Weed Mapping Workflows using Esri GIS software

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San Francisco Estuary Invasive Spartina Project

Preserving native wetlands

Invasive Cordgrass

Spartina densiflora

Spartina anglica

Spartina alterniflora x foliosa

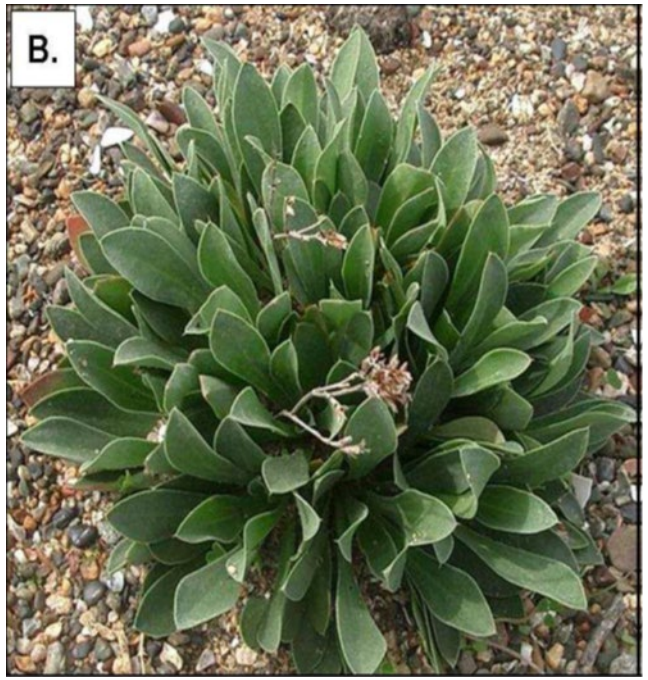
We also have native *S. foliosa*

Invasive Limonium & Paspalum

Ask Drew Kerr for more info!

Limonium ramosissimum

Algerian sea lavender



From Archbald & Boyer 2014

Paspalum vaginatum

Seashore Paspalum

Photo by Drew Kerr

We also have native *Limonium* & *Paspalum* species!

Mapping Goals

- Document Extent & Distribution
  - More than presence/absence
  - Exact locations
  - Abundance
- Inform Treatment
  - Control
  - Eradication (*Spartina densiflora, S. anglica*)
- Document Change Over Time
  - Changing mosaic as treated

Who Does This?

- Grant funded through Cal-IPC 💙
- Biologists with training in
  - Plant Identification
  - Walking in the marsh
  - GPS software use
- Drew Kerr, Olofson Environmental, me

