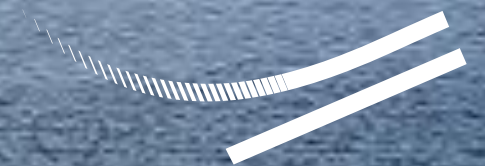


# Using GIS and Custom Apps for Wind Farm Environmental Assessments (EAs)

ESAA EnviroTech 2022

April 21, 2022



**DILLON**  
CONSULTING

# Jeff Benjamin – Dillon Associate, GIS Analyst

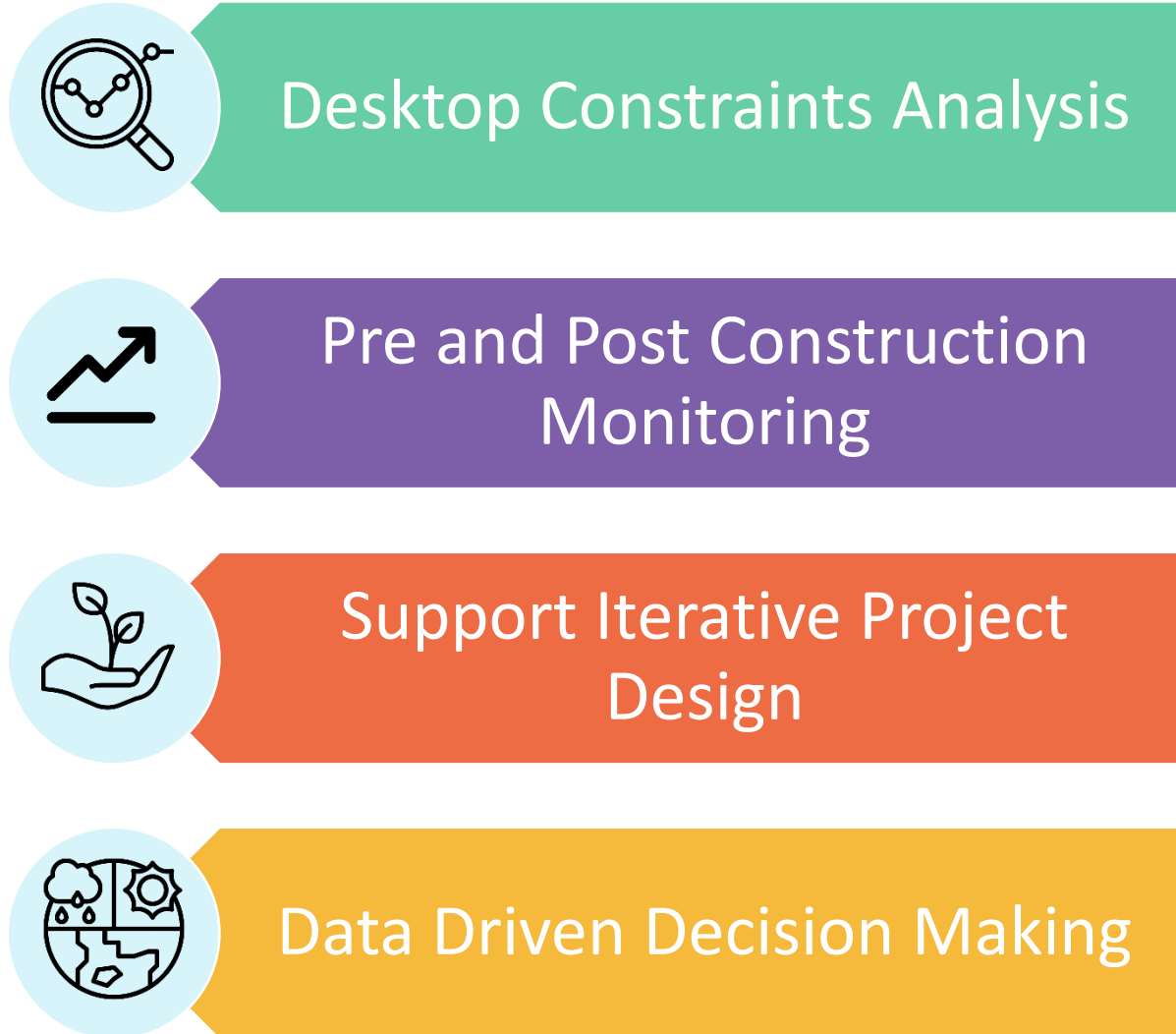


- Biology Degree Dalhousie
- GIS Diploma NBCC
- 13 Years Consulting Experience
- Technical Group Strategist for Spatial Information Management Team
- Visual assessments, database design, data collection, WebGIS, water resources, Environmental Assessments

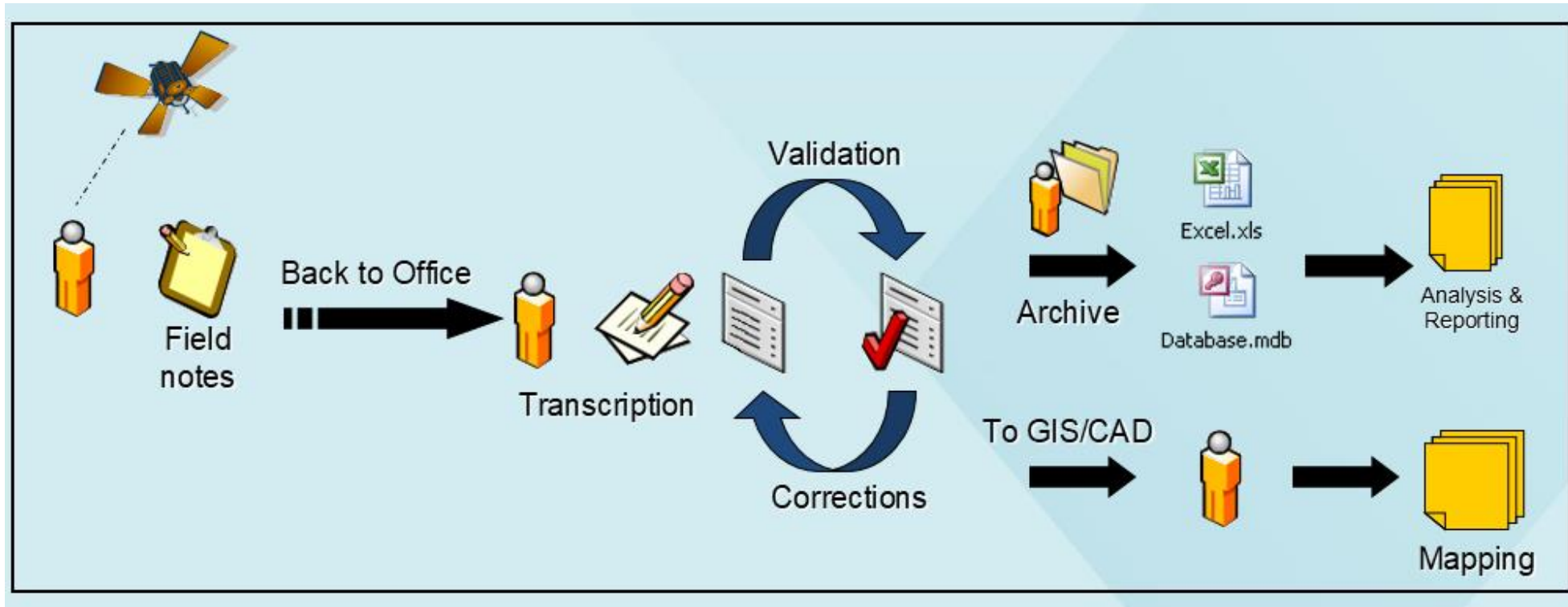
# Presentation Outline

1. Bio
2. Overview
3. Wetland Predictive Modelling
4. Web GIS
5. Biophysical Data Collection
6. Automated Reporting Applications
7. Overview/Summary

