Benton Soil and Water
CONSERVATION DISTRICT

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# 2017 Water Quality Monitoring at Collins Bay and Scatter Bar Pond

## Background

Changes in Willamette River hydrology caused by dams, channelization, and bank hardening have led to silt deposition in off-channel habitats and less lateral movement of the river channel. The subsequent change in water flow regimes and shallowing of off-channel habitat have created habitat that is ideal for establishment of non-native and invasive plants. Aquatic invasive species (AIS) can the spread by floodwaters, waterflow, boats, and people.
AIS are widespread in some aquatic habitats and typically form dense infestations where they occur. These dense mats further trap sediments, creating shallower habitat that is suitable for further AIS expansion and reducing available open water habitat utilized by fish and wildlife species. AIS reduce dissolved oxygen through seasonal rapid growth and senescence and reduce water movement – leading to increases in water temperatures. They trap suspended particles which increases sedimentation rates, and further exacerbate heat-loading. AIS can also alter nutrient cycling patterns, leading to increased nutrient loading and contributions to eutrophication. Water quality impacts can include high pH, low dissolved oxygen, and other conditions unfavorable for aquatic life. In addition, these warm nutrient enriched habitats also support populations of potentially toxigenic cyanobacteria which can impact human health and drinking water. Some AIS have incredibly high transpiration rates and reduce water levels in summer months.

Invasive water primrose (*Ludwigia spp.*) is an AIS that is known as the worst invasive aquatic plant in the state of Oregon. The extent of Ludwigia growth along the Willamette River over the past 10 years is at a rate of weed spread that is rarely seen in AIS, and has changed the composition of backwaters, oxbows, and river channels. In the past few years, it has even began colonizing along the mainstem Willamette in reaches with lower flows. Ludwigia likely arrived in the Willamette River through the aquarium trade and has rapidly expanded to take over significant portions of the Willamette River's slower waters, displacing amphibians, turtles, and fishes as it chokes their habitat and open water. Many impacted species require open water habitat with native emergent vegetation to feed, bask, reproduce, and hide from predators. Infestations of Ludwigia results in thick vegetation mats that limit movement of aquatic species.

Unlike native aquatic plants, which exchange oxygen beneath the water's surface, Ludwigia removes it from the water then releases it into the air – decreasing oxygen available for other aquatic species. When Ludwigia is treated with herbicide, mats of dead floating Ludwigia remain. Remaining islands of Ludwigia, which can be thick enough to walk across, have significant organic matter in various states of decay, likely further deteriorating water quality as the plants break down.

In 2017, a unique opportunity came about to partner with U.S. Geological Survey (USGS), Portland State University (PSU), Oregon Parks and Recreation Department (OPRD), and Willamette Riverkeeper on a regional monitoring effort to learn more about the impacts of

*Ludwigia hexapetala, Ludwigia peploides,* and other AIS. This monitoring effort includes two sites in the Willamette Mainstem Cooperative project area (Collins Bay and Scatter Bar Pond; monitoring conducted under ODA OSWB grant funds) and Willamette Mission State Park (monitoring conducted separately under OWEB FIP grant funds). Both Collins Bay and Scatter Bar Pond (Figure 1) were included in 2015 and 2016 monitoring efforts, and this collaborative opportunity with USGS and PSU allowed for more rigorous scientific monitoring at these two sites in 2017.

**Methods**

Collins Bay is an approximately 10.5 acre river inlet connected to the mainstem of the Willamette River, the entirety of which was infested with Ludwigia. Annual herbicide treatment has been occurring there since 2014 (Figure 2). Scatter Bar Pond is a 6 acre pond seasonally connected to the Willamette River, also infested with Ludwigia (Figure 3). Herbicide treatments began there in 2018 at Scatter Bar Pond, indicating that during water quality sampling Collins Bay was treated with herbicide while Scatter Bar Pond was not.

USGS conducted three surveys water quality surveys each at Scatter Bar Pond and Collins Bay during 2017: 1) before glyphosate treatments (surveys conducted July 2017), 2) after first round of glyphosate applications (surveys conducted September 2017), and 3) after second round of glyphosate applications and after plant senescence (surveys conducted November 2017).

USGS collected high-frequency water-quality data using a calibrated and GPS enabled Yellow Springs Instrument (YSI) EXO2 sonde to characterize water temperature, specific conductance, pH, dissolved oxygen (DO), turbidity, total chlorophyll, phycocyanin (blue-green algae pigment), and fluorescing dissolved organic matter (fDOM) at a measurement frequency of 0.5 seconds. Measurement depths varied from the water surface to just off the bottom of the bay. Data were edited for start and end times (in and out of water) but not sure elevated values or spikes in optical parameters (turbidity, total chlorophyll, phycocyanin, and fDOM). Heavy plant abundance in 2017 caused unavoidable spikes in values which may not be representative of conditions but commonly observed due to the release of organic and inorganic materials from the surface of plants when disturbed by movements.

**Results**

Temperatures at Collins Bay were the warmest in July (between 20-28 °C) and above the 18 °C standard for designated salmon and trout rearing and migration. Temperatures had decreased by September and into November, dropping below the standard for both of those months (USGS Slides 4-6). Scatter Bar Pond temperatures held a similar pattern, though July temperatures were slightly warmer than at Collins Bay, likely due to the lack of connectivity to the river at Scatter Bar Pond (USGS Slides 28-30).

During July and September, DO varied across Collins Bay, but the overall average was between 5-10 mg/L (6.5 mg/L is the minimum DO requirement for salmon and trout) (USGS Slides 7-8). Samples that were along the perimeter where Ludwigia was more prevalent was between 0.1-5.0 mg/L. By November, the east side of Collins Bay was between 5-10 mg/L while the west side ranged from 0.1–10 mg/L (USGS Slide 9). At Scatter Bar Pond, DO was the highest in July, though still low (USGS Slide 31). DO decreased through November (USGS

Slides 32-33). In November, Scatter Bar Pond had a minimum DO of 0.1 mg/L. While there are differences between the two sites, specifically connectivity to the river which can increase DO, it is interesting that the site treated with herbicide had higher DO in November than the site that had untreated Ludwigia present.

Specific conductance was extremely high at Collins Bay throughout, but especially in September when it was over 1000 uS/cm, compared to the mainstem at 67 uS/cm (USGS Slides 10-12). High conductivity can hamper seed germination and plant reestablishment, hindering native planting restoration efforts at the site. For example, conductance values of 600-900 uS/cm were considered too high for a BLM wetland restoration and revegetation project in the Klamath Basin. Scatter Bar Pond specific conductance was highest in July, but overall no where near the values found at Collins Bay (USGS Slides 34-36). High specific conductance may be linked to high rates of decomposition, but more likely is caused by Bowers Slough, which drains into Collins Bay. In 2019, we returned to sample water quality and found high specific conductance at the mouth of the slough, and even higher further up the slough (over 1000 uS/cm). Results from 2019 monitoring will be written up at a later time.

pH at Collins Bay and Scatter Bar Pond did not dramatically differ throughout the season and was within the range for fish use (6.5-8) (USGS Slides 13-15; 37-39). Turbidity, chlorophyll, and phycocyanin were variable at both sites, but lowered throughout the season (USGS Slides 16-24; 40-48). Fluorescing dissolved organic matter (fDOM) increased at both sites between July and November (USGS Slides 25-27; 49-51).

**Conclusions**

- Aquatic plants (macro and algae) produce swings in dissolved oxygen to levels that do not meet water quality standards.
- Community respiration in the water and bed sediments cause hypoxic conditions.
- Low oxygen may limit suitable habitat for cold water fish but may provide opportunity for denitrification.
- Connectedness of side channels, hydrology, and local influences (groundwater and quarry discharges) may affect water-quality.
- Dissolved oxygen was low at the sites during the day, below what is deemed acceptable for salmonids. Respiration was likely exceeding photosynthesis, lowering dissolved oxygen. *Ludwigia sp.* pull oxygen from the water and release it above the water, unlike submerged aquatic vegetation which exchanges the oxygen under water. What's more is that as *Ludwigia sp.* treated with herbicide continue to decay, the excess organic matter only decreases the dissolved oxygen in a water body, such as Collins Bay. This can continue have severe impacts on water quality of the water body.

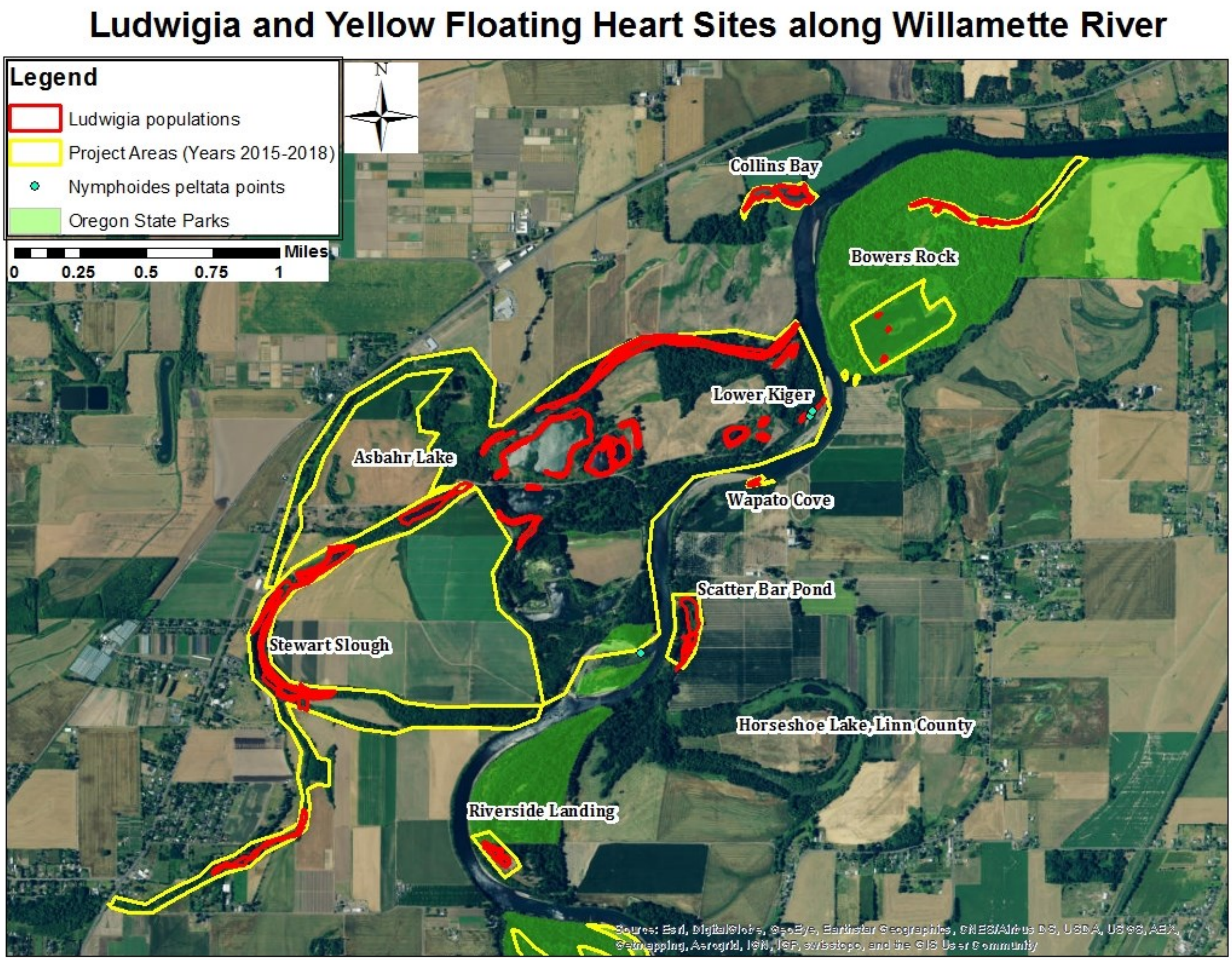


**Figure 1.** Project area for the Willamette Mainstem Cooperative—Corvallis to Albany reach of the Willamette River.

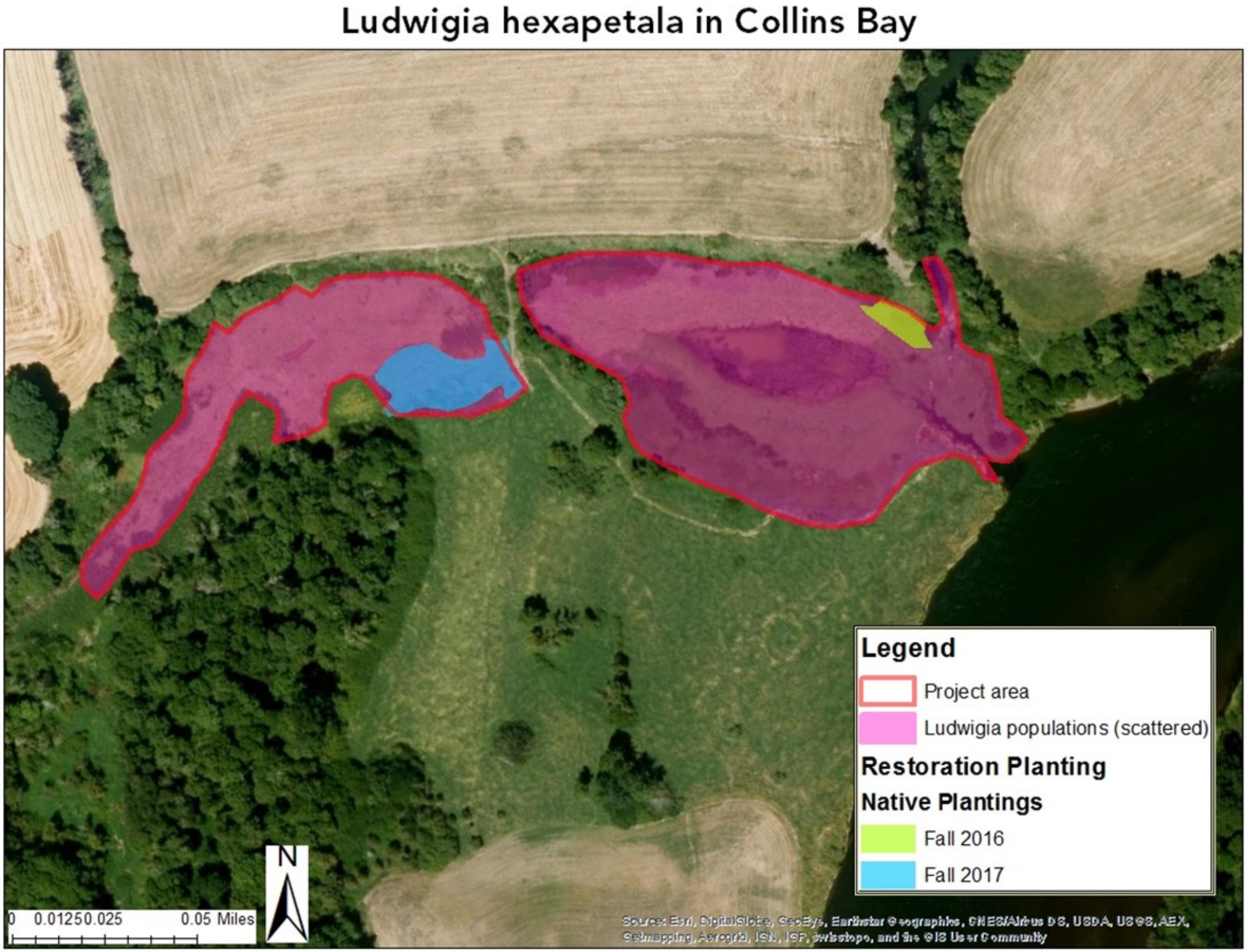


**Figure 2.** Site context for Collins Bay. *Ludwigia hexapetala* populations and restoration plantings at Collins Bay.

# Scatter Bar Pond

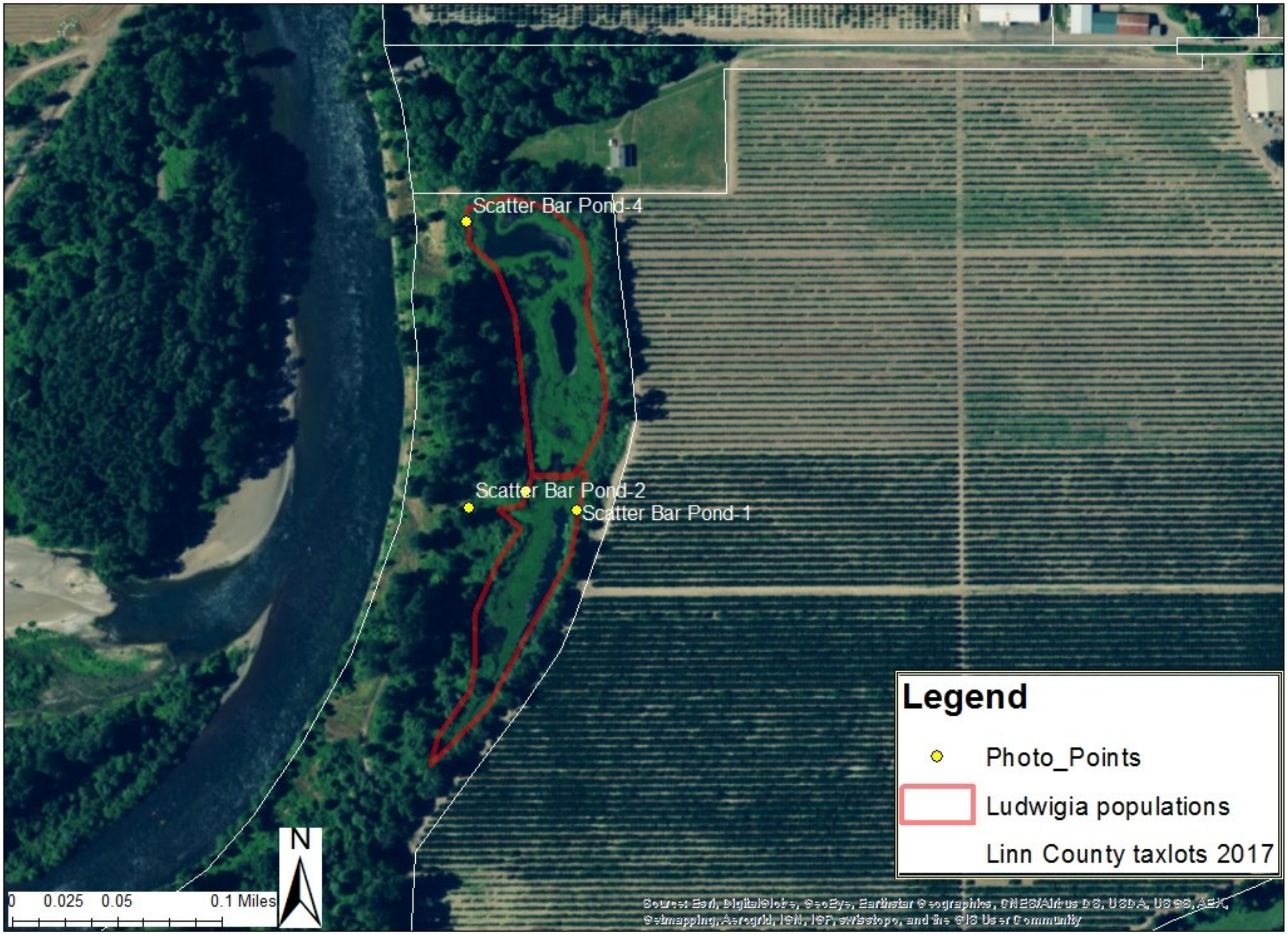


**Figure 3.** Site context for Scatter Bar Pond.

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# Water-Quality Conditions in Collins Bay and Scatter Bar Ponds, Willamette River Off-Channel Habitats

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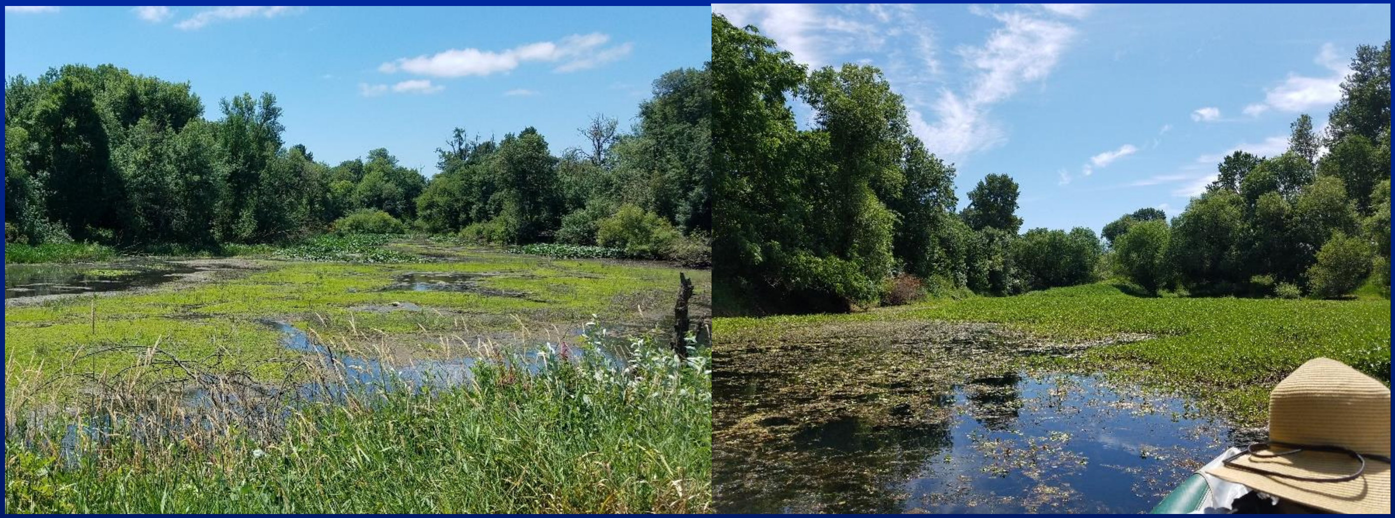

U.S. Department of the Interior
U.S. Geological Survey

# Water-Quality Circumnavigation Maps: Metadata and Considerations

- Water-quality data collected from Collins Bay and Scatter Bar Pond with a YSI EXO2 sonde.

