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Header 2

List View

General Information | Contact | Default Values | Discount | Document Information | Clarification Request

Procurement Folder: 1029877

Procurement Type: Central Purchase Order

Vendor ID: VS0000039384

Legal Name: ST MARYS UNIVERSITY OF MINNESOTA

Alias/DBA:

Total Bid: \$89,000.00

Response Date: 05/19/2022

Response Time: 9:04

Responded By User ID: gsssmumn

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SO Doc Code: CRFQ

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Status: Closed

Solicitation Description: National Wetlands Inventory Mapping Updates for 24 counties

Total of Header Attachments: 2

Total of All Attachments: 2

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Ln Total Or Contract Amount
1	NWI Wetlands Data for 24 WV counties				89000.00

Comm Code	Manufacturer	Specification	Model #
81151601			

Commodity Line Comments:

Extended Description:

NWI Wetlands Data will be created for 24 counties in WV as shown on Attachment A in the Specifications

West Virginia Department of Environmental Protection

**National Wetlands Inventory Update
24 Counties**



Photo: Northern Swamp Wetland Type Canaan Valley, WV. Credit: Elizabeth Byers

Prepared by:

GeoSpatial Services

Saint Mary's University of Minnesota

May 2022

GeoSpatial Services History and Overview

GeoSpatial Services provides a full range of consulting and development services focused on wetland delineation, wetland functional assessment, natural resource management, climate resiliency, and spatial analysis using Geographic Information Systems (GIS) technology. GSS operates as a Saint Mary's University of Minnesota (SMUMN) project center and has a strong history of developing wetlands, soils, and other GIS information for a broad spectrum of partners in both government and private industry. Our key partners include the Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, Bureau of Land Management, various State DNR offices, Houston Engineering, NV5 Spatial, and BP Pipelines.

In 1995, the Department of Resource Analysis (RA) and Master of Science (M.S.) in RA degree program were initiated at SMUMN, with a focus on environmental research for the Upper Mississippi River watershed. The first M.S. in RA class graduated in 1997. A focus on applying GIS technology in support of natural resource planning and environmental science grew out of SMUMN's long commitment to the Upper Mississippi River, where GIS was applied as an analysis and trending tool for biological studies.

By combining GIS education with experiential learning, GSS provides a unique educational opportunity for SMUMN graduate and undergraduate students to work in a mentored environment learning about GIS and the technology's relationship with diverse industries.

GeoSpatial Services employs thirty-two full-time individuals, including professional wetland scientists and delineators, environmental scientists, paleo-limnologists, GIS analysts, wetland image interpreters, field biologists, project managers and systems administrators. The organization continues to diversify as new projects enhance the experience of the professional staff.

Organizational Experience

GeoSpatial Services (GSS) staff have been involved in the design, development and implementation of wetland functional assessment tools over the last 20 years. GSS has worked with a variety of federal, state, tribal, and regional governments as well as non-profit organizations and private clients in the United States (Alaska, Arizona, California, Hawaii, Minnesota, Montana, North Carolina, North Dakota, New Jersey, New Mexico, Oregon, Washington, Wisconsin, and Wyoming) and Canada (British Columbia). GSS has experience in the design, development and implementation of both Level 1 (based solely on remotely sensed data and GIS analysis) and Level 2 (field data based rapid approaches supplemented with GIS analysis) wetland functional assessments.

The scope of these projects has ranged from development of new assessments to the adaptation of existing assessments to new geographies. Many of these projects have also included development of a comprehensive wetland inventory and the identification of potentially restorable wetlands.

However, each project had a goal of incorporating wetland functional assessment and value determination into long term monitoring and protection plans.

GeoSpatial Services has also been a dedicated cooperator with the U.S. Fish and Wildlife Service (USFWS) since 2000. Original projects completed by GSS for the USFWS focused on updating legacy GIS data for the NWI in Michigan and Texas. As a result of excellent performance on these early projects, GSS was selected to create the original NWI mapping for Alaska's Yukon Delta National Wildlife Refuge (NWR), Togiak NWR, the Arctic National Petroleum Reserve Area (NPPRA), and Wrangell – St. Elias National Park. These endeavors were multi-year projects, which included extensive photo interpretation and field validation to create a digital wetland data layer that conformed to the FGDC Wetland Mapping Standard.

GeoSpatial Services has performed work for other federal government agencies including the Bureau of Land Management (BLM), National Park Service (NPS), Natural Resource Conservation Service (NRCS), U.S. Army Corps of Engineers (USACE), and the U.S. Department of Agriculture (USDA). State level partners include: Department of Natural Resources offices in Wisconsin, Iowa, Illinois, Montana, and Minnesota; the Minnesota Board of Water and Soil Resources; the Minnesota Pollution Control Agency; the Montana Natural Heritage Program; and the Iowa Geological Survey.

