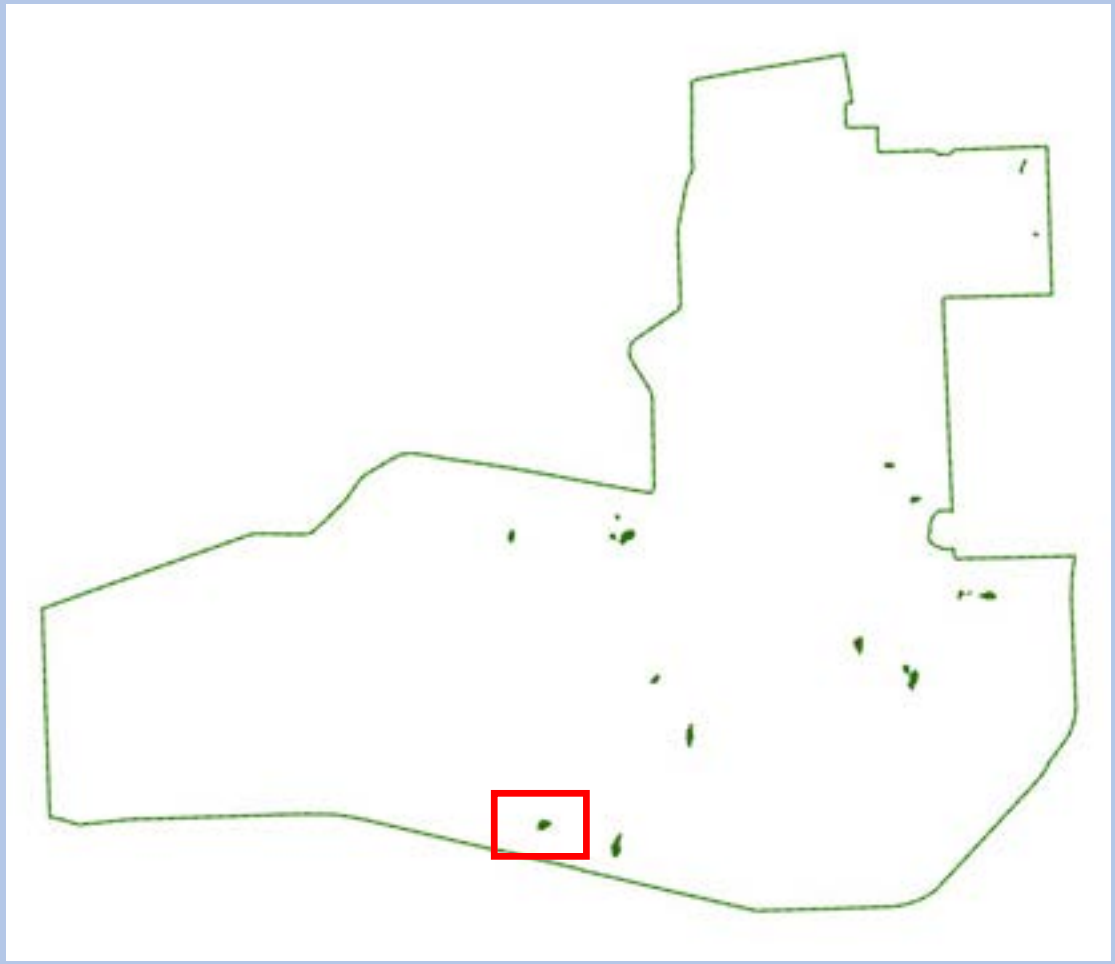