- Parameters: water temperature, specific conductance, pH, dissolved oxygen, turbidity, total chlorophyll, phycocyanin (blue-green algae pigment), fluorescing dissolved organic matter (fDOM).

- Measurement frequency: 0.5 second

- Measurement depths: vary from the surface to just off the bottom

- Three circumnavigation transects (total per waterbody) were conducted in July, September, and November 2017.

- Data have been edited for start and end times (in and out of water) but not for elevated values or spikes in optical parameters (turbidity, total chlorophyll, phycocyanin, and fDOM). Heavy plant abundance caused unavoidable spikes in values which may not be representative of conditions but commonly observed due to the release of organic and inorganic materials from the surface of the plants when disturbed by movements of the sonde or in windy conditions.

- Data are provisional and subject to revision.

- Final datasets will be published in Science Base.

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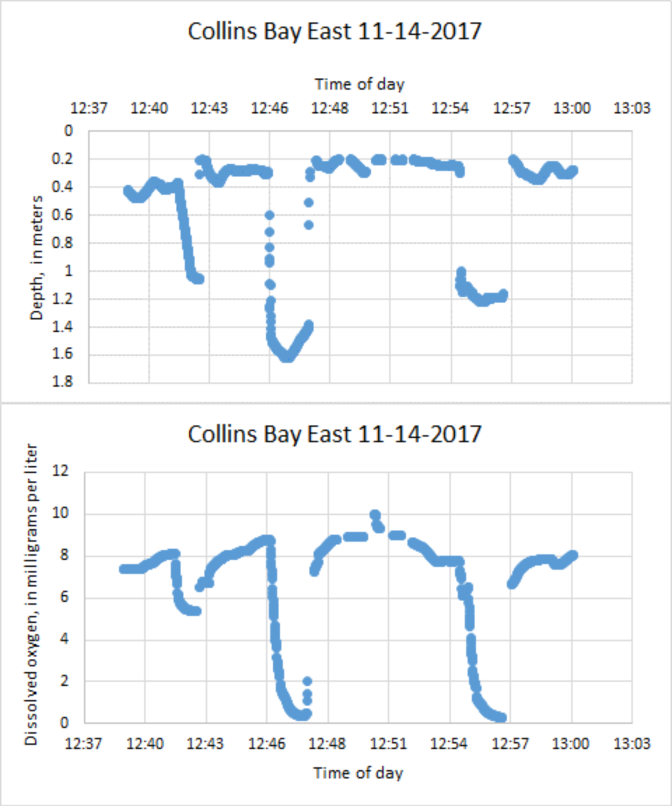
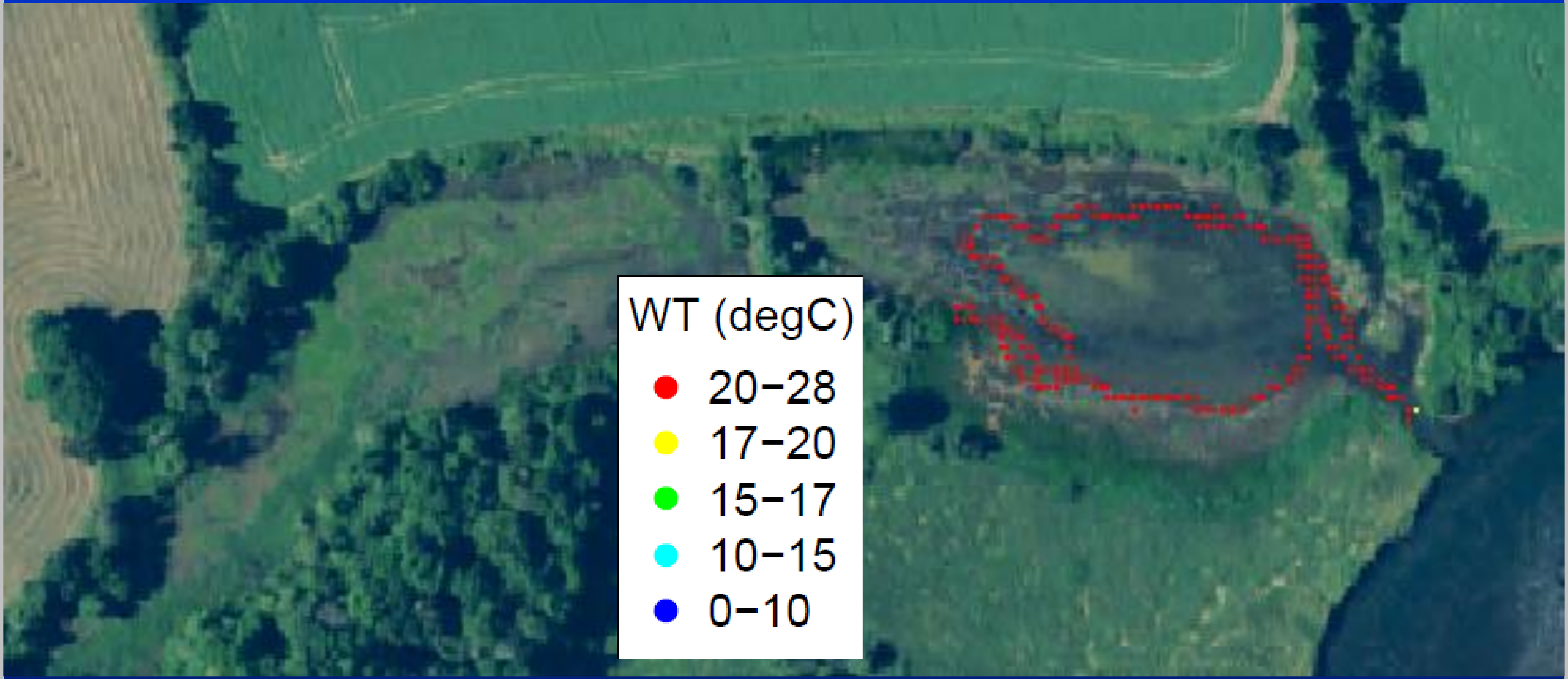
# Effect of Measurement Depth on Water Quality

- Measurement depths varied from near the surface to just off the bottom, which often had pronounced effects on water quality, including water temperature, conductance, and dissolved oxygen. For example, the DO in Collins Bay East was significantly lower near the bottom.
- The following graphs show measurement depths from three profiles ranging in depth from 1 to 1.6 meters, and the corresponding concentrations in dissolved oxygen in Collins Bay East.
- Dissolved oxygen was 7-10 mg/L near the surface, but much lower toward the bottom where less than 1 mg/L was measured.
- Data files containing measurement depth are available upon request, but will be published along with the associated locational and water quality data used to create the color maps.
- In a few maps (e.g., dissolved oxygen and specific conductance in Scatter Bar Ponds in November), specific data points are identified to show where some high or low values occurred in deeper water



# Collins Bay 7-7-17
# Water Temperature (degrees Celsius)




USGS Unpublished Data Subject to Revision

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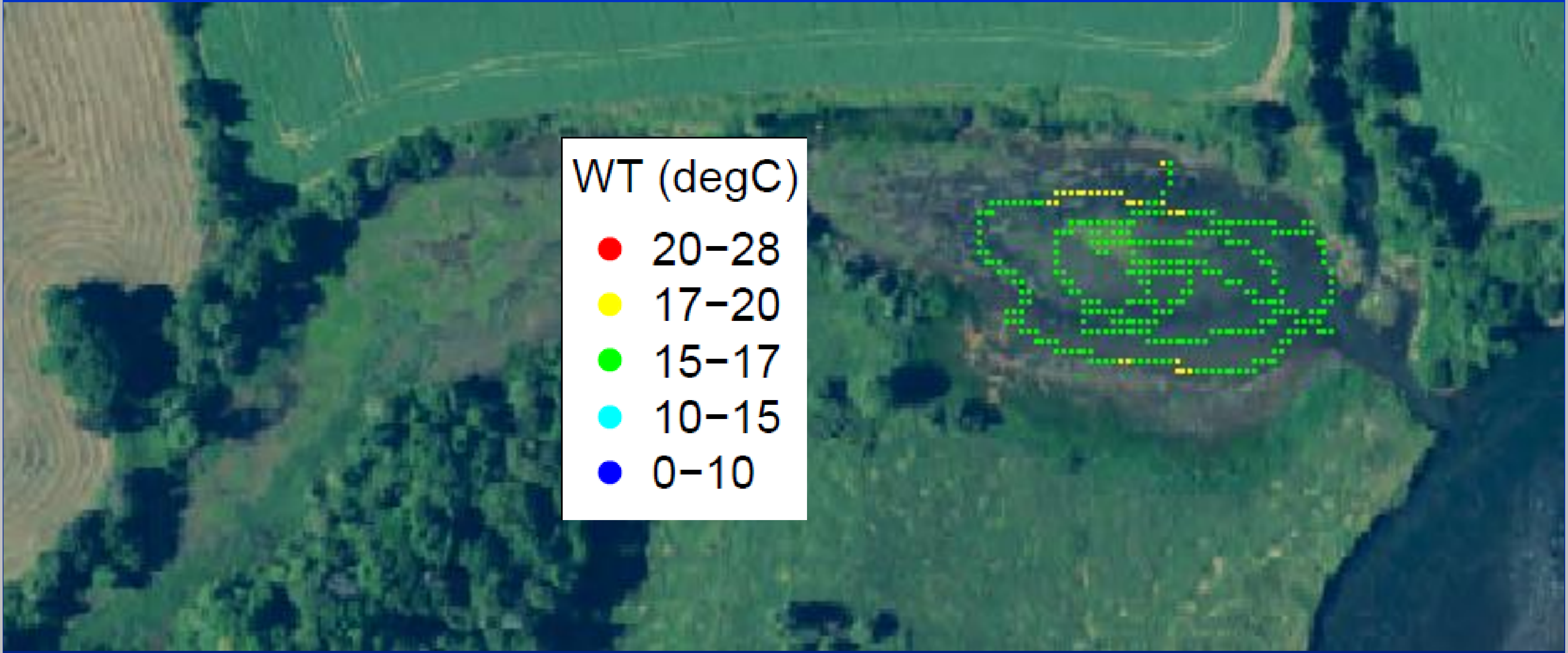


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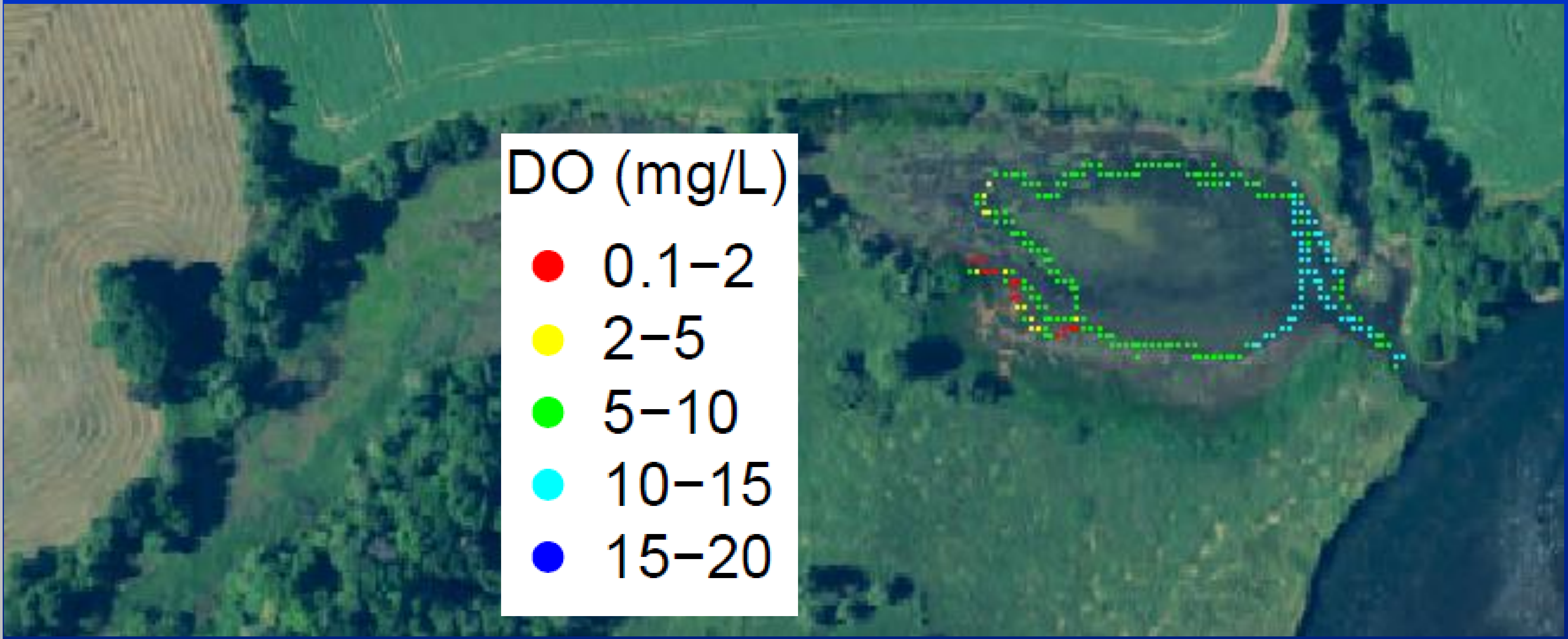
# Collins Bay 7-7-17
# Dissolved oxygen (milligrams per liter)

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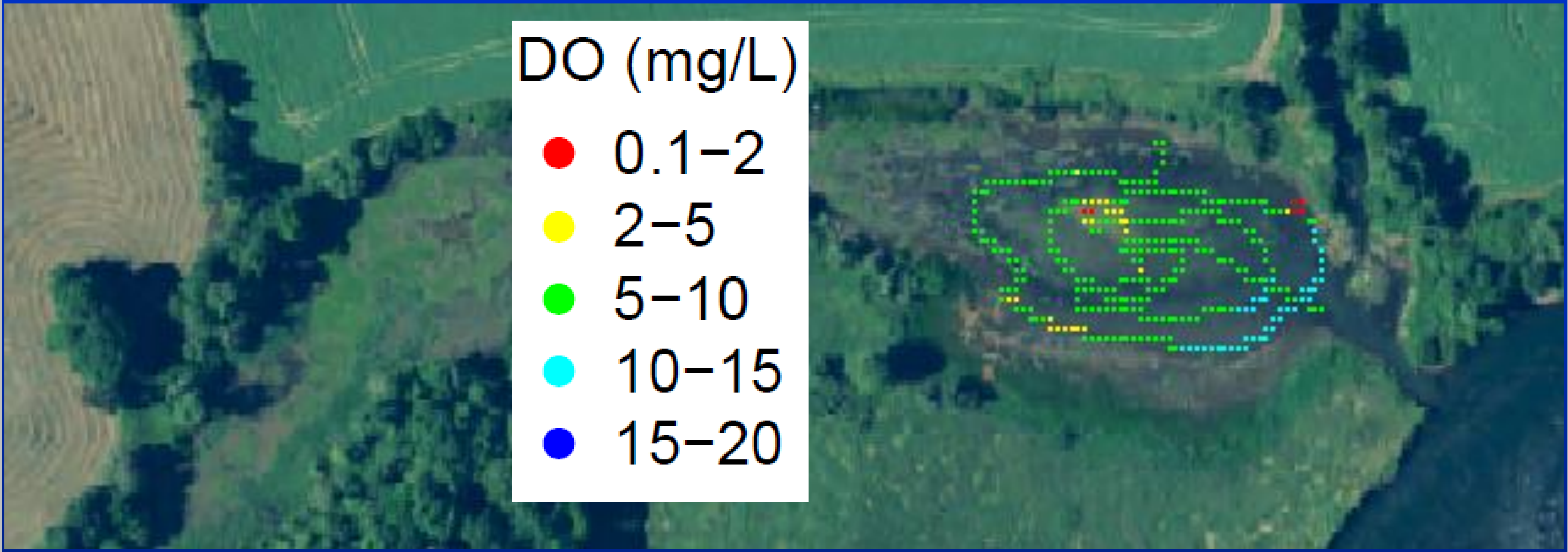


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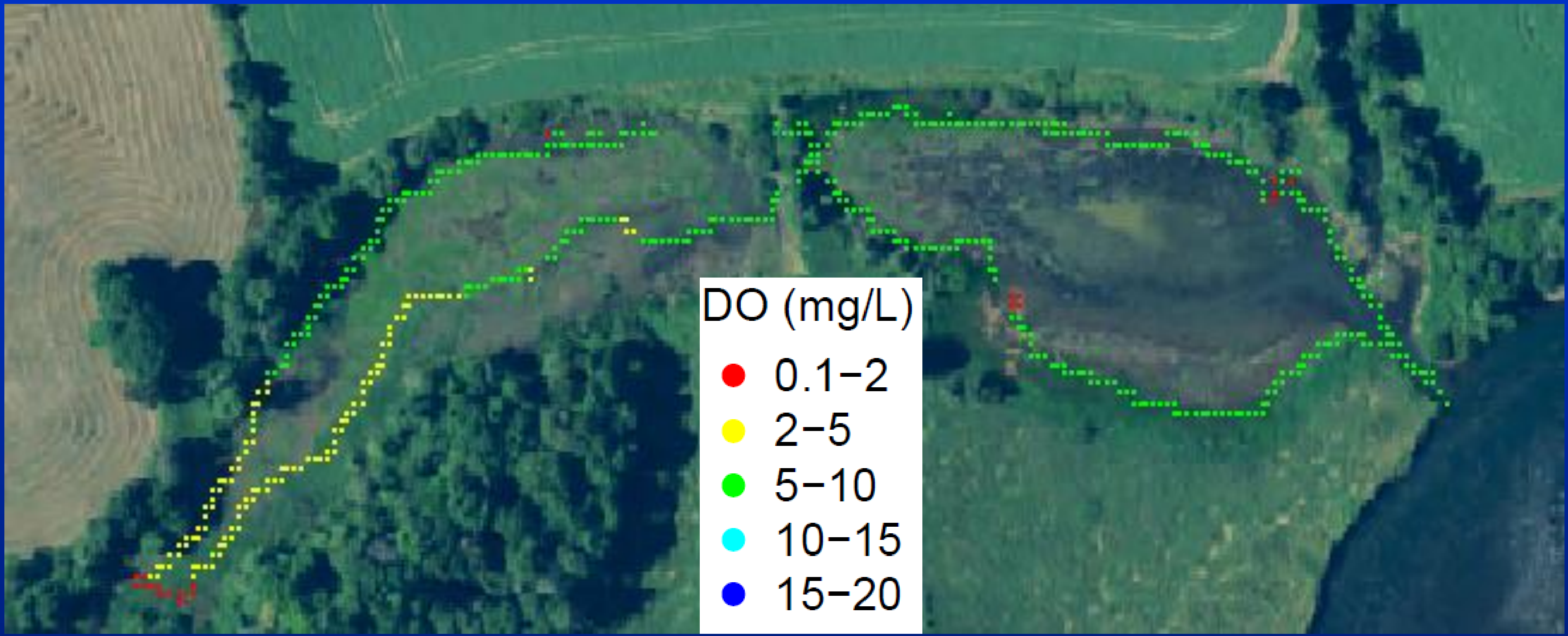


