Award 19493988

Socio-Environmental Science Investigations to Promote Geospatial Thinking: Integrating ArcGIS Digital Technologies

Judy Morrison

Research Conversation February 21, 2023

Today's Presentation

- Overview of the SESI NSF grant project
- What is ArcGIS and how is it used in classrooms?
- Research questions
- Preliminary findings
- Some exemplary projects
- Future research

NSF Collaborative Research Grant-Logistics

- ITEST - Innovative Technology Experiences for Students and Teachers
- Three sites, each with own budget, submitted one proposal to NSF
- Funded March 2020 for 4 years
- Variety of schools, teachers, and communities
- Each site works with local teachers, collaboration across the sites
- Cross-site researchers collaborate on publications and presentations
- Teachers encouraged to participate in writing and presenting with faculty

NSF COLLABORATIVE RESEARCH GRANT- Partners

Texas	Washington	Delaware & Pennsylvania
• Two urban high schools, faculty at Texas Christian University	• Three high schools (two suburban, one alternative), faculty at WSU Tri-Cities	• Two high schools (one magnet, one traditional), faculty at Lehigh University

WSU Tri-Cities SESI Team

- Judy Morrison- PI
- Jonah Firestone-Co-PI
- Sarah Newcomer- Senior Personnel
- Danielle Malone- Research Assistant
- Lindsay Lightner- Project Coordinator

Goals of the Project

Provide integrated teacher professional development and curriculum planning

Teachers learn GIS and spatial reasoning skills in curricular contexts

Teachers implement integrated activities and projects into current curriculum

Develop students' spatial thinking

Increase student engagement and interest in STEM-related fields

Increase students' knowledge of technology

Four Year Project- PD

Year 1- June 2020-May 2021	Year 2- June 2021-May 2022	Year 3- June 2022-May 2023	Year 4- June 2023-May 2024
• Initial PD with teachers (zoom) to introduce them to ArcGIS (5 Ts) • Some activities implemented in classrooms • Four afterschool PD sessions (zoom) • On-going learning about ArcGIS by the team	• Met with teachers face-to-face for summer PD (5 Ts + 3 new) • Four afterschool PD sessions at the high schools • Continued implementation of activities and some projects	• Summer PD on TC campus 5 days (7 Ts + 2 new) • Four afterschool PD sessions (3 new Ts) • Continued implementation of activities and projects	• Summer PD on TC campus 5 days (10 Ts) • Four afterschool PD sessions • Continued implementation of activities and projects

Participant Support

- Hourly stipends for all PD sessions
- Research stipends
  - Questionnaires, interviews
  - Administer student surveys
- STEM Clock Hours
- Travel funds
- Classroom resources
  - I-pads
  - IR Thermometers
  - Water quality test kits
- On site classroom support

Build significant participant support into your grant proposal!

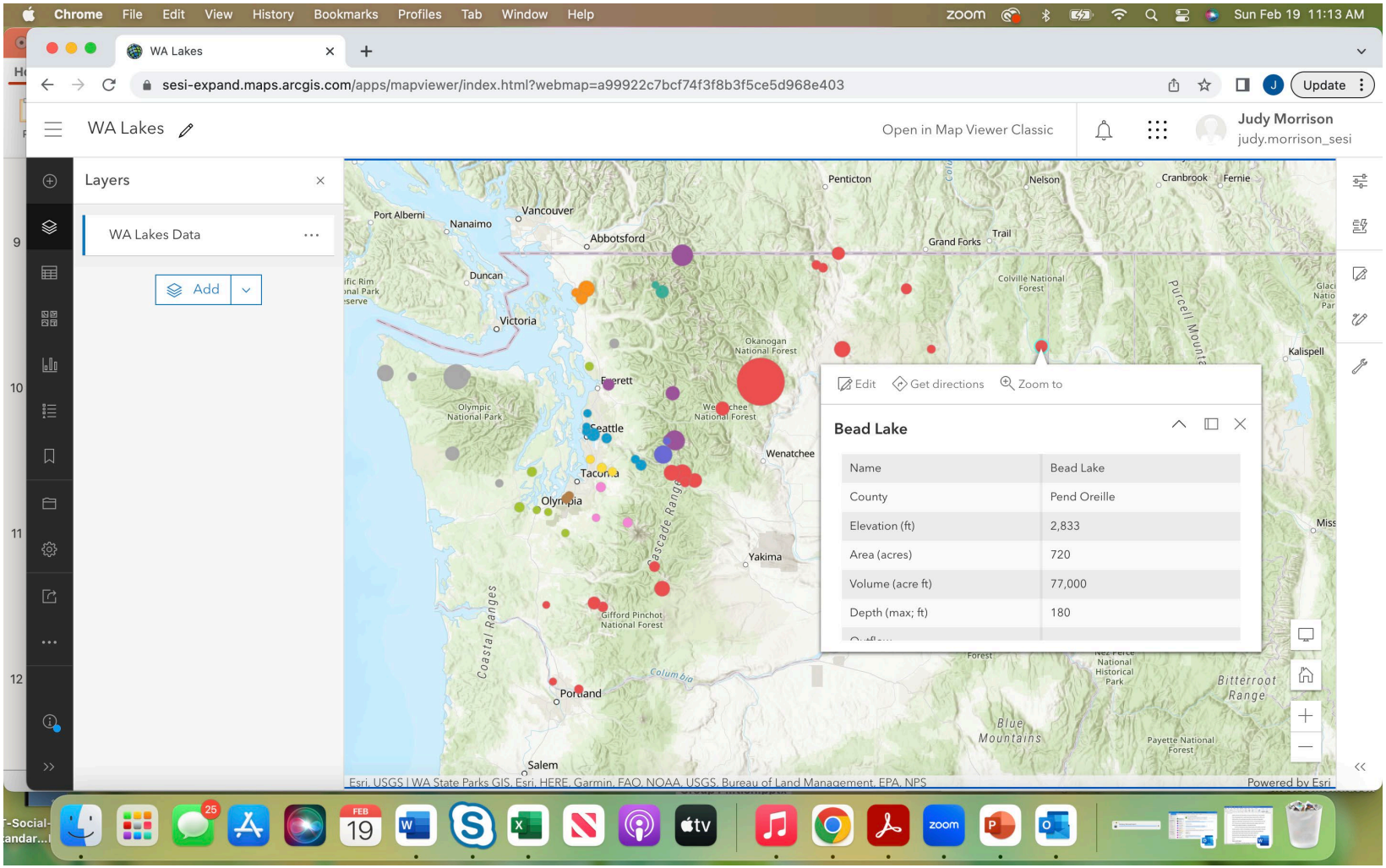
What is ArcGIS?