Photo by Drew Kerr

Mapping Frequency & Precision

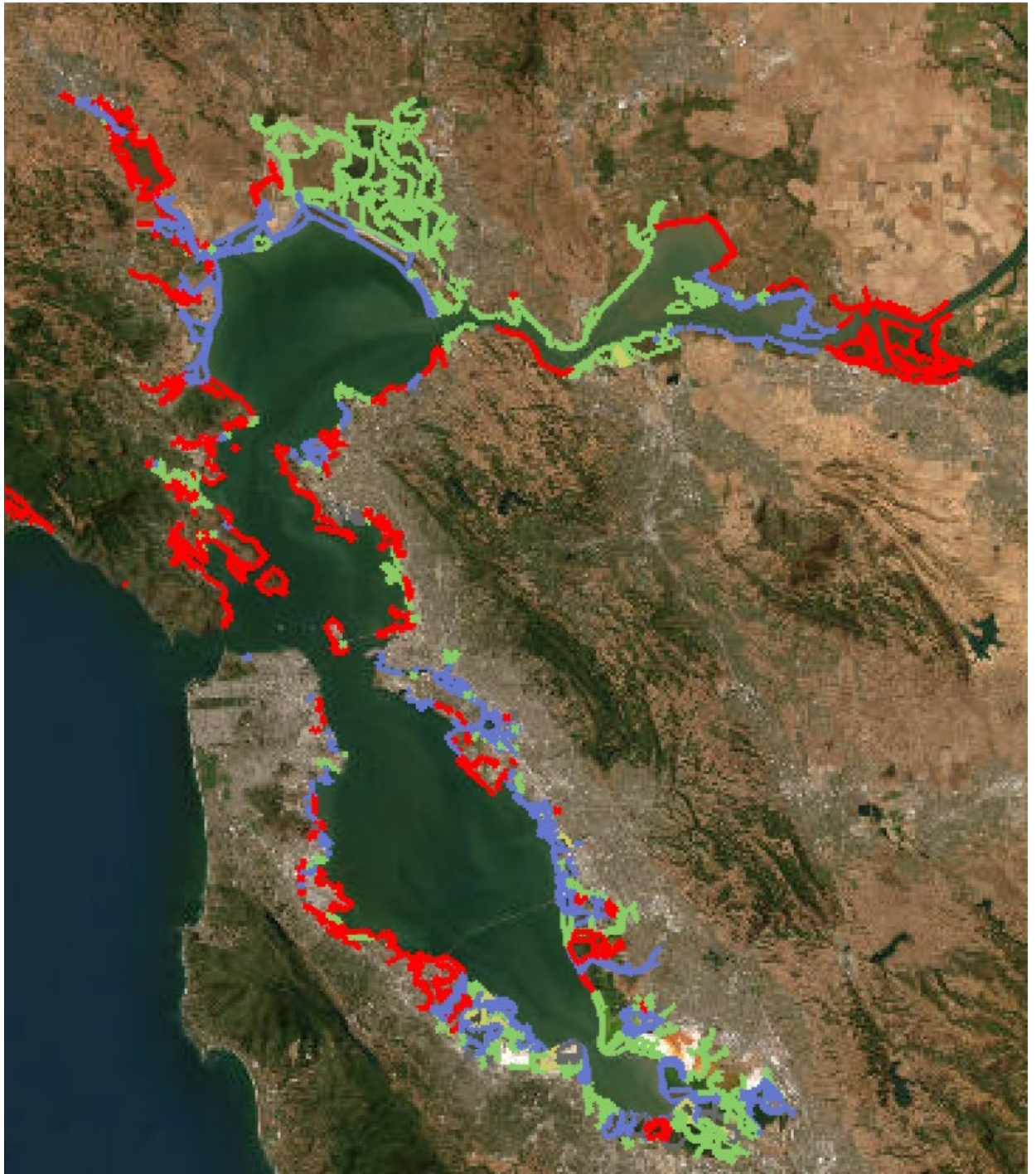
<u>Limonium/Paspalum</u>

- Initial year mapping
- Treatment polys thereafter
- Coarse cover class bins
- Map new patches during treatment if distinct