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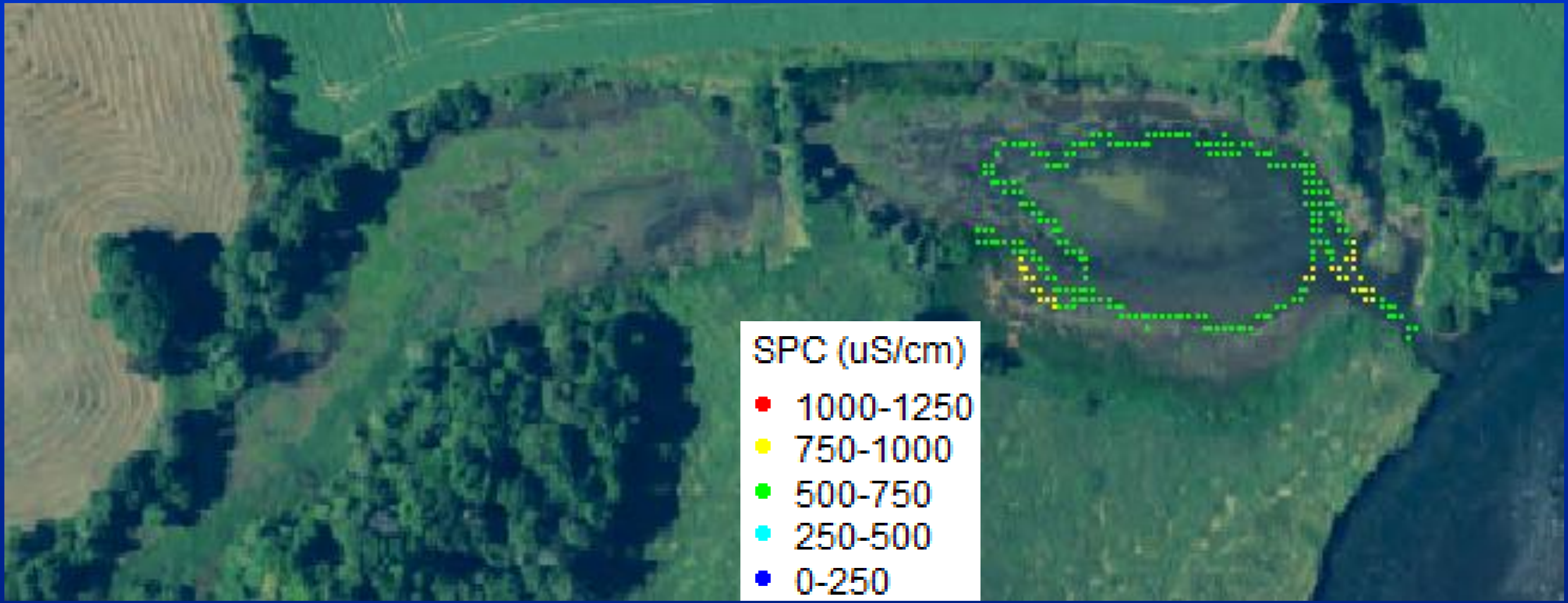
# Collins Bay 7-7-17
# Specific conductance (microSiemens per cm)

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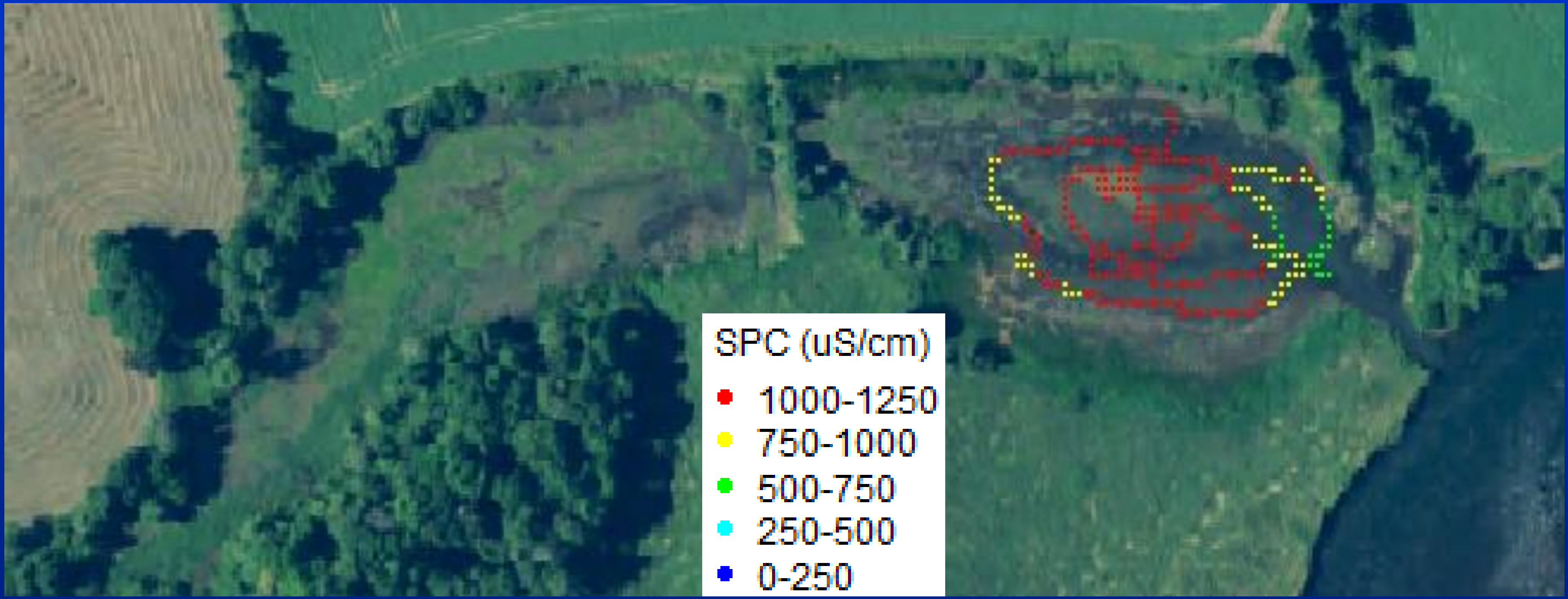


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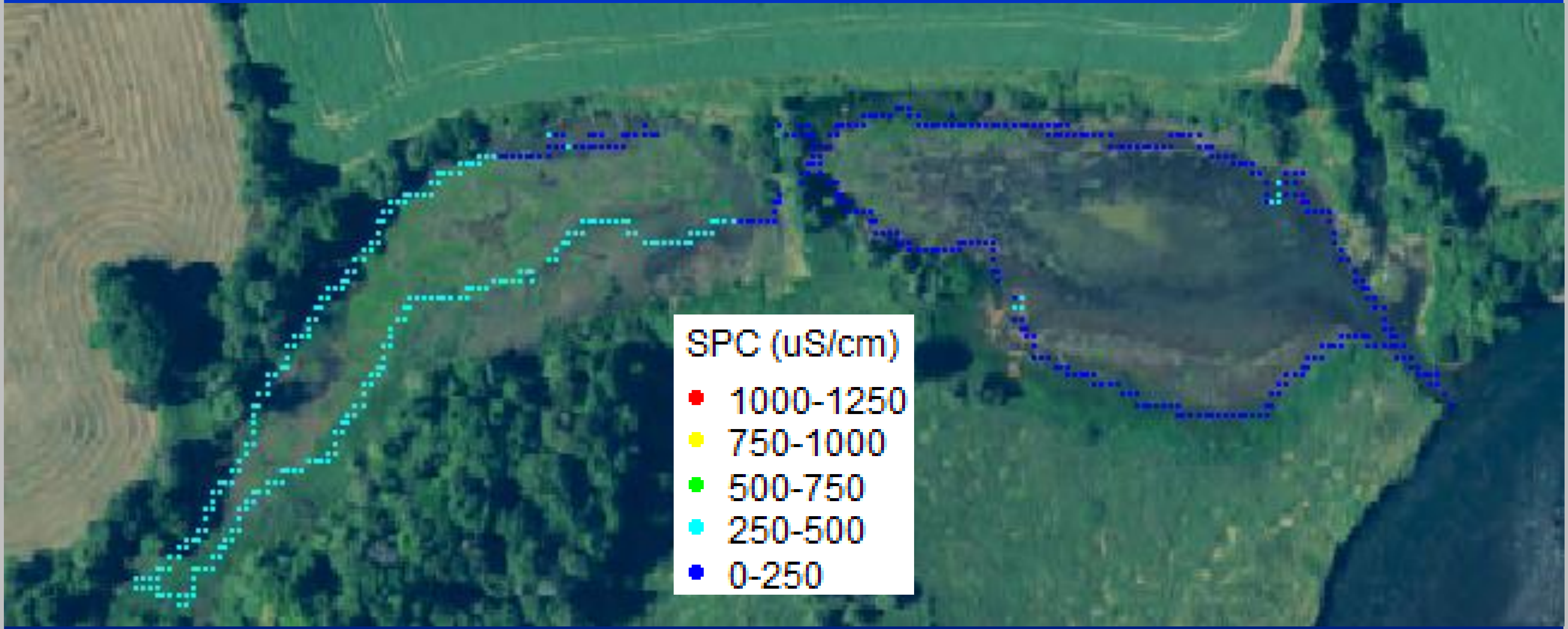


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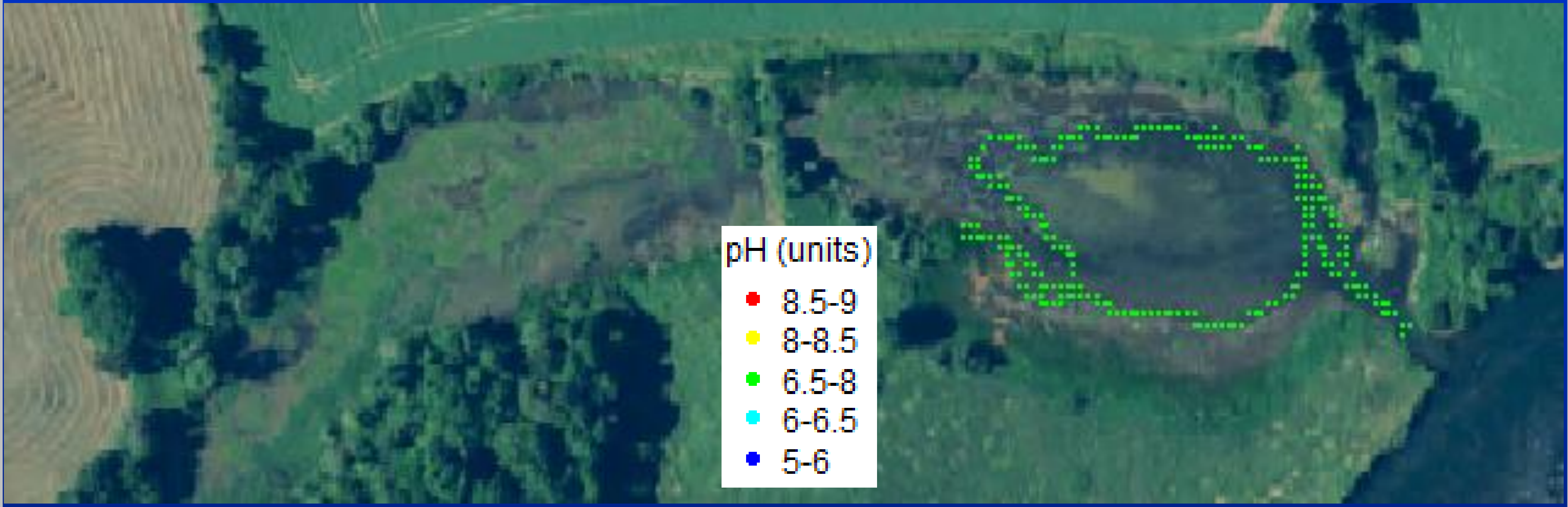
# pH (standard units)

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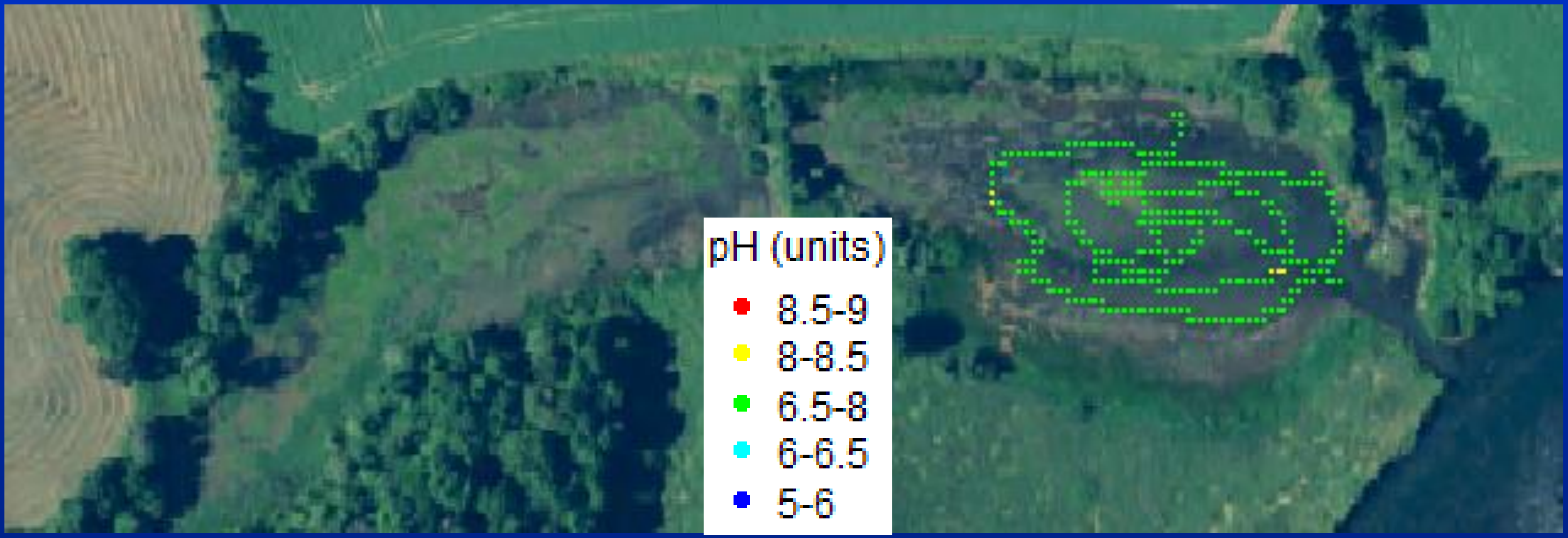


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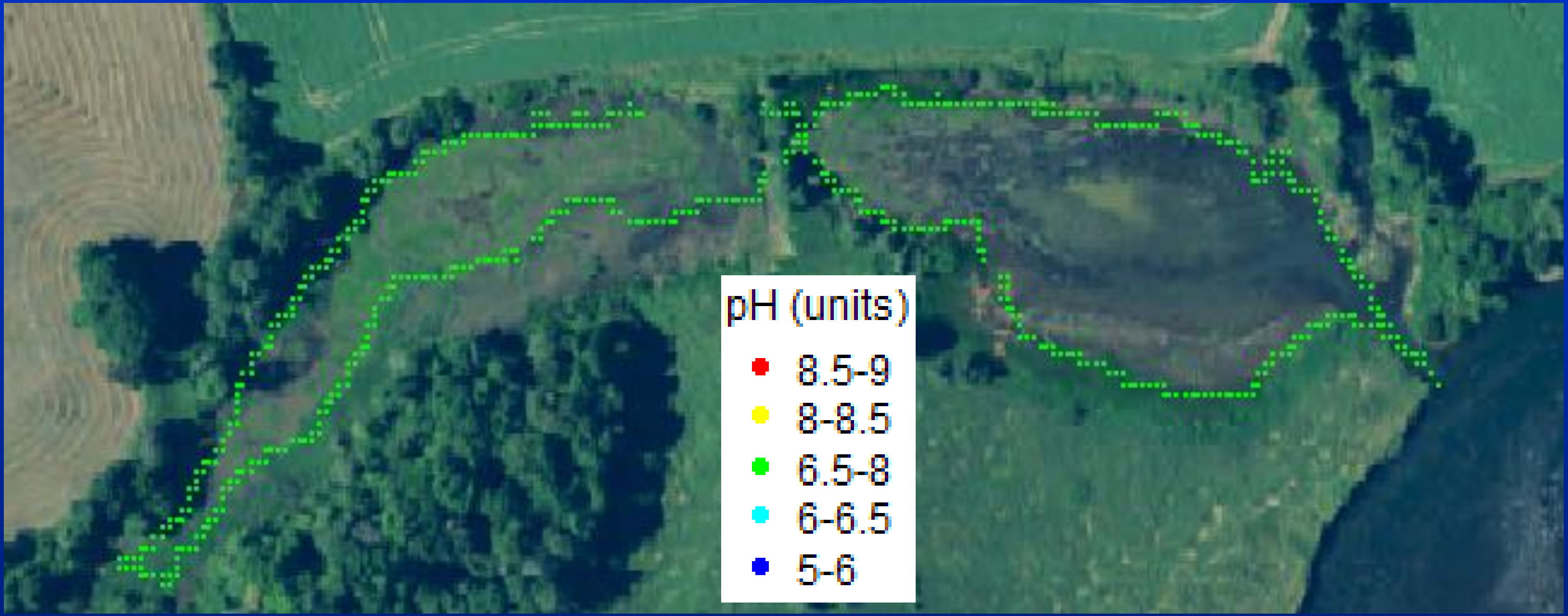


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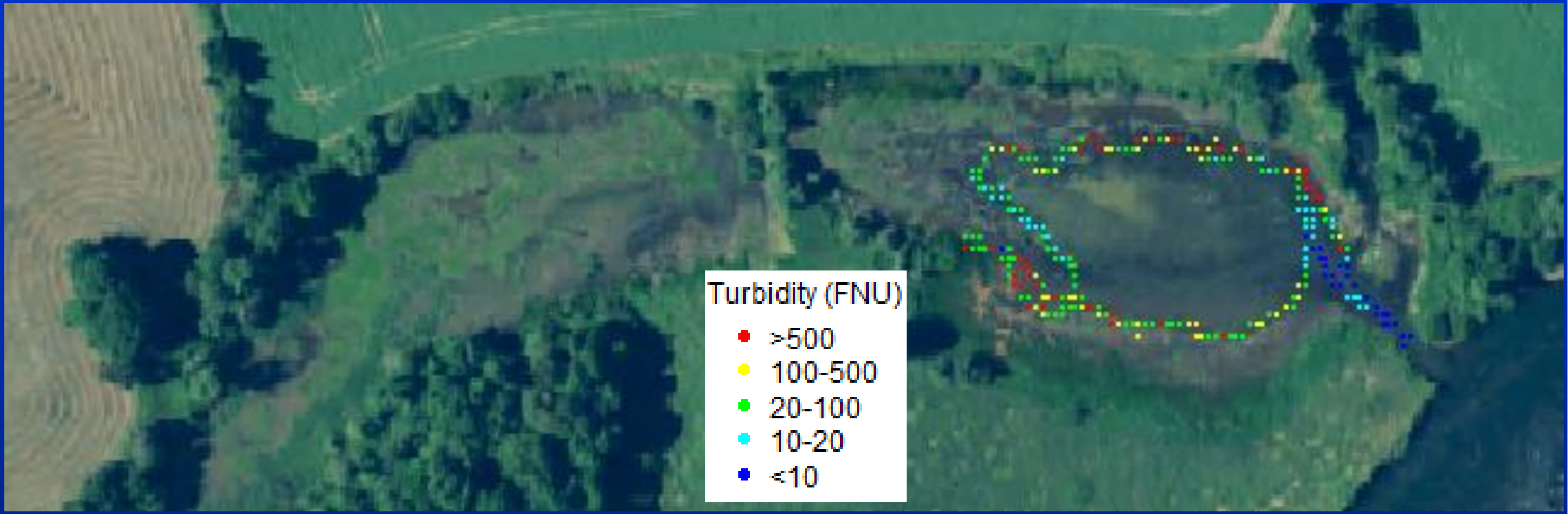
# Collins Bay 7-7-17
# Turbidity (in formazin nephelometric units)

