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STORIES FROM THE PIT: WHAT WETLAND SOILS CAN TELL US ABOUT THE LANDSCAPE

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PRAIRIE POTHOLE WETLANDS

- LAKES VS. WETLANDS: DOES LIGHT REACH THE BOTTOM? IS IT BIG ENOUGH TO HAVE WAVE ACTION ON THE SHORE? IS IT STRATIFIED?
- PRAIRIE POTHOLE REGION SPANS 800,000 KM^2 AND ENCOMPASSES MILLIONS OF FRESHWATER MINERAL SOIL WETLANDS

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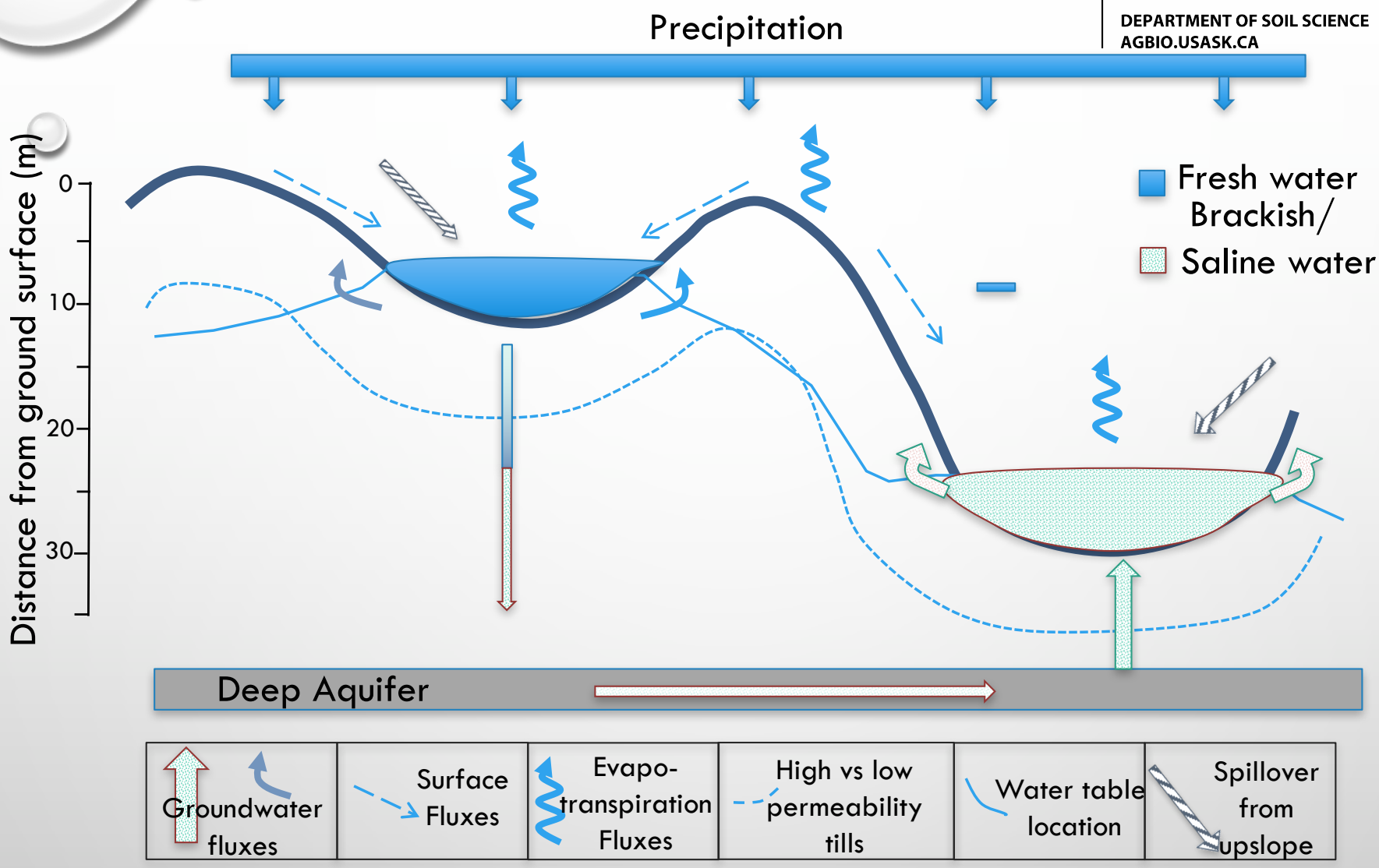

(adapted from Naschon et al. 2013)

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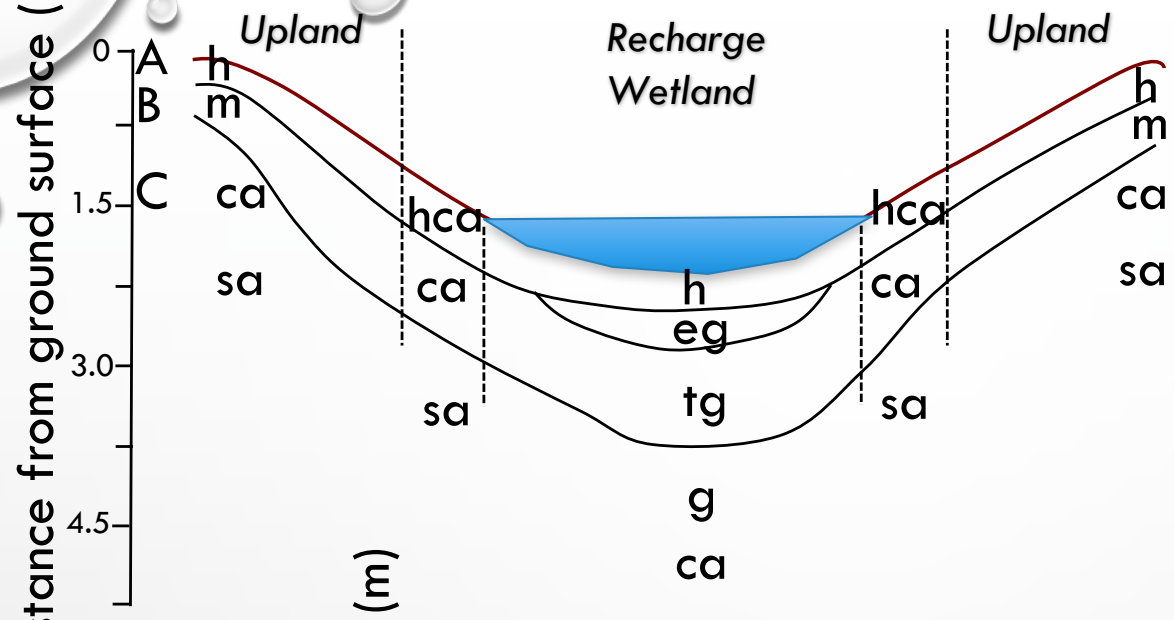

h humus
m decalcification/oxidation
t textural contrast
g gleying
ca $CaCO_3$
sa $CaSO_4$