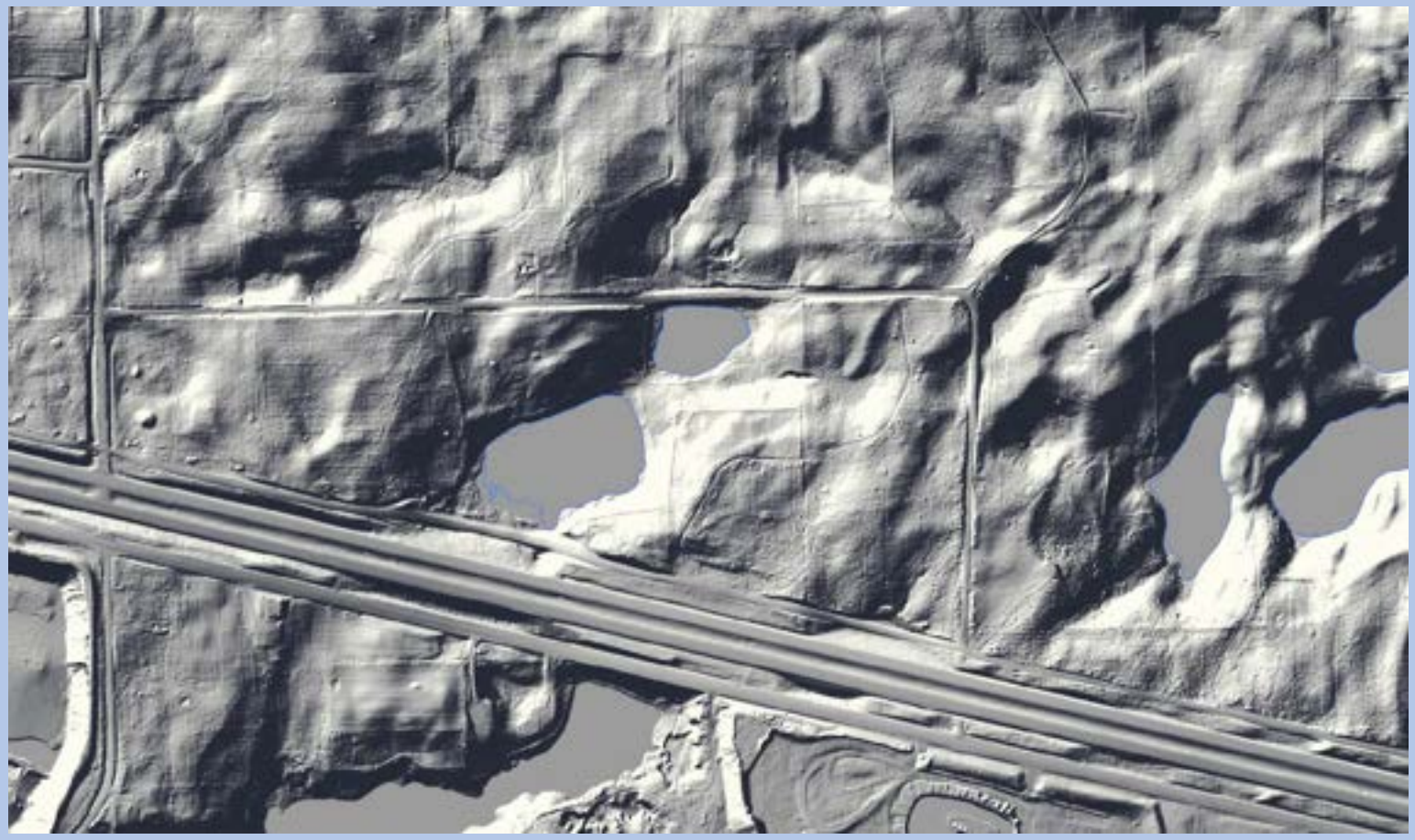