# Value of WebGIS Applications for Environmental Assessments

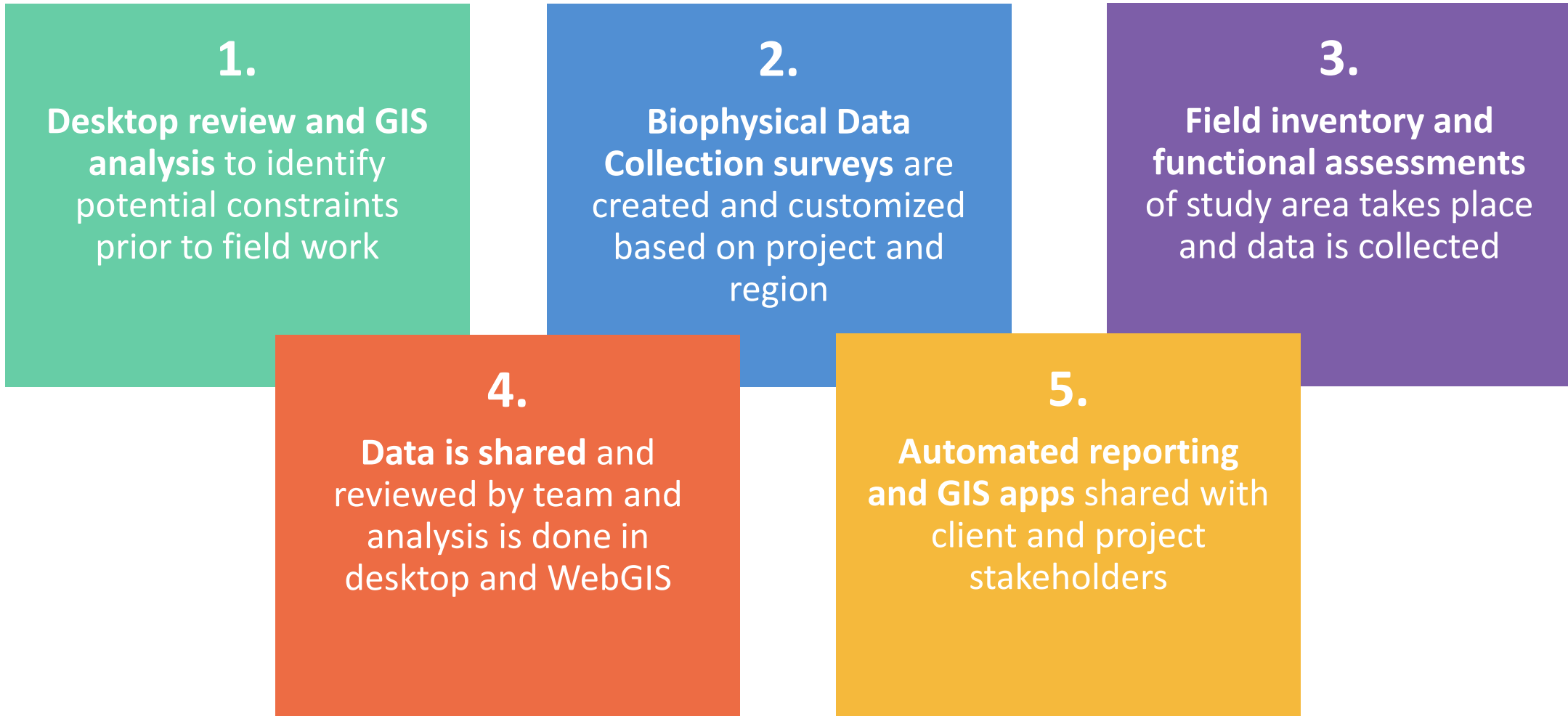


# Paper Based Workflow



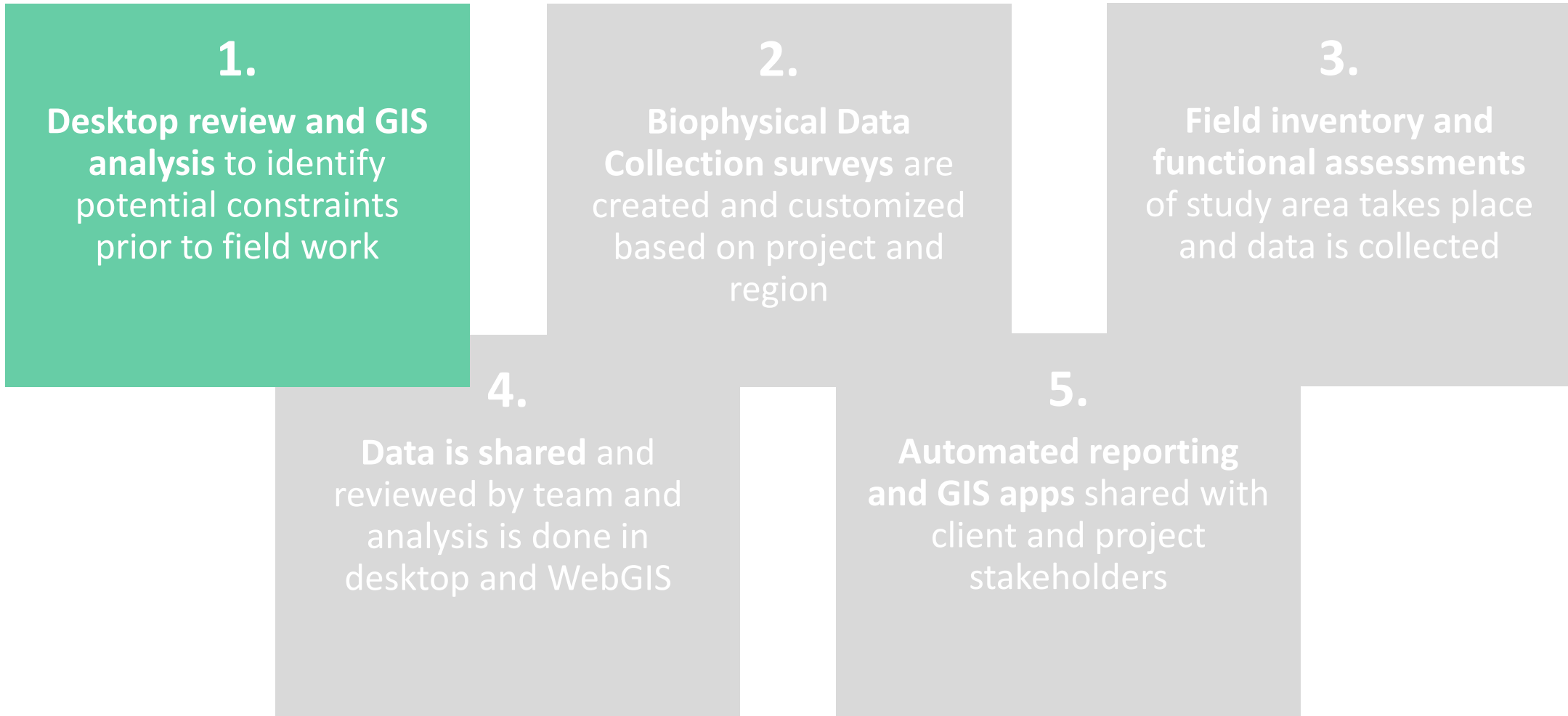
# Web Based Workflow

Using GIS and Custom Apps in 5 phases:

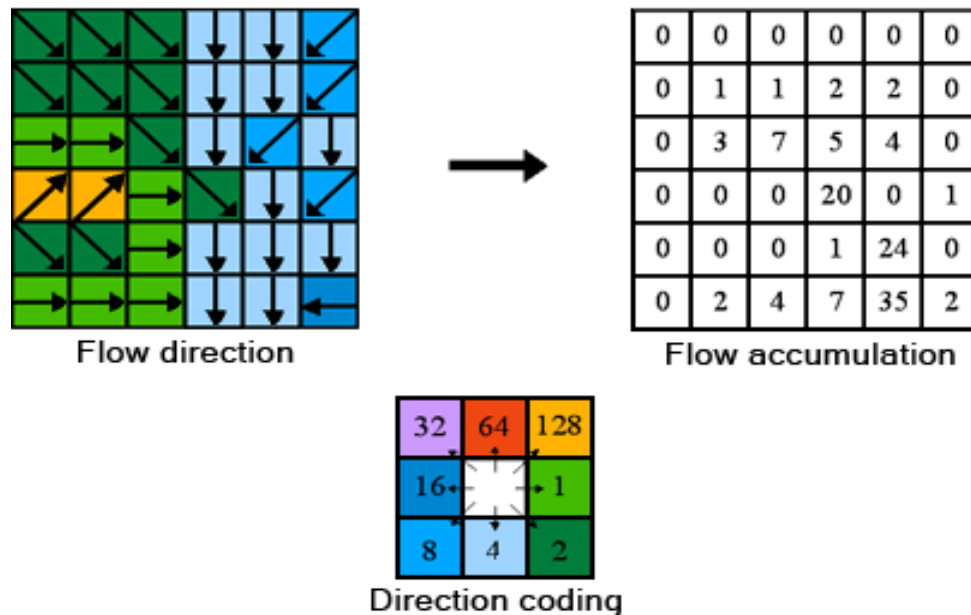


# Web Based Workflow

Using GIS and Custom Apps in 5 phases:



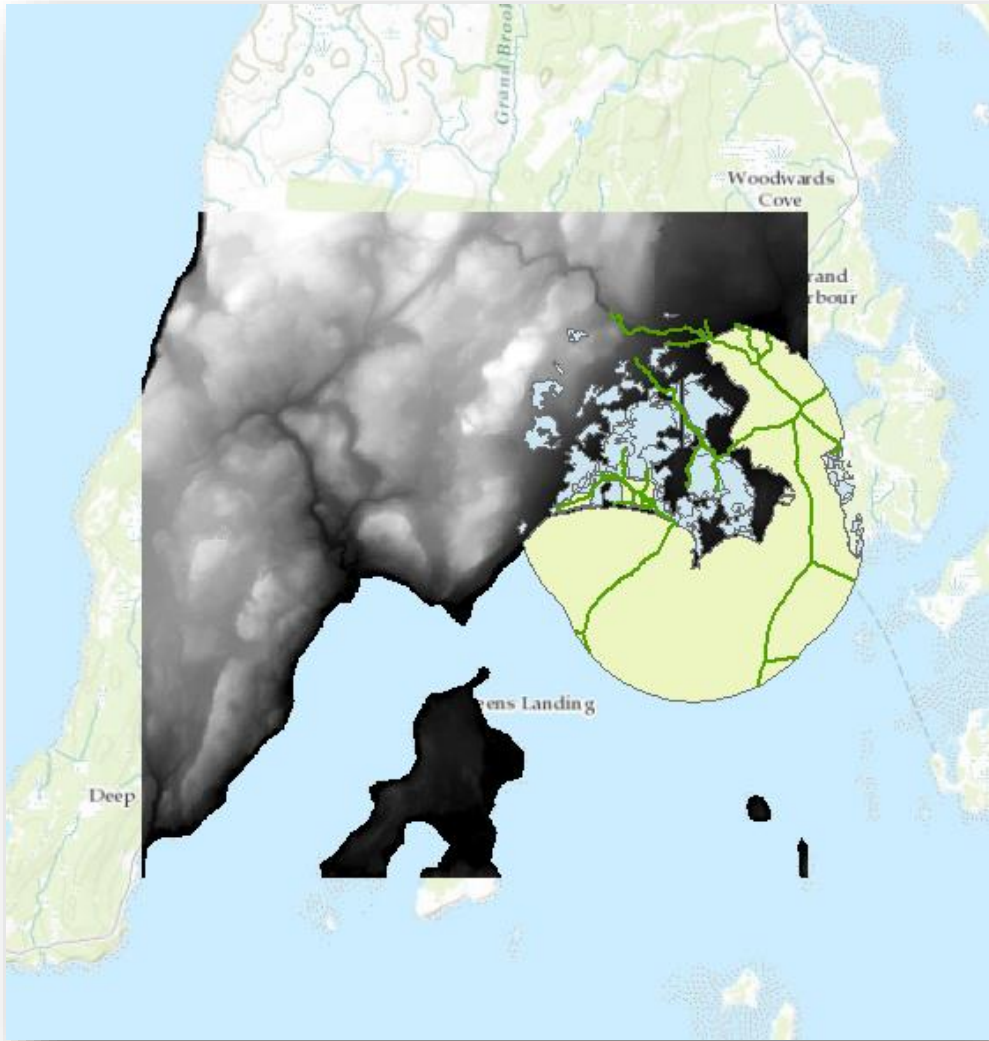
# Wet Areas Model - Desktop Analysis



- A wet area modeling was developed using GIS
  - Used to predict potential watercourse and wetland crossings not mapped in provincial or wetland watercourse datasets
  - Requires LiDAR Digital Elevation Models (DEM)
  - A flow accumulation analysis completed to determine the area that flows into each cell
  - Compared the elevation of each cell against nearest known mapped water feature (lakes, rivers, wetlands, etc.)
  - Compared against aerial imagery of study area

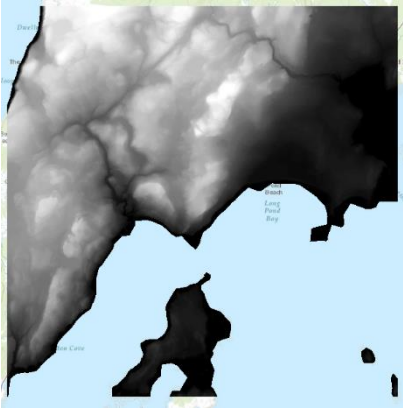
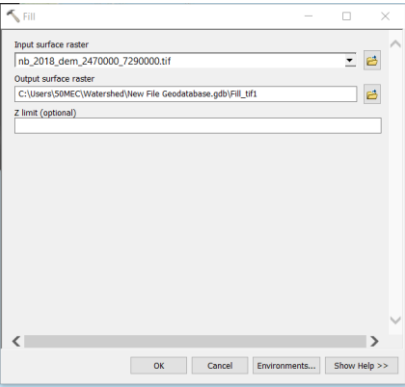


# Wet Areas Model

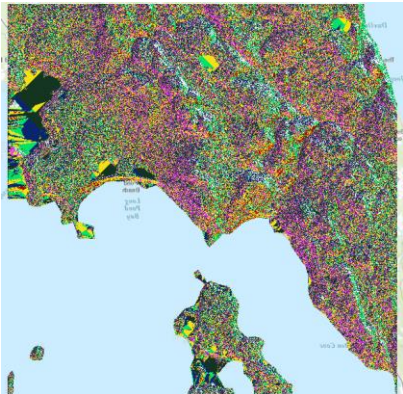
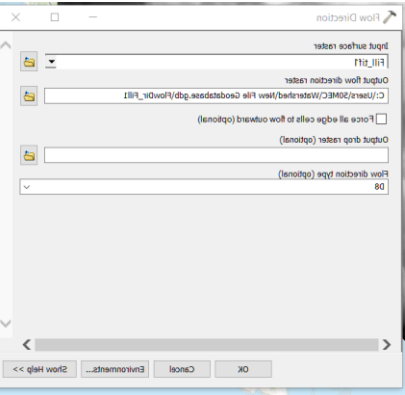
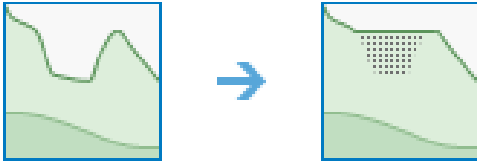


- Spatial Analyst
- DEM – combine using mosaic if necessary
- Wetland, watercourse and waterbody features classes

# Wet Areas Model



- Run Fill tool on the DEM
  - Fills sinks in a surface raster to remove small imperfections in the data



- Run Flow Direction using Fill result
  - Creates a raster of flow direction from each cell to its downslope neighbor, or neighbors, using D8, Multiple Flow Direction (MFD) or D-Infinity (DINF) methods.

**Illustration**

78	72	69	71	58	49
74	67	56	49	46	50
69	53	44	37	38	48
64	58	55	22	31	24
68	61	47	21	16	19
74	53	34	12	11	12

Elev\_Ras

=

2	2	2	4	4	8
2	2	2	4	4	8
1	1	2	4	8	4
128	128	1	2	4	8
2	2	1	4	4	4
1	1	1	1	4	16

Flow\_Dir

# Wet Areas Model



- Run Flow Accumulation using the Flow direction result
  - Creates a raster of accumulated flow into each cell. A weight factor can optionally be applied.