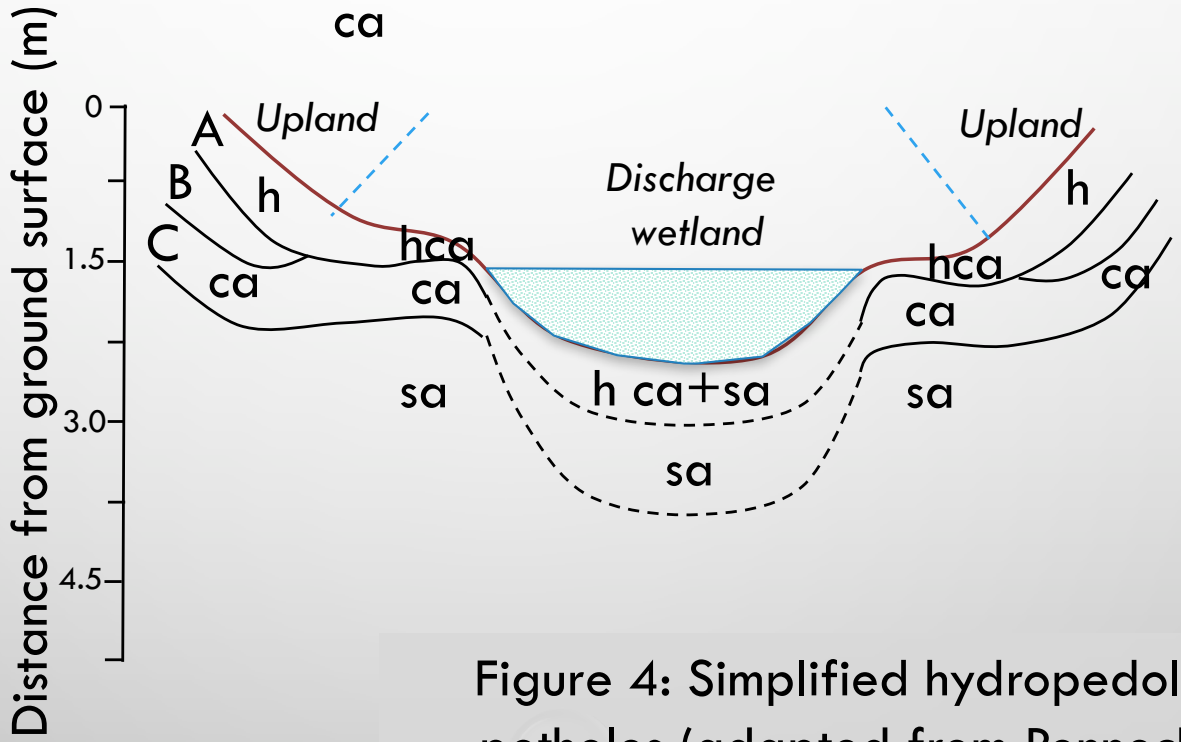

Figure 4: Simplified hydropedology of prairie potholes (adapted from Pennock et al. 2011). Uppercase labels correspond to master horizons

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WETLAND ECOSYSTEM SERVICES

- WATER AND NUTRIENT RETENTION AND CYCLING
- WATER FILTRATION
- GROUNDWATER RECHARGE
- WILDLIFE HABITAT
- BIODIVERSITY
- CARBON SEQUESTRATION

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C SEQUESTRATION IN WETLAND SOILS

- IN NORTH AMERICA, FRESHWATER MINERAL SOIL WETLANDS HAVE BEEN ESTIMATED TO ACCOUNT FOR 40 GT OF C
- DESPITE THE POTENTIAL IMPORTANCE OF WETLAND SOILS FOR ACCURATE INVENTORY OF SOIL C STOCKS, THEY OFTEN FALL BETWEEN THE CRACKS: TOO WET FOR SOIL SCIENTISTS AND TOO DRY FOR WETLAND SCIENTISTS
- OVER THE PAST DECADE, MUCH MORE RECOGNITION OF THEIR SIGNIFICANCE, BUT STILL ROOM FOR IMPROVEMENT!

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C IN WETLAND SOILS: CULTIVATION

Wetland type	n	Soil organic carbon SOC_{eqm} to 30 cm (Mg ha^{-1})
Cultivated	7	87.2 (21.7)
Uncultivated	7	168.6 (21.5)
Native	12	175.1 (52.8)

Uncultivated wetlands occupy only 11% of site area but contain 23% of SOC stores!