Shrub swamp in Training Area 5D



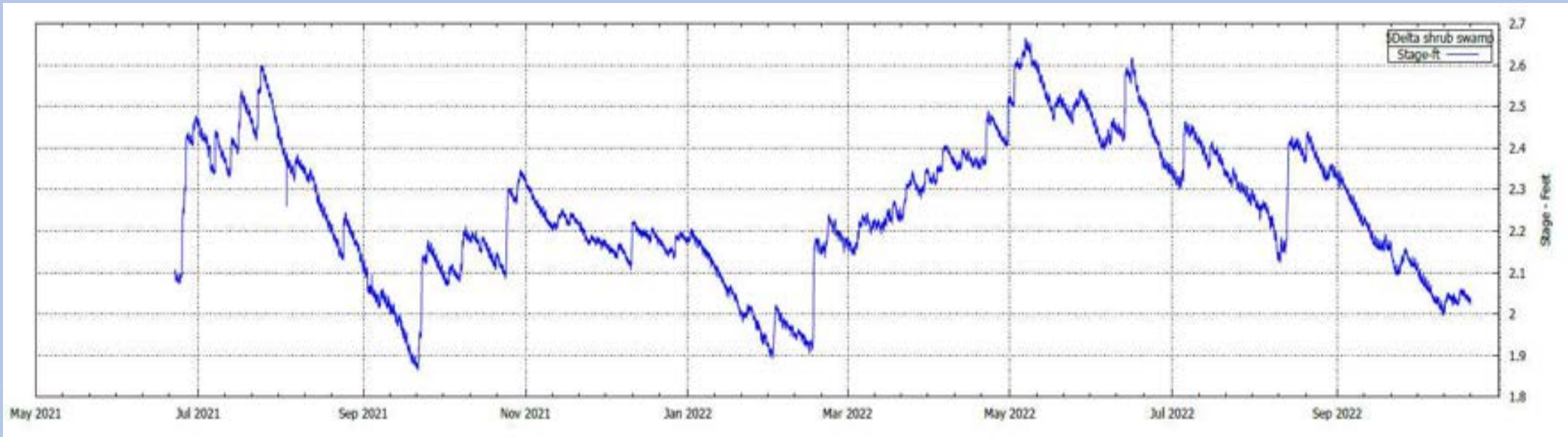
Data record

- June 2021 to current *
- Measures temperature and stage at 15 minute intervals

Metrics

- Temperature: hourly average, daily average, minimum & maximum, diurnal range
- Stage + volumetrics

Stage and volumetrics



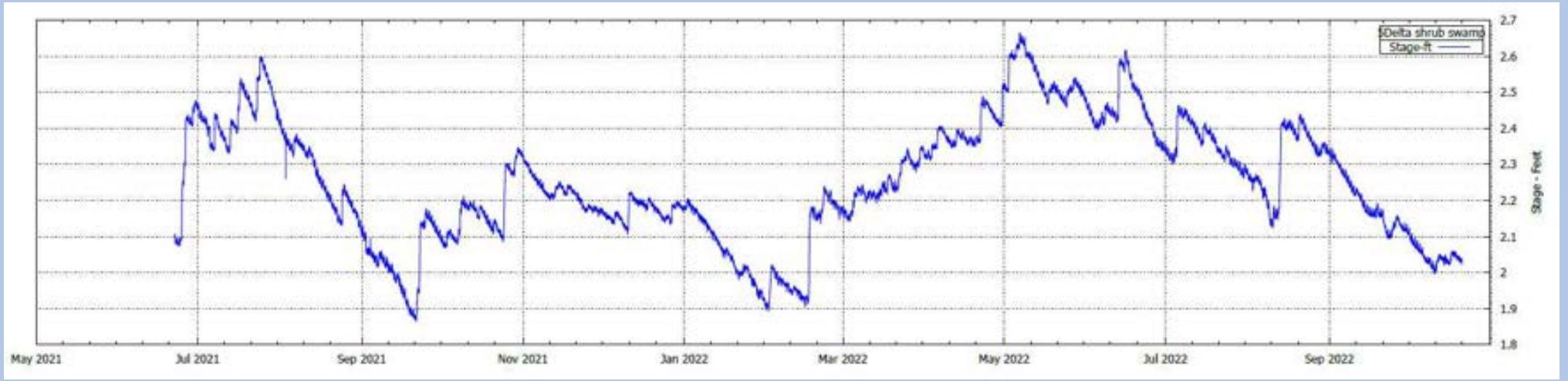
- Max height: >2.6’ above sensor July 2021, May & June 2022
- Min height: ~1.9’ above sensor Nov 2021, Feb 2022
- > 0.7’ change over 3 months (twice)

- 1.6 acres = ~69,700 ft^2
- Multiply 69,700 ft^2 x 0.7 ft = 48,790 ft^3
- 48,000 ft3 (359,000 gallons) change over 3 months