- **ArcGIS Online:** is a geographic information system created by Environmental Systems Research Institute (Esri)
  - Used by educators, geographers, and other professionals (e.g., city/urban planning committees, law enforcement, conservationist, etc.)
  - Used to collect and analyze data, explore geographic trends, and make decisions regarding a specific problem or issue

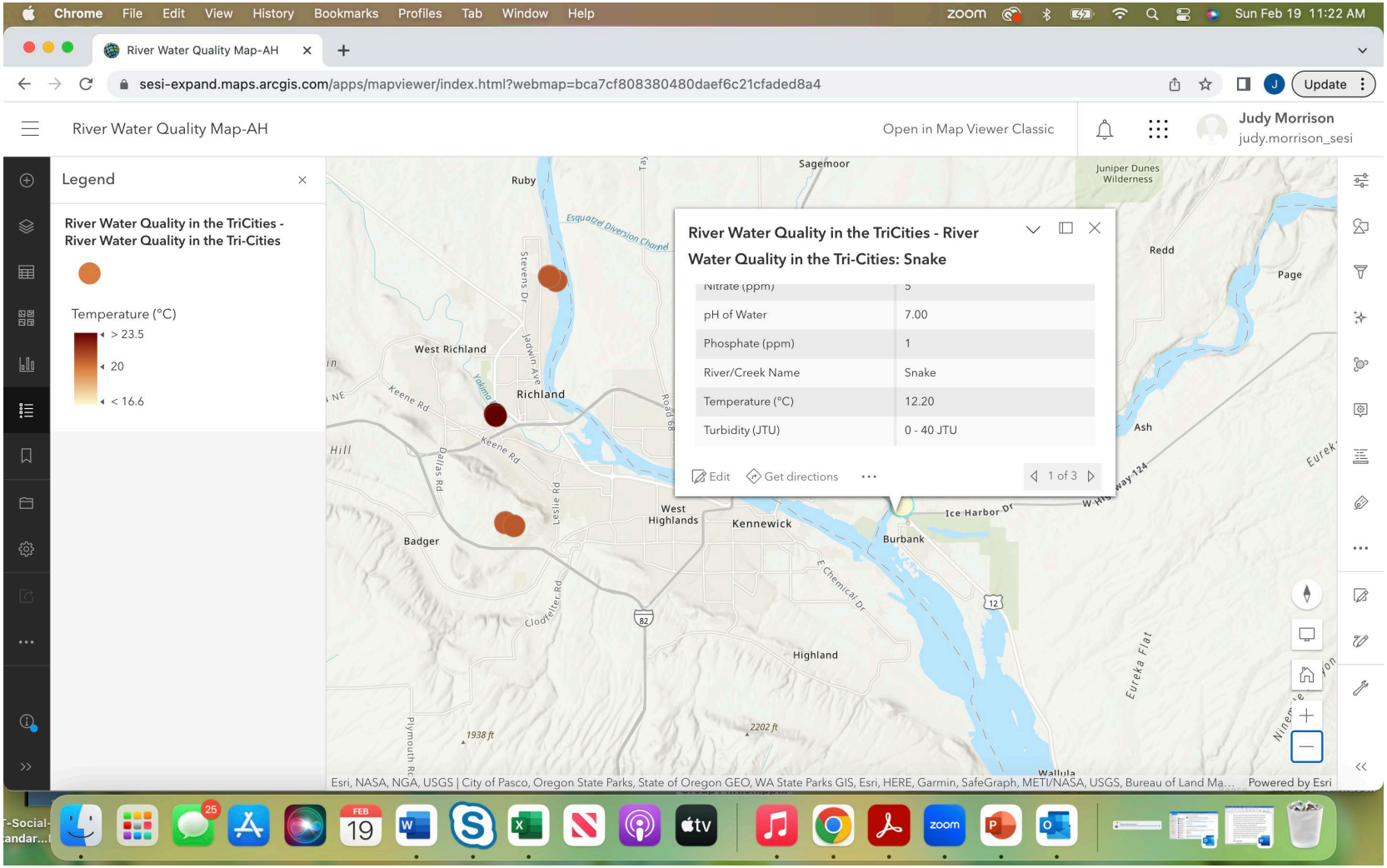
- **ArcGIS Field Maps**: app that employs data-driven maps to allow data gathering and editing, asset and information location, and real-time location reporting, users mark GIS data point on map, synchronizes with ArcGIS platform