### Illustration

2	2	2	4	4	8
2	2	2	4	4	8
1	1	2	4	8	4
128	128	1	2	4	8
2	2	1	4	4	4
1	1	1	1	4	16

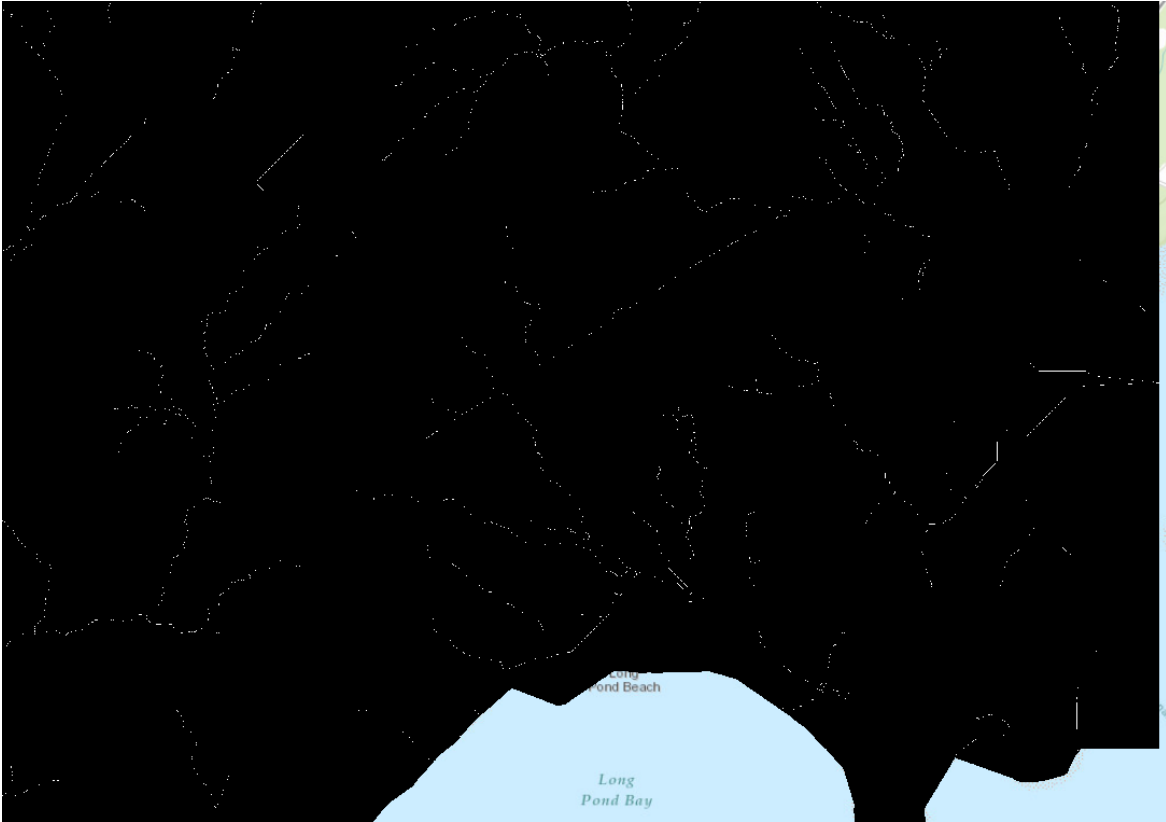
Flow\_Dir

=

0	0	0	0	0	0
0	1	1	2	2	0
0	3	7	5	4	0
0	0	0	20	0	1
0	0	0	1	24	0
0	2	4	7	35	1

Flow\_Acc

# Wet Areas Model



- Classify Flow Accumulation into two groups for 1 m cell size greater and less than 100,000 cells is a good starting point

Layer Properties

General Source Key Metadata Extent Display Symbology Time

Show:  
Vector Field  
Unique Values  
Classified  
Stretched  
Discrete Color

Draw raster grouping values into classes

Fields  
Value: <VALUE> Normalization: <None>

Classification  
Manual Classes: 2 Classify...

Color Ramp

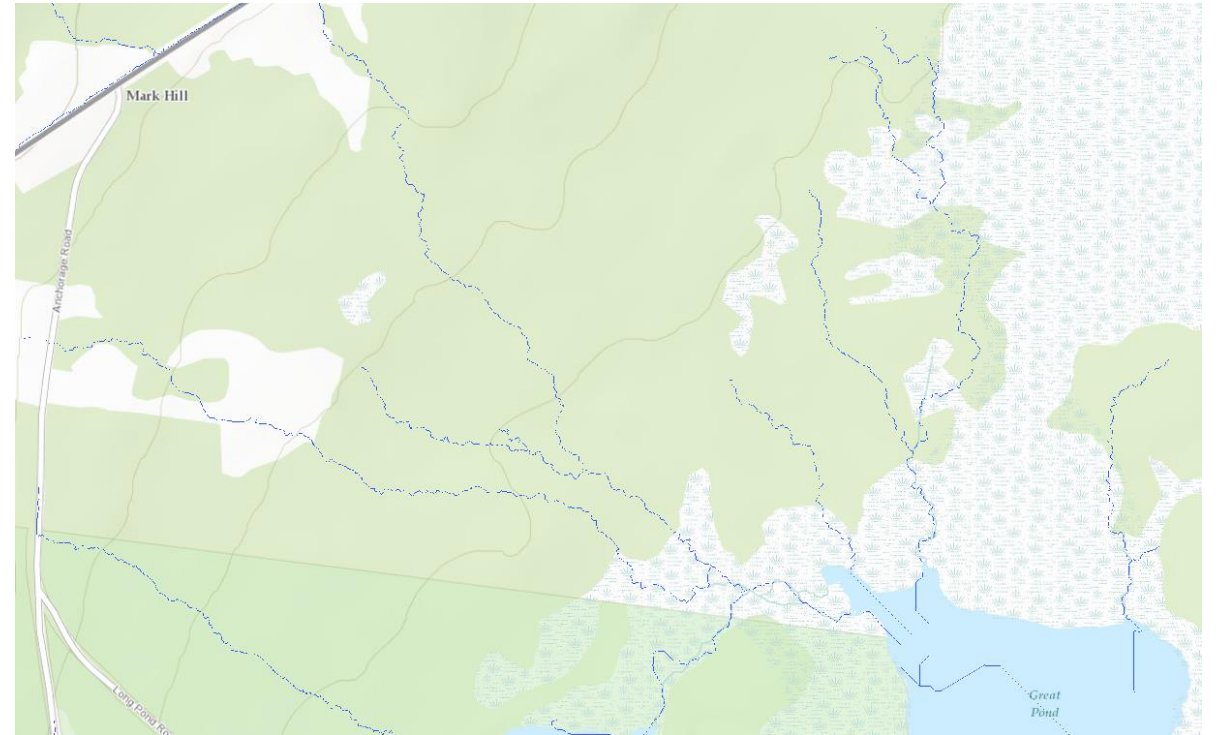
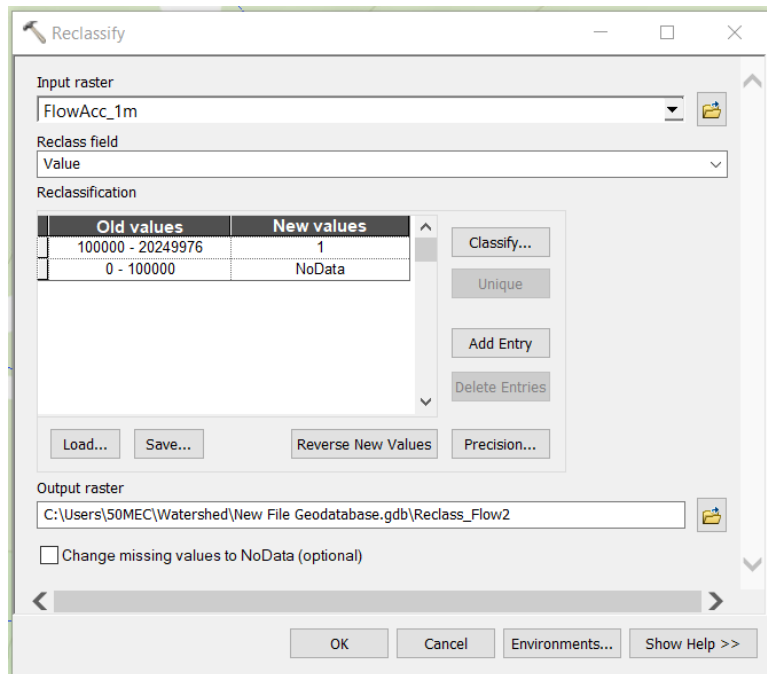
Sym...	Range	Label
	0 - 100,000	0 - 100,000
	100,000 - 20,249,976	100,000.0001 - 20,249,976

Show class breaks using cell values  
 Use hillshade effect Z: 1  
Display NoData as

OK Cancel Apply

# Wet Areas Model

- Reclassify Tool using above thresholds so anything above 100k is 1 and below is NoData
- Good predictor of potential drainage areas - used as input into model