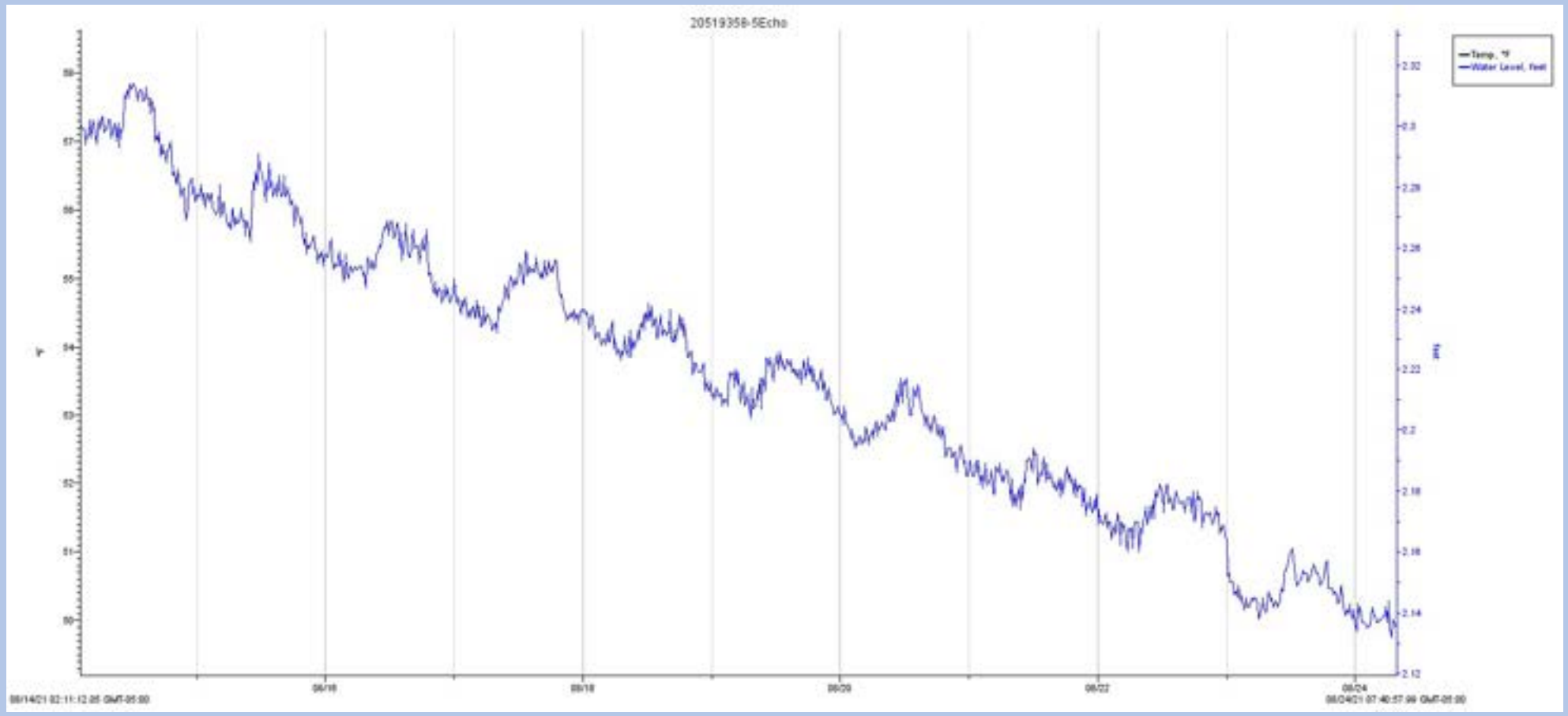
Stage and volumetrics part 2

- every tenth of a foot in elevation change (0.1 ft) = 6,970 ft3 (~52,000 gallons) of water

- Rate of recharge (+ elevation / time)
- Rate of discharge (- elevation / time)