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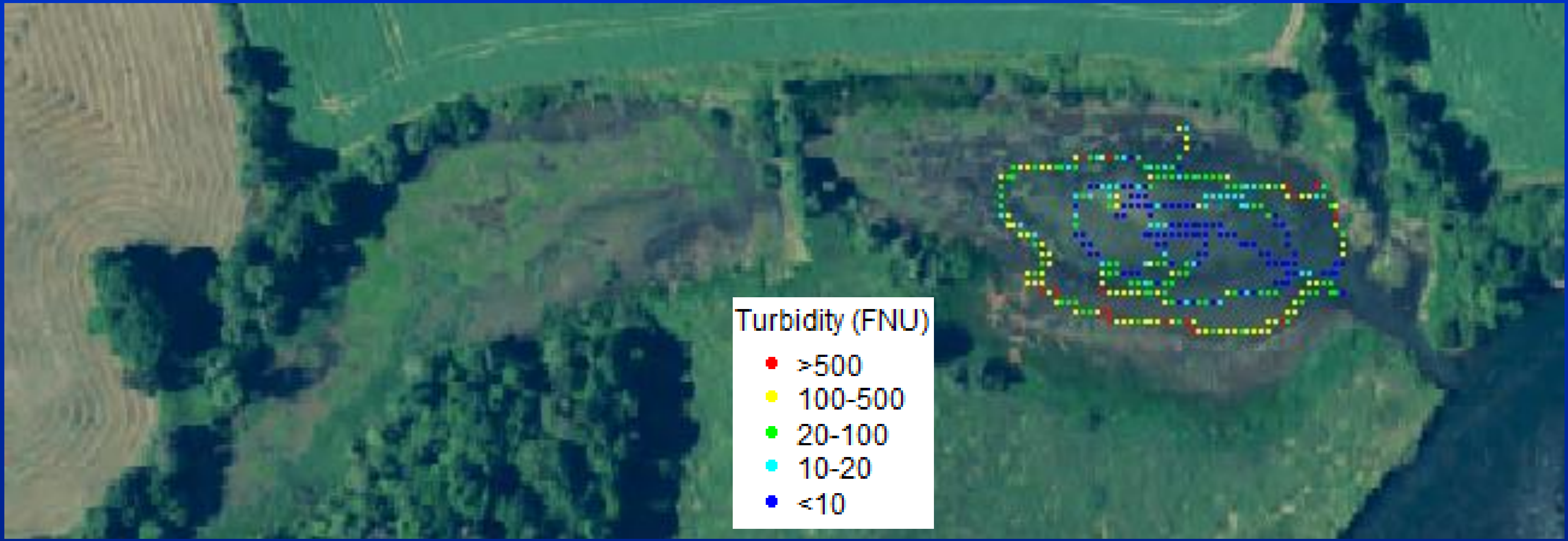


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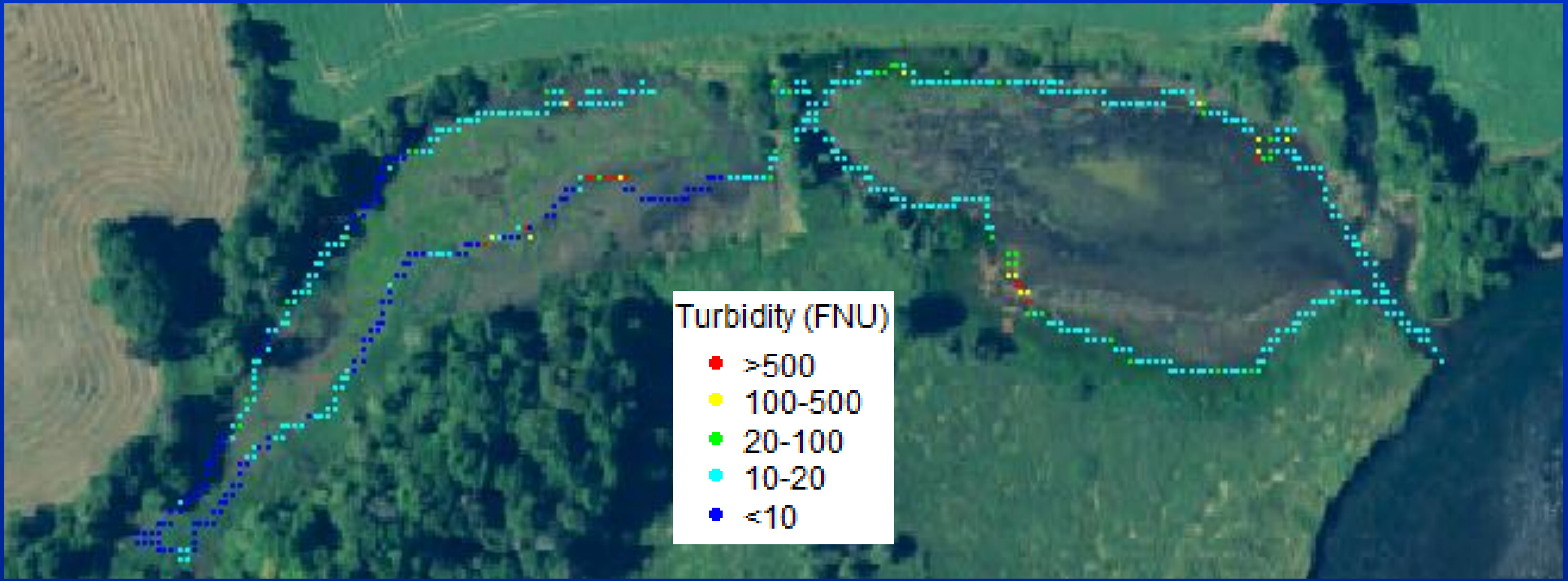


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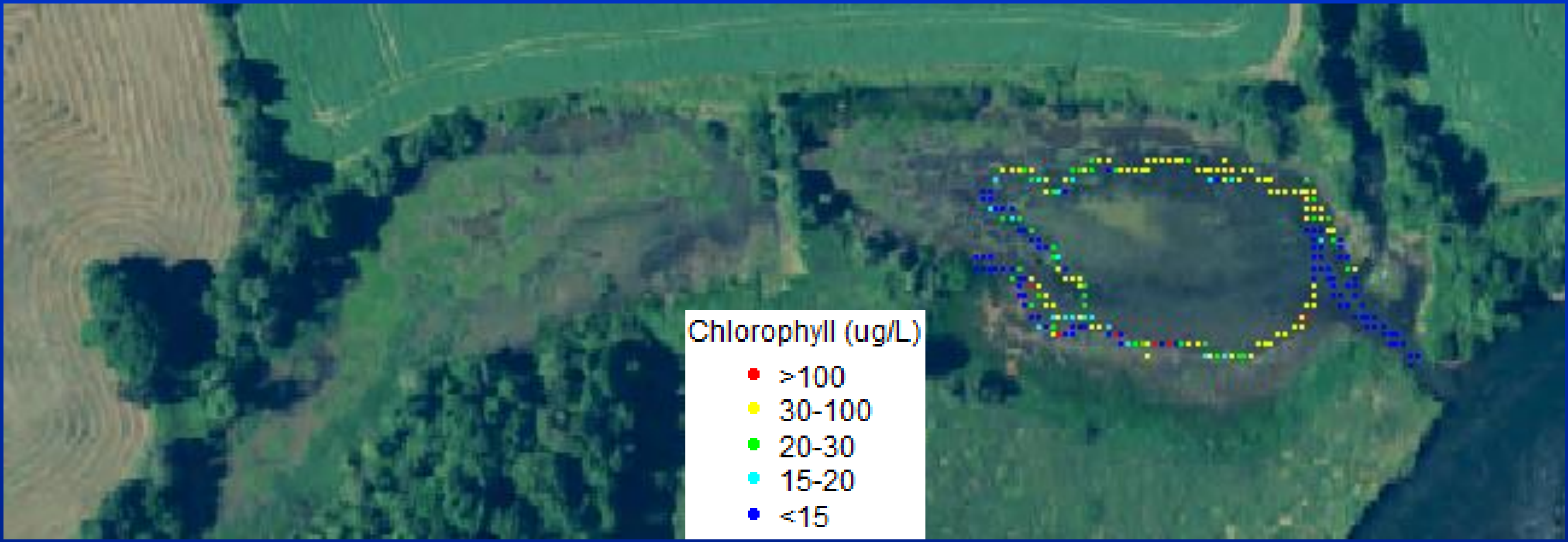
# Collins Bay 7-7-17
# Total chlorophyll (micrograms per liter)

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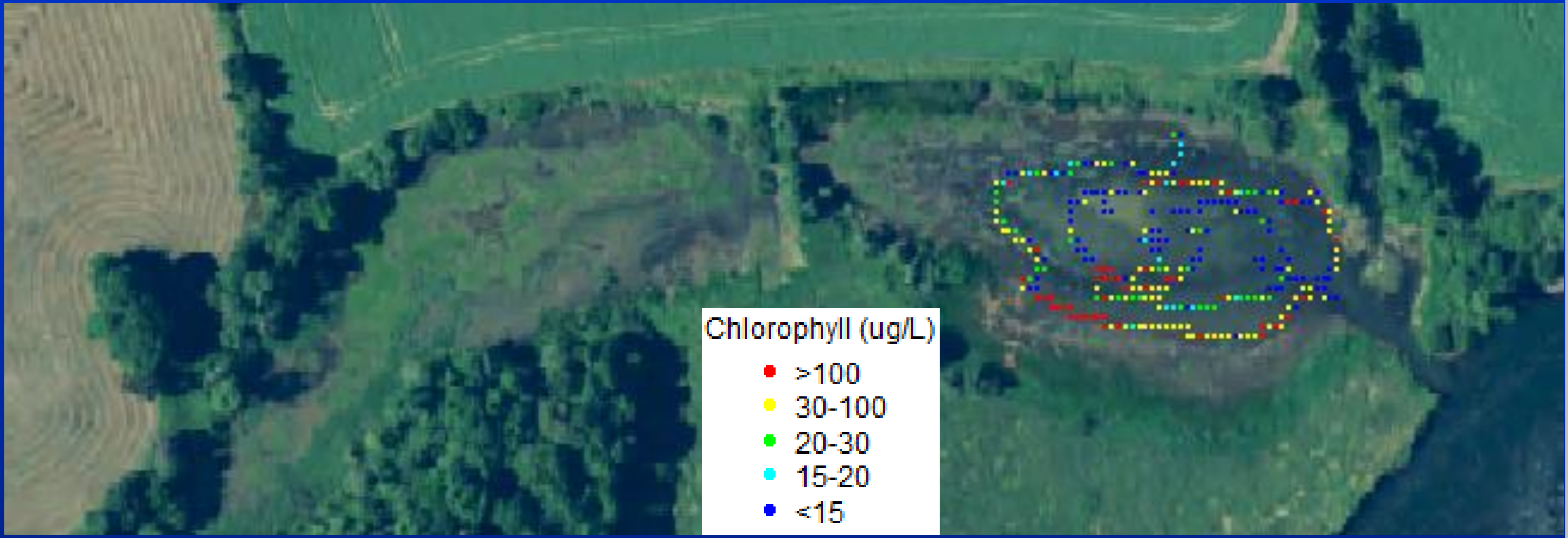


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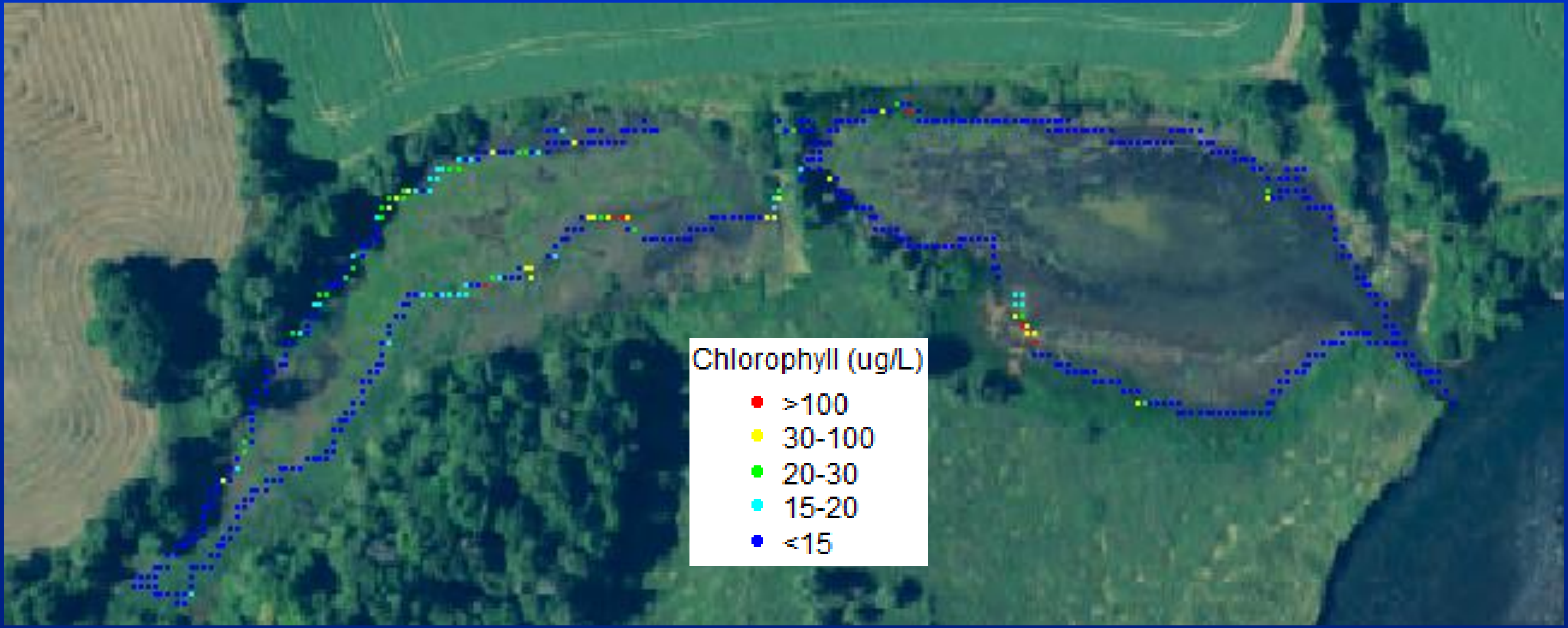


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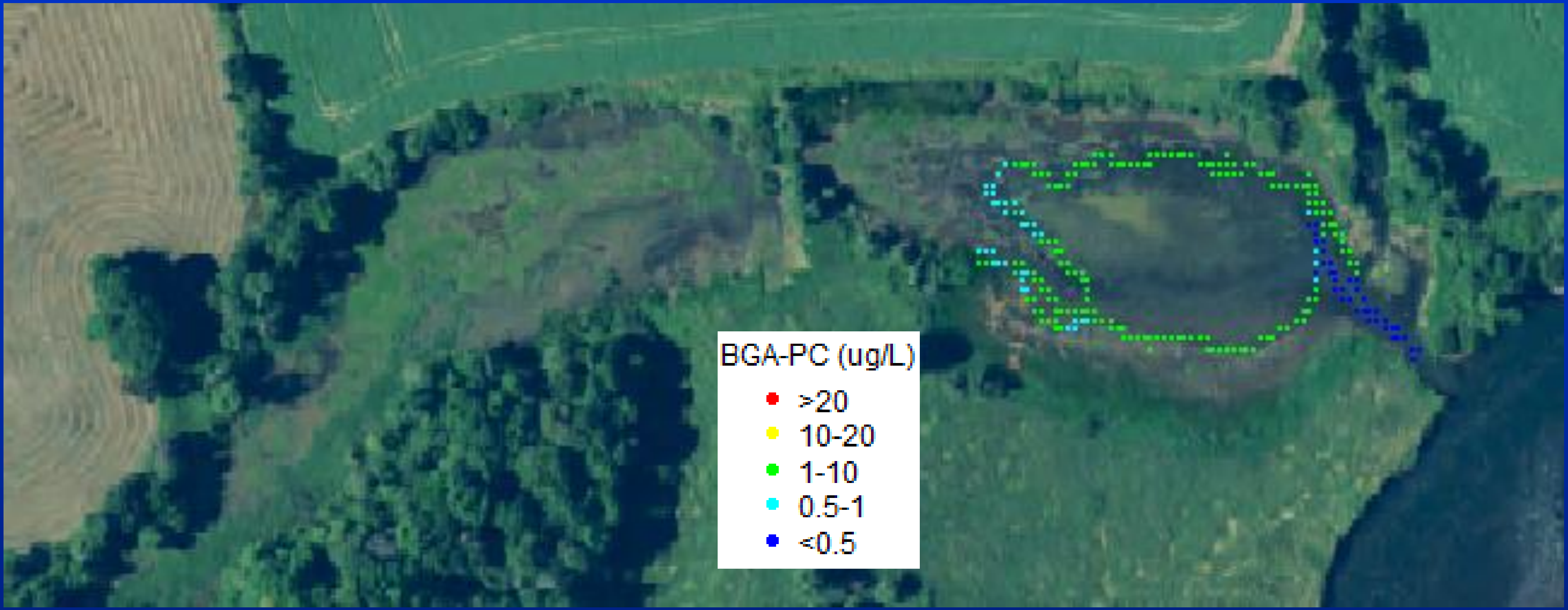
# Collins Bay 7-7-17
# Phycocyanin (micrograms per liter)

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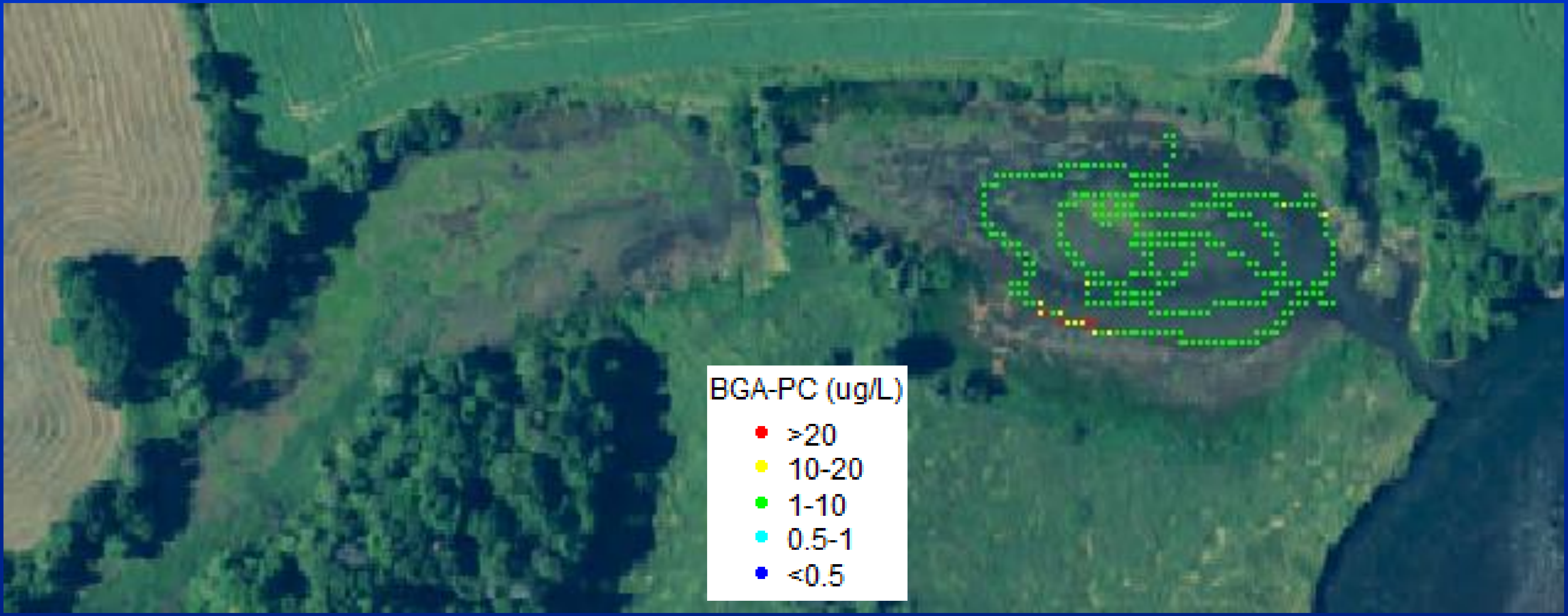


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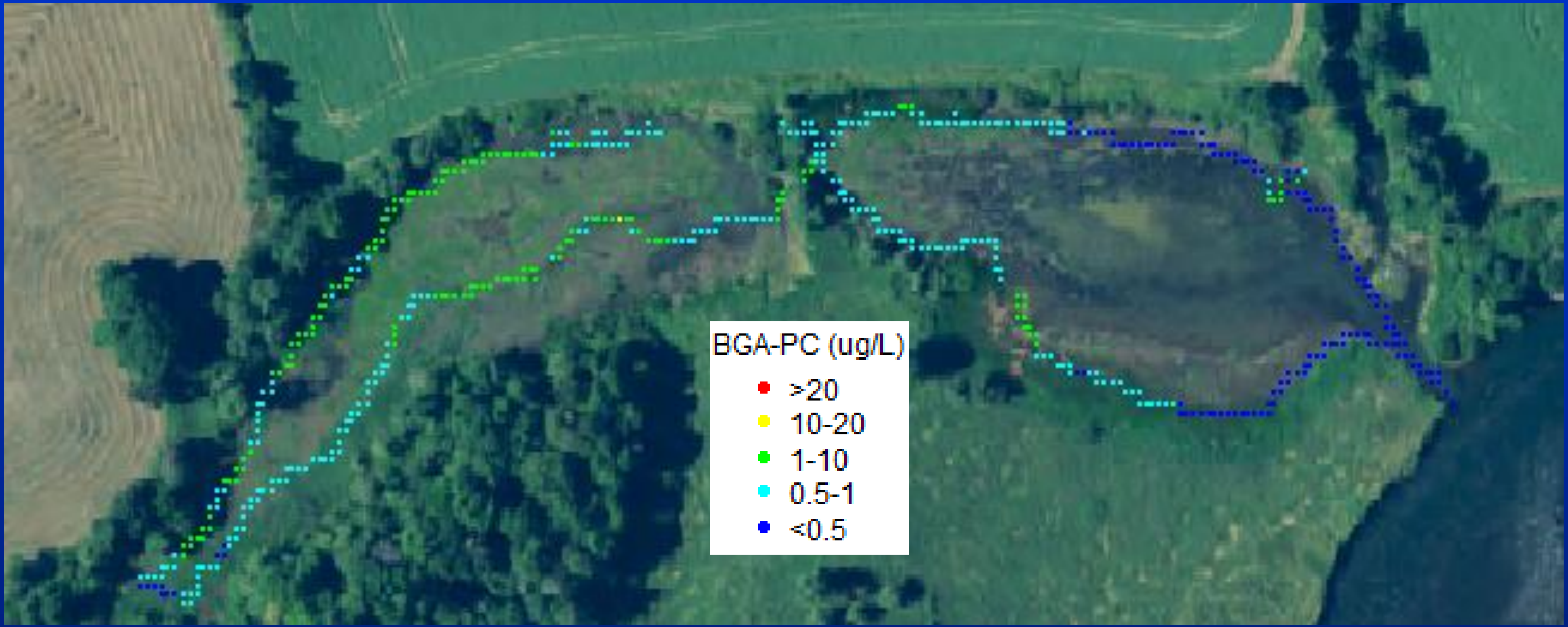