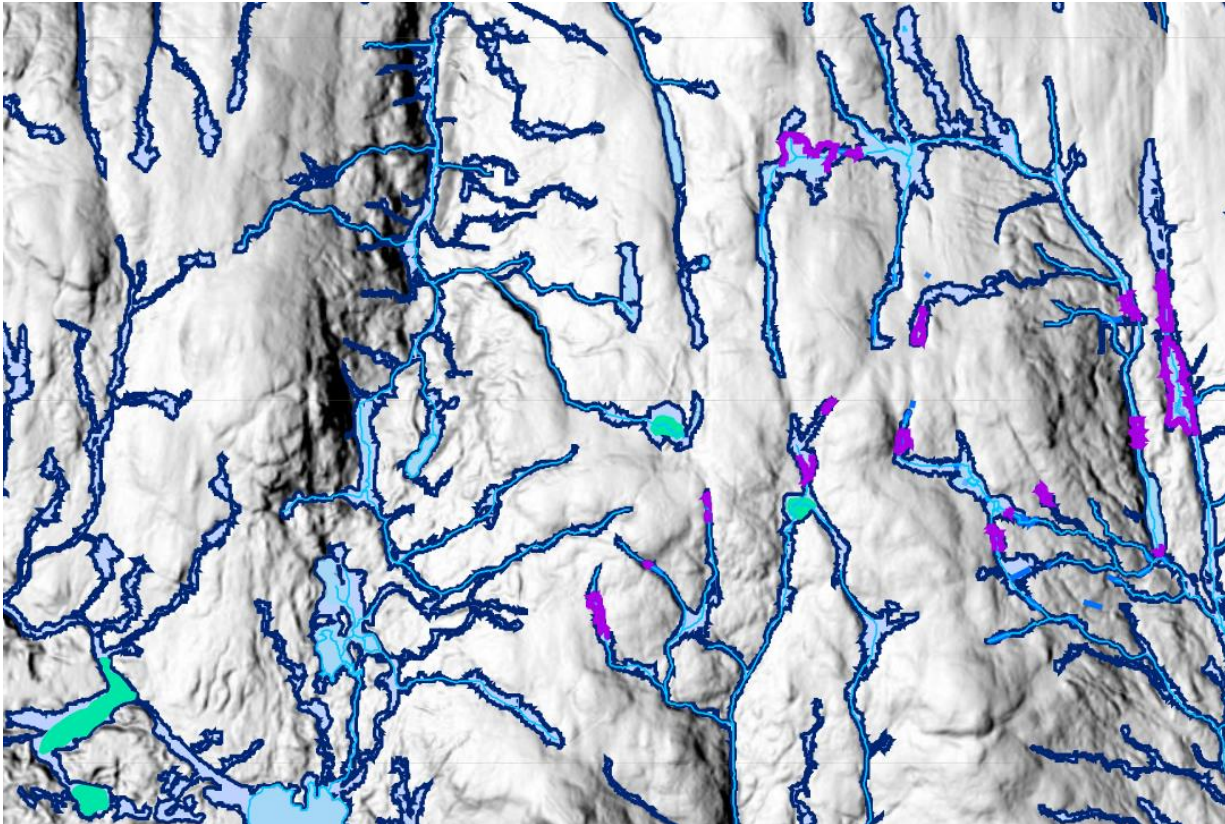
# Wet Areas Model

- Merge all water features classes together – converted to raster



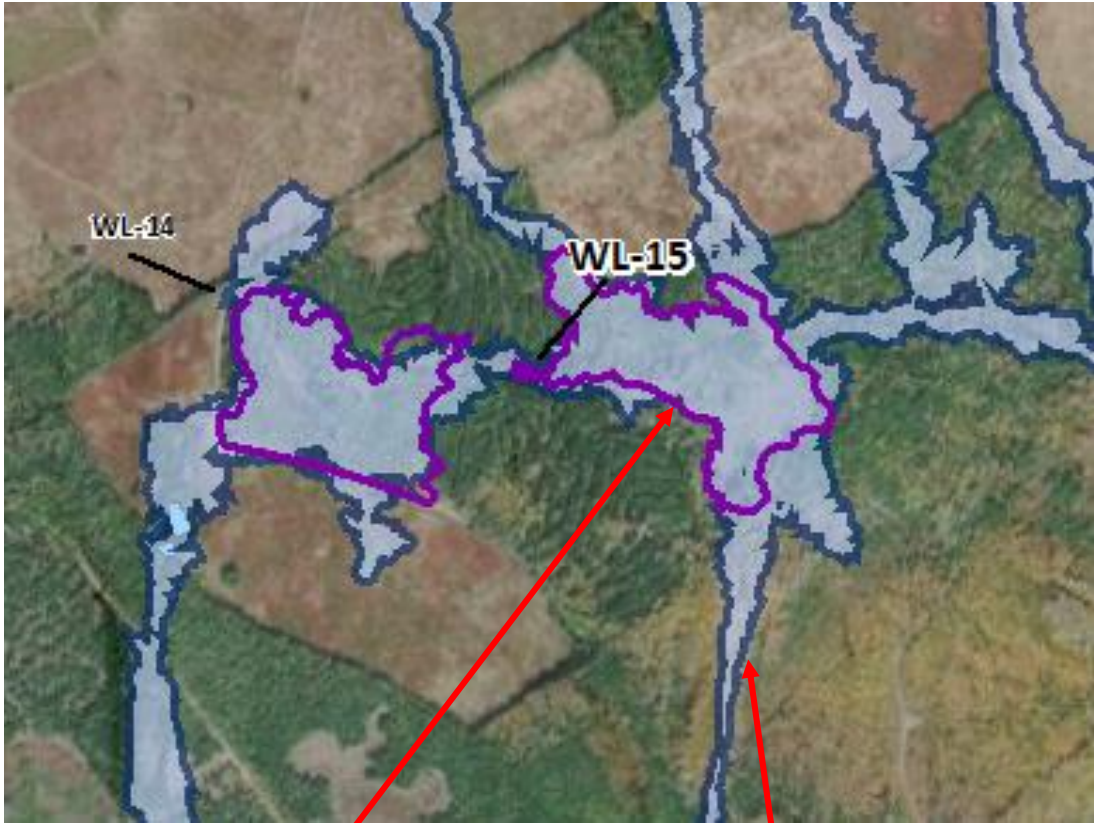
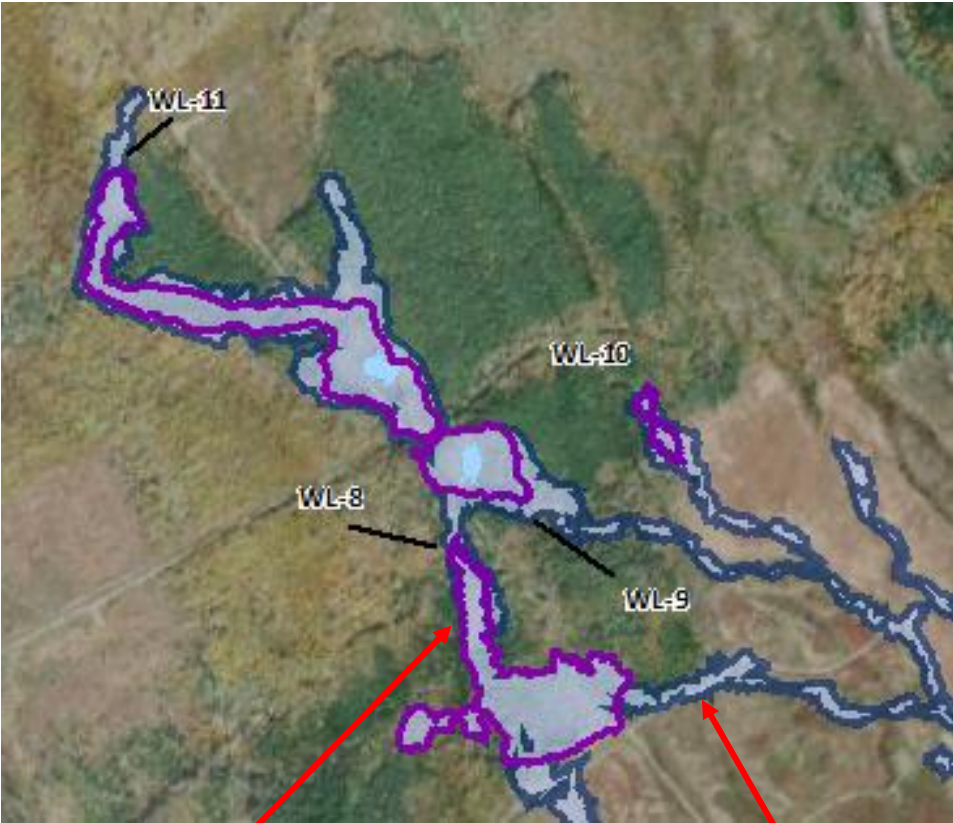
- Elevations across study area compared to elevations of nearest water feature
- Where difference is less than 1 m = strong predictor of potential wet area

# Wet Areas Model



- Predicted water course crossings and wet areas
  - Help plan and prioritize field work
  - Supplement gaps in areas not delineated in the field

# Wet Areas Model



Field delineated wetland

Predicted wet area

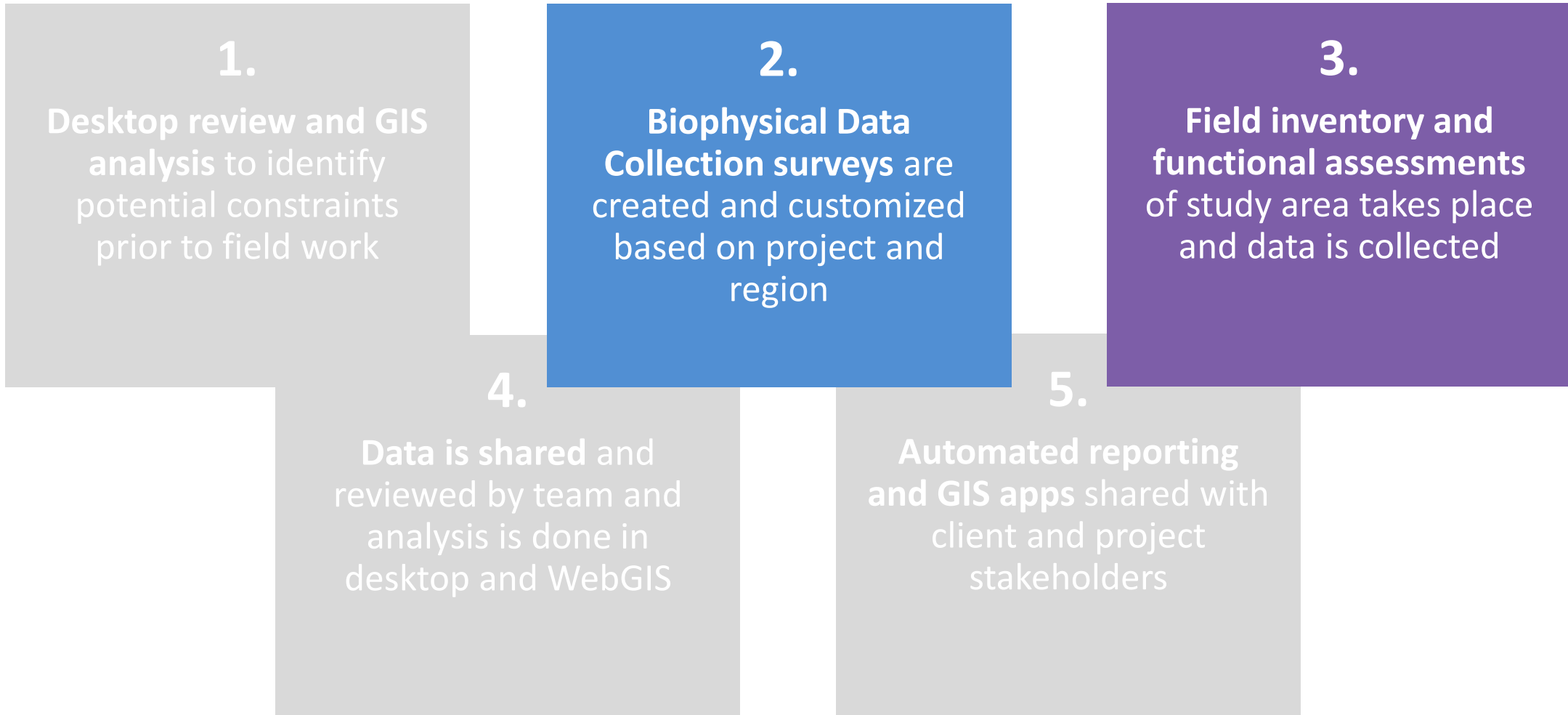
Field delineated wetland

Predicted wet area

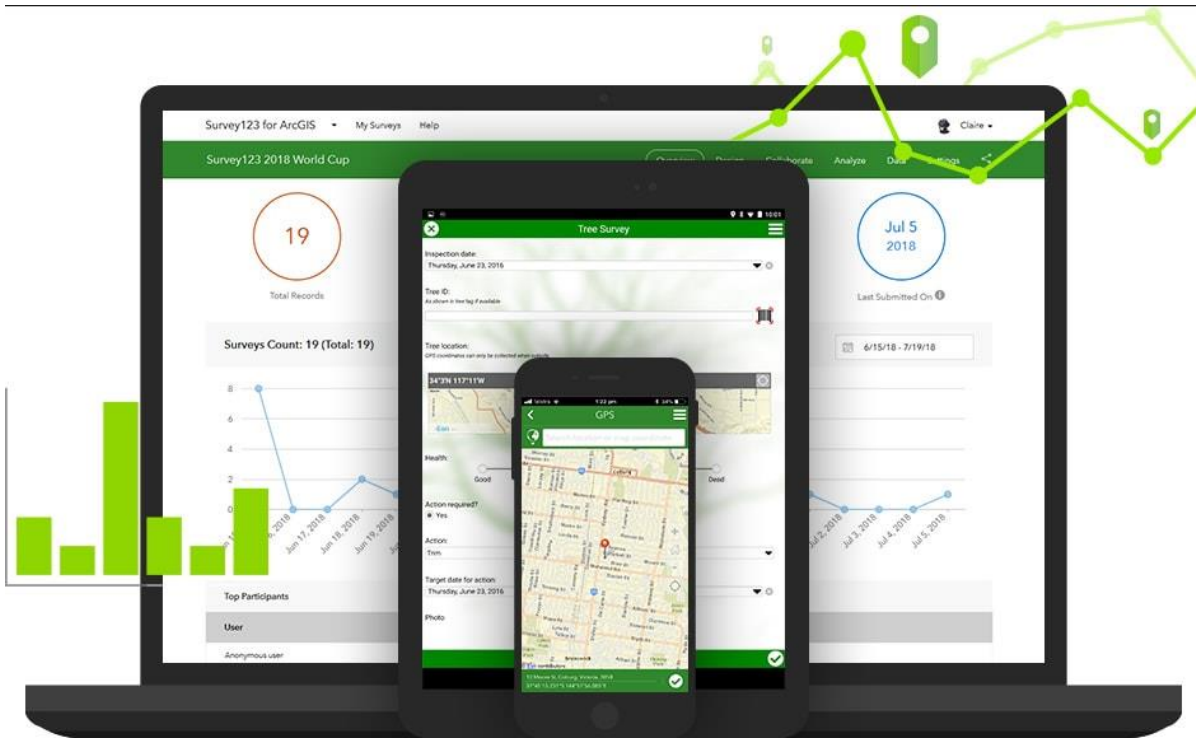


# Web Based Workflow

Using GIS and Custom Apps in 5 phases:

