Grand Canyon Monitoring and Research Center



Managing Data Resources and Online Content for GCMRC & GCDAMP

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Project K: Geospatial Science and Technology



Project Elements

- Geospatial Data Analysis
- Data Management / Data Science
- Access to Data Resources

Support Other Projects

- Support science projects with specific tasks
- Align this support with the goal of modernizing and improving data management, analysis, and data access strategies
- Often leveraging newer technologies to achieve these goals
- Center-wide support through the development of systems and resources



Geospatial Data Analysis – Support to Science Projects

Geospatial Data Analysis

Provide geospatial expertise to science projects on:

- Field mapping methods
- Development of customized field maps
- Sample site unit definition and selection
- GIS layer development
- GIS tool development and support.
- Oversight and support for various GIS-related tasks including:
 - Spatial analysis, including use of Python programming
 - Training for staff and cooperators in GIS data entry
 - Database management and Geospatial data set concepts
 - Data processing techniques
 - Production of printed maps and online map products







Geospatial Data Management – Support to GCMRC

Enterprise GIS Administration

- Storing and serving geospatial data in an enterprise environment
- Involves maintaining on-premise servers, system configurations
- Testing and migration of systems to newer versions of software
- Database administrative tasks

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 Code development for automating the upload of data and publishing geospatial services online





Data Management – Support to Science Projects



Fish Monitoring Database

- Migration from Oracle to PostgreSQL (2021)
- Updated Workflow for Data Staging and QAQC (2022-23)
- Leveraging tools such as Microsoft Teams & SharePoint to collaborate with fish cooperators across the GCDAMP.
- Lake Powell Water Quality
 - Published release of WQ database (2022)
 - Development of online tools (2023-24)
- On-premise Data Resources
 - Coordination with SBSC IT and GCMRC science projects to improve data management practices (on-going)



Access to Enterprise Data Resources



Case Study: Fish Monitoring Data

Benefits of open-source data

- Live link to data resources
- Can use intuitive tools to look for trends in data
 - Tableau software shown here
- Review recent and historical data
- Search for anomalies / errors

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• Query and download data via the live database connection