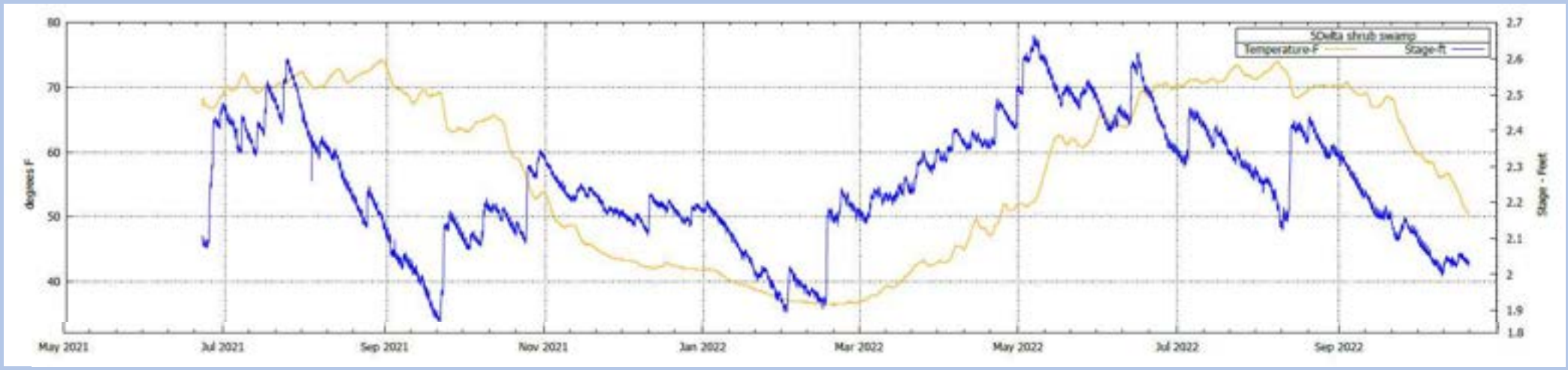


Daily view of stage: ET? Tidal influence?

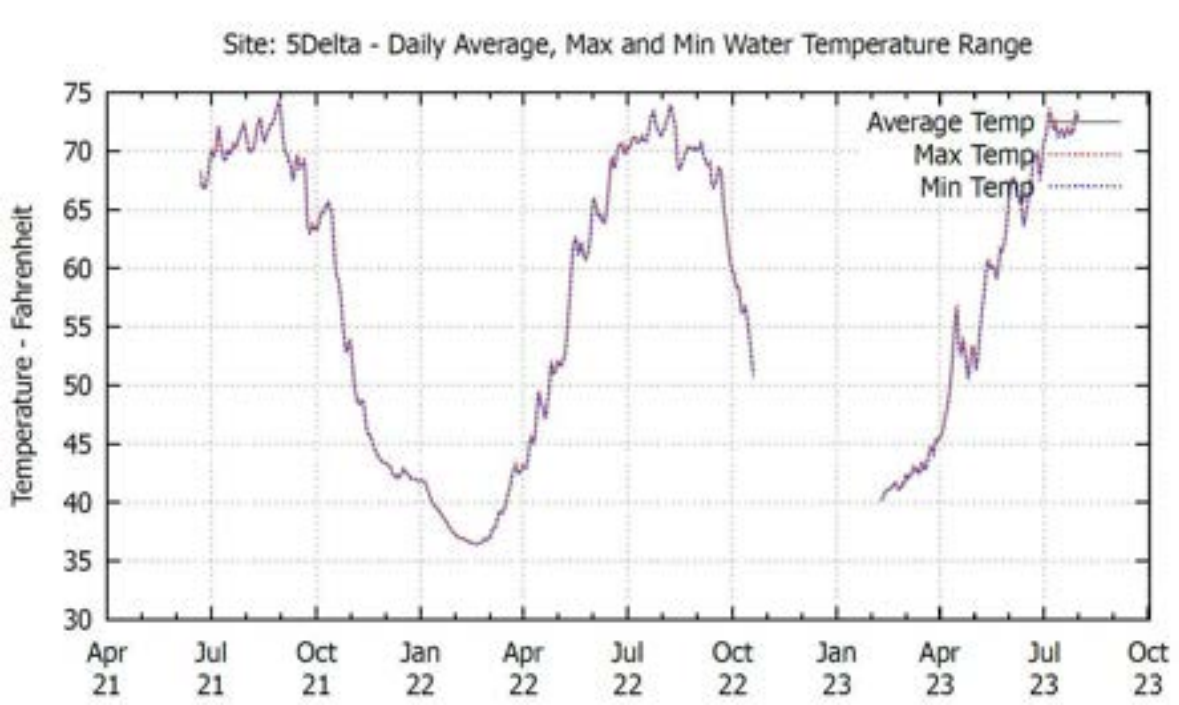


Temperature regime

- Annual max and min: 70°F to 35°F
- Timing of annual max similar
- Low annual max variability