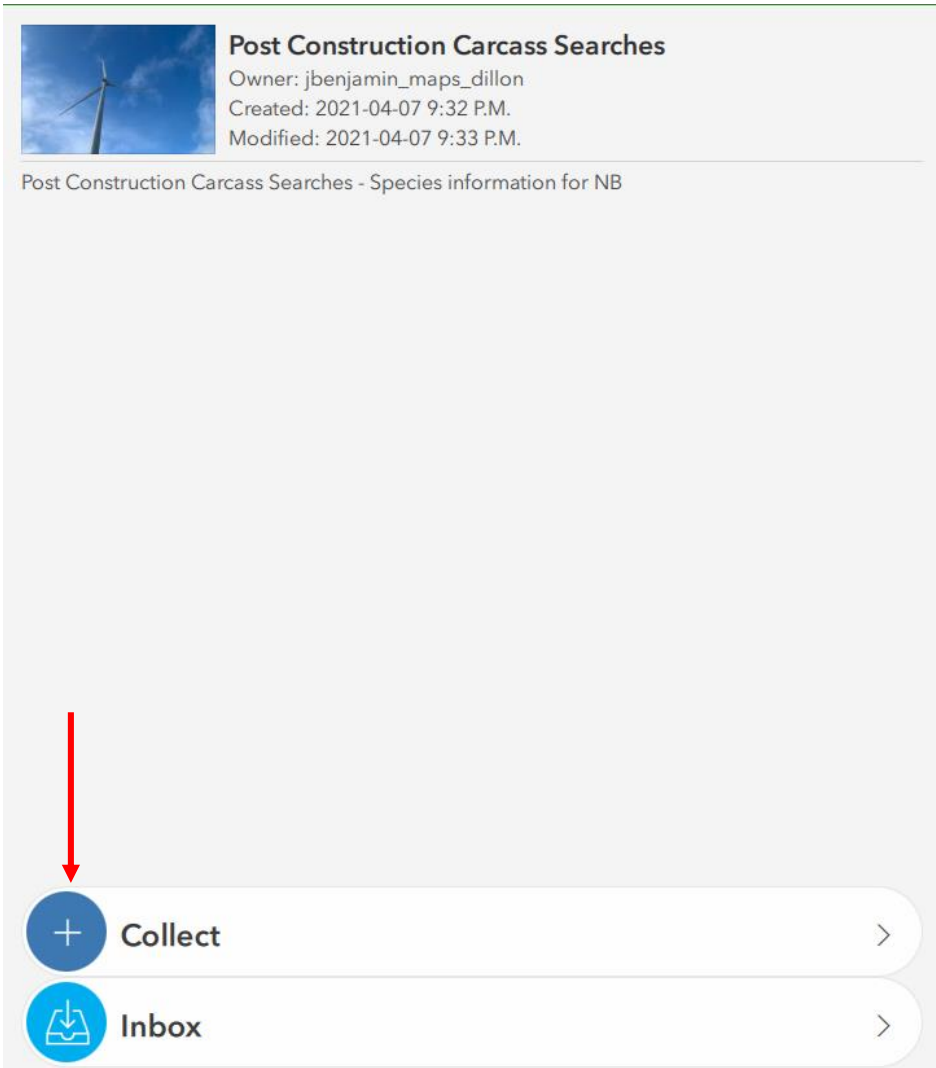


# Biophysical Data Collection using Survey 123





- ArcGIS Survey 123 is a complete, form-centric solution for creating, sharing, and analyzing surveys
- Collect data via web or mobile devices, even when disconnected from the internet
- Find assets and information
- Report real-time locations
- Everyone uses and has access to the same data
- Fully integrated with ArcGIS and Field Maps


# Biophysical Data Collection using Survey 123

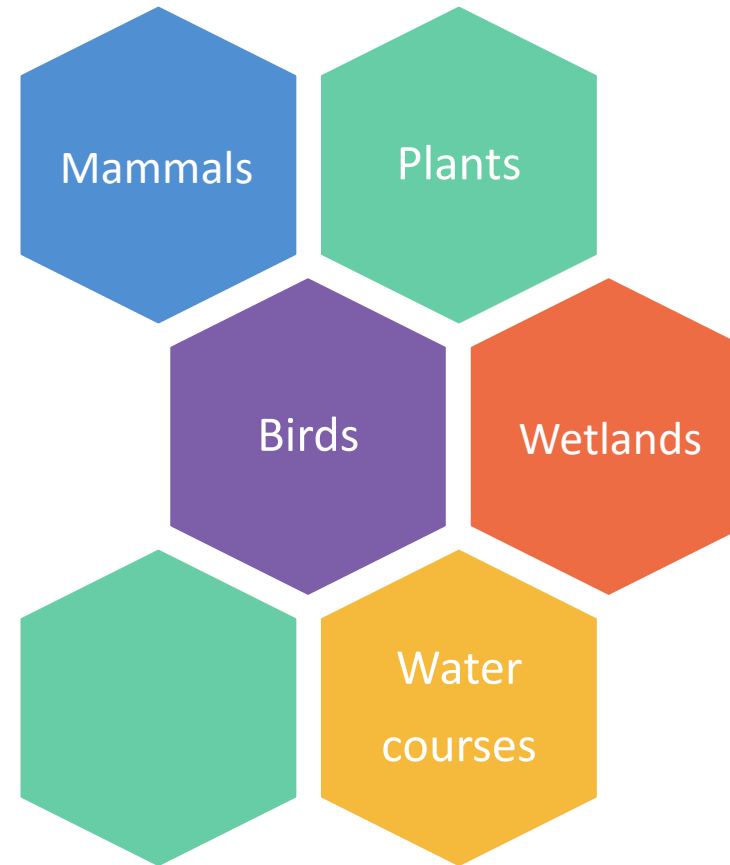


**Post Construction Carcass Searches**  
Owner: jbenjamin\_maps\_dillon  
Created: 2021-04-07 9:32 P.M.  
Modified: 2021-04-07 9:33 P.M.

Post Construction Carcass Searches - Species information for NB

  **Collect** >

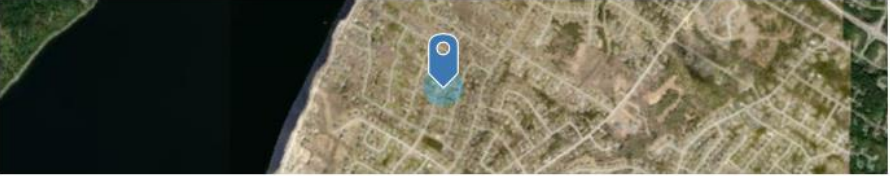
 **Inbox** >



# Collection tools for plants, birds, mammals, wetlands and watercourses

Carcass Search Event

📍 45°26'N 65°59'W ± 94 m



Project Name:  
Test

Turbine Name:  
T1

Search Date: \*  
📅 Wednesday, April 13, 2022 ⌚ 11:25 ...

Search Surveyor: \*  
JAB

Planned Search Area (sqm): \*  
22500

Bird Found: \*  
 Yes  No

✓

Planned Search Area (sqm): \*  
22500

Bird Found: \*  
 Yes  No

Raptor Found: \*  
 Yes  No

Bat Found: \*  
 Yes  No

Area Not Searched? \*  
 Yes  No

Total Birds:  
0

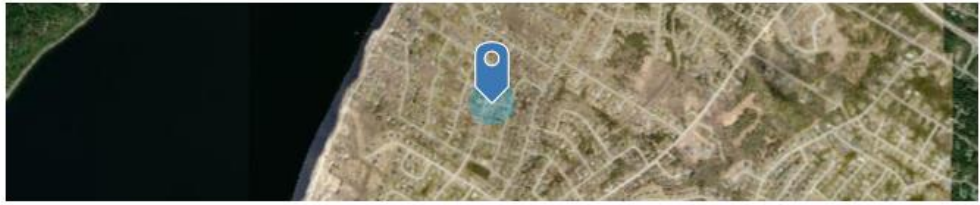
Total Raptors:  
0

Total Bats:  
0

▼ **Bird Record:**

Bird Carcass

📍 45°26'N 65°59'W ± 97 m



**Bird:** \*

🔍 CAWA (Canada Warbler)

**Scientific Name:**

*Cardellina canadensis*

**Weather** \*

Sun     Overcast/  
Cloud     Sun with  
Clouds     Rain     Snow

**Wind Direction** \*

N     NNE     NE     ENE     E  
 ESE     SE     SSE     S     SSW  
 SW     WSW     W     WNW     NW  
 NNW

**Species Age Class:** \*

Adult     Fledgling     Immature     Juvenile     Nestling  
 Unknown

**Habitat Type Surrounding Turbine:** \*

Soil     Gravel     Rock     Crop     Grass  
 Other  
Vegetation

**Nearby Structures:** \*

(i.e., Fence, Power-Line, Substation and distance to them)

Fence     Power-  
Line     Building     Substation     Other  
 None

**Distance to Nearby Structure:**

**Distance and Direction to Turbine** \*

**SAR or SOCC?**

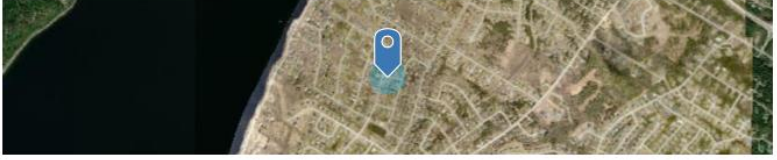
SAR

# Biophysical Data Collection using Survey 123

▼ **Bird Record:**

Bird Carcass

📍 45°26'N 65°59'W ± 97 m



**Bird: \***

🔍 CAWA (Canada Warbler) ✕ ▼

**Scientific Name:**  
Cardellina canadensis

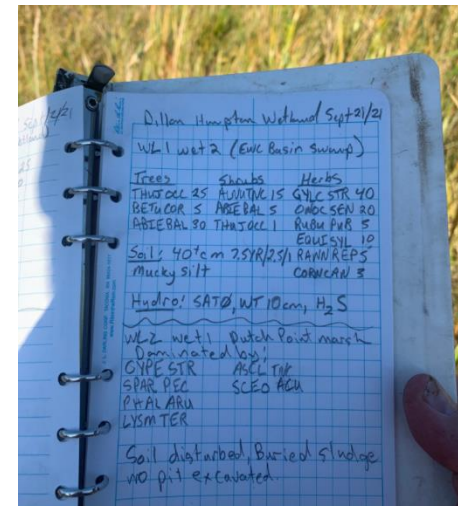
**Weather \***

Sun     Overcast/Cloud     Sun with Clouds     Rain     Snow

**Wind Direction \***

N     NNE     NE     ENE     E  
 ESE     SE     SSE     S     SSW  
 SW     WSW     W     WNW     NW  
 NNW


- Tools built using specific provincial requirements and included AC CDC species ranking
- Automatically attached to each data point collected
- Traditionally this data would have been collected using paper and hand held GPS units



**▼ Areas Not Searched**

Area Not Searched

Area: 478 m<sup>2</sup>, Perimeter: 83 m



Area (sqm):

478.3855199879239

Rationale for Not Searched

1 of 1

Bird Found: \*

Yes  No

Raptor Found: \*

Yes  No

Bat Found: \*

Yes  No

Area Not Searched? \*

Yes  No

Total Birds:

1

Total Raptors:

0

Total Bats:

0

Area Searched (sqm):