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	2023	February	LF20230202	RAINBOW TROUT	GCMRC	1409		
	2023	February	LF20230202	GREEN SUNFISH	GCMRC	290		
	2023	February	LF20230202	FLANNELMOUTH SUCKER	GCMRC	105		
	2023	February	LF20230202	COMMON CARP	GCMRC	19		
	2023	February	LF20230202	BROWN TROUT	GCMRC	702		
	2023	February	LF20230202	BLUEGILL	GCMRC	37		
	2023	February	LF20230202	BLACK CRAPPIE	GCMRC	1		
	2023	April	LC20230418	SPECKLED DACE	USFWS	15		
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Month of tr	TripID	Total Samples	Total Specimens	5	BLACK BULLHEAD
February	LF20230202	109	2,575		BLACK CRAPPIE
April	LC20230418	536	1,505		BLUEGILL
	LF20230406	116	1,949		BLUEHEAD SUCKER
May	GC20230426	1,703	12,046		BROWN TROUT
	GC2023042	3,571	3,571		CHANNEL CATFISH
	LC20230516	543	2,711		COMMON CARP
July	GC20230701	1,723	11,986		CRAYFISH
	GC2023070	6,072	6,072		FATHEAD MINNOW
	LC20230622	706	11,843		FLANNELMOUTH SU.
	LF20230629	54	1,434		FLANNELMOUTH/RA.
September	LC20230912	543	1,081		GIZZARD SHAD
October	GC20231006	1,730	10,535		GREEN SUNFISH
	GC2023100	5,063	5,063		HUMPBACK CHUB
	LC20231017	544	3,256		LARGEMOUTH BASS
January	LF20220121	117	4,314		MOSQUITO FISH
March	LF20220308	40	432	1	NO FISH CAUGHT
April	GC20220401	352	4,016		PLAINS KILLIFISH
	LC20220419	543	3,577		RAINBOW TROUT
	LF20220411	112	2,546		RED SHINER
May	GC20220504	1,735	7,041		SMALLMOUTH BASS
	GC2022050	2,507	2,507		SPECKLED DACE
	LC20220517	540	3,707		STRIPED BASS
	LC20220518	151	6,092		THREADFIN SHAD
June	GC20220609	60	385	1	UNIDENTIFIED FISH
	GC20220622	12	98		UNIDENTIFIED SUCK.
July	GC2022062	32	797		WALLEYE
	GC20220701	1,725	11,008		YELLOW BULLHEAD
	GC2022070	3,801	3,801		Organization
	GC20220706	34	199		Highlight organizatio
	LC20220624	845	5,168		
	LF20220629	53	1,371		
	LF20220711	50	422	1	
September	GC20220901	493	7,572		
	GC2022090	52	2,544		
	GC20220915	310	8,550		
	Month of tr February April May July September October January March April May June July September	Month of tr. TripID February LF20230202 April LF20230420 April LF20230420 May GC20230426 GC20230426 GC20230426 July GC2023070. LF20230629 LF20230629 September LC20230120 October GC2023100. CC023100. LC20231017 January LF20220121 March LF20220308 April GC20220504 GC20220504 GC2022054 July GC2022054 GC20220517 LC20220518 June GC20220504 GC2022070. GC20220524 July GC2022054 GC20220517 LC20220518 July GC2022070. GC2022070. GC2022070. GC2022070. GC2022070. GC2022070. GC2022070. GC2022070. GC2022070. GC2022070. GC2022070. GC2022070. GC2022070.	Month of tr TripID Total Samples February LF20230202 109 April LC20230418 536 LF20230406 116 May GC20230426 1,703 GC20230420 3,571 1 LC20230516 543 1 July GC20230701 1,723 GC20230702 6,072 1 LC20230516 543 1 July GC20230701 1,723 GC20230701 1,723 1 GC20230702 5,072 1 LC20230517 544 1 September LC20220101 117 March LF20220121 117 May GC20220504 1,735 GC20220505 2,507 1 LC20220517 540	Month of tr. TripID Total Samples Total Specimens February LF20230202 109 2,575 April LC20230418 536 1,505 LF20230406 116 1,949 May GC20230426 1,703 12,046 GC2023042. 3,571 3,571 LC20230516 543 2,711 July GC20230701 1,723 11,986 GC2023070. 6,072 6,072 1,2046 LC2023052 706 11,843 1,843 LF2023062 54 1,434 1,434 September LC2023012 543 1,081 October GC2023100 1,730 10,535 GC2023101 5,063 5,063 1,244 March LF20220121 117 4,314 March LF20220308 40 432 April GC20220501 3,577 1,2546 L20220517 540 3,707 L20220518 <	Number of the section of the se

Access to Online Data Resources

Access to Geospatial Data Online

Direct Access to GIS Services:

https://grandcanyon.usgs.gov/server/rest/services

- Grand Canyon Geospatial Portal
 - https://grandcanyon.usgs.gov/portal
- ESRI's ArcGIS Online platform
 - Map layers, Web Maps, Web Apps
- Custom web-based applications
 - Sandbar Monitoring App
 - Long-term Monitoring Cameras Site

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ryone (public)	🥑 Thomas Gushue	Open in Map Viewer	used to calculate the size of each sandbar in terms of the area of exposed sand and the volume of sand contained in the bar. Both of these calculations are relative to an elevation of interest.
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Access to Data Telemetry / Internet of Things (IoT)

Glen Canyon Dam IoT Field Site

Sensor-to-Cloud data transmission

- Field computer on-site communicates with sensor
- Data are extracted at scheduled times
- Data packets are sent via MQTT encrypted messages using a cellular connection to a data brokering client in Amazon Web Services.