- **StoryMaps**: visual presentation platform within ArcGIS, allows for embedded maps in series of slides

ArcGIS map

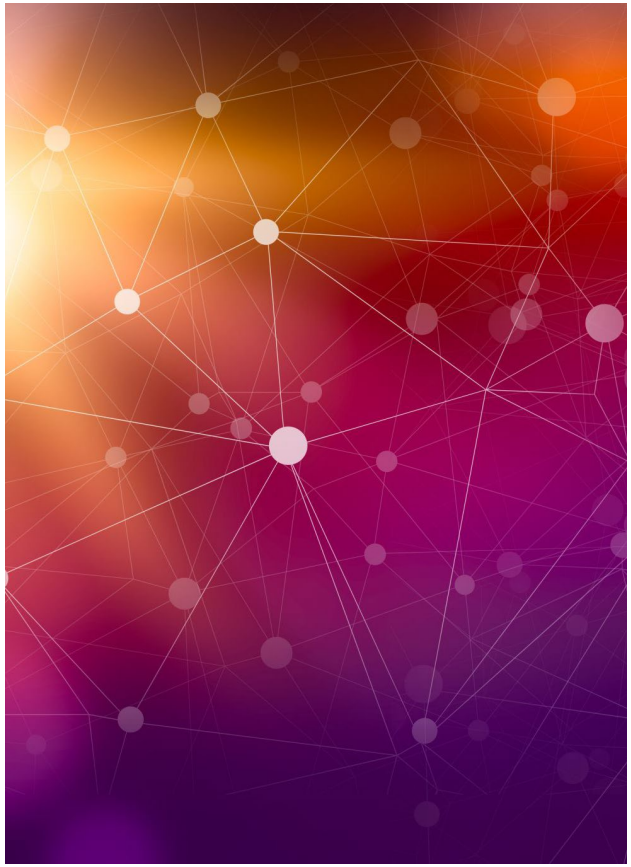

Chrome File Edit View History Bookmarks Profiles Tab Window Help
Sun Feb 19 11:13 AM
WA Lakes
sesi-expand.maps.arcgis.com/apps/mapviewer/index.html?webmap=a99922c7bcf74f3f8b3f5ce5d968e403
Update
WA Lakes
Open in Map Viewer Classic
Judy Morrison
judy.morrison_sesi
Layers
WA Lakes Data
Add
Edit
Get directions
Zoom to
Bead Lake
Name
Bead Lake
County
Pend Oreille
Elevation (ft)
2,833
Area (acres)
720
Volume (acre ft)
77,000
Depth (max; ft)
180
Penticton
Nelson
Cranbrook
Fernie
Port Alberni
Nanaimo
Vancouver
Abbotsford
Grand Forks
Trail
Duncan
Victoria
Colville National Forest
Okanogan National Forest
Kalispell
Everett
Olympic National Park
Seattle
Wenatchee
Wenatchee National Forest
Tacoma
Olympia
Yakima
Cascade Range
Coastal Ranges
Gifford Pinchot National Forest
Columbia
Portland
Salem
Bitterroot Range
Blue Mountains
Payette National Forest
Esri, USGS | WA State Parks GIS, Esri, HERE, Garmin, FAO, NOAA, USGS, Bureau of Land Management, EPA, NPS
Powered by Esri