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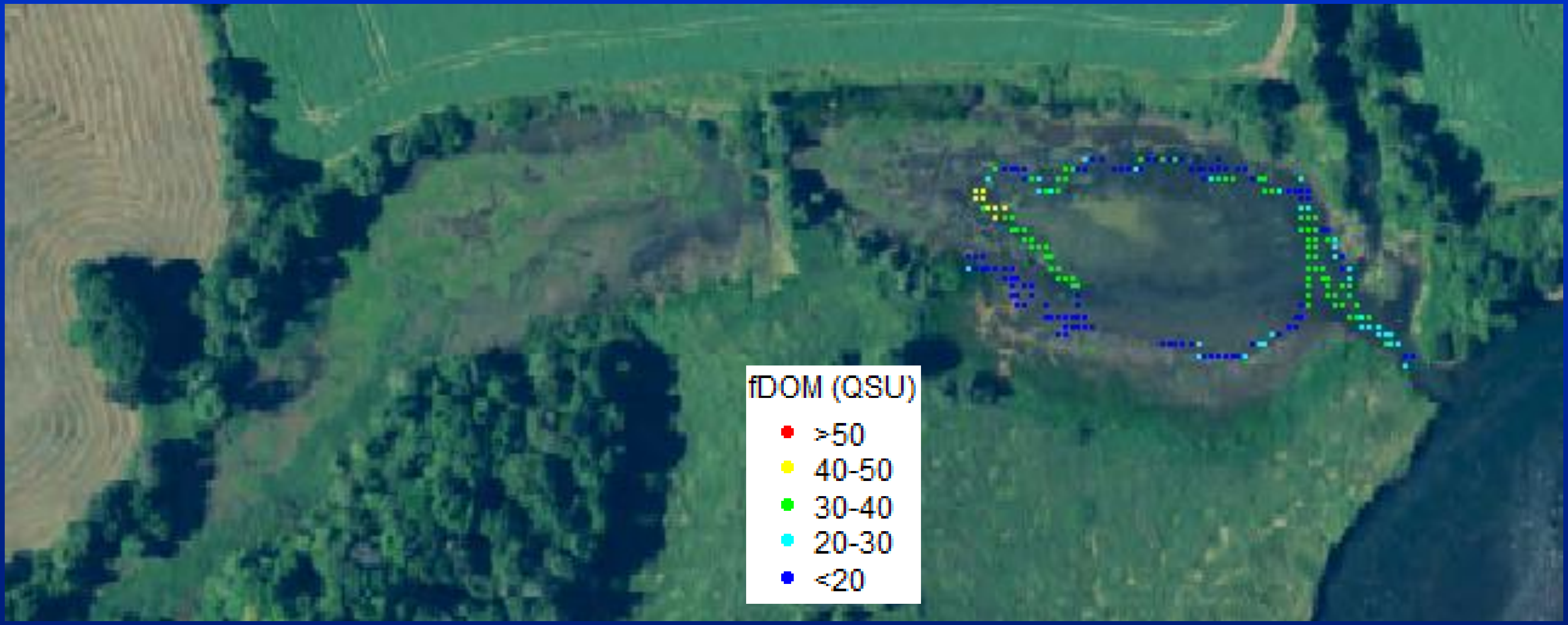
# Collins Bay 7-7-17
# Fluorescing dissolved organic matter
# (Quinine sulfate equivalent units)

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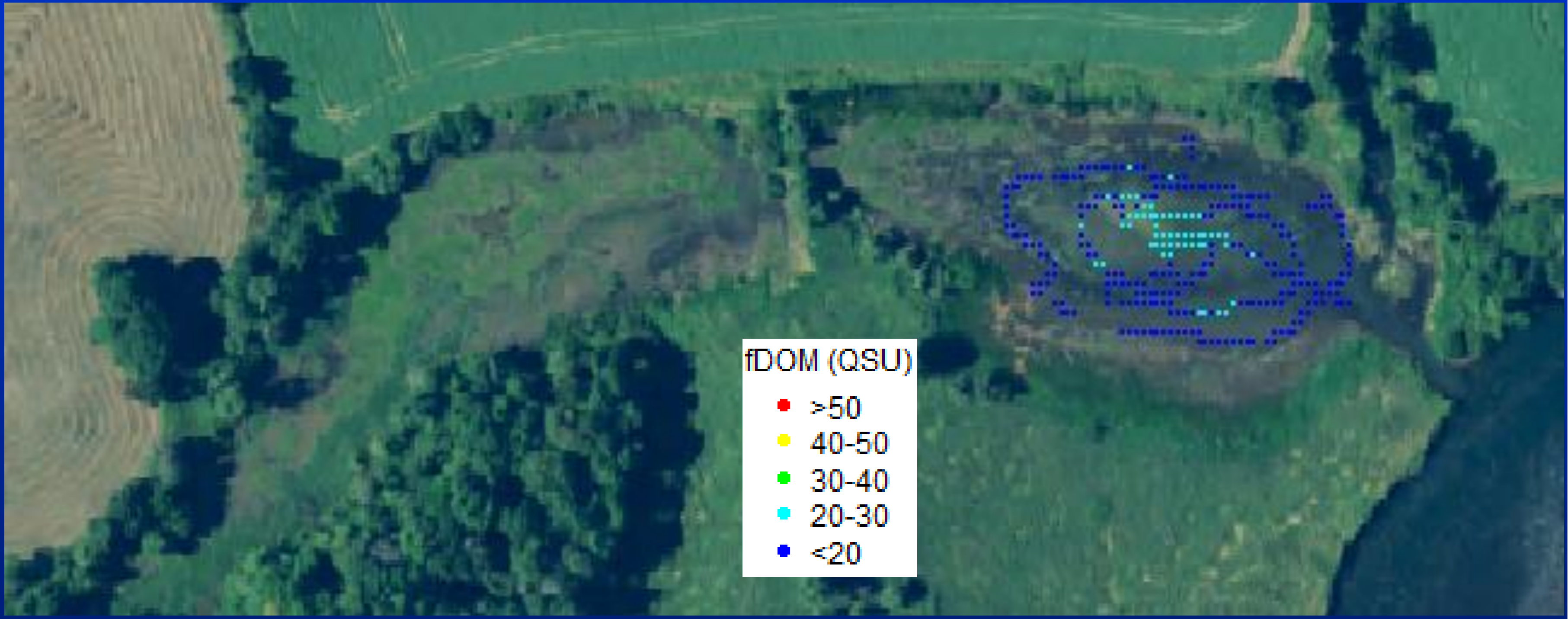


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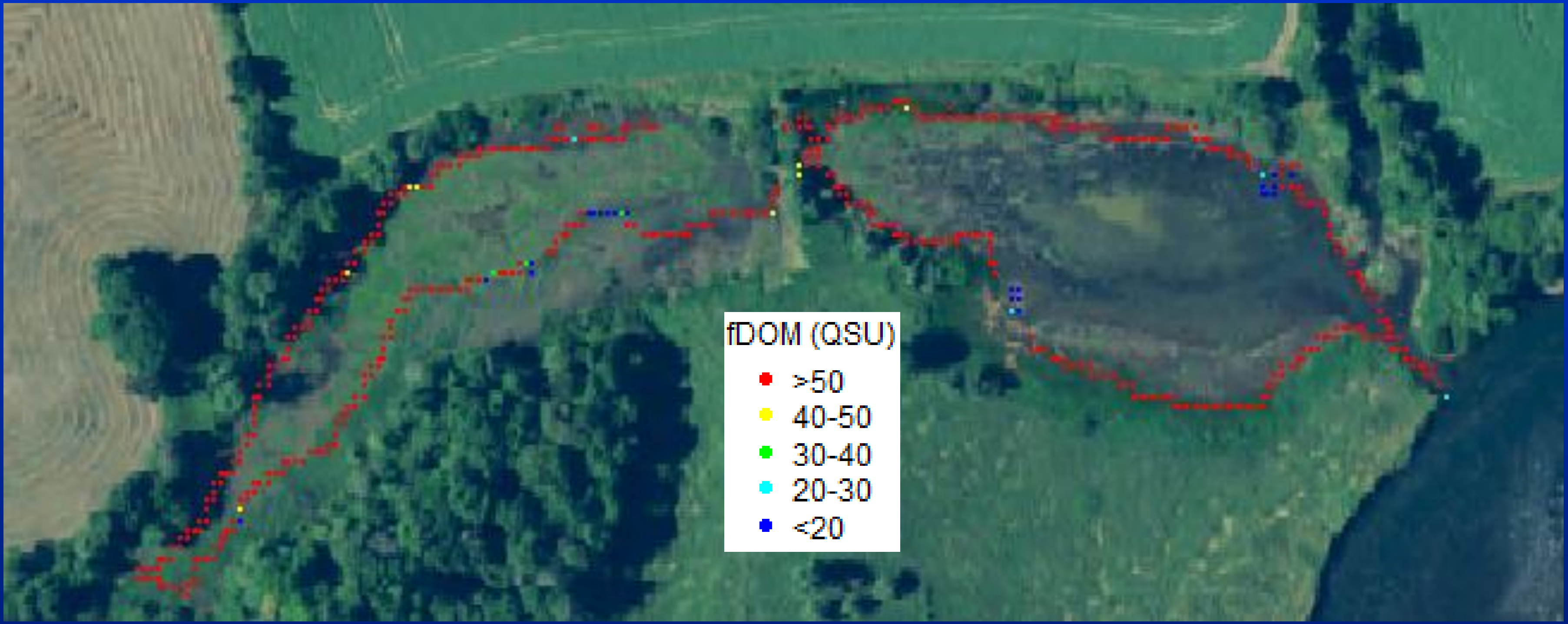


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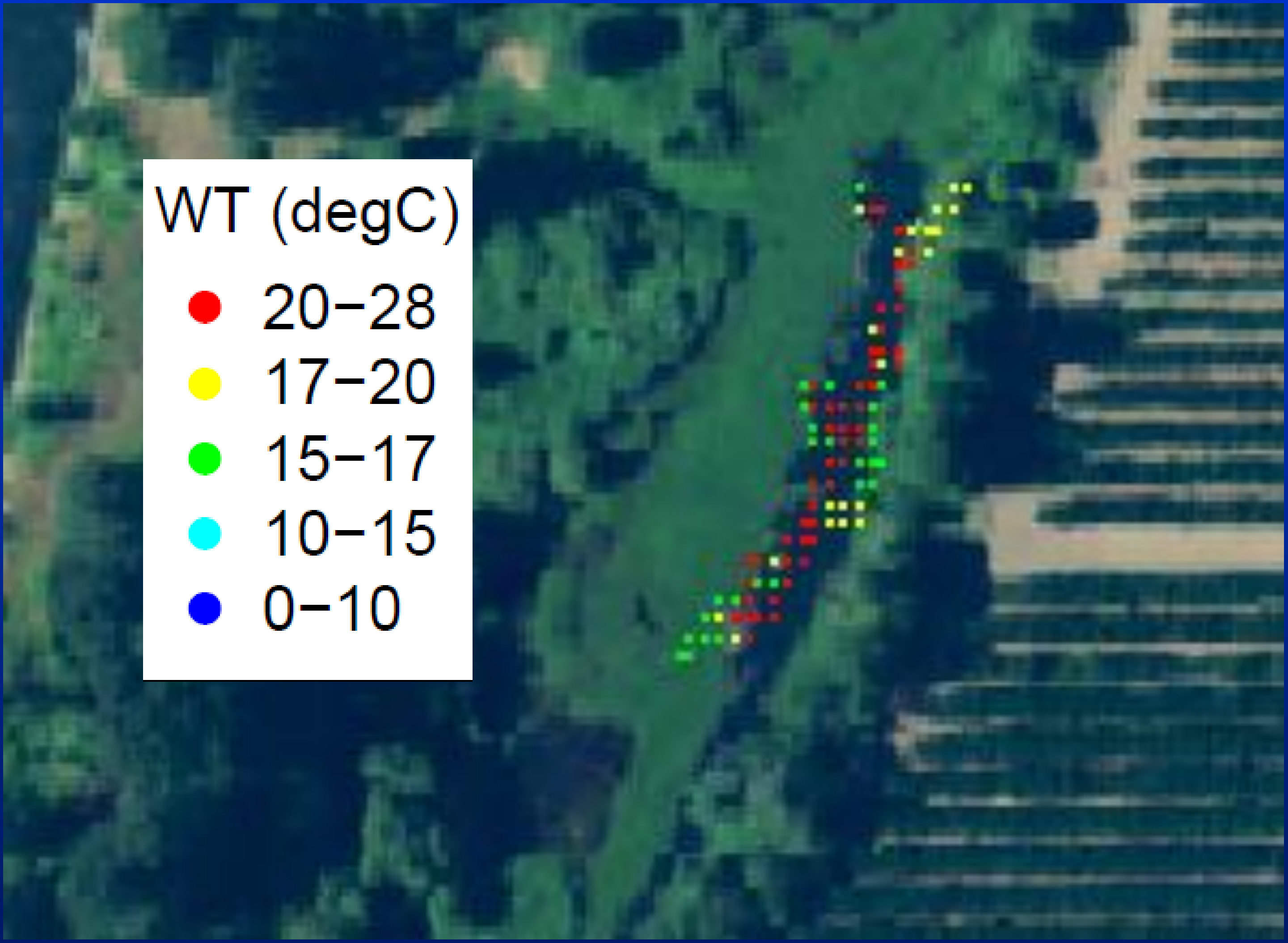
# Scatter Bar Pond 7-7-17
# Water temperature (degrees Celsius)

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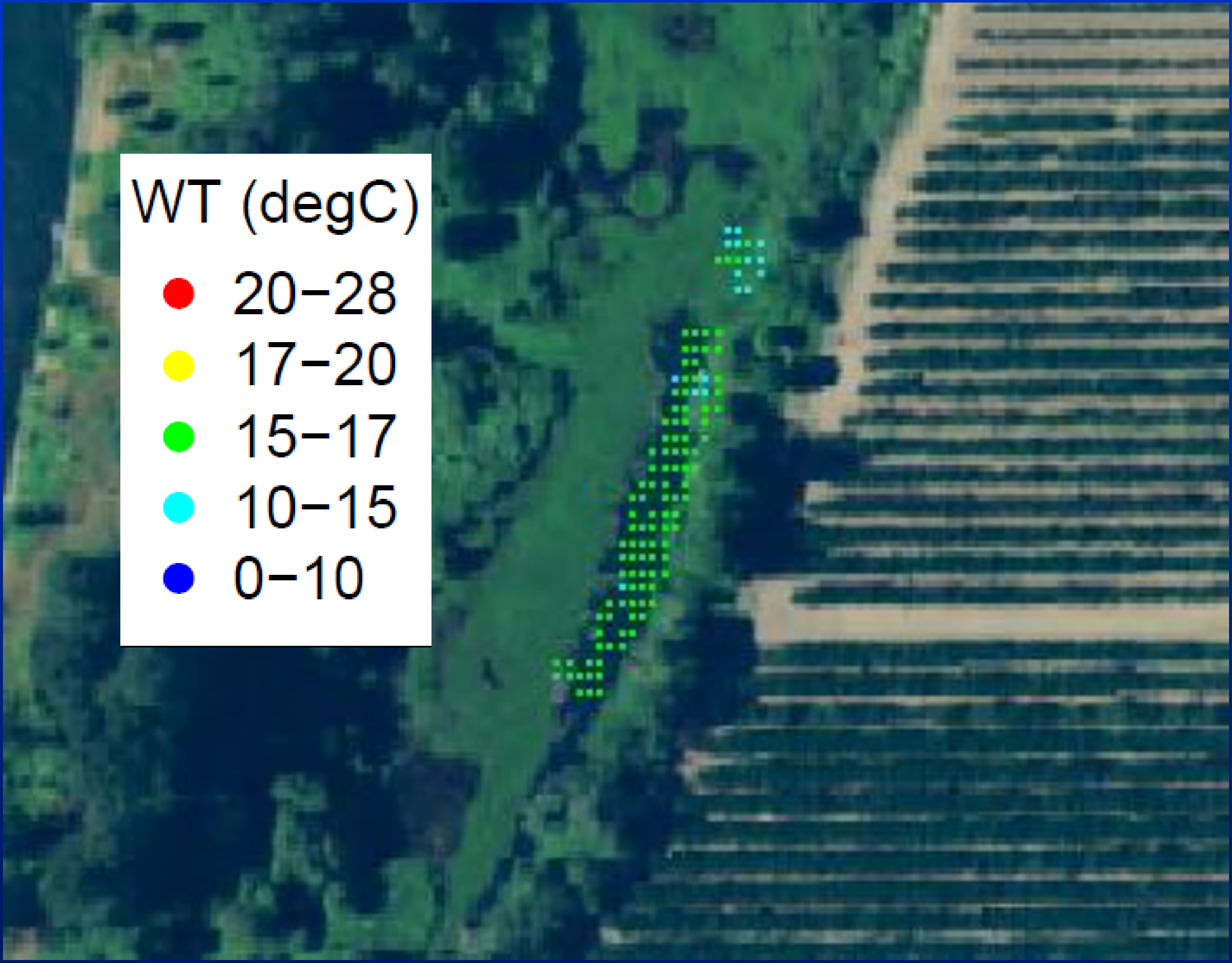


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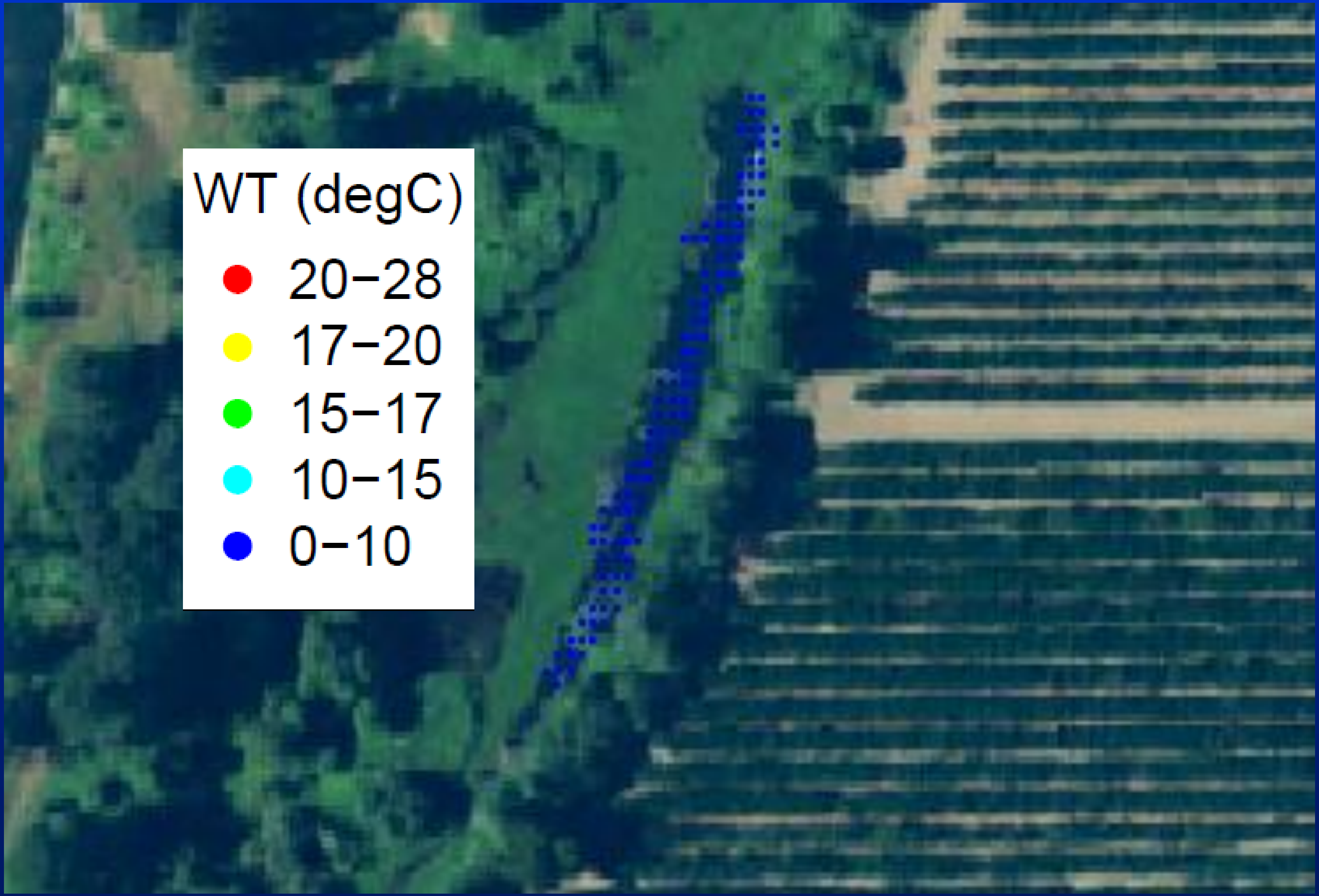