Bedard-Haughn et al. 2006 Geoderma. 135: 296-306

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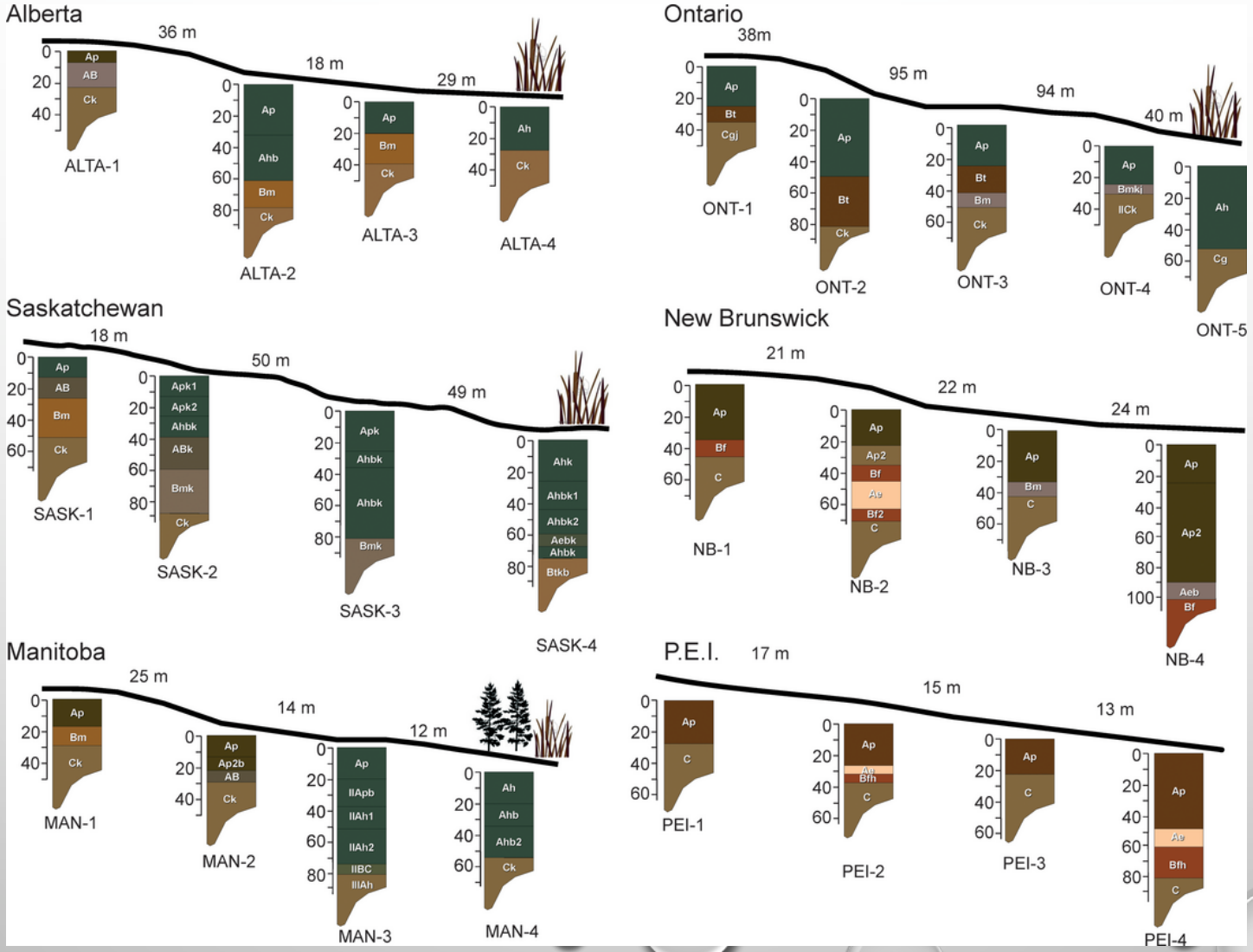
TILLAGE REDISTRIBUTION



VandenBygaart et al. 2012 Global Change Biology 18: 1441–1452

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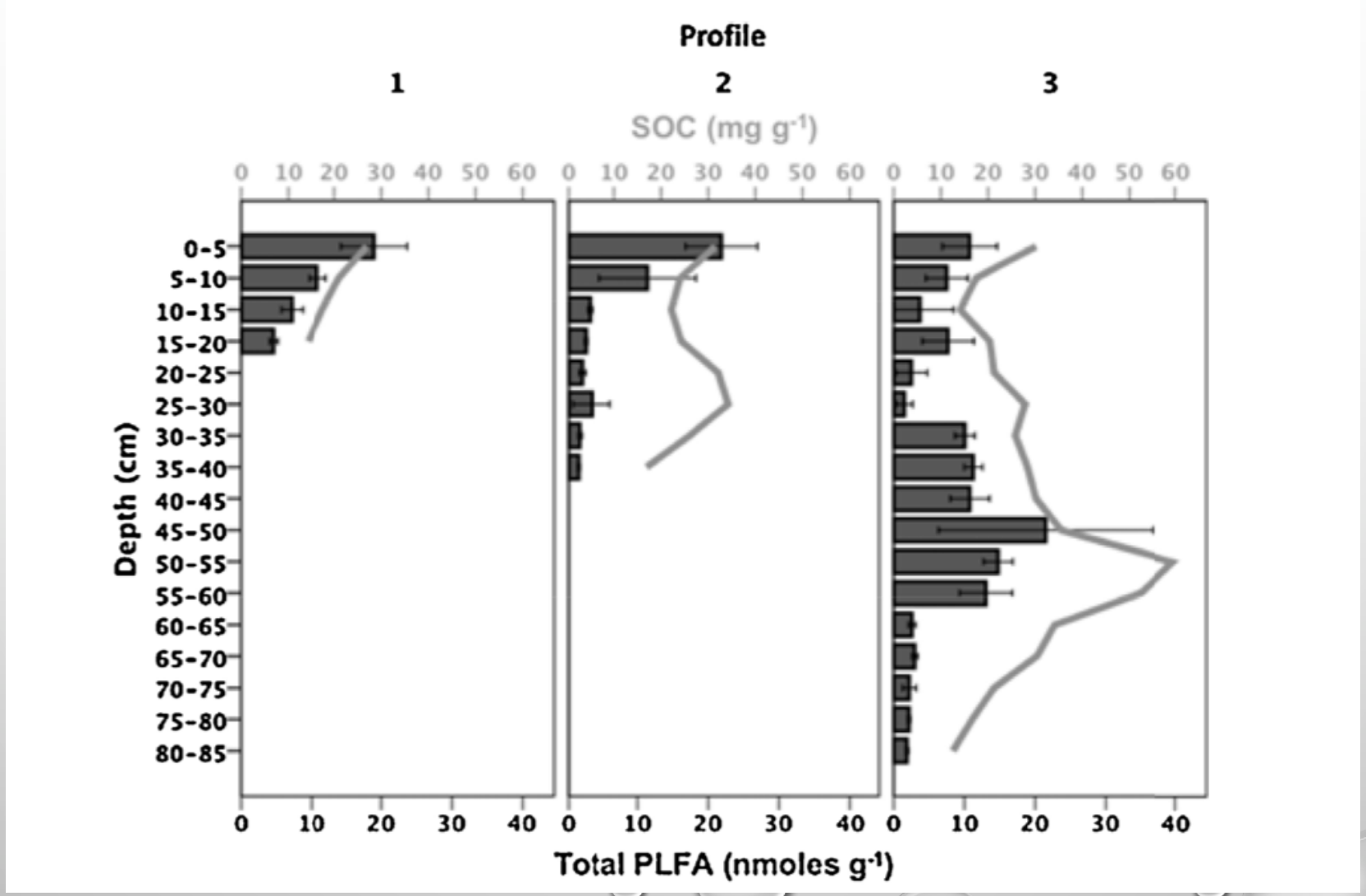
BURIED C: LIVING AND NONLIVING C