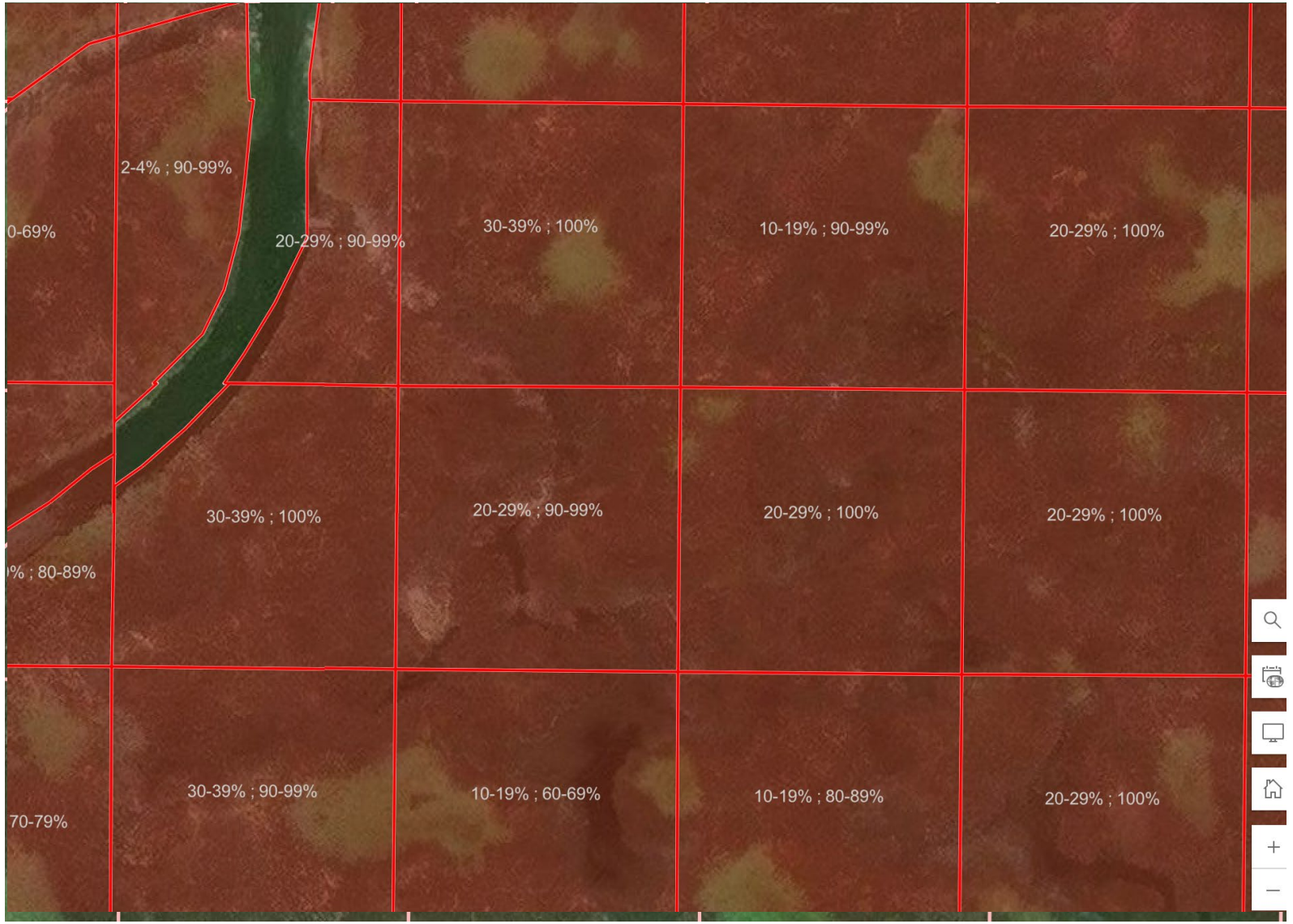
Mapping Frequency & Precision

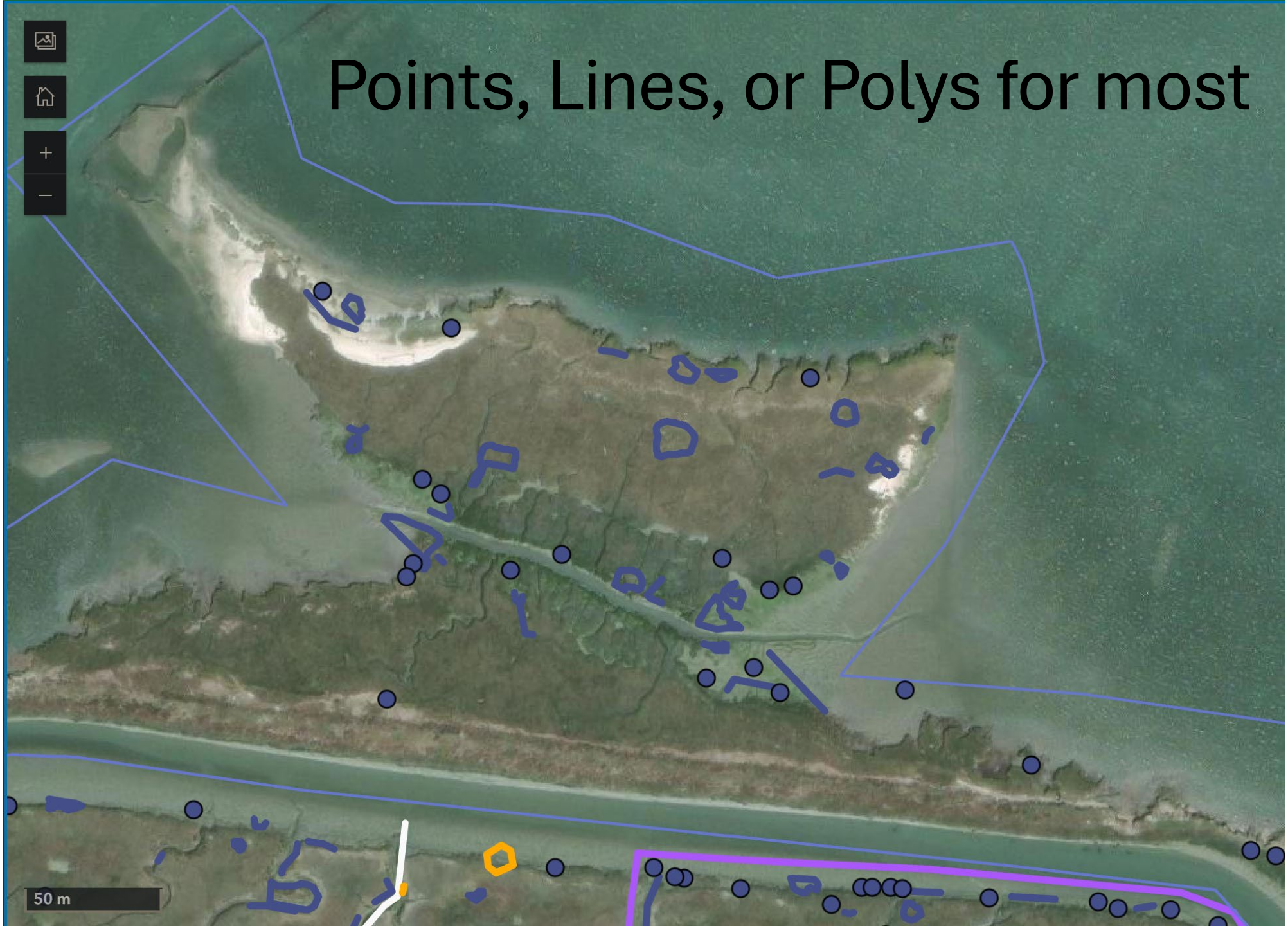
Spartina

- Inventory mapping 1-2x/year in prioritized sites
- Grids every 2 years
- Feature-level treatment documentation