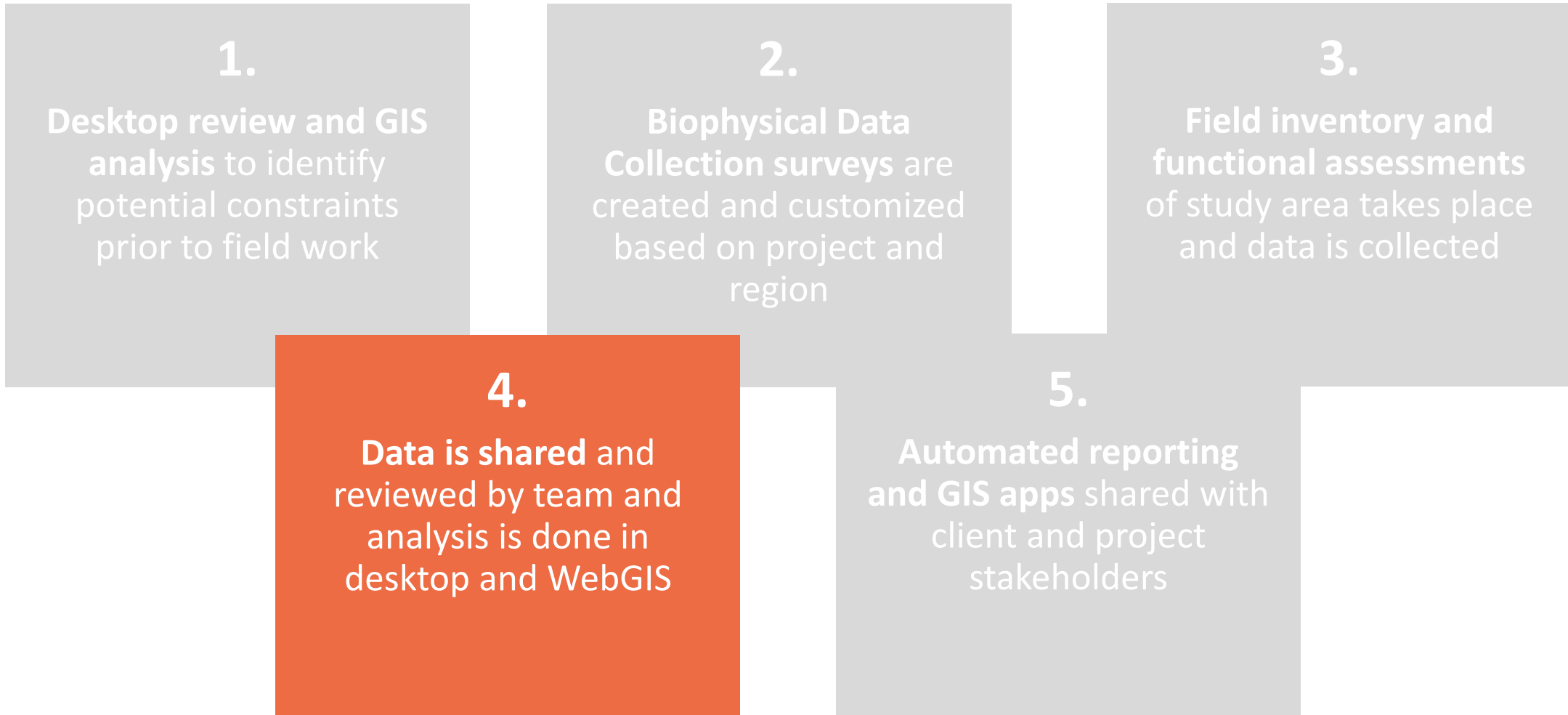
22021.614480012075

Percent Searched

97.873842133387

# Web Based Workflow

Using GIS and Custom Apps in 5 phases:





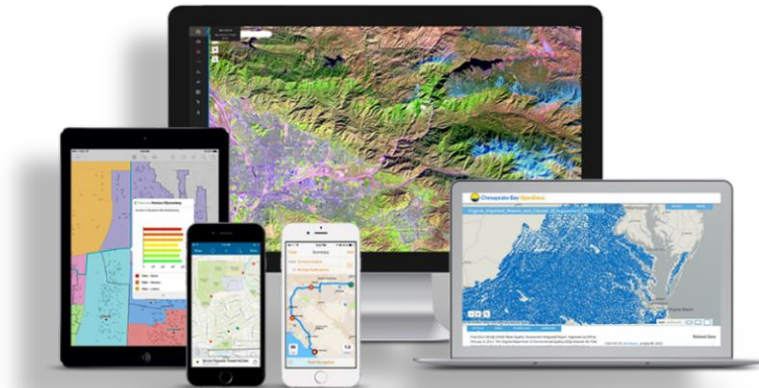
# Desktop to ArcGIS Online

- Creation of appropriate symbology
- Publishing of feature services to the web
- Creation of webmap with standard widgets
- Using publicly available feature services where possible (GeoNB, ESRI)



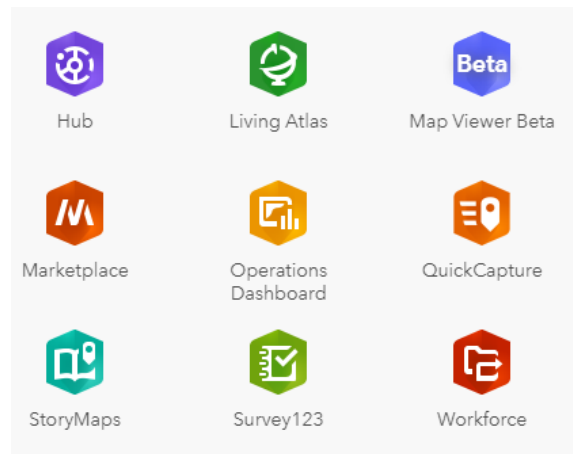
# Why WebGIS?

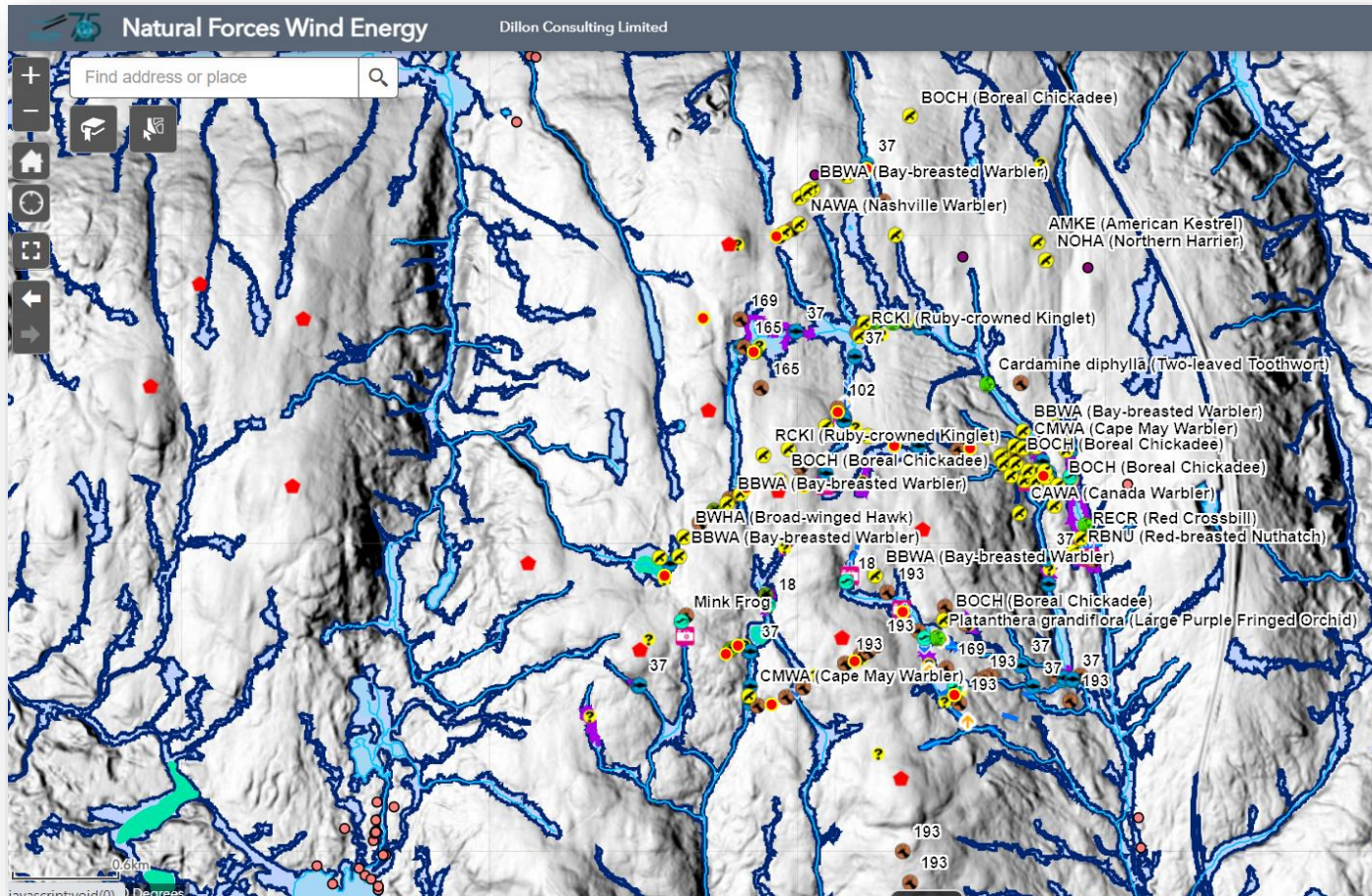
- Most data has a spatial component
- Allows anyone to answer basic GIS questions
- Data in hands of decision makers
- Dynamic and real time access to data
- Everyone has access to same authoritative information



# ArcGIS Online / Portal

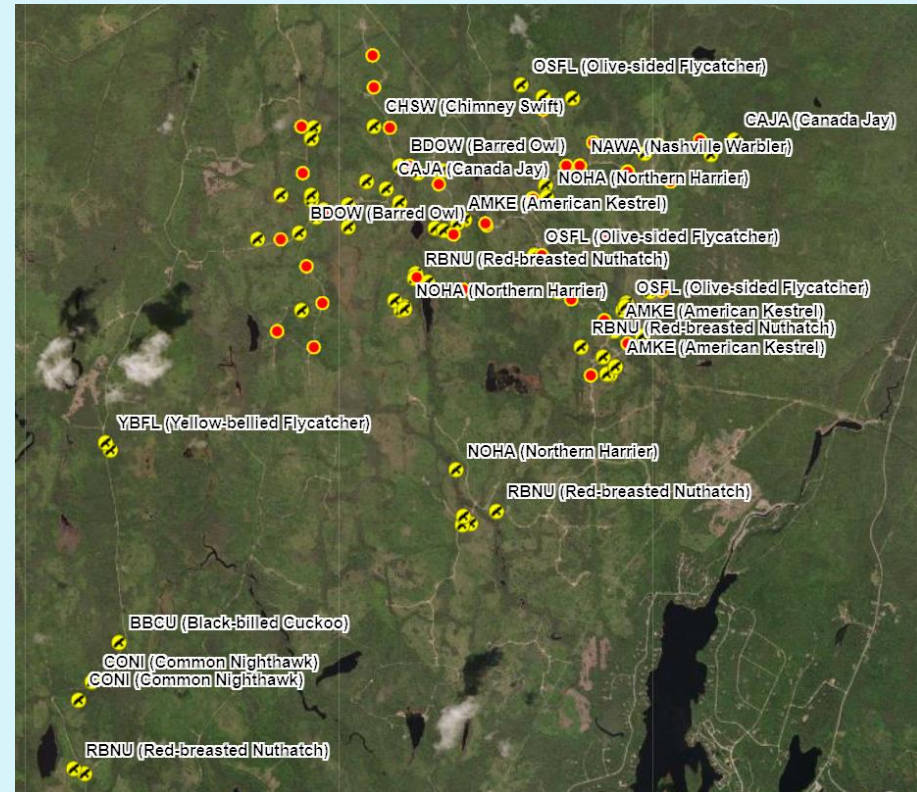
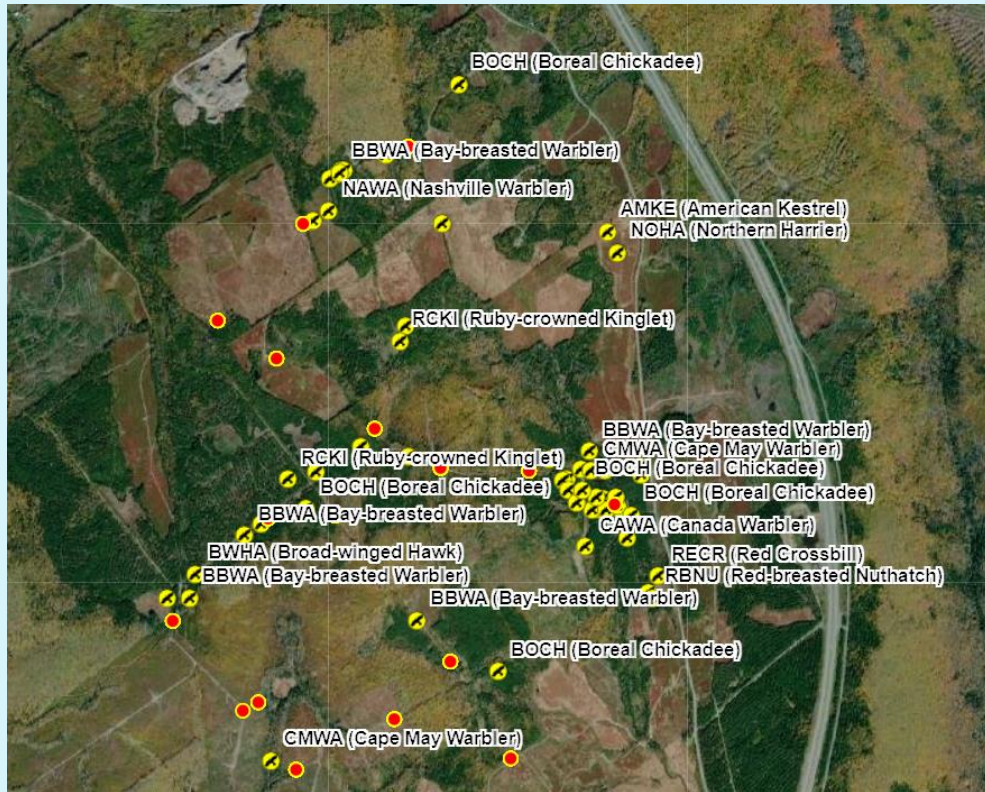
- ESRI complement to ArcGIS Desktop applications
- Cloud-based data management / internal server
- Data viewers, data editors, and mobile data collection
- Survey 123 / Field Maps, QuickCapture, and Workforce mobile data collection applications
- Dashboards, Story Maps, and Data Hub