Helgason et al. 2014 Agriculture, Ecosystems and Environment 196: 94–102

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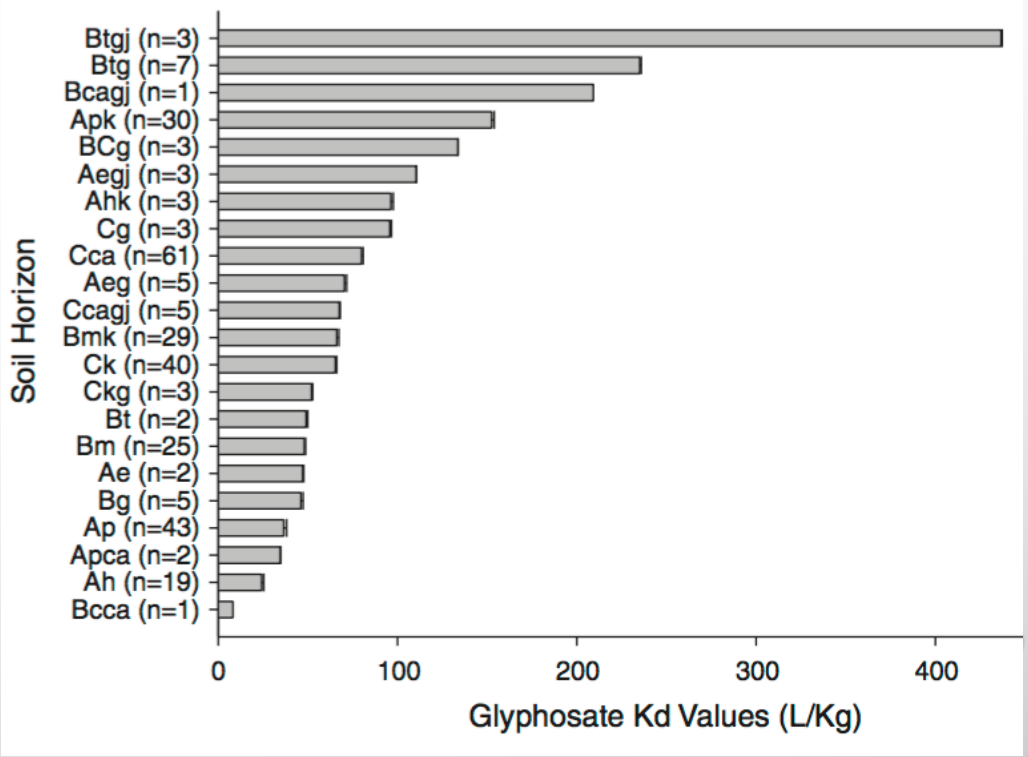
ATTENUATION OF AGRO-CHEMICALS

- HERBICIDE SORPTION VARIES WITH SOIL PROPERTIES
  - SOC KEY FOR 2,4-D AND ATRAZINE ATTENUATION
  - Btg HORIZONS HAVE MAX GLYPHOSATE ATTENUATION



Singh et al. Geoderma 232-234: 107-116

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MANAGEMENT CHALLENGES

- AGRICULTURAL CHALLENGES
  - SITE ACCESS IN SPRING
    - UNSEEDED ACRES
  - MID-SEASON FLOODING
    - CROP LOSS
  - WETLANDS AS HOSTS OF WEEDS/PATHOGENS
  - LARGE EQUIPMENT
- WETLAND CHALLENGES
  - HYDROLOGIC MANIPULATION
  - SALINIZATION
  - EUTROPHICATION
  - EXCESS CHEMICAL BUILDUP
  - SEDIMENTATION
  - INVASION OF EXOTIC SPECIES

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DRAINAGE

- PROS: CAN GET ON THE LAND EARLIER, LESS RISK OF IN-SEASON FLOODING, FEWER WETLANDS TO WORK AROUND
- CONS: LOSS OF ABOVE ECOSYSTEM SERVICES, RISK OF DOWNSTREAM EFFECTS (WATER QUALITY, NEIGHBOR RELATIONS)

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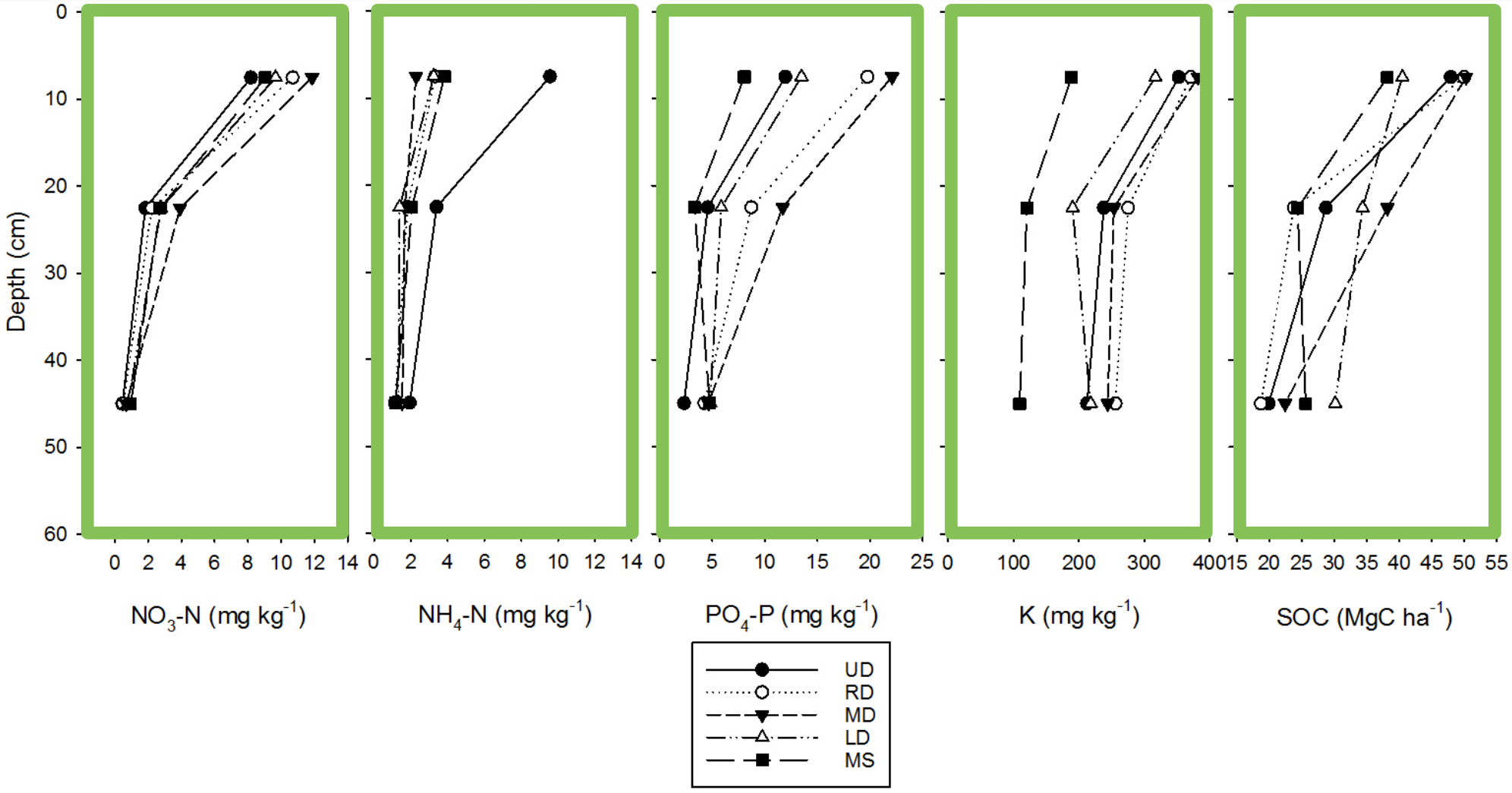
WETLAND SOC, N, P, K