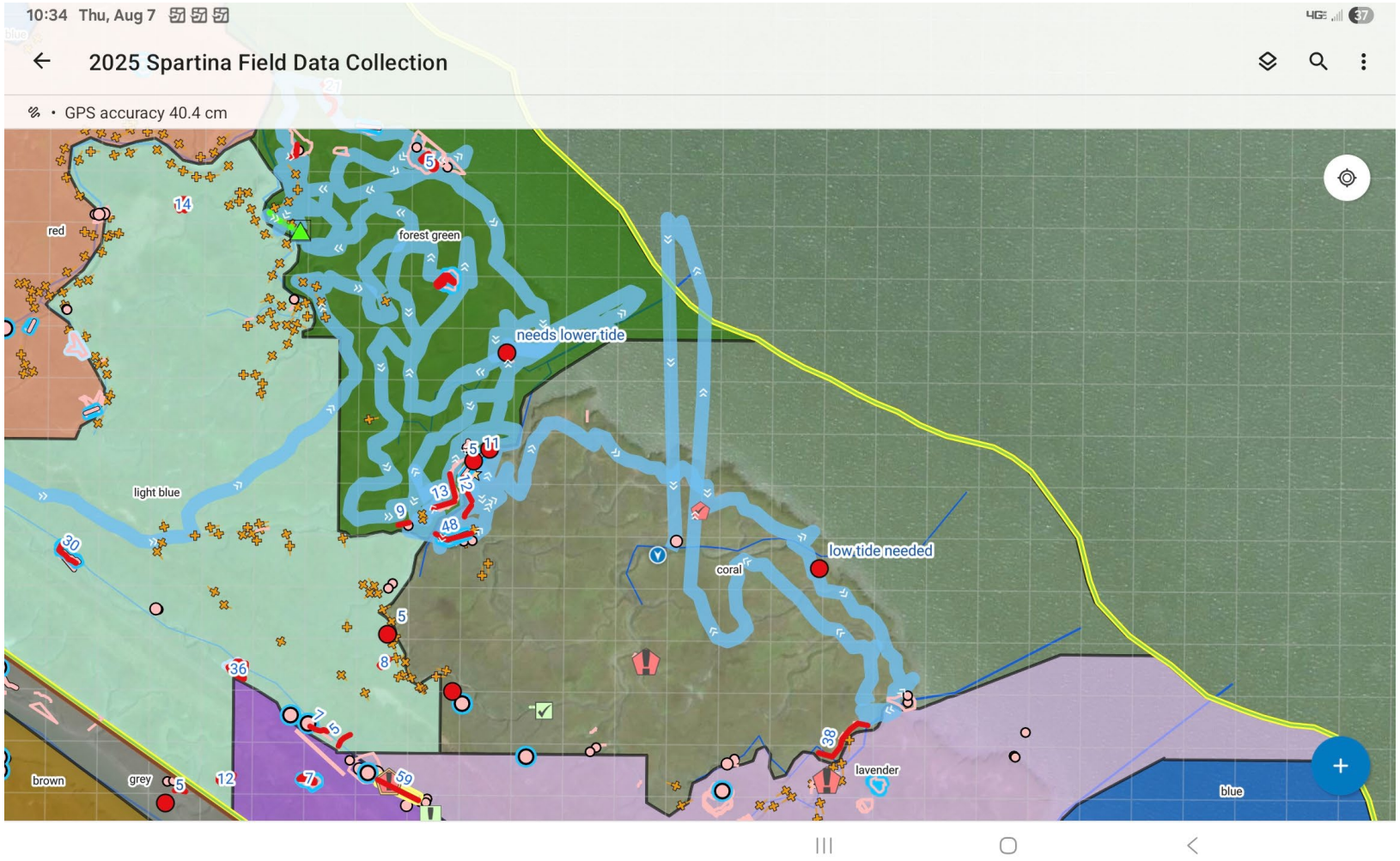
Grids for dense infestations




Points, Lines, or Polys for most
50 m

Field Software Needs

- Background Imagery
- View
- Collect
- Update
- Real-time data sharing
- Breadcrumb trails