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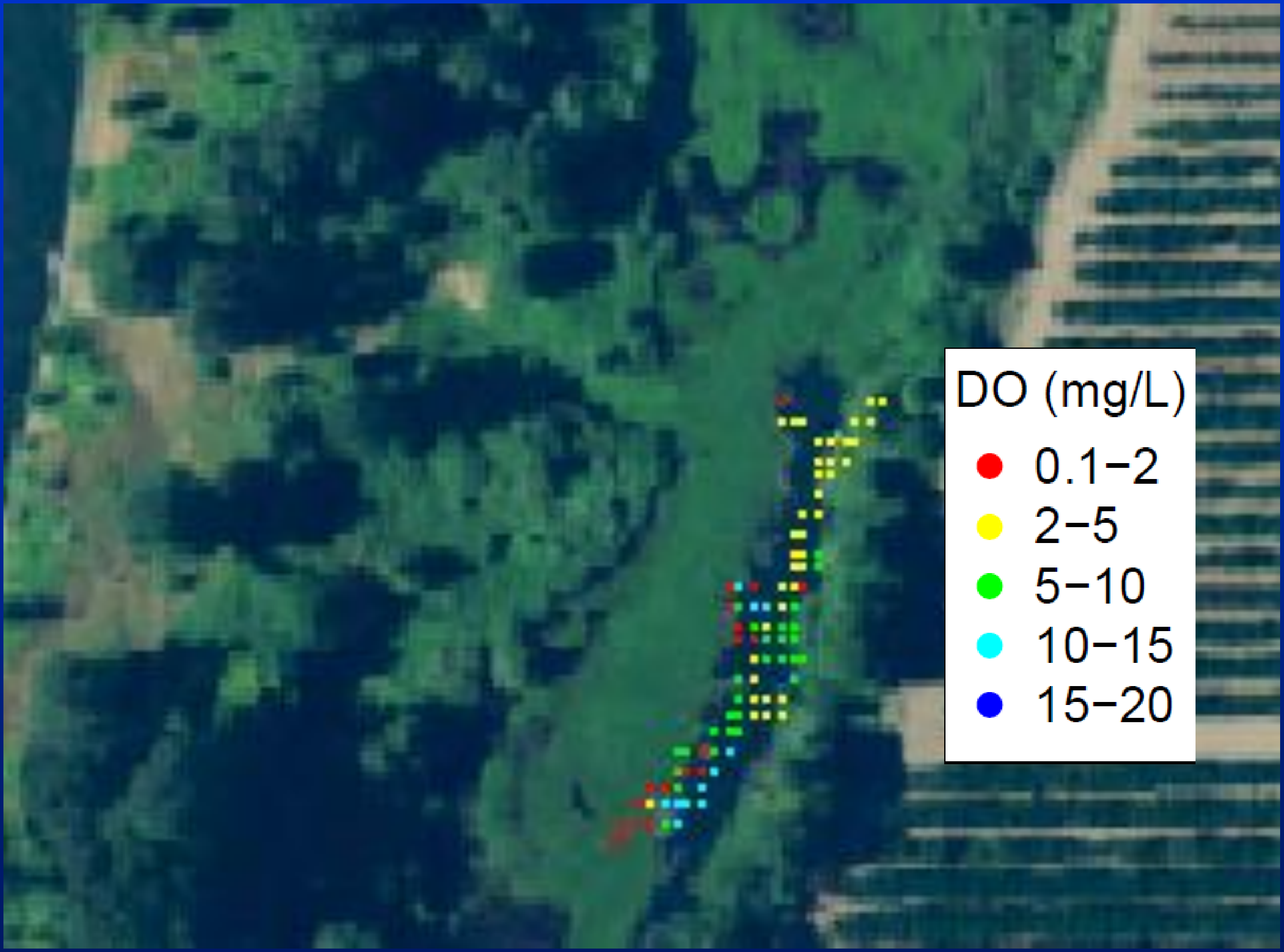
# Scatter Bar Pond 7-7-17
# Dissolved oxygen (milligrams per liter)

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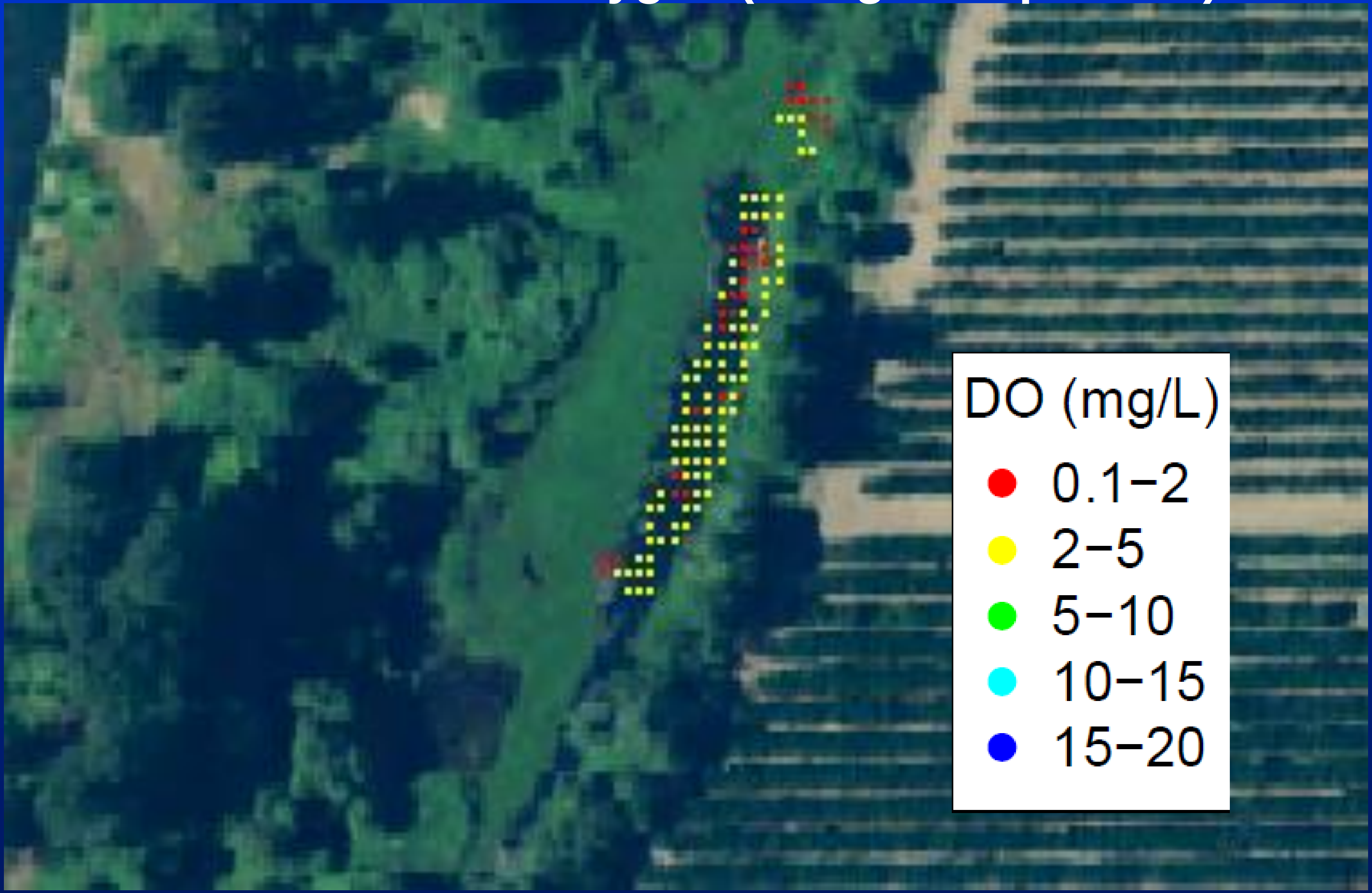


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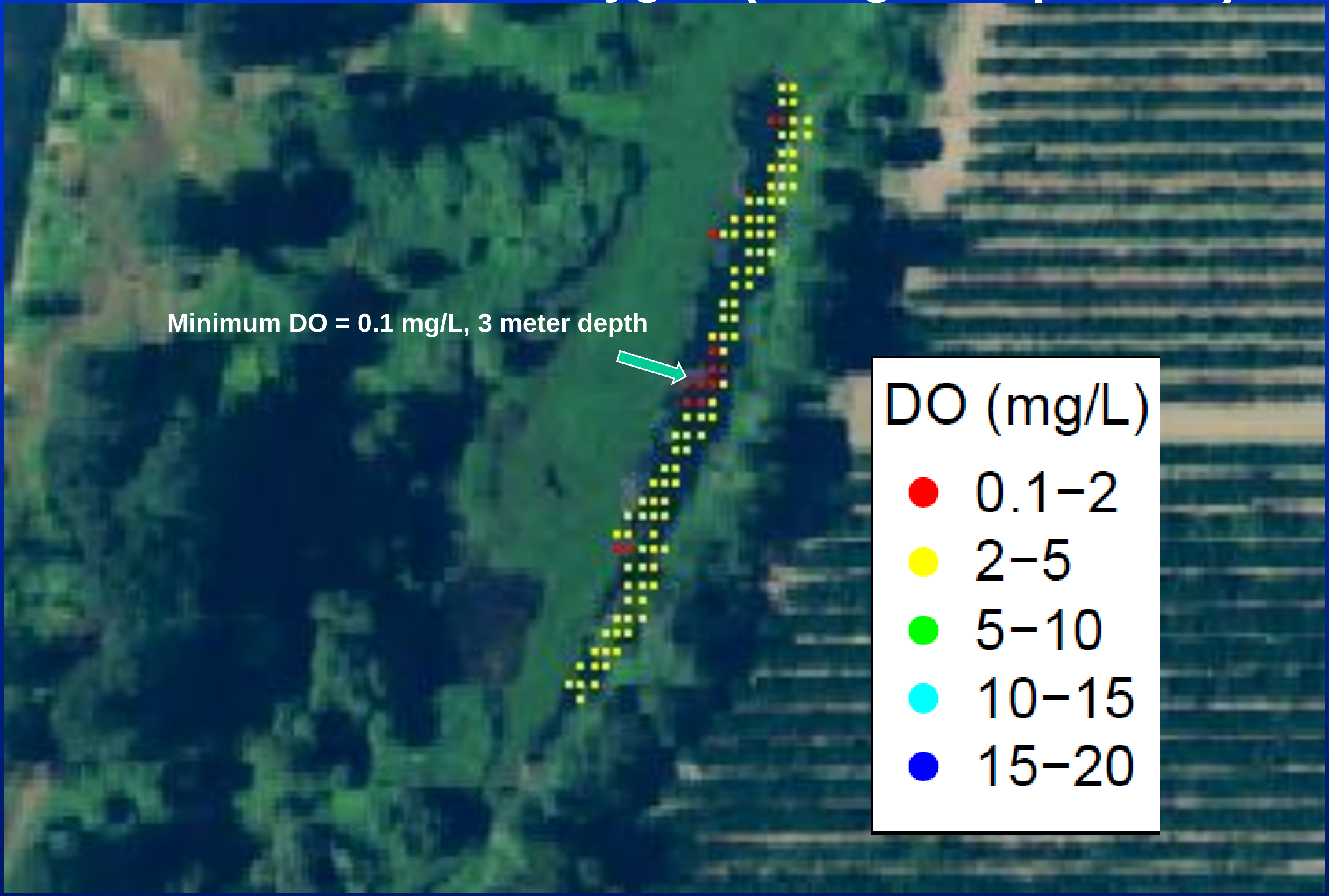


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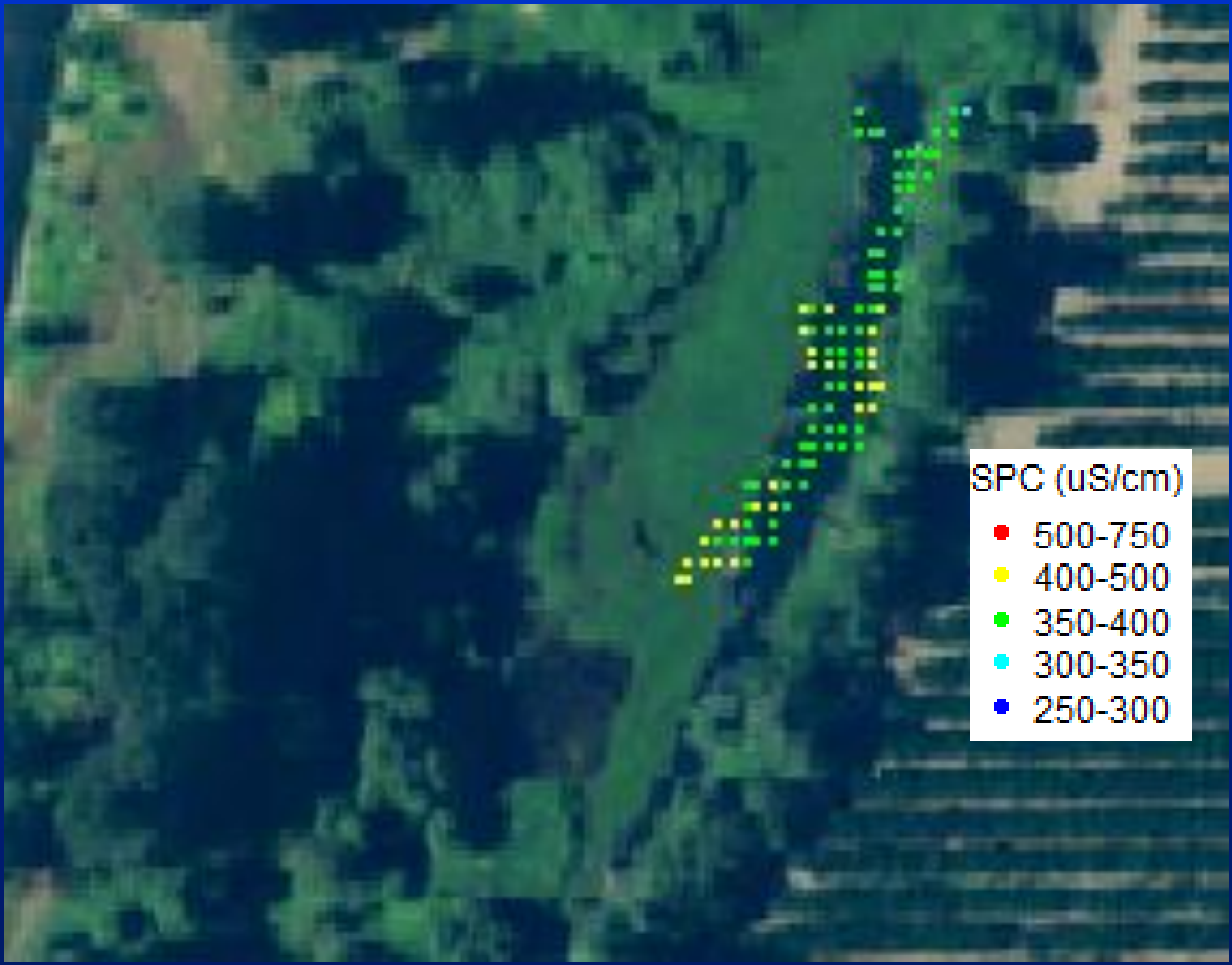
# Scatter Bar Pond 7-7-17
# Specific conductance (microSiemens per cm)

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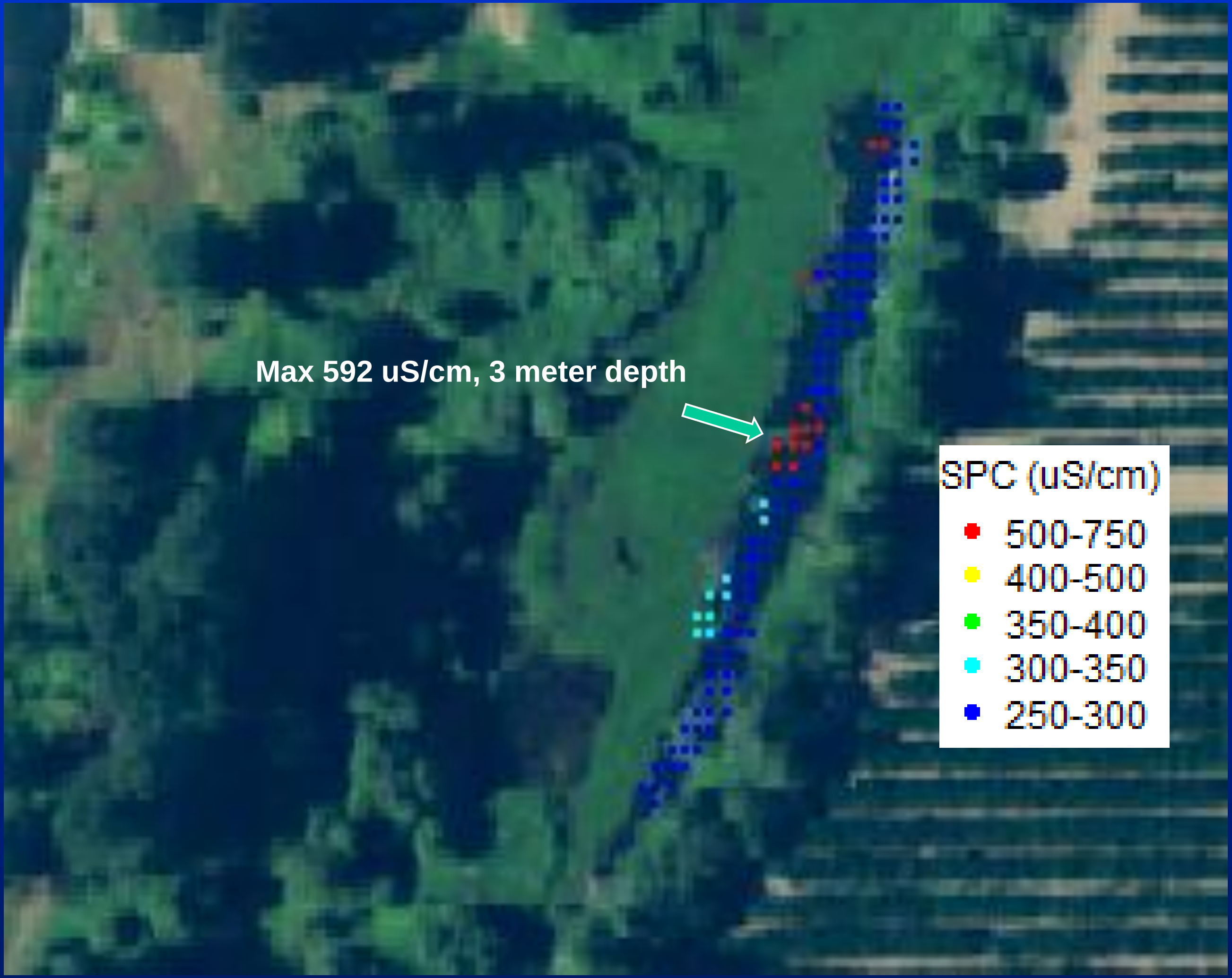


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# Scatter Bar Pond 7-7-17
# pH (standard units)