Brown et al. 2017 Soil Tillage Research 168: 187-197

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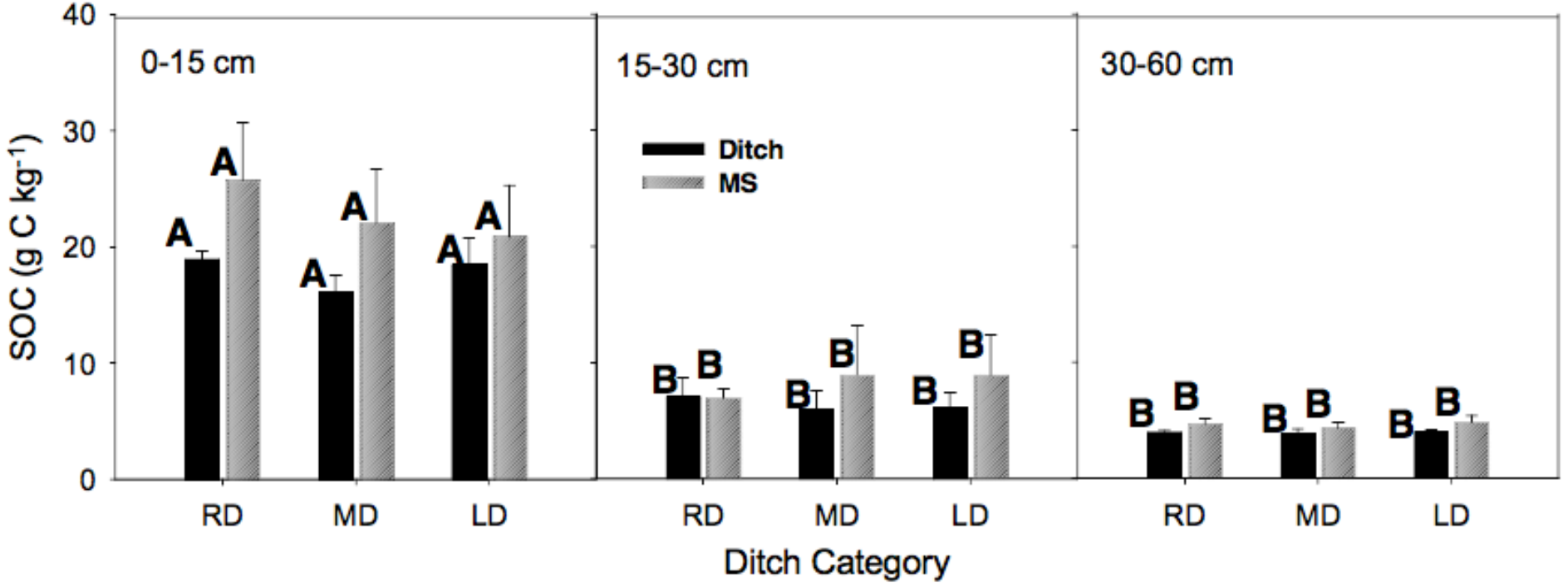
DITCH SOC



Zhang et al 2016 Geoderma 289: 66-71

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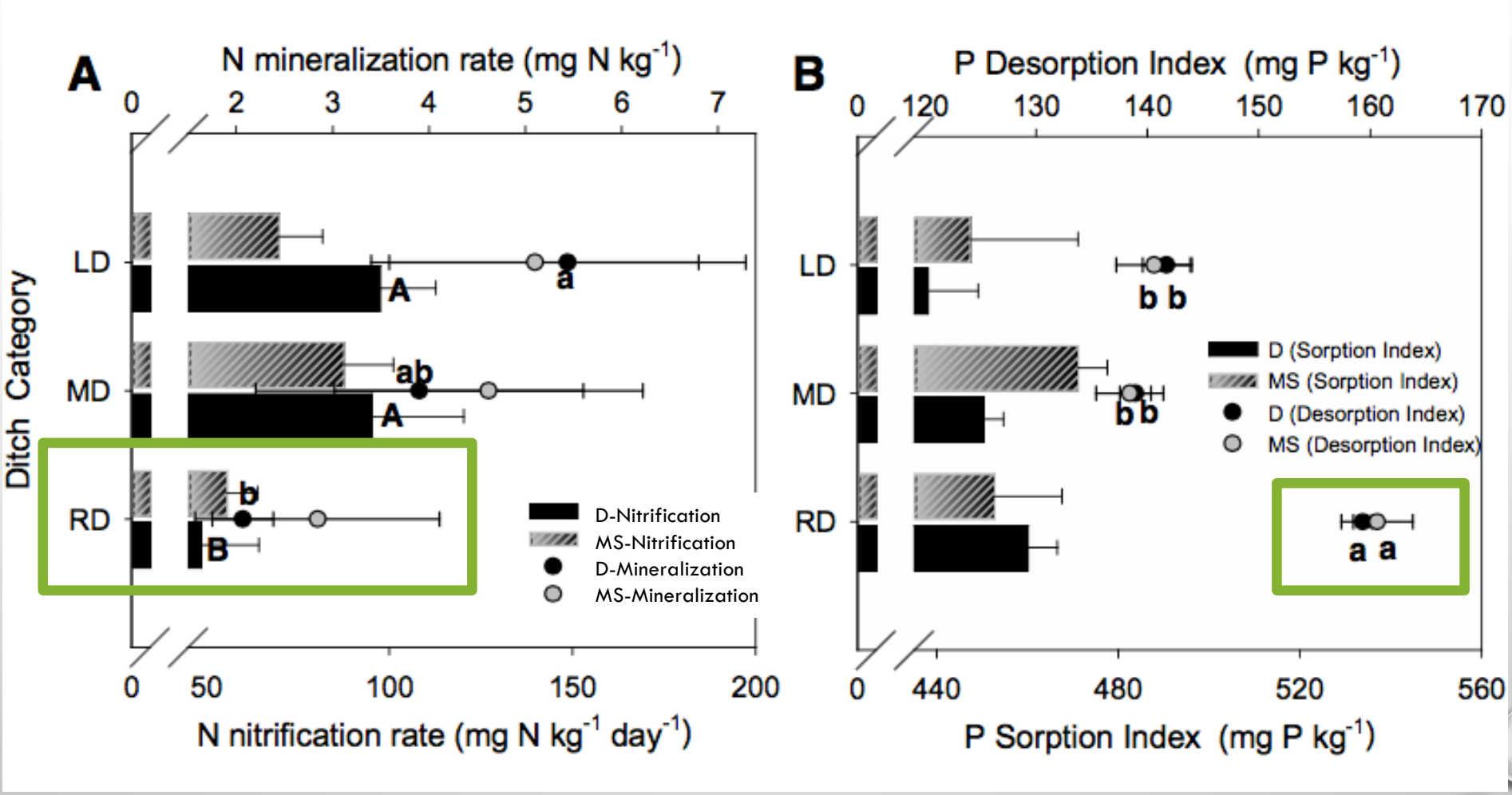
DITCH N MIN/NIT AND P DE/SORPTION