ArcGIS map


River Water Quality Map-AH
sesi-expand.maps.arcgis.com/apps/mapviewer/index.html?webmap=bca7cf808380480daef6c21cfaded8a4
Update
River Water Quality Map-AH
Open in Map Viewer Classic
Judy Morrison
judy.morrison_sesi
Legend
River Water Quality in the TriCities - River Water Quality in the Tri-Cities
Temperature (°C)
> 23.5
20
< 16.6
River Water Quality in the TriCities - River Water Quality in the Tri-Cities: Snake
pH of Water 7.00
Phosphate (ppm) 1
River/Creek Name Snake
Temperature (°C) 12.20
Turbidity (JTU) 0 - 40 JTU
Edit
Get directions
1 of 3
Ruby
Sagemoor
Juniper Dunes Wilderness
Redd
Page
West Richland
Richland
Kennewick
West Highlands
Burbank
Badger
Highland
Ash
Esri, NASA, NGA, USGS | City of Pasco, Oregon State Parks, State of Oregon GEO, WA State Parks GIS, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, Bureau of Land Ma…
Powered by Esri

Socio-Environmental Science Investigations (SESI)

- Inquiry-based investigations
- Map-based mobile data collection (Field maps)
- Analysis with web-based mapping software (ArcGIS online)
- Pedagogical framework: place-based education and socio-scientific investigations
- Local issues and community-based decision-making
- Field work culminates in decision making to improve local community



Research Questions:

Teachers

1. What impact does this experience have on their:
    a. Geospatial technology use,
    b. Geospatial technology content knowledge, and
    c. Geospatial technology pedagogical content knowledge?

2. In what ways do teachers use geospatial technologies to promote engagement with learners who typically are unengaged?

3. In what ways do teachers use curriculum learning activities to support language learners and students with disabilities?

4. In what ways do participant teachers transfer their geospatial technology pedagogical content knowledge to other areas in their classroom curriculum?

Research Questions:

Students

1. What impact does this curriculum enhancement have on geospatial technology reasoning (GTR)?

2. What student or teacher variables may be related to the likelihood of adequate or better performance on their GTR skills?

3. For treatment students versus those in a comparable control group, what impact does this curriculum enhancement have on their:

    a. Spatial learning attitudes,

    b. Interest in learning science and science-related careers,

    c. Interest in using technology to learn science,

    d. Interest in careers in technology, and

    e. Attitudes towards geospatial technology?

Research Questions:

Research Practice Partnership (RPP)

To what degree does each RPP implement the planned components of the program model?

Which components of the SESI-ExpAND RPP model transfer most readily across different contexts?

What are we doing to answer our Qs?

Teachers

- Interviews (pre and post)
- Questionnaire on technology use, curriculum planning, PBL, GSTPACK
- Surveys on collaboration
- Classroom observations, curricular materials

Students

- Geospatial skills
- Engagement in STEM
- Classroom observations

Partnership

- Integrated Professional development- observations, interviews
- Collaborations across sites- observations, interviews
- Tracking PD and implementation across sites and schools

What are we finding?

Teachers

- GS:TPACK: survey builds on the concept of pedagogical content knowledge (PCK) and technological pedagogical content knowledge (TPACK). 16 out of 17 teachers improved pre-post during Year 1.
- Classroom observations and curricular materials show integrated projects and activities being implemented
- Projects developed show engagement of ELs and students w/disabilities

What are we finding?

Students

- Variables impacting engagement: technology, ease of access to mapping tools, time to learn in one trimester

Partnership

- Implementation of planned PD revised due to Covid, remote learning first year did not have large impact, some positive aspects seen
- Sharing components across the three sites has strengthened the project

Examples of Activities

Trees & Ecological Services: students explore their school property in order to locate, measure and identify trees and examine their impacts on the community

Urban Heat Island: students measure the temperature of a variety of outdoor surfaces (e.g., asphalt, concrete, grass) in sun and shade at different times of the day

Built Environment Scavenger Hunt: students explore their school grounds for examples of human infrastructure and code examples by service provided

Animals on Campus: students take pictures and document any animal life they can find around the school (spiders, ants, etc.)

Examples of activities in classrooms other than STEM

Research Questions:

- In what ways do teachers use geospatial technologies to promote engagement with learners who typically are unengaged?

- In what ways do teachers use curriculum learning activities to support language learners and students with disabilities?

Special Education Classroom

Class included eight 12th-grade students: two with intellectual disabilities, three with learning disabilities, and three with health impairments

Goals:

- Expose students to authentic experiences of using technology
- Expand their awareness of capabilities for using technology to solve problems
- Connect students to the school to increase their feeling of belonging