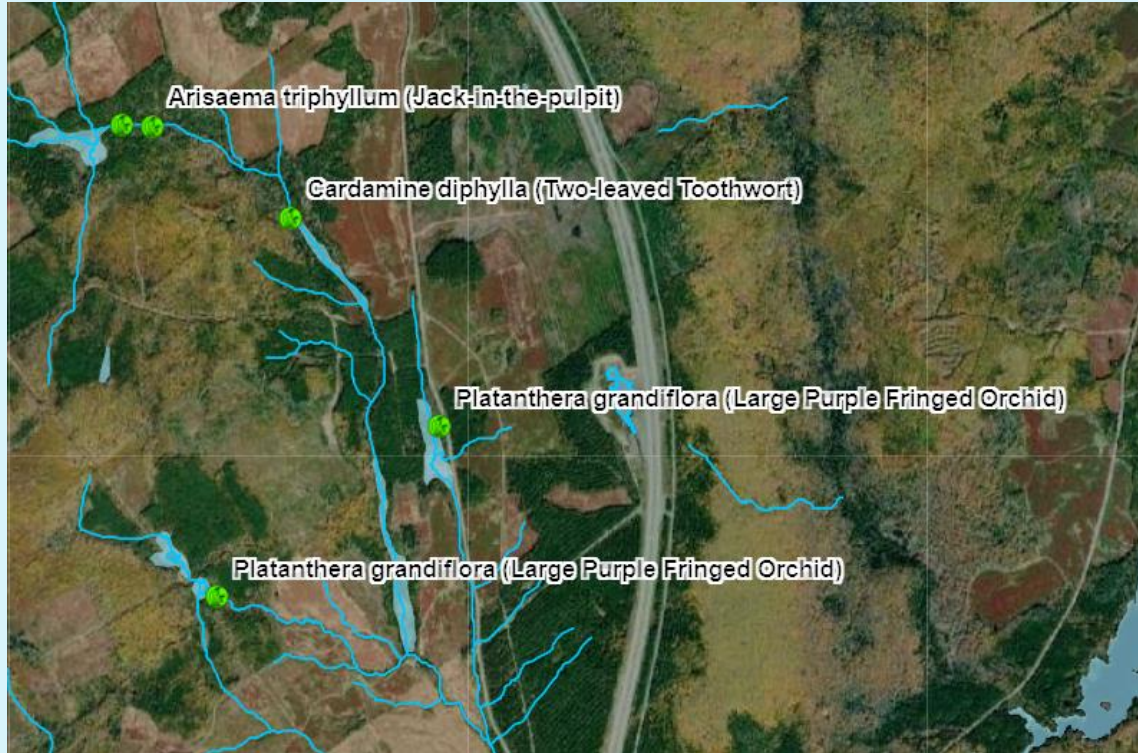




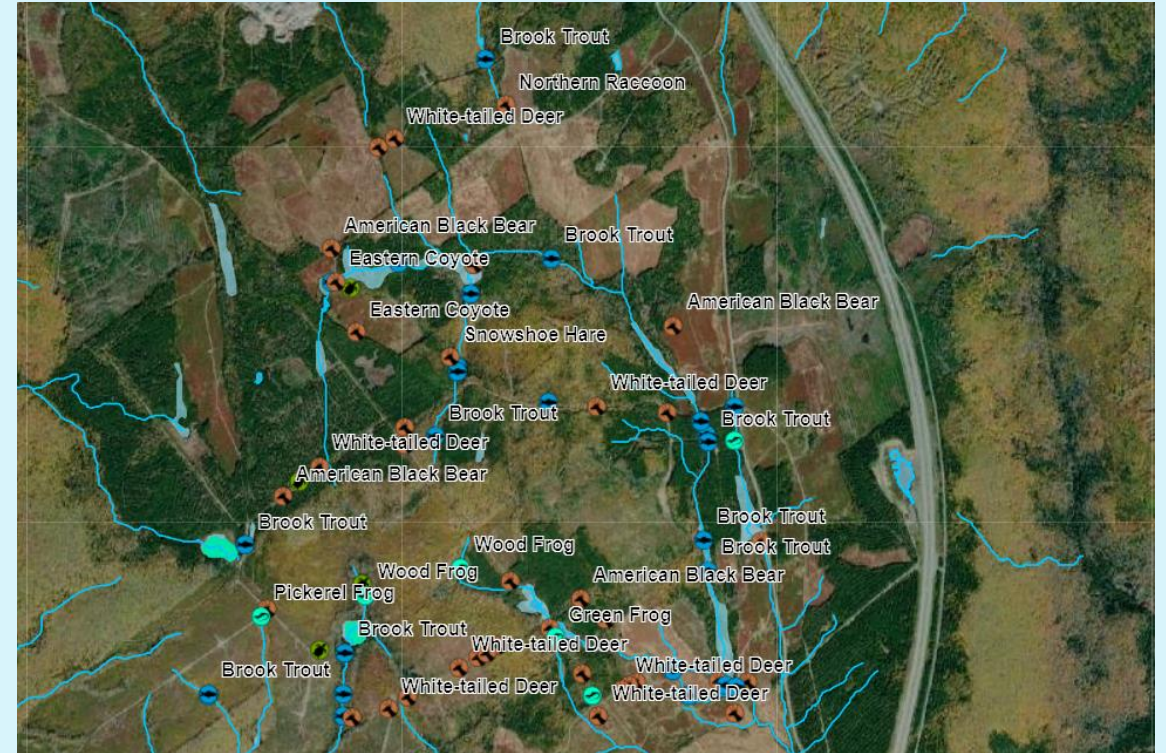
- Cloud-based software to create and share interactive web maps
- Data-driven mapping and analysis tools to gain a better understanding of the wetlands and project area
- Work effectively and collaboratively using Field Maps and Survey 123 for collecting biophysical data