Zhang et al 2016 Geoderma 289: 66-71

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MANAGING RIPARIAN ZONES

- RIPARIAN ZONES OFTEN MARGINAL LAND DUE TO INCREASED MOISTURE AND/OR SALINITY
- SHORT ROTATION WILLOW MIGHT BE GROWN HERE AS BUFFER AND FOR BIOENERGY FEEDSTOCK
- EFFECTS ON SOIL?

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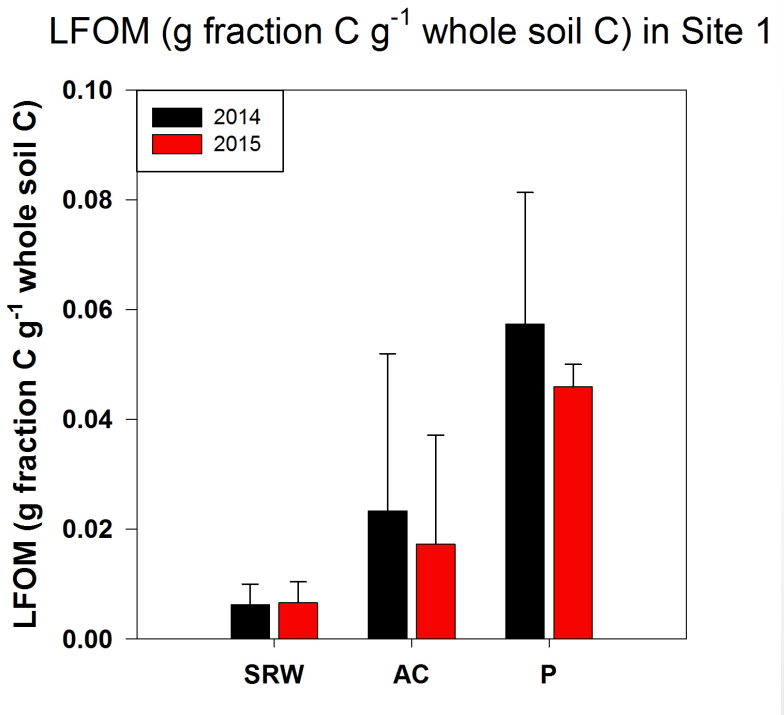
LIGHT FRACTION ORGANIC MATTER

Site 1

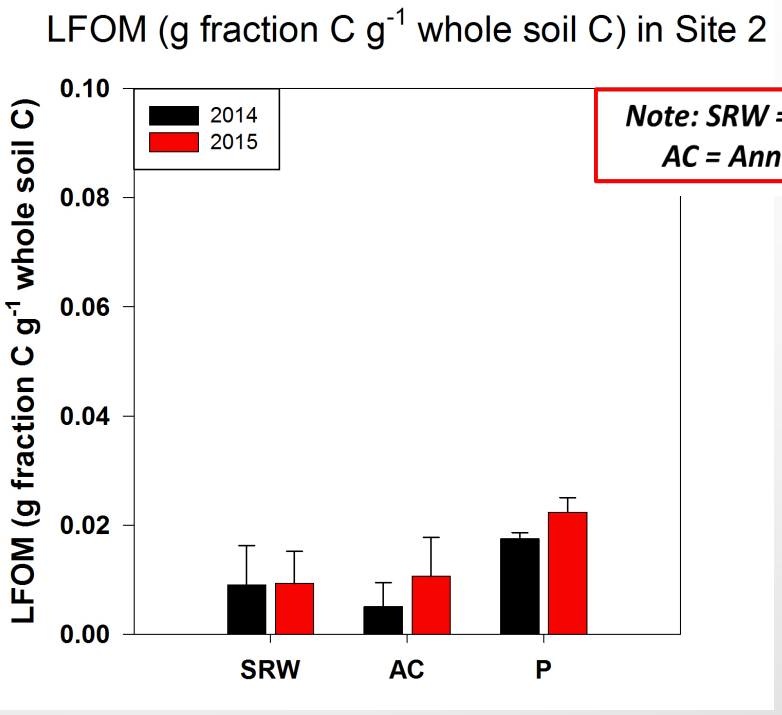


ANOVA:
Land use practice (P = <0.001)***
Year (P = 0.433) NS
Interaction (P = 0.792) NS

Holm-Sidak Pairwise Multiple Comparison

Comparison	P Value	Significant?
P vs. SRW	<0.001	Yes***
P vs. AC	0.004	Yes**
SRW vs. AC	0.046	Yes*

Site 2



Note: SRW = Short Rotation Willow, AC = Annual crop, P = Pasture,

ANOVA:
Land use practice (P = 0.012)*
Year (P = 0.230) NS
Interaction (P = 0.610)**

Holm-Sidak Pairwise Multiple Comparison

Comparison	P Value	Significant?
P vs. SRW	0.005	Yes**
P vs. AC	0.007	Yes**
SRW vs. AC	0.670	No

Figures showing LFOM C at 0-15 cm under different land uses

Shahariar PhD project (in progress)

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LET'S START MAXIMIZING BENEFITS

- CHALLENGE: WHERE ARE/WERE THE WETLANDS?
  - DIVERSE TOPOGRAPHY, HYDROLOGY
  - DIVERSE TEXTURE, MINERALOGY
  - WIDE RANGE OF WETLAND SIZE, PERMANENCE, AND FUNCTION
  - RANGE OF WETLAND CHEMISTRY
  - CLIMATE VARIABILITY LEADS TO VARIABLE CONNECTIVITY
- HOW CAN WE MAKE DECISIONS WITHOUT ALL THE INFORMATION?!