“TRASH IS A PROBLEM” ACTIVITY

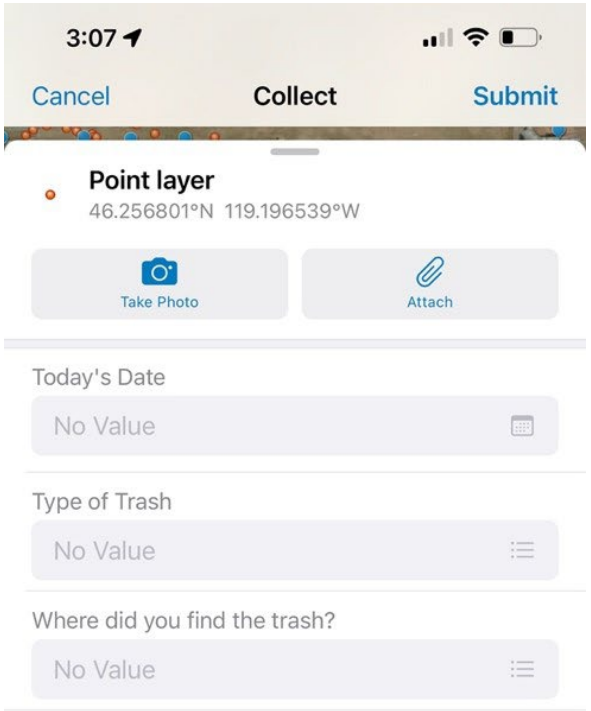
- Students identified issues within the school that they believed could be investigated
- They shared experiences about regularly seeing a lot of garbage on school grounds
- This topic worked well for data collection and mapping in ArcGIS Online

TRASH IS A PROBLEM ACTIVITY (CONT.)

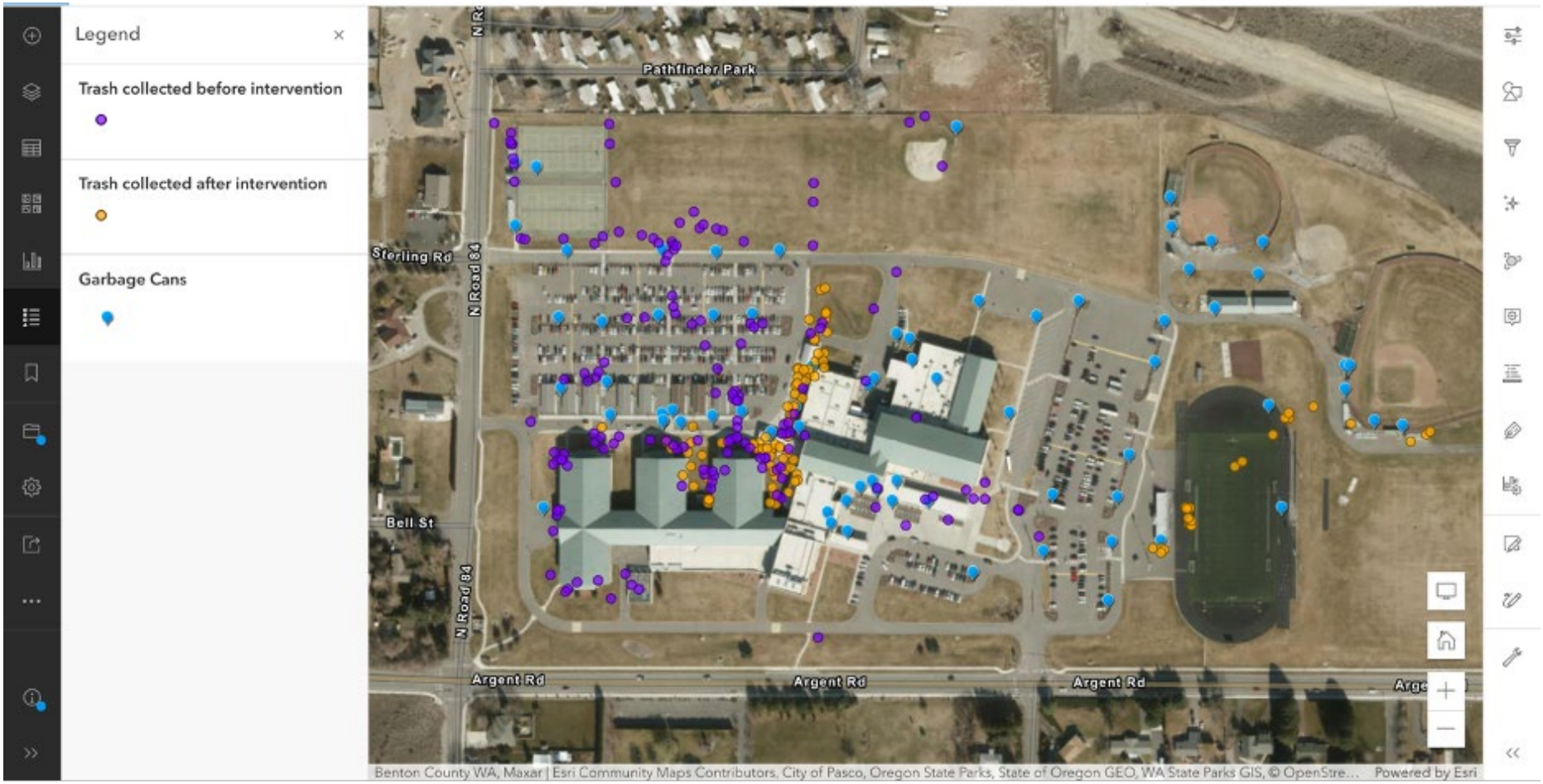
Students-

- Collected data using FieldMaps on their phones
- Recorded where trash and garbage cans were on campus (lunch areas, parking lots)
- Made conclusions about why trash was in certain areas and why cans weren't used (too full, too dirty)
- Proposed solutions for solving problem (made posters, school-wide announcements, gave PBIS points, talked to administration)
- Follow up: collected data after interventions and mapping where and how much garbage was present

Data Collector from Field Maps App



Trash is a Problem map displaying two data layers: trash data collected before Trash Awareness Week (purple) and garbage cans (blue) on campus.