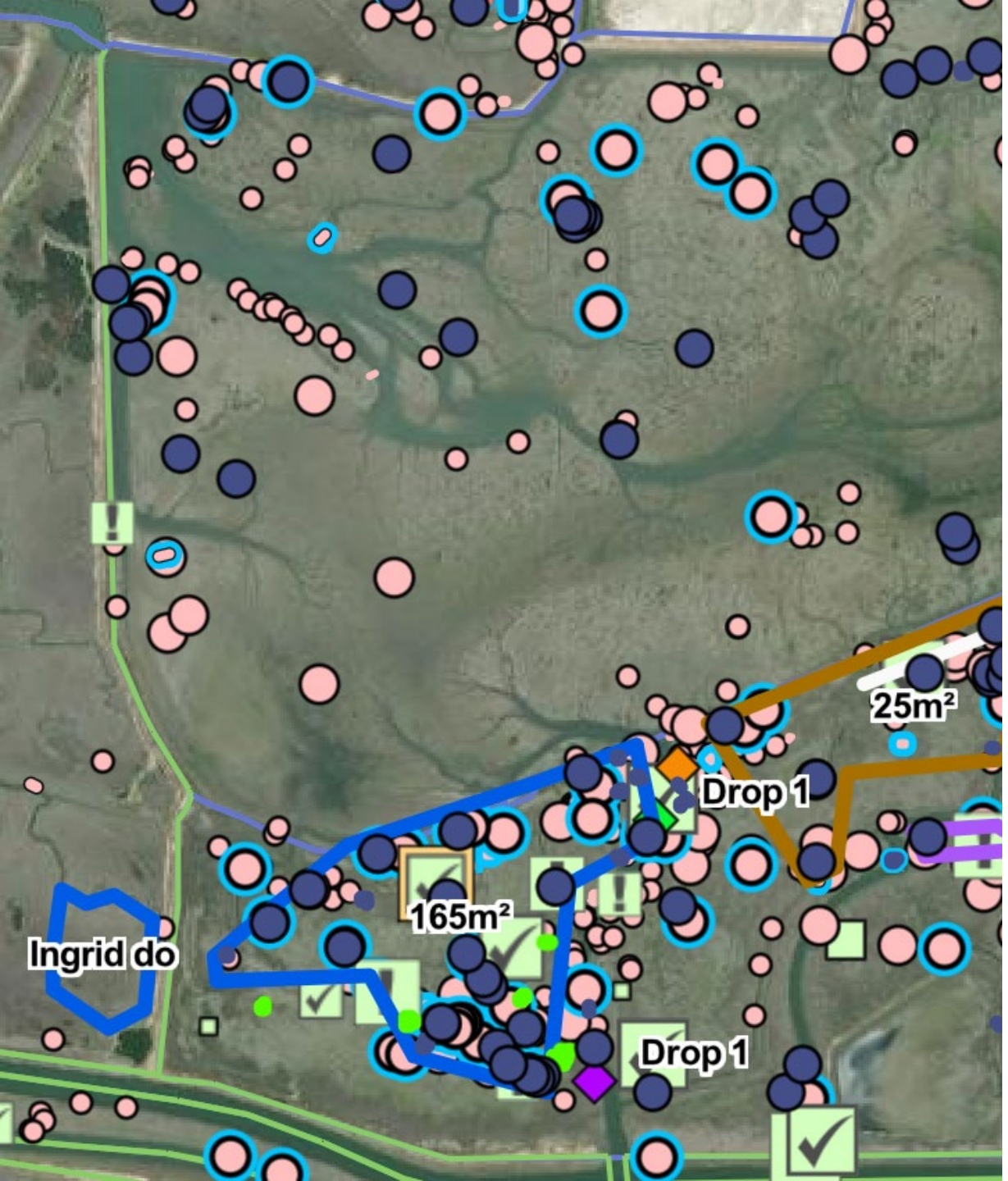
Esri Field Work Options

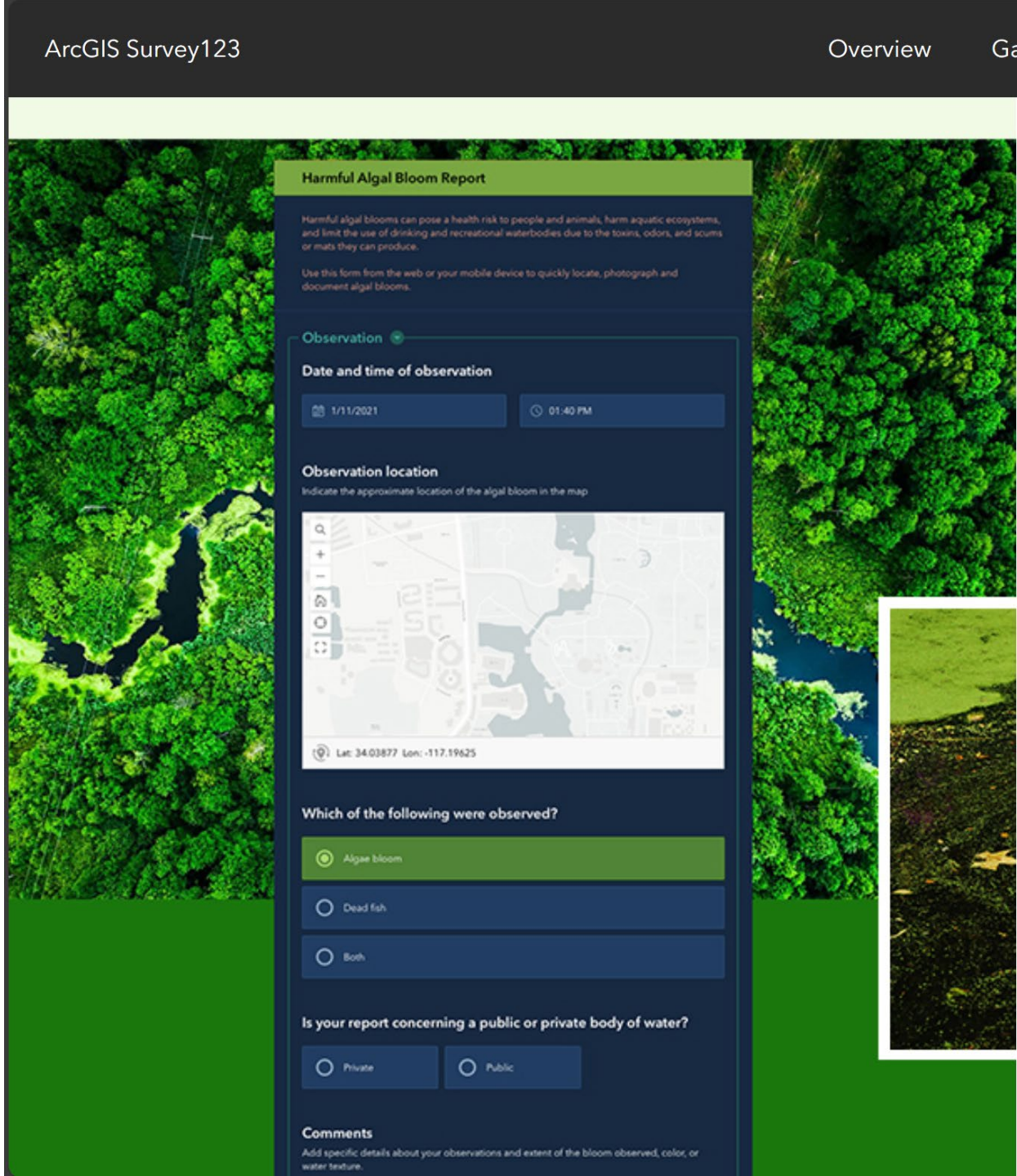
Esri Field Maps

- MAP-CENTRIC
- Looks like a map
- Arcade formulas
- Example: Invasive Spartina mapping!

Esri Survey123

- DATA-CENTRIC
- Looks like a survey
- Excel formulas
- Example: US Census Bureau