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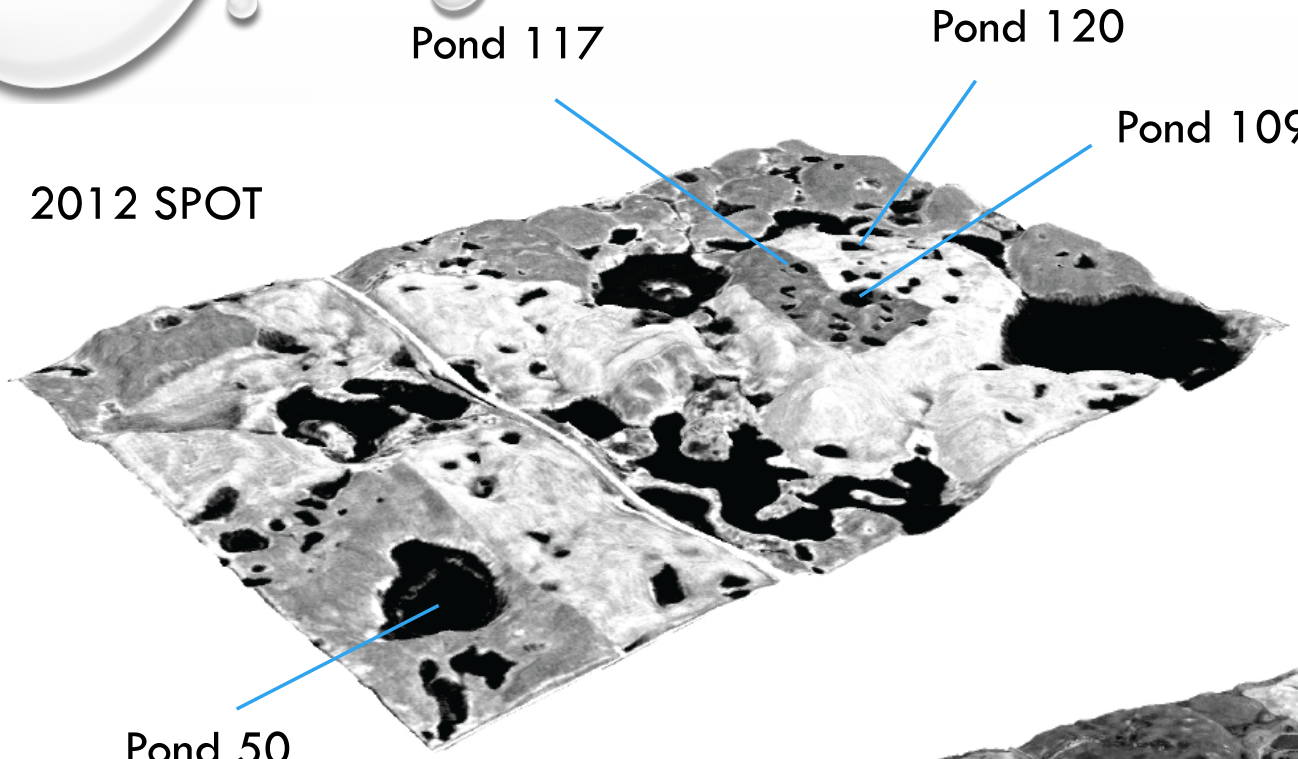
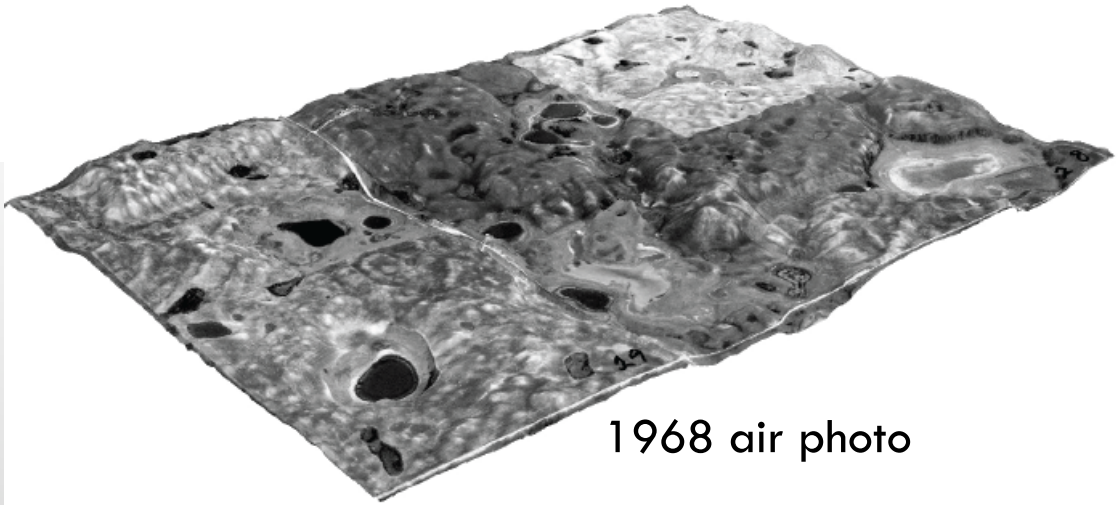