Trash is a Problem map displaying two data layers: trash data collected before intervention (purple), trash data collected after intervention (orange) and garbage cans (blue) on campus.

Outcomes of Activity

Students developed skills in:

- Authentic data collection
- Using the data to make inferences
- Drawing conclusions
- Proposing solutions

Students gained experiences:

- Using geospatial technology embedded in a real-world, local context problem
- Connecting with peers on a school-wide initiative

These skills are essential in many discipline-based curriculum contexts but may not often be available to the students in a special education classroom

Alternative, PBL High School Multi-disciplinary Project

- Included science (physics), math (geometry), and PE
- Placed (school) based
- Students learned about disc golf and designed a course to be built on school grounds
- Each group of students proposed a course after doing research and design
- Involved outside work and field trip

This Photo by Unknown Author is licensed under CC BY-SA


Benton County WA, Maxar, Microsoft
Powered by Esri

Dissemination to date

Publications (published, in press, under review, inn progress)

- American Biology Teacher
- Journal of Science Education and Technology
- Journal of Geography
- Theory and Research in Social Education
- Social Education
- The Science Teacher
- Journal of Special Education Technology
- Innovations in Science Teacher Education

Book chapter in:

- Theoretical and Practical Teaching Strategies for K-12 Science
- Teaching Strategies in the Digital Age

Dissemination to date

- Presentations (accepted, presented) at conferences:
  - **STELLAR**- Science Technology and Engineering Library Leaders in Action
  - **SSMA**- School Science and Mathematics Association
  - **SITE**- Society for Information Technology and Teacher Education
  - **NCSS**- National Council for the Social Studies
  - **NCGE**- National Council for Geographic Education
  - **NARST**- National Association of Research on Science Teaching
  - **NAAEE**- North American Association for Environmental Education
  - **ISTE**- International Society for Technology in Education
  - **ICRSME**- International Consortium for Research in Science and Mathematics Education
  - **ASTE**- Association of Science Teacher Education
  - **AERA**- American Educational Research Association
  - Esri Ed Summit
  - Innovative Learning Summit