25m²
Drop 1
165m²
Ingrid do
Drop 1

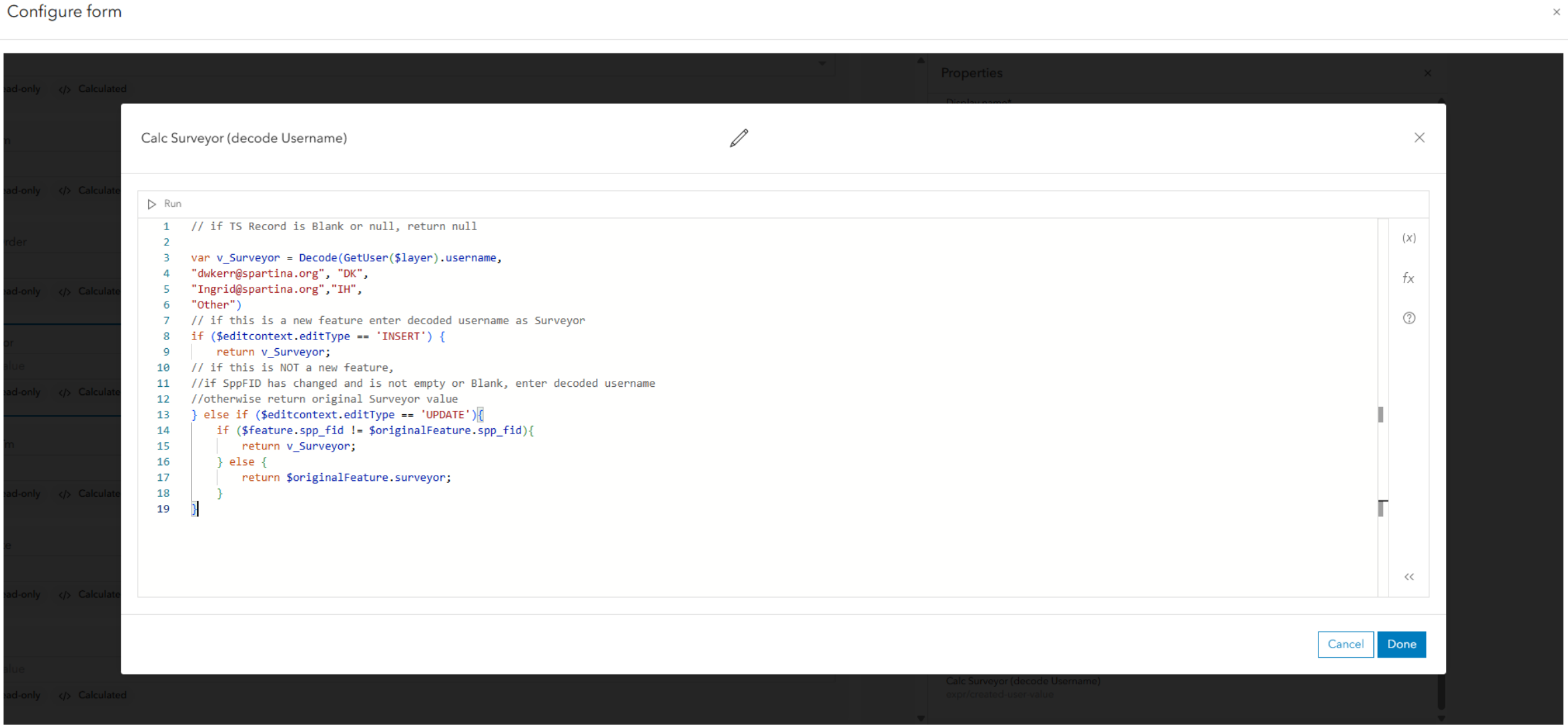

ArcGIS Survey123
Overview
Harmful Algal Bloom Report
Harmful algal blooms can pose a health risk to people and animals, harm aquatic ecosystems, and limit the use of drinking and recreational waterbodies due to the toxins, odors, and scums or mats they can produce.
Use this form from the web or your mobile device to quickly locate, photograph and document algal blooms.
Observation
Date and time of observation
1/11/2021
01:40 PM
Observation location
Indicate the approximate location of the algal bloom in the map
Lat: 34.03877 Lon: -117.19625
Which of the following were observed?
Algae bloom
Dead fish
Both
Is your report concerning a public or private body of water?
Private
Public
Comments
Add specific details about your observations and extent of the bloom observed, color, or water texture.

Field Maps Customizations

Arcade ❤️

- Automatically Record
  - Name
  - Date & time
  - GPS details

Field Maps Customizations



Field Maps Customizations

Now invdttm for insert, original for update

Run

```
1  if ($editcontext.editType == 'INSERT') {
2      return Now();
3  } else {
4      return $originalfeature.INVDtTm;
5  }
```

Field Maps Customizations

Arcade

- Business Logic
  - If-this-then-that

Draw Order Calc

Run

```
1  if($feature.fmsym == 'foliosa' || $feature.fmsym == 'sprayed' || $feature.fmsym == 'manual'){
2      return 1
3  } else if($feature.fmsym == "hide"){
4      return 0
5  } else if ($feature.senescent == -1){
6      return 1
7  } else {
8      return 2
9  }
```

Field Maps Customizations

Arcade

- Automatically Calculate

Calculate AvgNetM2

Run

```
var CoverCode = $feature.CoverNN
var piRsquared = 3.14* $feature.Radius * $feature.Radius

CoverCode * piRsquared
```

Calc MinNetm2

Run

```
var CoverCode = $feature.covernn
var v_GrossArea = AreaGeodetic($feature)

var decodedMinValue = Decode (CoverCode, "0",0,".005",.001,".01",.01,".03",.02,".075",.05,".15",.1,".25",.2,".35",.3,".45",.4,".55",.5,".65",.6,".75",.7,".85",.8,".95",.9,"1",1,0)

if(v_GrossArea > 0 && !IsEmpty($feature.covernn)) {
    return decodedMinValue * v_GrossArea
} else {
    return null
}