Cannot use single observation of water level in these highly dynamic systems



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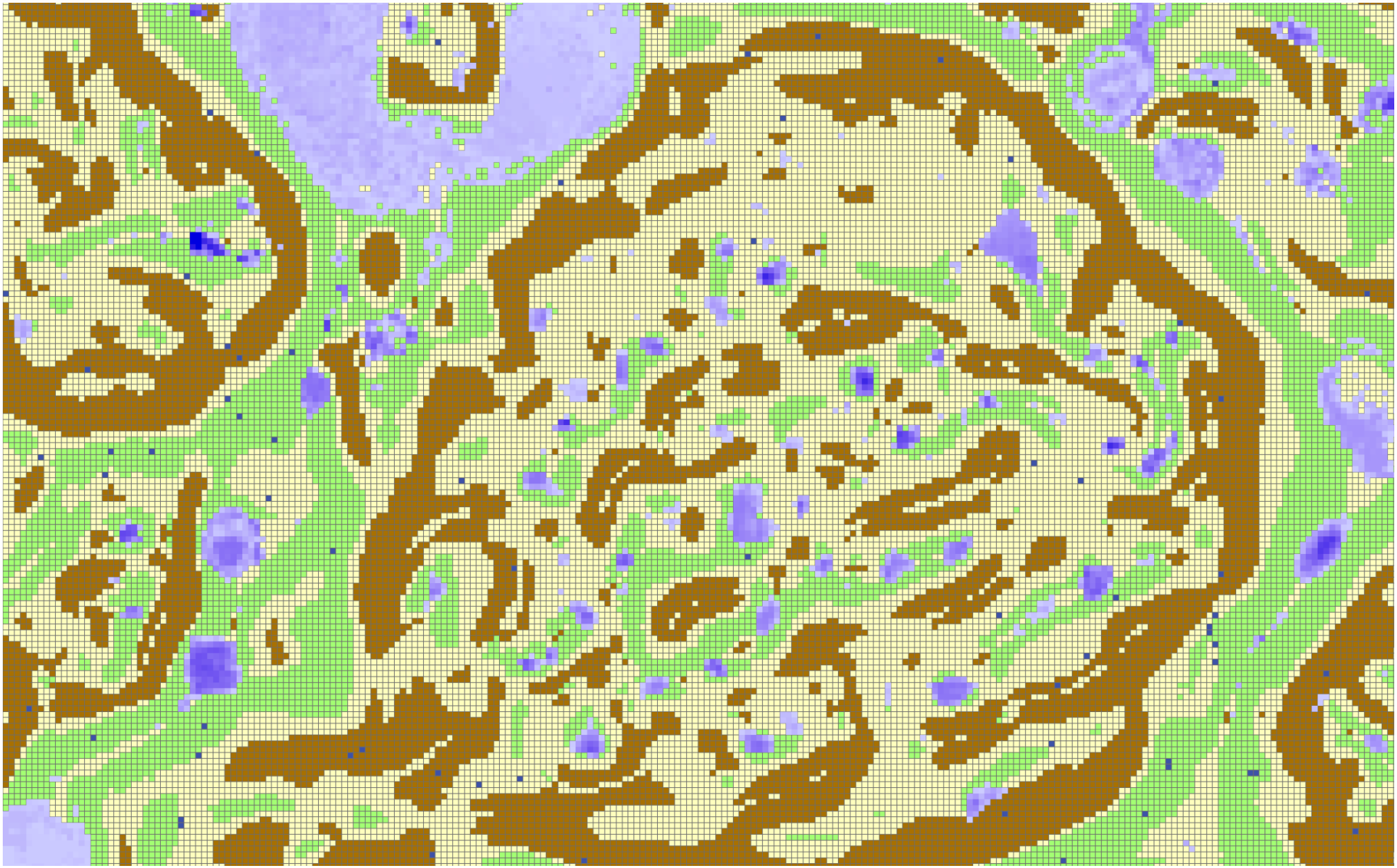
DIGITAL SOIL MAPPING



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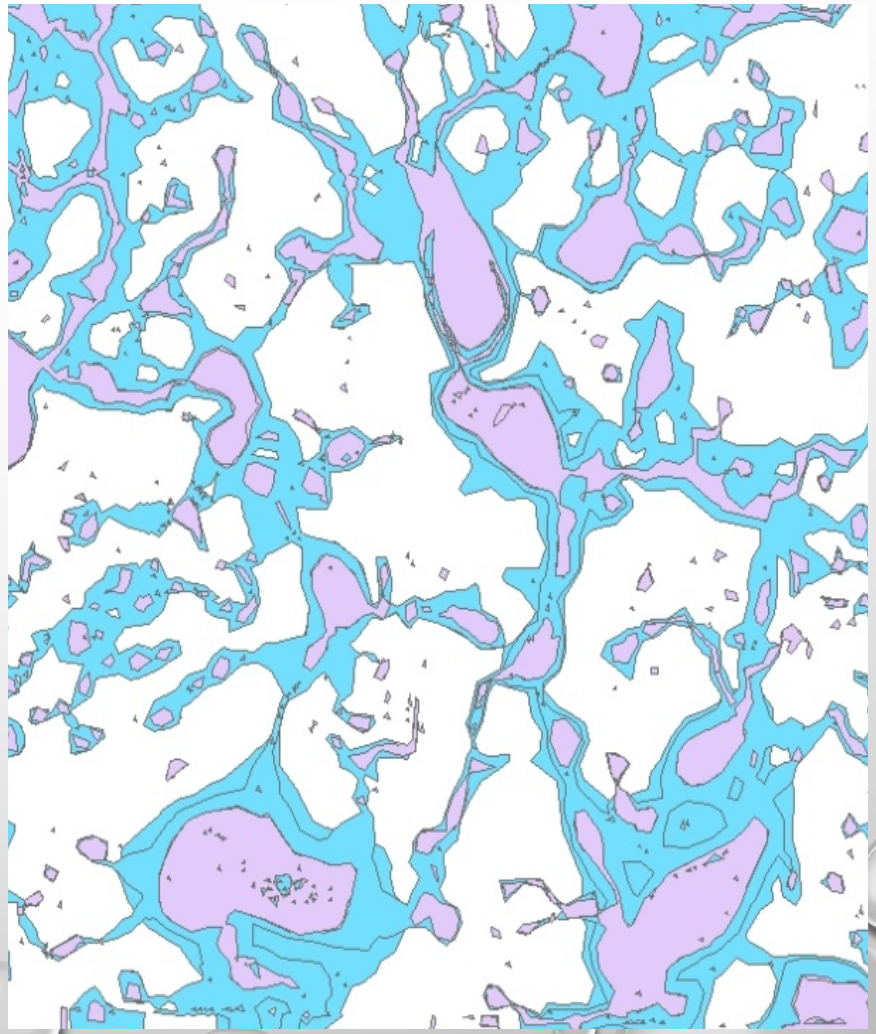
OPPORTUNITY: THINKING BIGGER…

- *STRATEGIC* RETENTION AND RESTORATION
  - REDUCE FLOOD RISK
  - INCREASE ATTENUATION OF NUTRIENTS/PESTICIDES
  - 'BEETLE BANKS' TO INCREASE BIODIVERSITY, INCLUDING POLLINATORS FOR CROPS
  - STILL ALLOWS FOR LARGE EQUIPMENT



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WHAT NEXT?

- FIRST STEP: TALK ABOUT WETLANDS
  - ACKNOWLEDGE THAT THEY ARE AND IMPORTANT COMPONENT OF PRAIRIE LANDSCAPES
- SECOND STEP: FILL KNOWLEDGE GAPS
  - WE LOST A LOT OF WETLANDS BEFORE WE HAD A CHANCE TO INVENTORY AND/OR UNDERSTAND THEM
- THIRD STEP: GET CREATIVE
  - THINK BEFORE WE DRAIN – WHAT ARE THE MANAGEMENT OPTIONS? OPPORTUNITIES?

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