USGS Unpublished Data Subject to Revision

# Scatter Bar Pond 9-19-17
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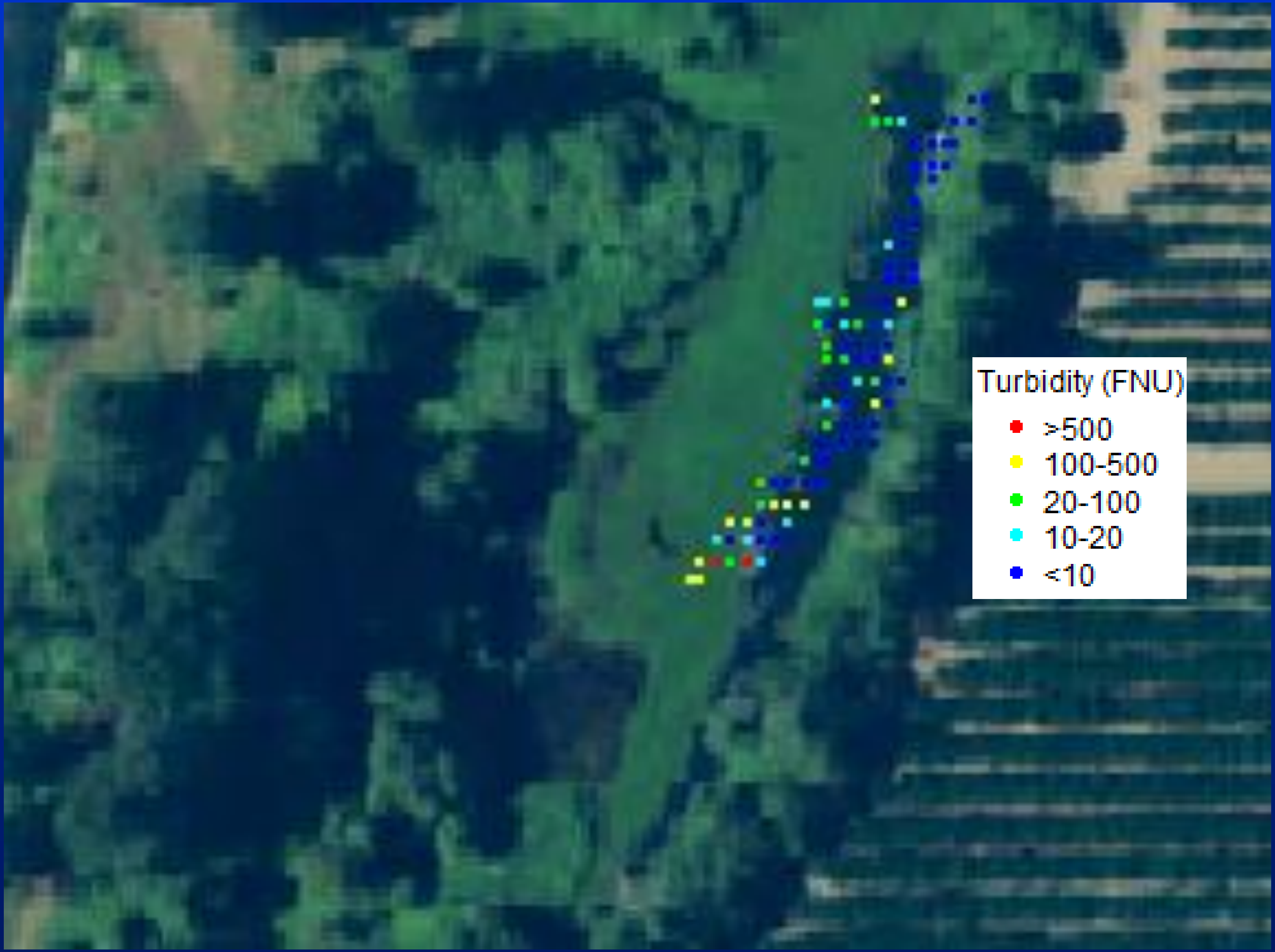
# Turbidity (in formazin nephelometric units)

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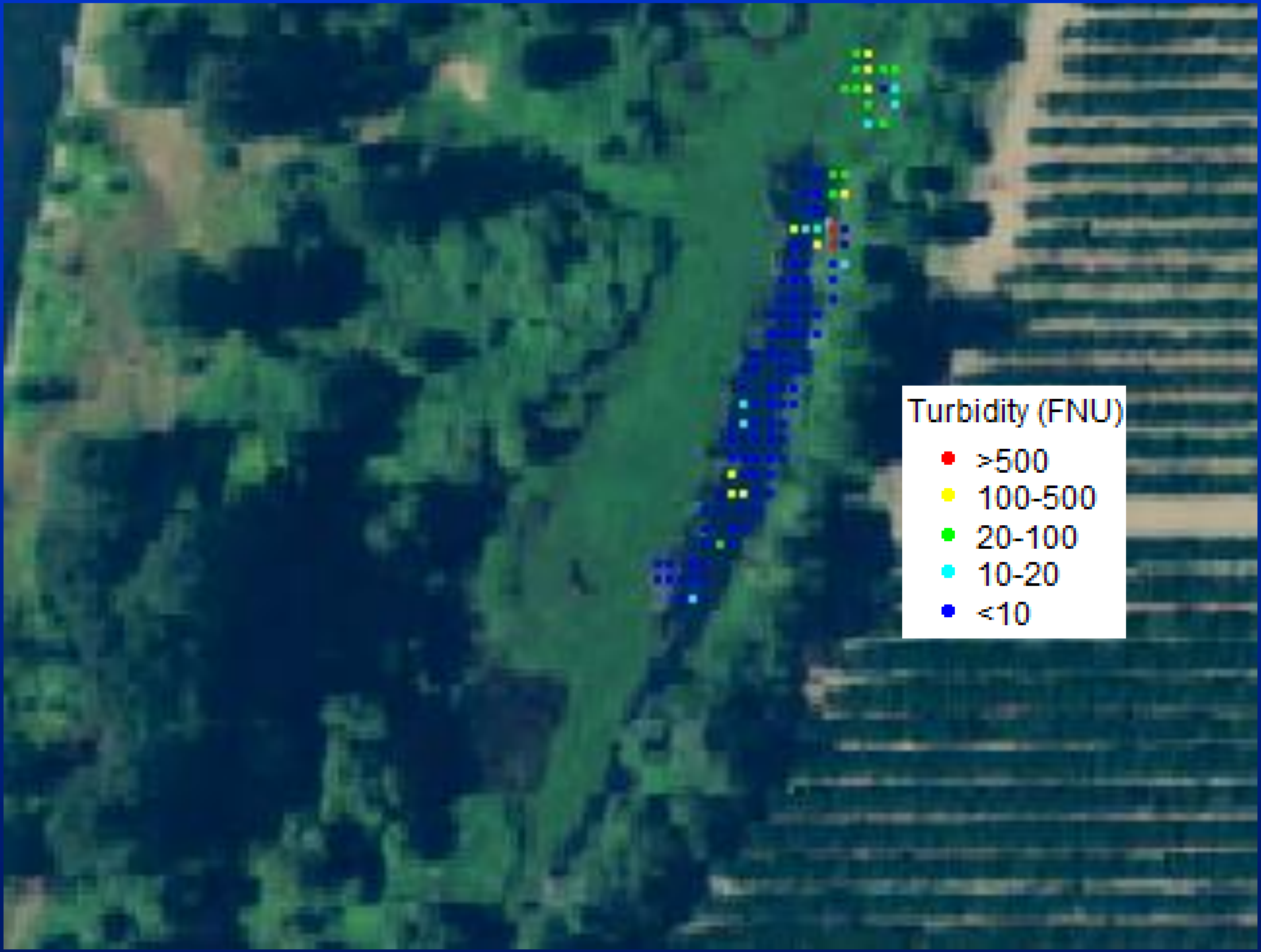


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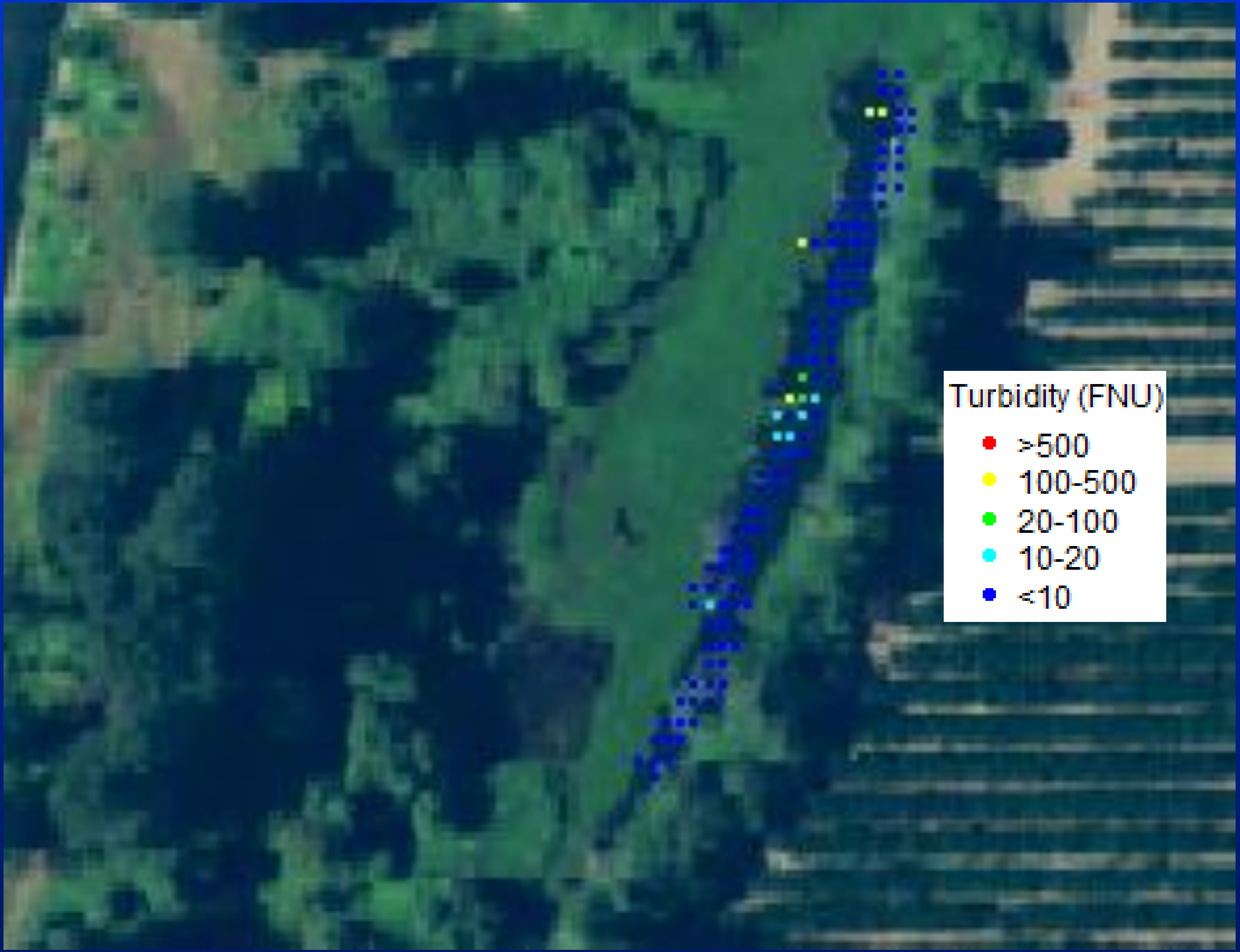
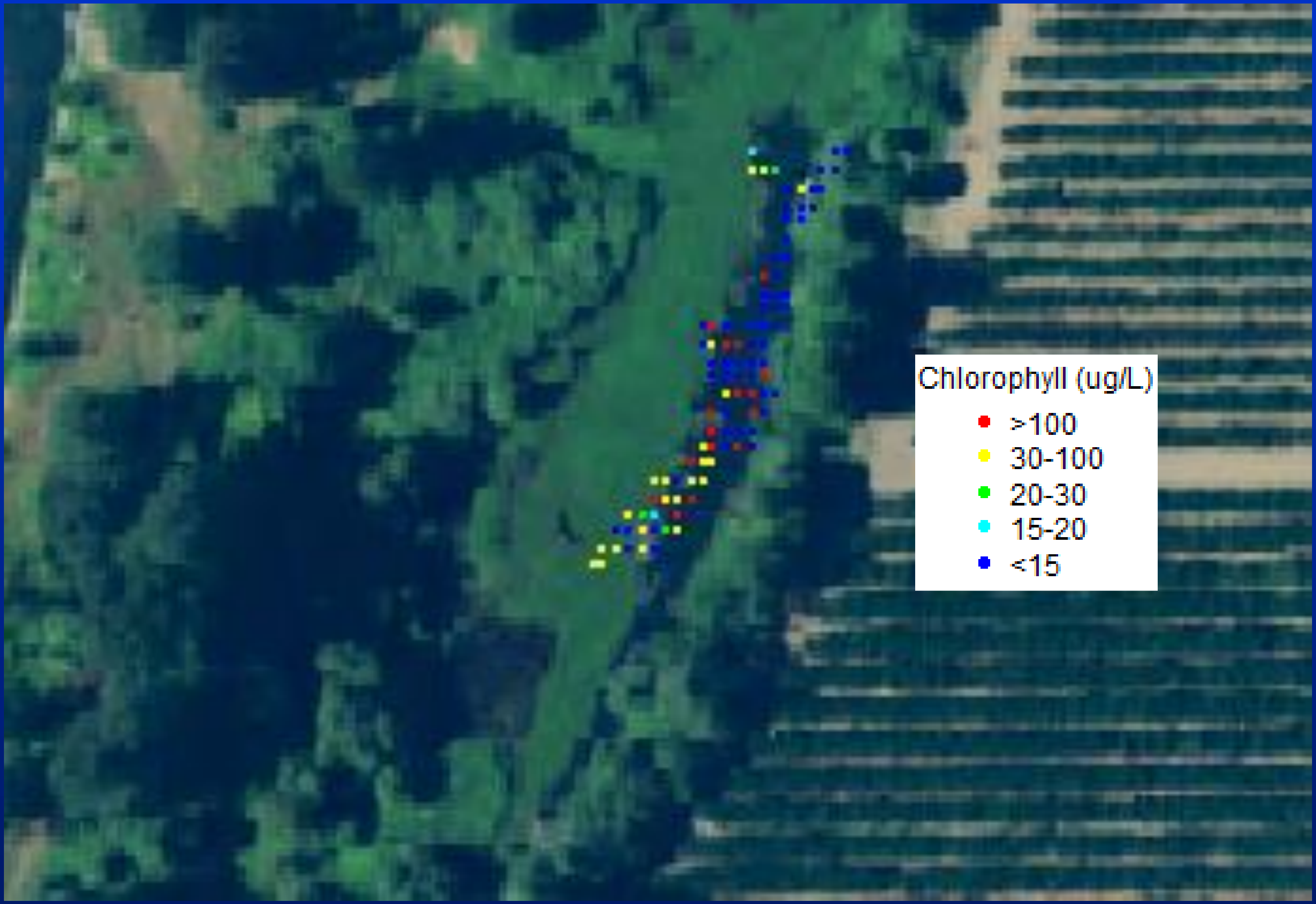
# Scatter Bar Pond 11-14-17
# Turbidity (in formazin nephelometric units)




USGS Unpublished Data Subject to Revision

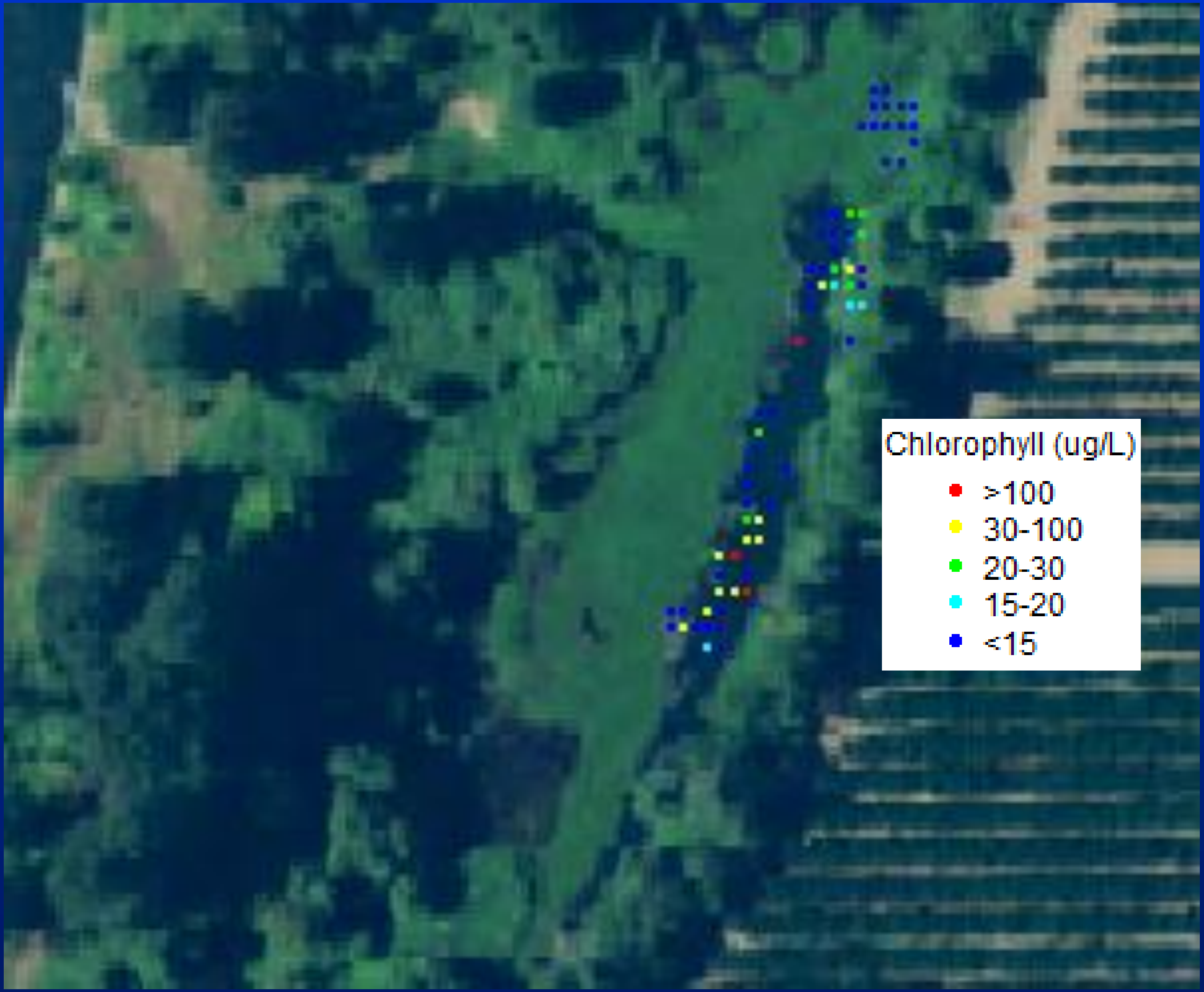
# Scatter Bar Pond 7-7-17
# Total chlorophyll (micrograms per liter)