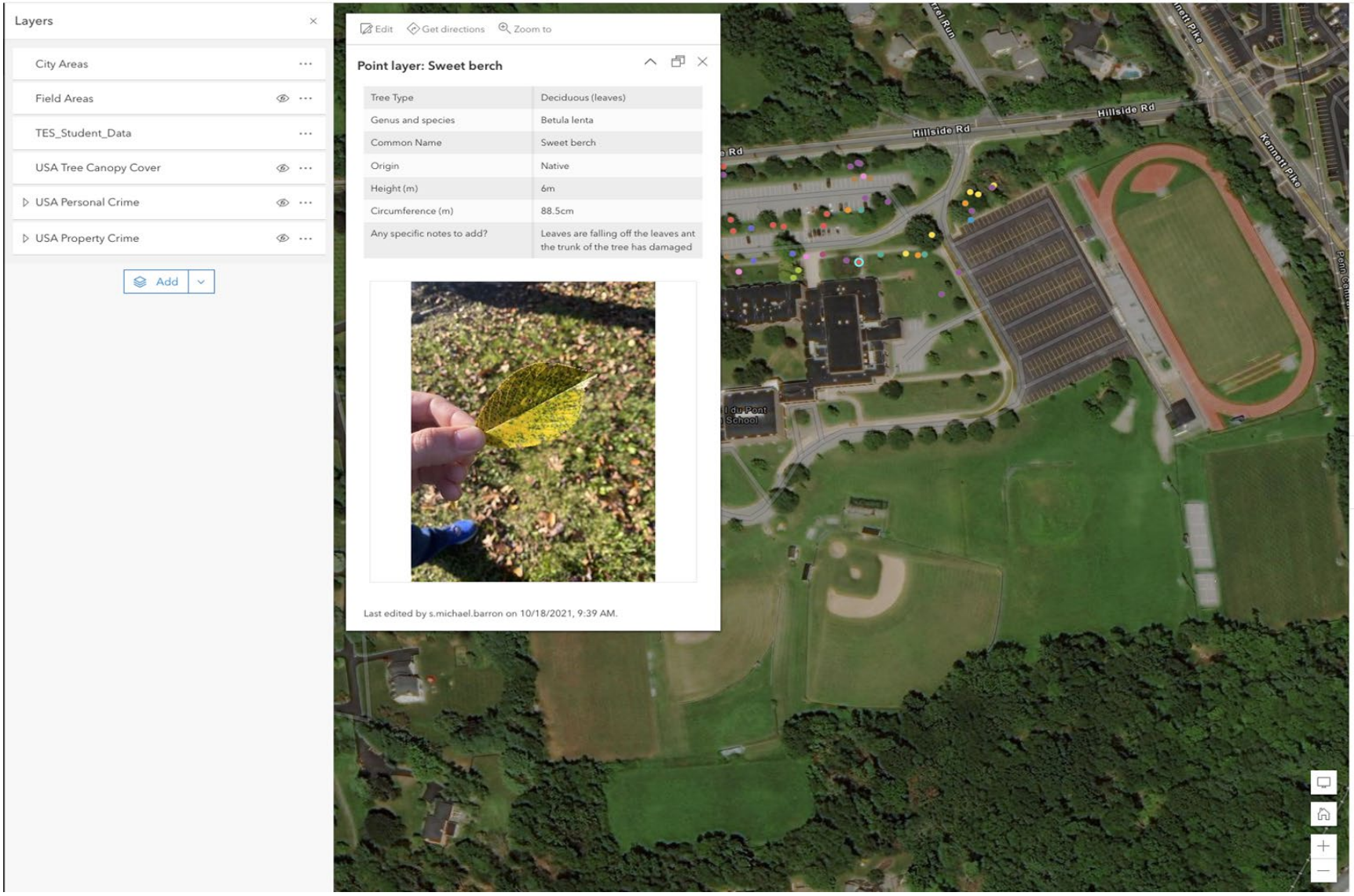
Next steps

- Year 4 will involve focus on collecting/analyzing student data
- Adding two Geography teachers
- Expand to socio-cultural investigations
- Work on cross site teacher-teacher collaborations