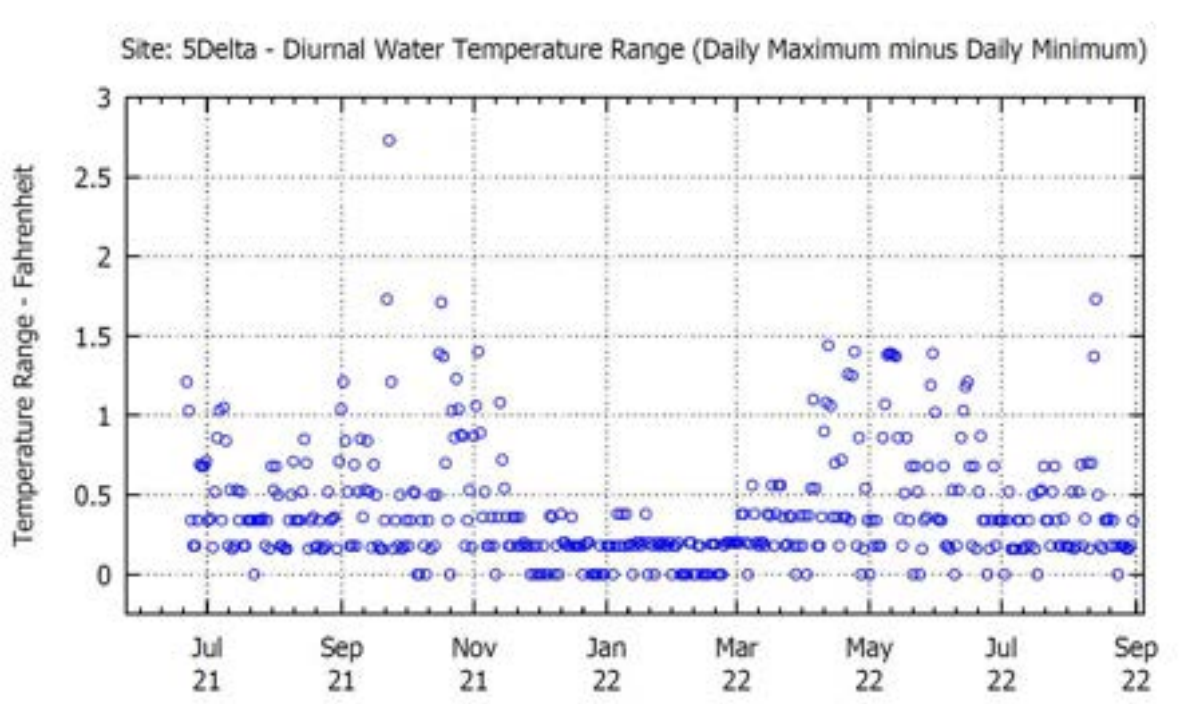


Temperature regime part 2



- Very little difference between a daily maximum and daily minimum temperature

Temperature regime part 3



- Largest temperature change in late September 2021 of ~2.75° F
- Low variability: > 90% of diurnal temperature range < 1° F

Hydrologic regime findings

- Established preliminary estimates on hydrologic regime: range of flooding, rates of discharge / recharge, rudimentary volumetrics, seasonality.
- Leaning toward stating that precipitation inputs < groundwater inputs
- Unknowns: diurnal signal? Depth below sensor (total volume), long term changes in metrics

Thermal regime findings

- Established preliminary estimates on thermal regime: diurnal variation low, seasonal highs/lows, rates of change (with/out recharge)

- Unknowns: temperature at different point in water column, variability over time

Questions?

Thank you for your attention!

References

- MNFI Natural Community Abstract: Inundated Shrub Swamp
- Faber-Langendoen & Maycock, 1989, Canadian Field-Naturalist
- Keane, 2017, Disturbance Regimes and the Historical Range and Variation in Terrestrial Ecosystems, USFWS. doi: 10.1016/B978-0-12-809633-8.02397-9