Data stored in cloud-based Postgres database

- Partnering with USGS Cloud Hosting Solutions
- Acceptable values defined for parameters
- Redesigned the real-time data visualization

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GCMRC IoT Diagram for Water Quality sensor at Glen Canyon Dam



Glen Canyon Dam, near Page, AZ





Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Access to Data Telemetry / Internet of Things (IoT)



Glen Canyon Dam IoT Field Site

https://tableau.usgs.gov/views/colorado-river-water-quality-gcd/GlenCanyonDamSiteDailyAverages



Glen Canyon Dam, near Page, AZ



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The water quality data shown here are filtered raw values and are subject to revision through quality control / quality assurance procedures. These data are being provided to meet the need for timely best science. The data have not received final approval by the U.S. Geological Survey (USGS) and are provided on the condition that neither the USGS nor the U.S. Government shall be held liable for any damages resulting from the authorized or unauthorized use of the data. Please visit GCMRC's Discharge, Sediment and Water Quality web site to plot or download the processed measurements from this station: https://www.gcmrc.gov/discharge_gw_sediment/station/GCDAMP/09379901

Preliminary Information-Subject to Revision. Not for Citation or Distribution.

Access to Data Telemetry / Internet of Things (IoT)

Little Colorado River IoT Site

Fish

Antenna

Array

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Sensor-to-Cloud data transmission

- Fish pit-tag antenna located in Little Colorado River now connected via cellular data service
- Radio signal between River IoT site and Rim site with cellular
- Access to provisional pit-tag readings for scientists and stakeholders in • near real-time
- Data download capabilities are now possible •





Little Colorado River

ittle Colorado River Pit Tag Data





Additional Project Support



Integrating Content: Lake Powell Water Quality

Published WQ Database; Online Web App

Programming Code Services

- USGS GitLab maintenance and support
- Python scripts & GUIs for automatic data downloads, field computer status, remote reboot for field systems
- Developing code-base for accessing data

Field Engineering Support

- Designing, installing and maintaining solar power systems to support sensor deployments.
- New water quality buoy to be deployed at Lees Ferry
- Low Earth Orbit (LEO) Satellite antennas
 - First deployment of its kind within the U.S. Geological Survey
 - Improved reliability of data and reduced costs



Added Benefits of Project - Collaborations and Affiliations



Pl serves as liaison to SBSC IT group

- Coordination with SBSC IT Lead on all topics relevant to information technology, data management, data access and cloud strategies
- USGS Ecosystems Mission Area, IT Advisory Council
 - Representation & active involvement in IT initiatives, trends, and advances that shape science in USGS <u>and</u> across the DOI
- USGS Center for Data Integration Community of Practice
 - Project successfully been funded to support data-centric work that has complimented our mission for GCDAMP
- USGS Cloud Hosting Solutions (CHS)
 - GCMRC (and SBSC) use of Amazon Web Services (AWS)
 - Expanded Use of CHS: data backups to AWS, hosting online web applications for science projects.
 - Glen Canyon Dam Water Quality Data LIVE



Figure 1: Conceptual framework illustrating the tiered approach to IMT governance in USGS



Added Benefits of Project – Integration and Innovation



Debris Flow / Flash Flood Risk Assessment

- Project staff developed / funded by USGS Hazards Mission Area
- Leveraging existing GCMRC data sets, many funded by GCDAMP, to develop preliminary risk assessment related to debris flows and flash floods in Grand Canyon.
- Funding has led to collaboration with NOAA NWS, Coconino County Emergency Services, National Park Service, Tribal Representation and Recreation use groups
- <u>Outcome</u>: NWS / County Alerts sent to satellite texting devices across the region. Has implications far beyond just weather alerts.

The suggestions and illustrations included in this slide are intended to improve debris flow and flash flood awareness and preparedness; however, they do not guarantee the safety of an individual or structure. The contributors and sponsors of this product do not assume liability for any injury, death, property damage, or other effects of debris flows or flash floods.



Future Direction and Ideas...



Geospatial

- Moving more data to enterprise databases, and available through online services
- Integrating data sources into online content
- Advanced data visualizations that bring together maps, data, and tools
- Data and Databases
 - Moving Databases to online access
 - Apply more data analytics to these resources
- IoT Real-time Data Access
 - Actively tracking advances in data communication
 - Rapid growth in emerging technologies







Thank you!

Questions?