USGS Unpublished Data Subject to Revision

USGS

# Scatter Bar Pond 9-19-17
# Total chlorophyll (micrograms per liter)




USGS Unpublished Data Subject to Revision

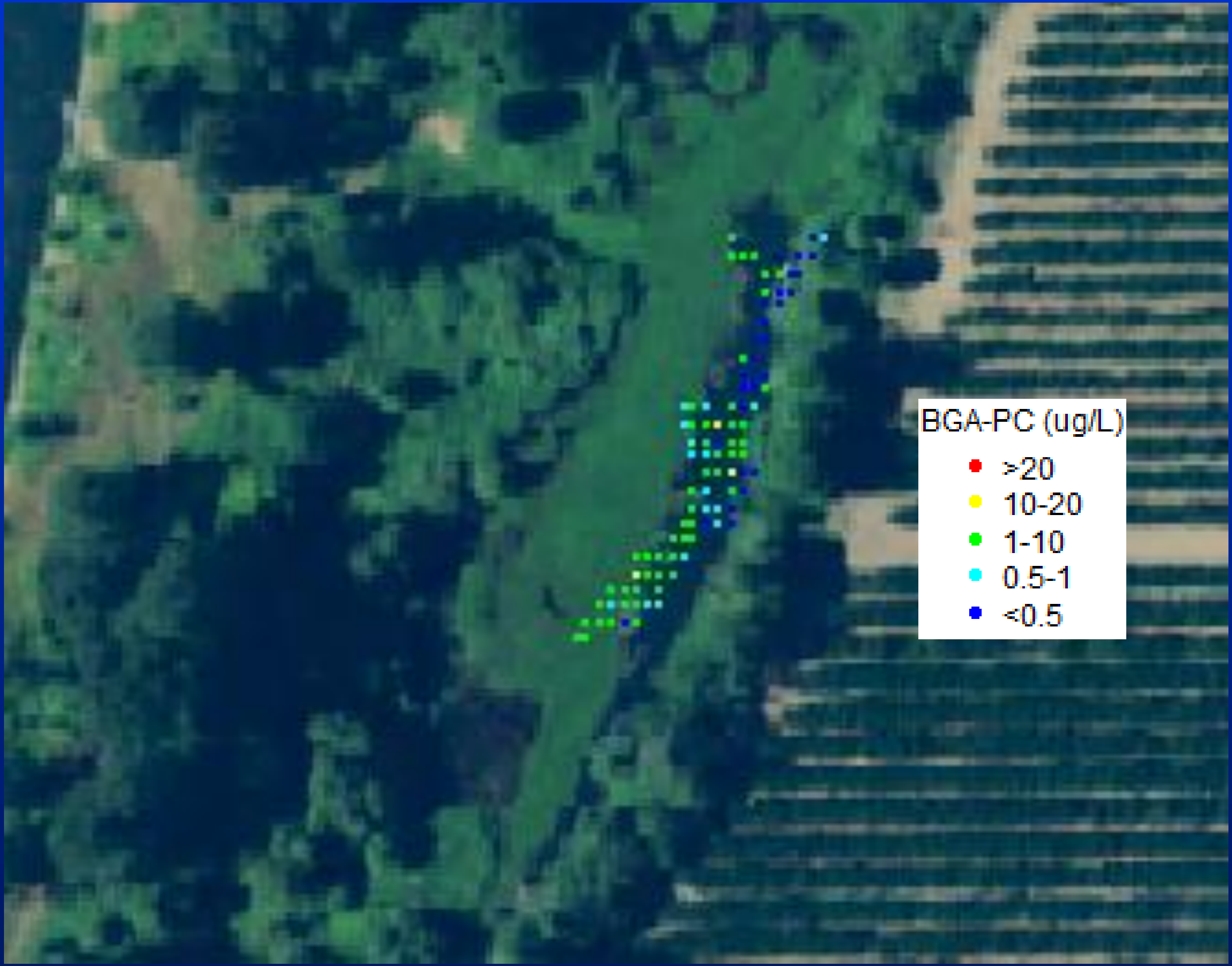
USGS

# Scatter Bar Pond 11-14-17
# Total chlorophyll (micrograms per liter)


USGS Unpublished Data Subject to Revision

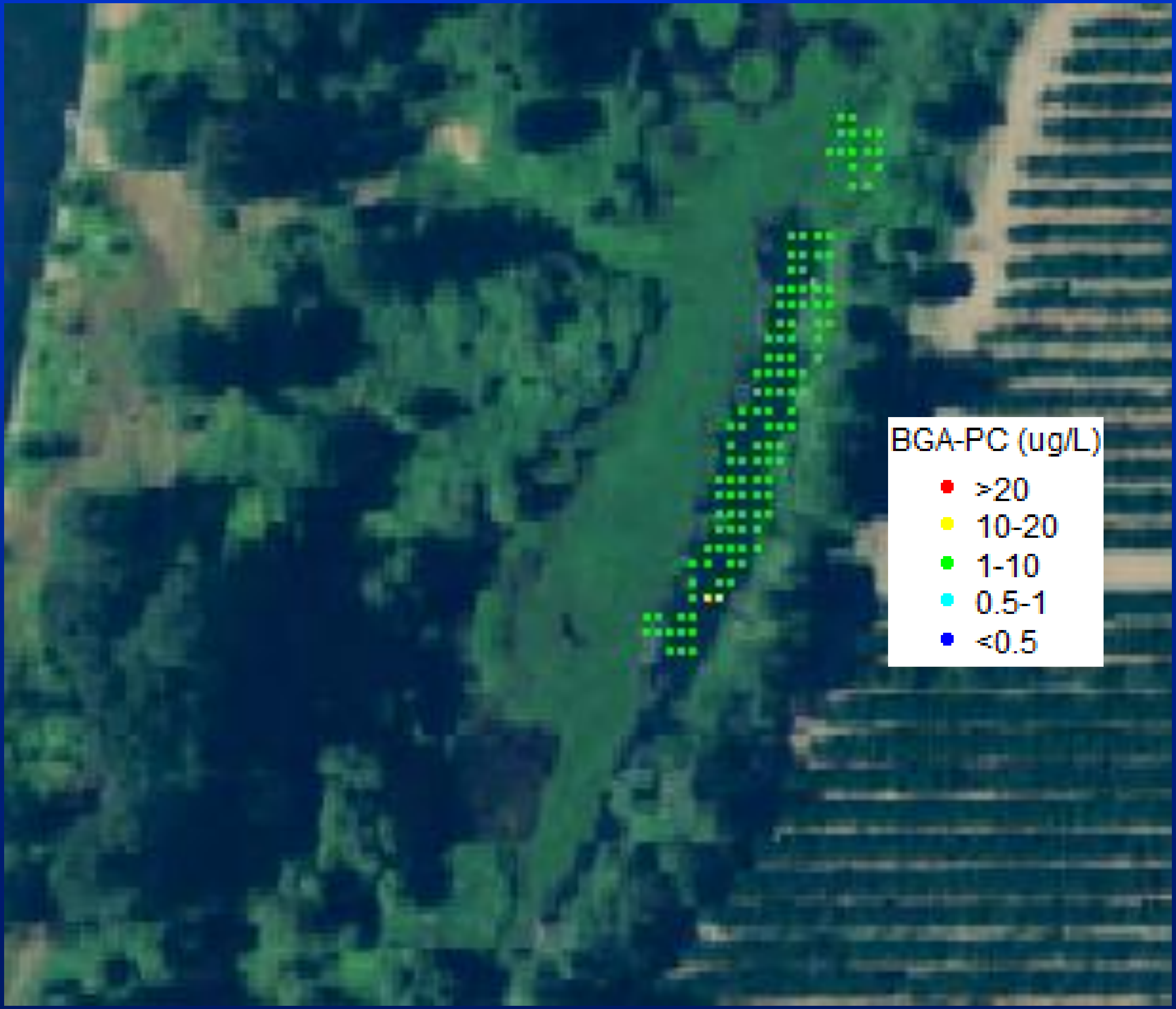
USGS

# Scatter Bar Pond 7-7-17
# Phycocyanin (micrograms per liter)



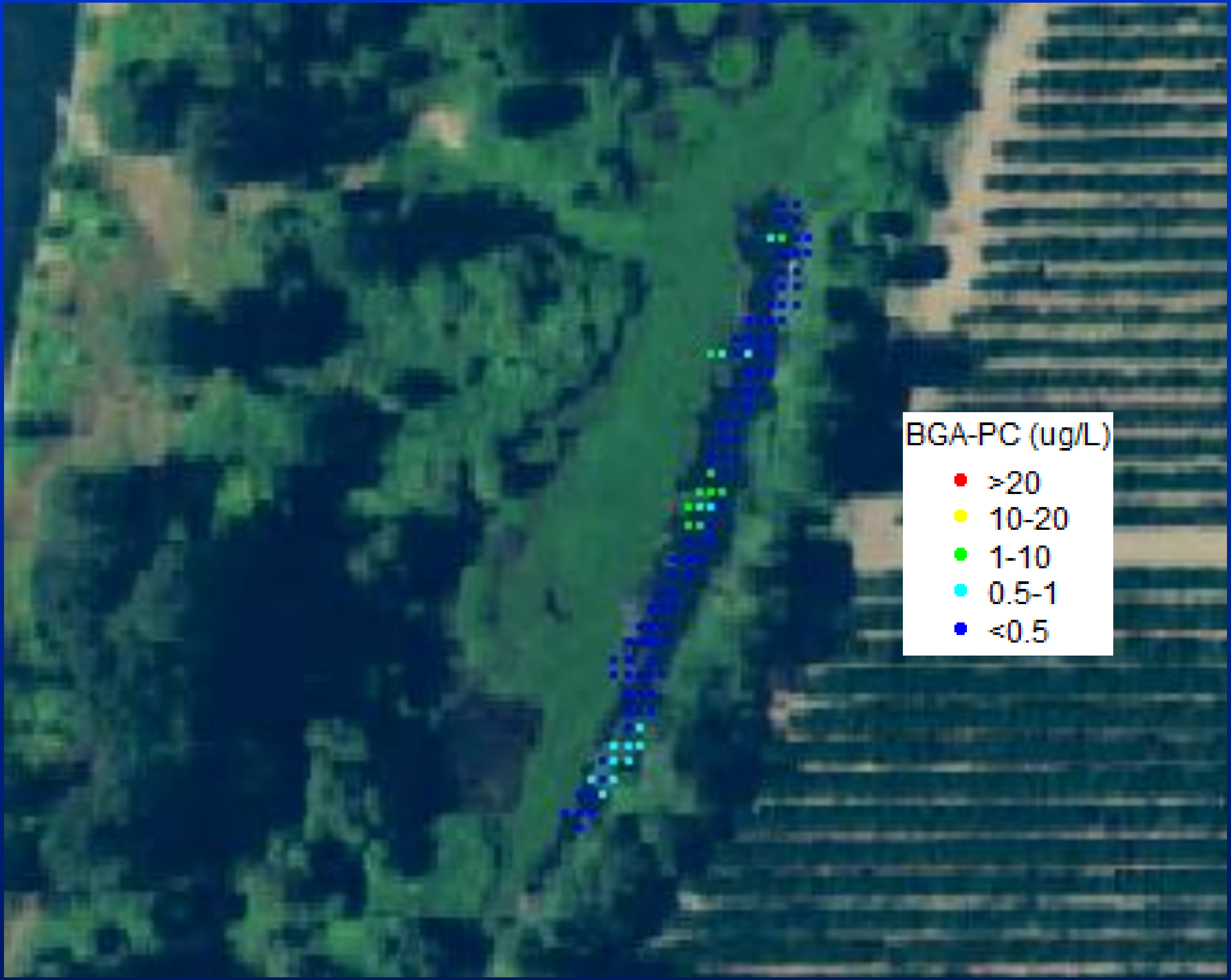

USGS Unpublished Data Subject to Revision

# Scatter Bar Pond 9-19-17
# Phycocyanin (micrograms per liter)



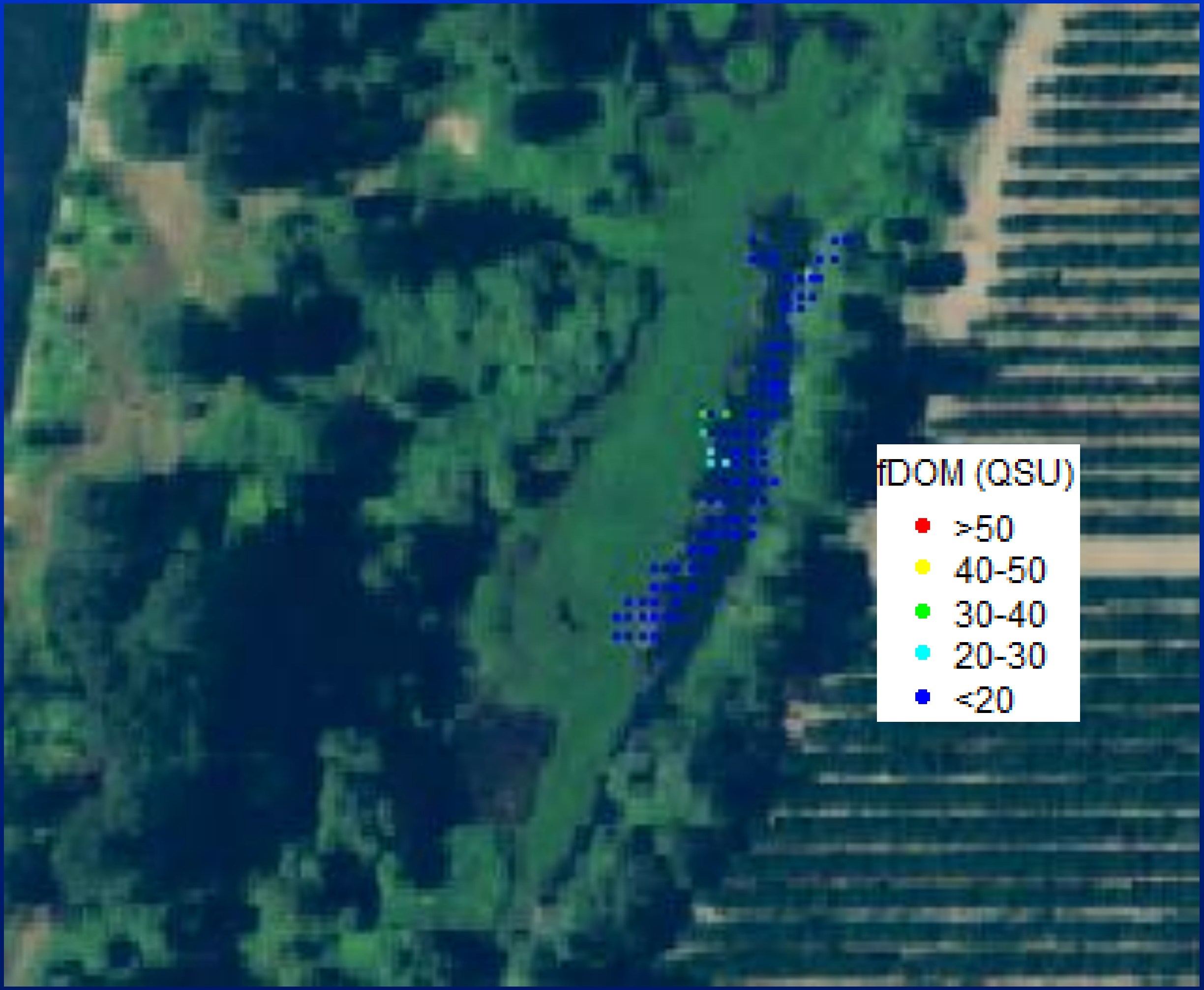

USGS Unpublished Data Subject to Revision

# Scatter Bar Pond 11-14-17
# Phycocyanin (micrograms per liter)



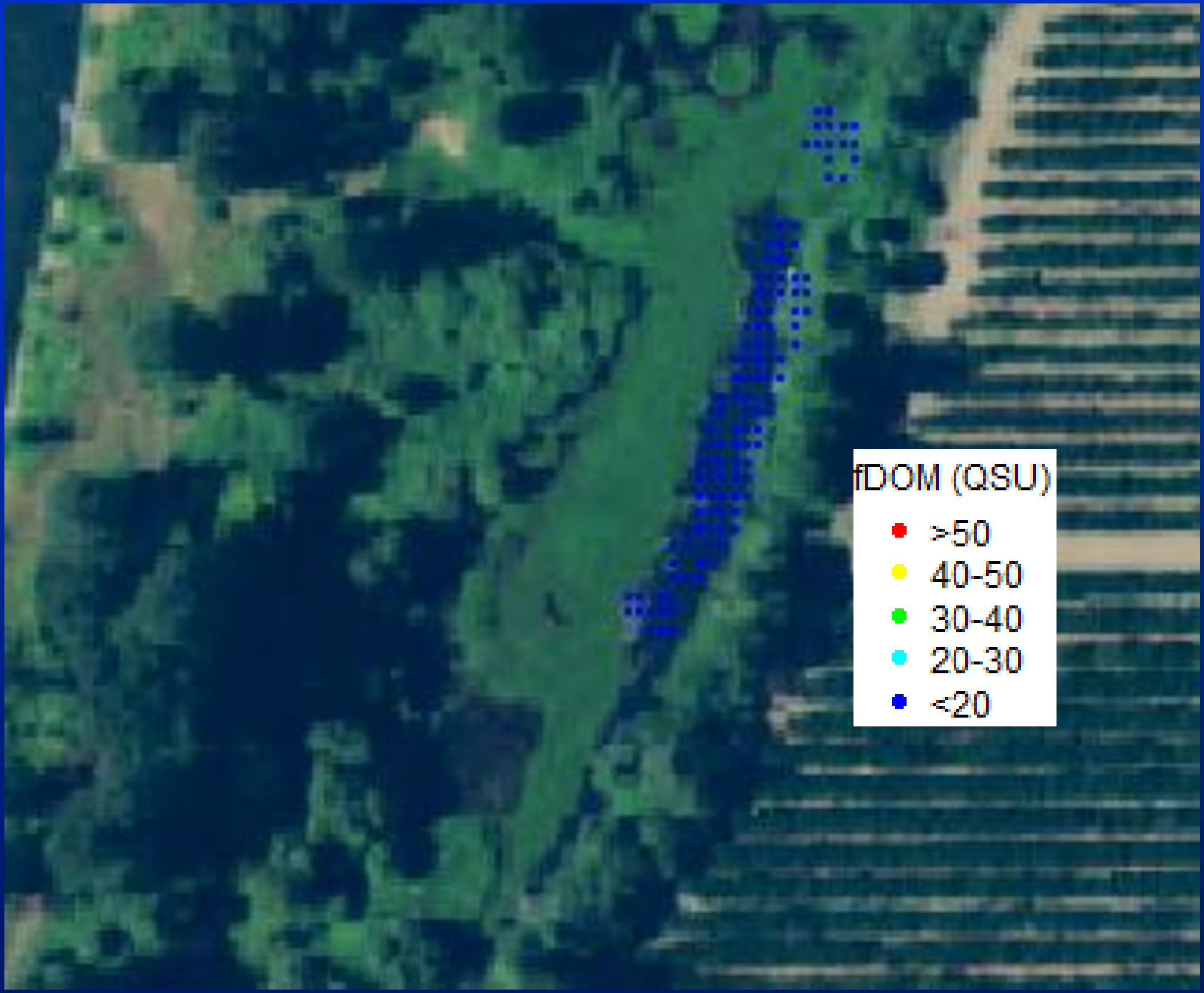

USGS Unpublished Data Subject to Revision

# Scatter Bar Pond 7-7-17
# Fluorescing dissolved organic matter (Quinine sulfate equivalent units)




USGS Unpublished Data Subject to Revision

# Scatter Bar Pond 9-19-17
# Fluorescing dissolved organic matter (Quinine sulfate equivalent units)




USGS Unpublished Data Subject to Revision

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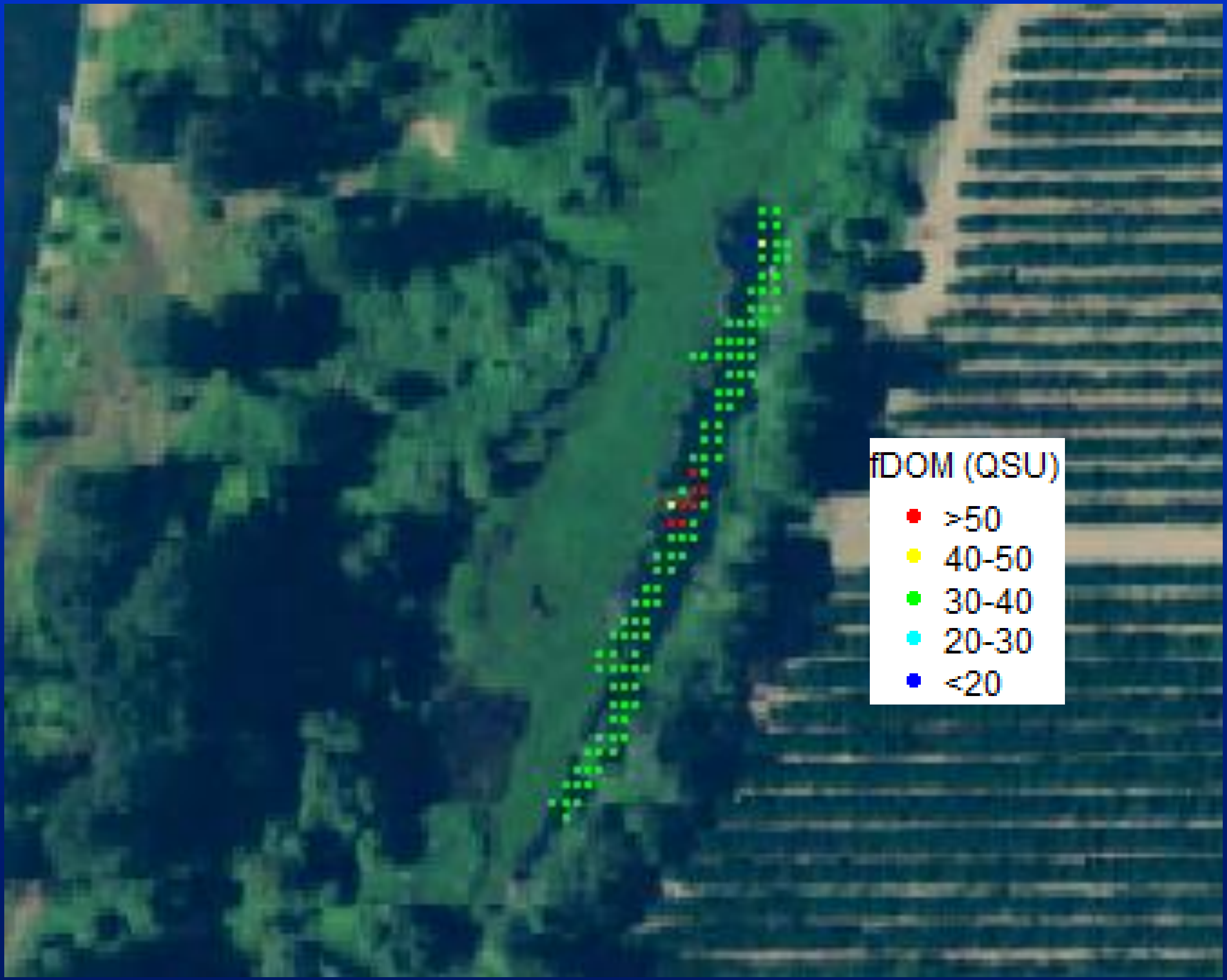
# Scatter Bar Pond 11-14-17
# Fluorescing dissolved organic matter
# (Quinine sulfate equivalent units)

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