```

Esri GIS Platform Options

ArcGIS Server/Enterprise

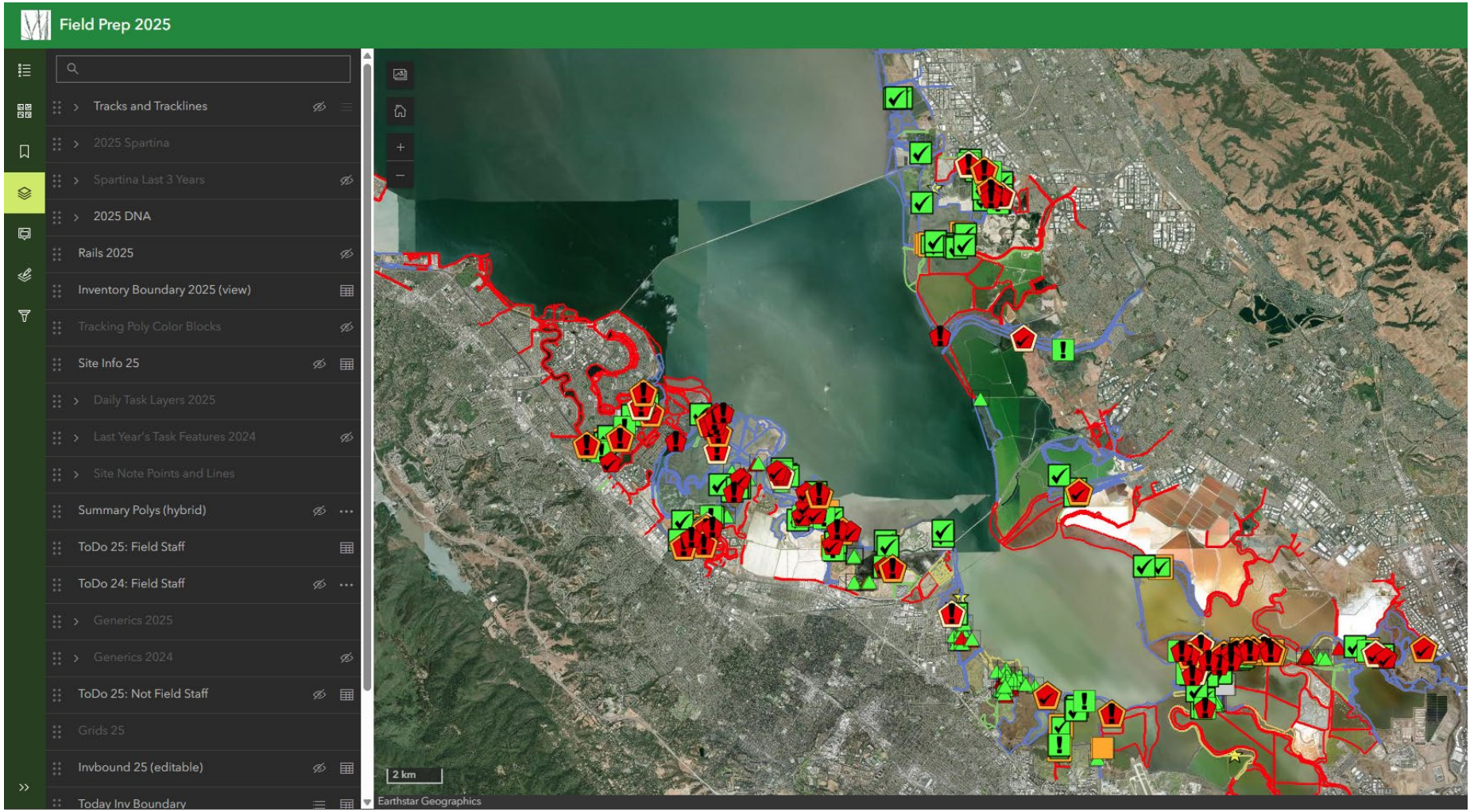
- Purchase software
- Install on server(s)
- Archiving, versioned editing, geodatabase choice, manual updates
- Hosted layers (no credits)
- Referenced layers (Enterprise geodatabase)

ArcGIS Online (AGOL)

- Software as a Service (SAAS) – online, Esri updates
- Last one in wins for edits
- No archiving or versioning
- Hosted layers (credits)

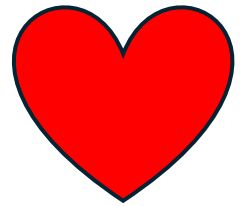
Esri GIS Mapping/Editing Options

- Web Maps
- Web Apps
- Desktop: ArcGIS Pro
- Mobile:
  - Field Maps
  - Survey123
  - Quick Capture



GIS Processing Customizations

Python



- Complex daily data summary: Per site
  - # samples
  - # features
  - Area mapped
  - Area treated

- Tracks to Tracklines - not automatic in Enterprise ☹

Resources I've found helpful

- Esri Conservation Program
- Fieldwork GIS/GPS Considerations
  - Fieldwork Handbook: A Practical Guide on the Go (Esri Press)
- Field Maps
  - ArcGIS Field Maps Resources (documentation)
- Arcade
  - ArcGIS Arcade Essentials (training)
  - Common calculated expressions for ArcGIS Field Maps (blog)
- AGOL
  - Explore Paris with ArcGIS Online (tutorial)
  - Building an App in ArcGIS Online to Expand Food Access (lab)
- Enterprise
  - ArcGIS Architecture Center (website)

	Site and Infestation Type	Treatment Type	Mapping Method	When Used
Coarse Strategy	Large, coalesced populations with greater than 500 m^2/ha treatment area, in greater than 9 ha sites with low perimeter-to-area ratios (<1:10)	Broadcast Treatment	Aerial Imagery Analysis	Target can be distinguished via remote sensing methods
			Grids	Quick summary of level of infestation and distribution across the landscape is desired, and neither the exact location of target plants nor differentiation from non-target plants within the grid area is necessary.
			Field-Based Infested Area Mapping	Site can be accessed (by ground or helicopter) to allow coarse GPS mapping of infested areas using large polygons, or by digitizing over background layers.
Precise Strategy	Densities less than 500 m^2/ha *or* Small (<9 ha) sites *or* Sites with high (>1:10) perimeter-to-area ratios	Spot Treatment	Long Distance Offsets (Points)	Patches can be seen only at a distance (cannot be reached efficiently). Identification may be questionable.
			Points	Small and/or isolated patches
			Lines	Linear patches
			Polygons	Exact border of the patch is important for informing treatment, or precise tracking of patch expansion over time is desired

Table 1 Site-level weed mapping methods and the conditions under which they were used by the San Francisco Estuary Invasive *Spartina* Project, California, USA

From D.W.Kerr et al. 2016, Biological Invasions