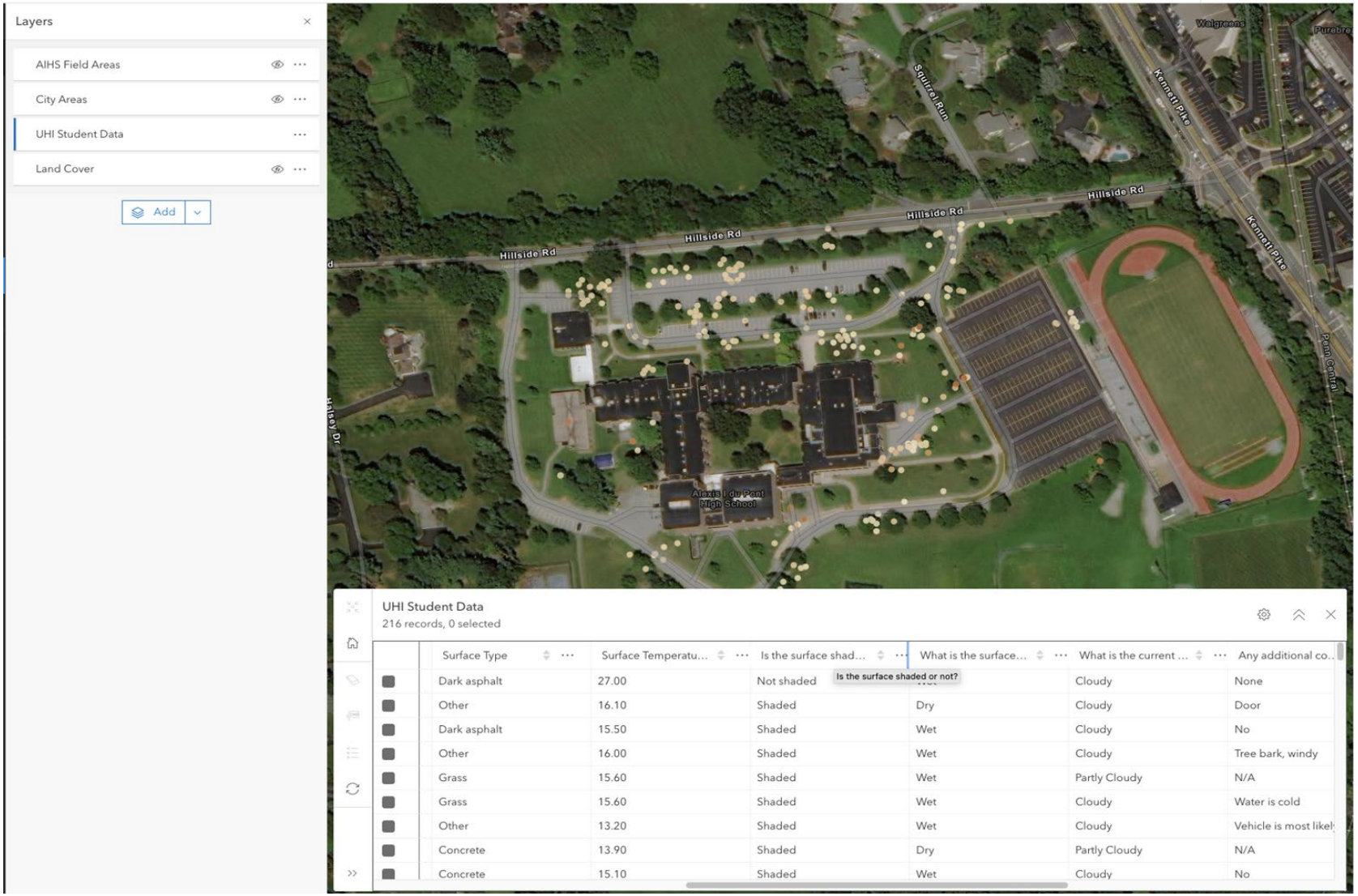
Future Research

- Expand to middle and elementary grades
- Extend to more disciplines
- Focus research on use of Story Maps

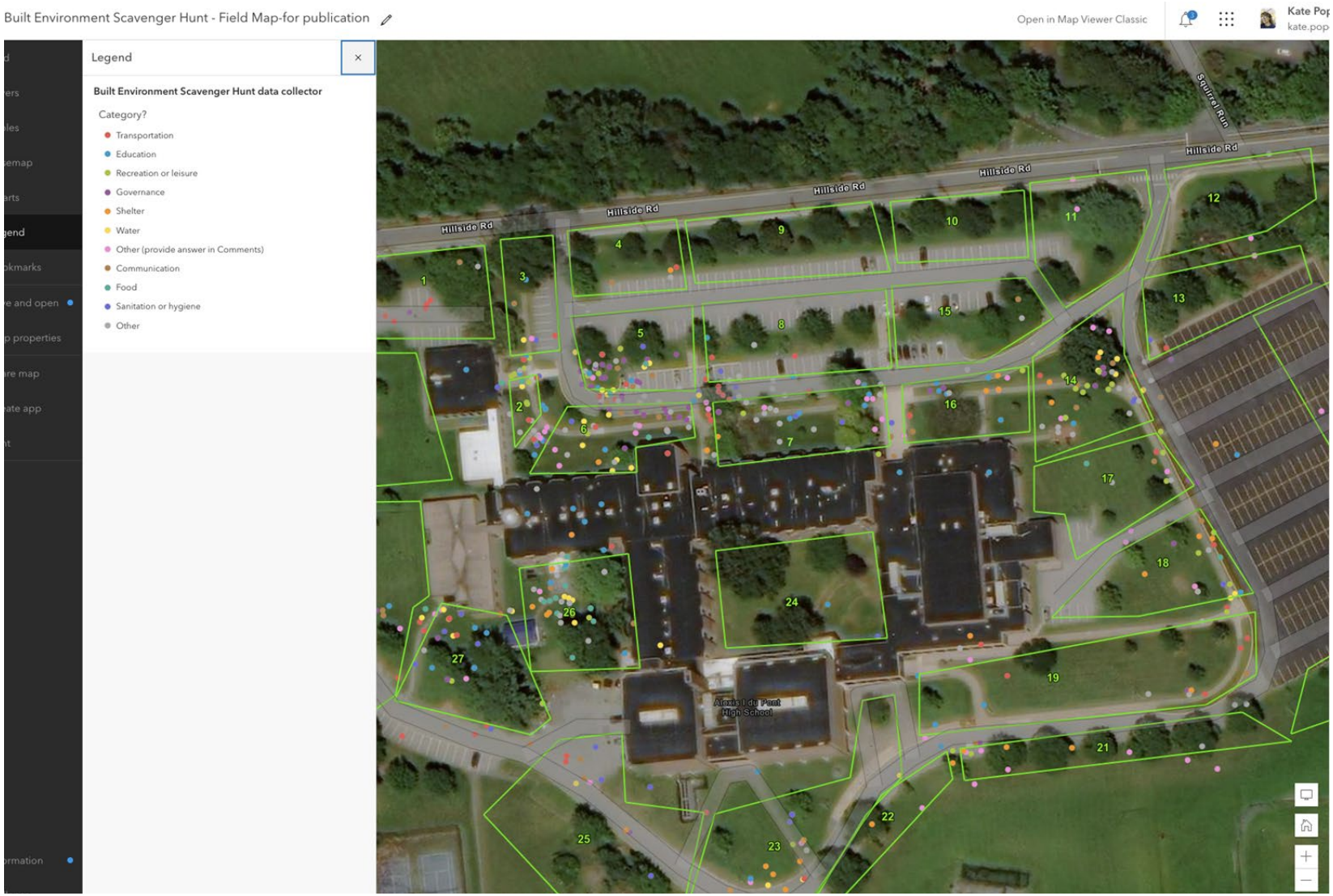
Questions?



Trees & Ecological Services



[Urban Heat Island]



[Built Environment Scavenger Hunt]

Campus Waste Management