# In total 6000 bird observations just in these two projects





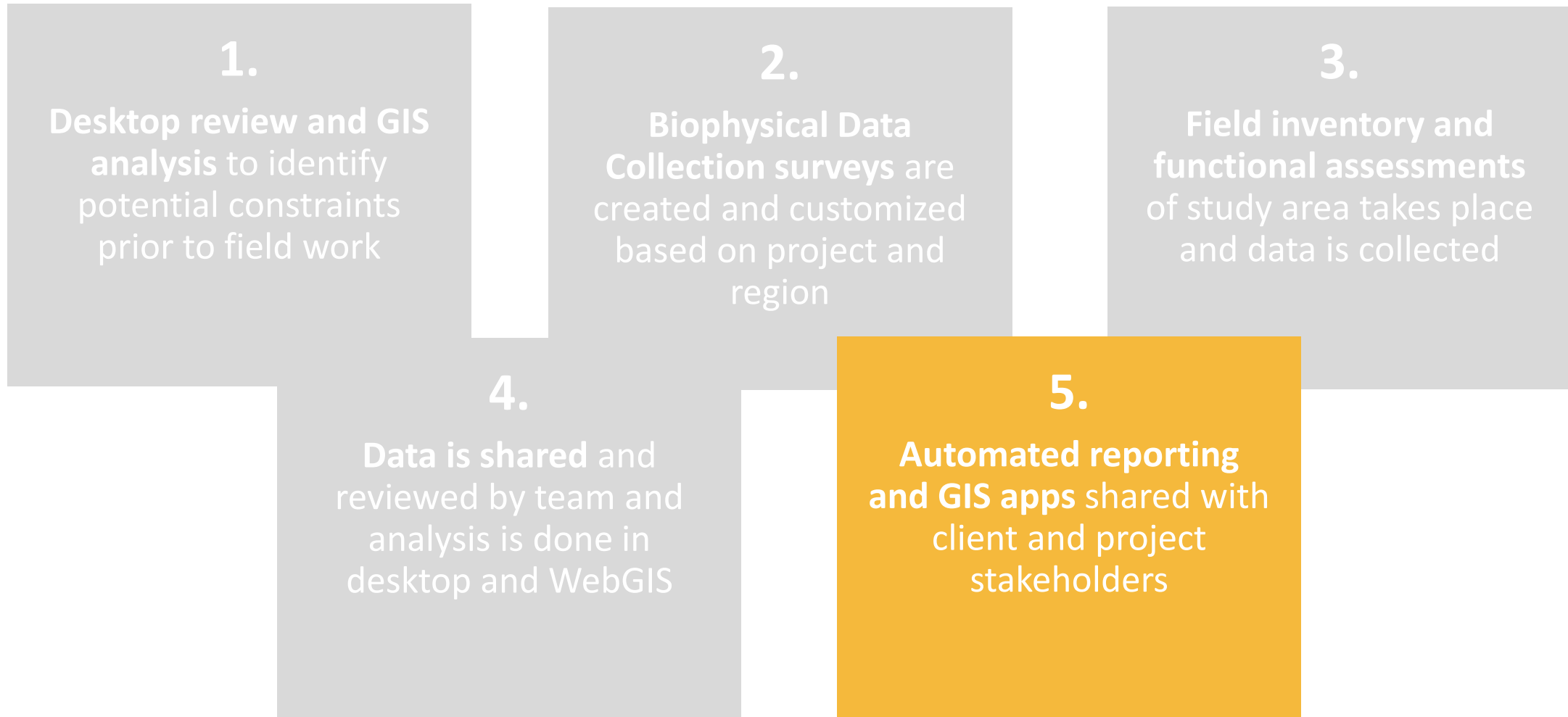
Plant Observation

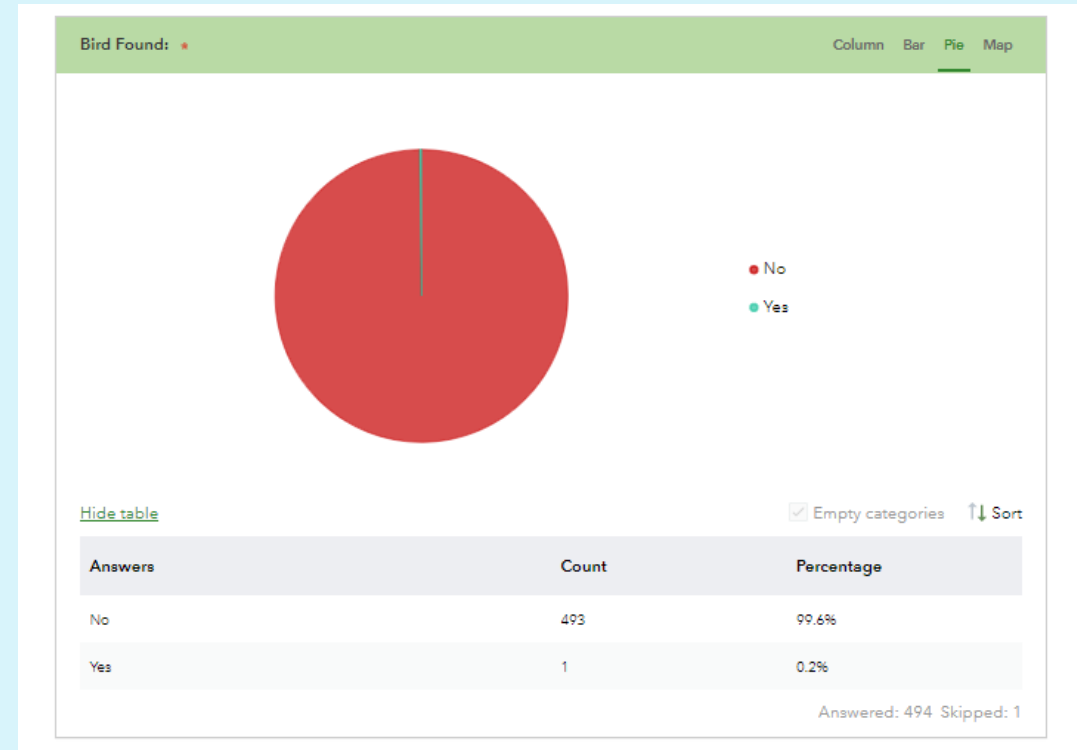
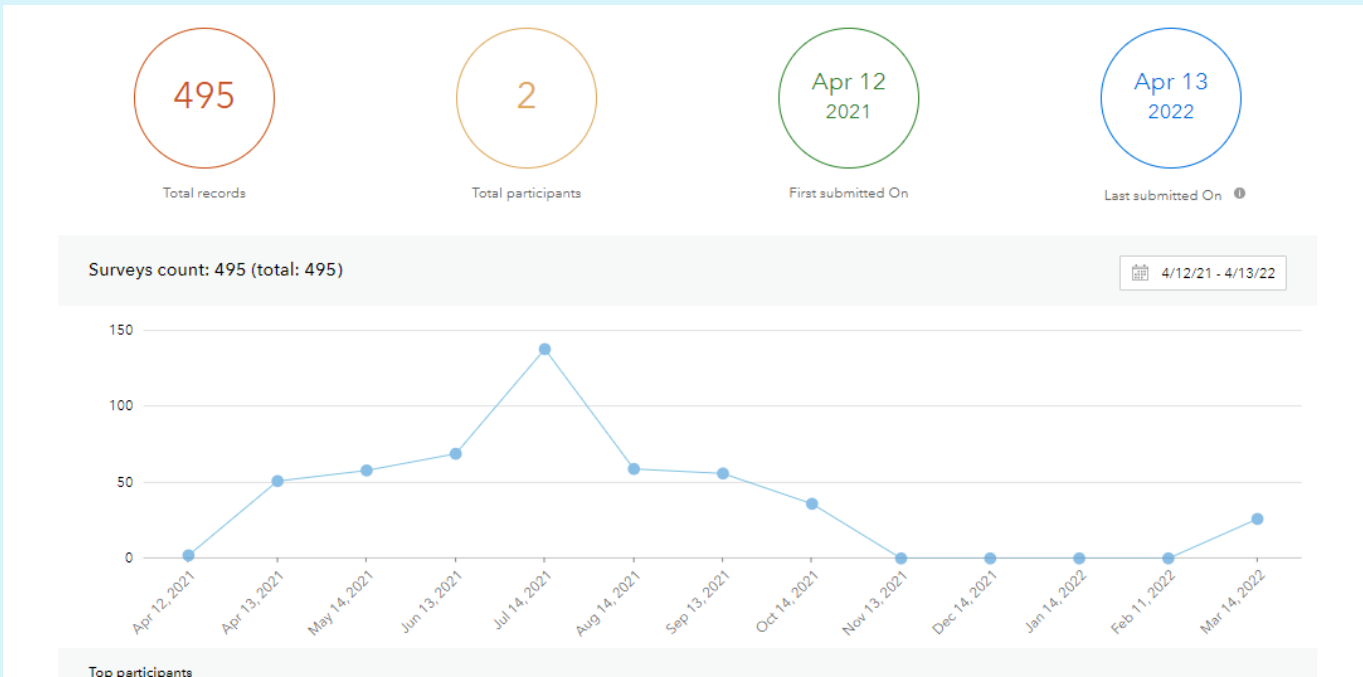


Vertebrate Observation

# Web Based Workflow

Using GIS and Custom Apps in 5 phases:







NB\_Carcess\_V05

Overview Design Collaborate Analyze Data Settings

4/12/21-4/13/22 Filter Report Export Open in Map Viewer Form view 455/495

Project Name	Turbine Name	Search Date	Search Surveyor	Planned Search Area (sqm)	Bird Found	Raptor Found	Bat Found	Area Not Searched?	Total Birds	Total Raptors	Total Bats	Sum_Area_Not_Searched Area (sqm)
Sussex 21-1670	T5	Apr 13, 2022, 1:00 PM	Bethany Goodine	22,500	No	No	No	No	0	0	0	22,500
Sussex 21-1670	T4	Apr 13, 2022, 12:54 PM	Bethany Goodine	22,500	No	No	No	No	0	0	0	22,500
Sussex 21-1670	T3	Apr 13, 2022, 12:25 PM	Bethany Goodine	22,500	No	No	No	No	0	0	0	22,500
Sussex 21-1670	T2	Apr 13, 2022, 12:00 PM	Bethany Goodine	22,500	No	No	No	No	0	0	0	22,500
Sussex 21-1670	T1	Apr 13, 2022, 11:00 AM	Bethany Goodine	22,500	No	No	No	No	0	0	0	22,500
Sussex 21-1670	T5	Apr 10, 2022, 11:25 AM	Bethany	22,500	No	No	No	No	0	0	0	22,500
Sussex 21-1670	T4	Apr 10, 2022, 11:02 AM	Bethany	22,500	No	No	No	No	0	0	0	22,500
Sussex 21-1670	T3	Apr 10, 2022, 10:48 AM	Bethany	22,500	No	No	No	No	0	0	0	22,500
Sussex 21-1670	T2	Apr 10, 2022, 10:30 AM	Bethany	22,500	No	No	No	Yes	0	0	0	22,500
Sussex 21-1670	T1	Apr 10, 2022, 10:29 AM	Bethany	22,500	No	No	No	No	0	0	0	22,500

1 of 495 selected

Total Birds: 0  
Total Raptors: 0  
Total Bats: 0  
Area Searched (sqm): 22,500  
Percent Searched: 100

Search Day Site Photo 1  
Search\_Photo\_1-20220...

Search Day Site Photo 2  
Search\_Photo\_2-20220...

- Collect data and photos in the field
- Can be reviewed and edited by PM and field staff in office

<b>Total Completed Searches: 16</b>		
<b>Total Birds Found:</b>	<b>Total Raptors Found:</b>	<b>Total Bats Found:</b>
0	0	0

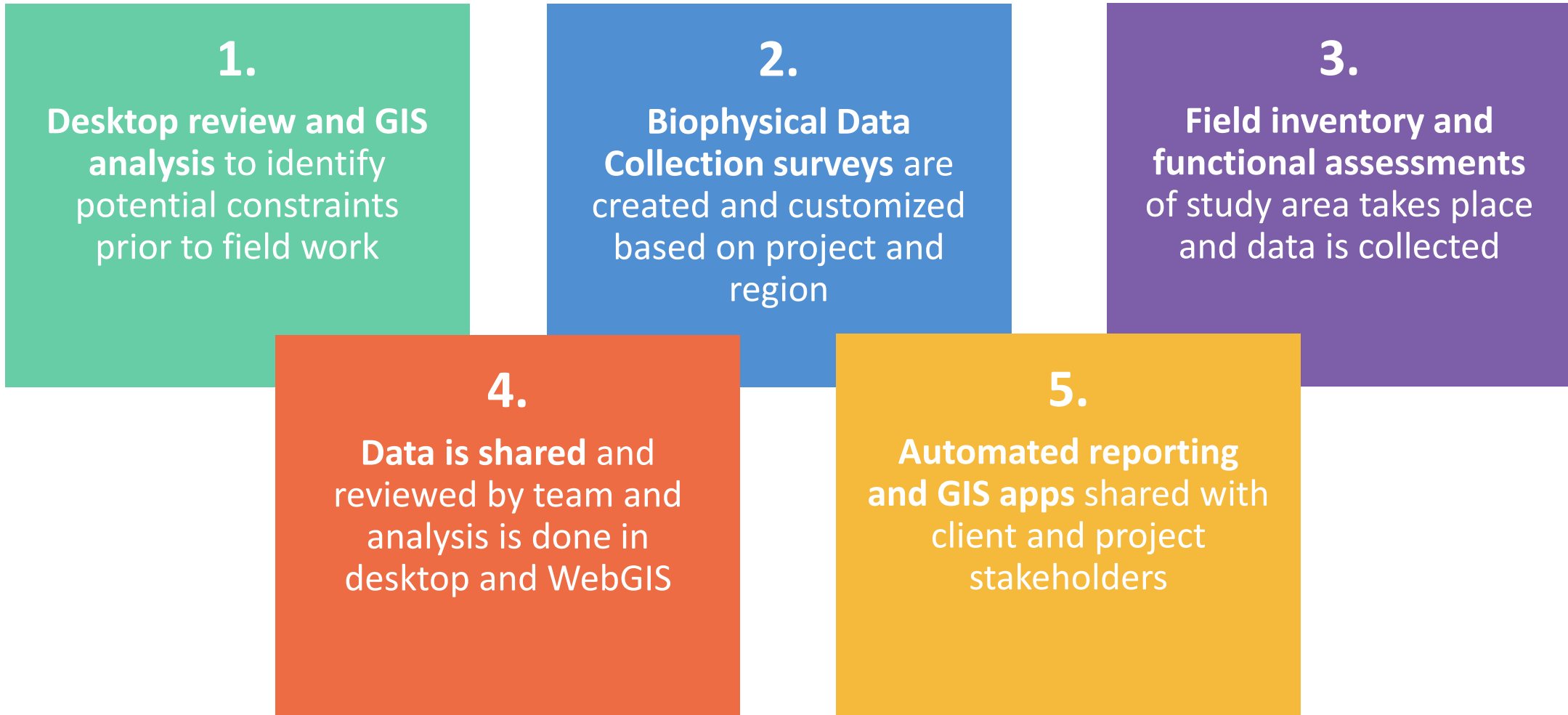
**Search Events Summary:**

Turbine	Search Date	Birds Found	Raptors Found	Bats Found	Area Not Searched?
T5	April 7, 2022 10:50 AM	0	0	0	No
T4	April 7, 2022 12:41 PM	0	0	0	No
T5	April 7, 2022 12:48 PM	0	0	0	No
T3	April 7, 2022 1:31 PM	0	0	0	No
T2	April 7, 2022 1:55 PM	0	0	0	No

- Automated report to provide stakeholder on a bi-weekly basis

# Overview/Summary

Using GIS and Custom Apps in 5 phases:



# Discussion / Questions

*“The application of GIS is limited only by the imagination of those who use it”.* - Jack Dangermond

Thank you