On recent projects, GSS is working with a variety of public and private partners on developing and incorporating wetland functional assessments and performance level determinations to mapping, classification, long term monitoring and protection projects. Partners in these projects include various state natural resource departments (WI, NM, and IL), local citizen-based watershed organizations, conservation districts, The Nature Conservancy and federal agencies (BLM, USACE, USFWS, U.S. Forest Service [USFS]).

Some examples of the many GeoSpatial Services projects that are on the US fish and Wildlife Service projects mapper and have been accepted as meeting the NWI FGDC Standard include: R06Y20P03, R02Y16P01, R06Y20P04, R06Y20P07 and R07Y18P03.

GeoSpatial Services Mission Statement:

GeoSpatial Services exists to provide partners with a full-spectrum of natural resource and GIS mapping, design and development services, while providing student interns with a hands-on opportunity to improve their science and technical skills as a part of their educational experience.

Relevant Project Work

Example 1:

Project Title: WATERSHED WETLAND INVENTORY, ANALYSIS AND RAPID CONDITION ASSESSMENT		
Client: Shakopee Mdewakanton Sioux Community (SMSC)		
Project Manager: Mr. Kevin Benck	Completion Date: December, 2021	Total Project Cost: \$89,000
Client Contact: Ms. Ferin Davis Anderson Environmental Supervisor	SMSC Community Shakopee, MN (952) 496-6183	E-mail: FerinDavis.Anderson@ shakopeedakota.org

The primary goal of this project was to develop a Level 1 and Level 2 wetland function rapid assessment specific to the goals and objectives of the SMSC Land and Natural Resources Departments Wetland Plan Monitoring and Assessment Program. The secondary goal of the project was to update the wetland mapping inventory. The functional assessments were developed using an iterative process.

The first step of the development was the identification of the functions and other metrics that would be included in the assessments. GSS reviewed the existing scientific literature and existing wetland rapid a function assessment and provided this information to the SMSC Land and Natural Resources Department. GSS facilitated a number of meetings with a small work group of SMSC staff to select the functions, identify the attributes used to “score” the functions and identify the range of conditions for each attribute in terms or each function and how those ranges would be scored. Concept diagrams were developed in collaboration with the work group to develop the logic of how the various components would be combined to provide soring for the metrics of the Level 2 assessment. Based on the resultant concept diagram for each function, GSS adapted their Level 1 assessment methodology based on Cowardan classification codes, HGM-based classification codes, and spatial analysis to align with the developed Level 2 assessment.

Completed Objectives: Documented the development process and produced a wetland rapid assessment calculator that has a GIS module for deriving the off-site inputs and a module that uses on-line data collection survey form for the on-site data. Other products included the updated wetland inventory mapping complete with Level 1 function data with complete documentation, a User’s Guide for conducting the Level 2 assessment using the calculator, and documentation of all components of the calculator and both modules.

Example 2:

Project Title: DEVELOPMENT OF AN EPA LEVEL 2 WETLAND RAPID ASSESSMENT METHOD		
Client: Three Affiliated Tribes of Fort Berthold		
Project Manager: Mr. Kevin Benck	Completion Date: December, 2022	Total Project Cost: \$137,000
Client Contact: Mary Iorio Manager – Water Quality	404 Frontage road New Town, ND 58763 (701) 421-7436	E-mail: miorio@ mhanation.com

The TAT Environmental Division is developing a comprehensive Wetland Program Plan for the Fort Berthold Community. Specifically, the TAT intends to develop the administrative, programmatic, legal and regulatory framework that will allow them to assess, monitor, control, and protect the health, of their wetland resources. To properly integrate the wetland program strategy into the existing water quality program, a comprehensive landscape level (EPA Level 1) inventory of existing wetlands for and a Level 2 wetland functional assessment for incorporating field-scale data into the long-term monitoring and baseline assessment of wetland conditions.

Existing rapid assessment methodologies (RAM) such as North Dakota Rapid Assessment Model and Index of Plant Community Integrity (NDTAM/IPCI), Minnesota Wetland Functional Assessment (MnRAM), New Mexico Rapid Assessment Method (NMRAM) or California Rapid Assessment Method (CRAM) and the scientific literature were reviewed in terms of the needs of the TAT Wetland Program to identify potential wetland functions and attributes that can be used to assess those functions for both the Level 1 and Level 2 assessment. GSS provided a summary of this information and facilitated the discussion and development of the various components of the Level 1 and Level 2 assessments that address the specific threats and stressors to wetlands within the Fort Berthold Reservation.

The final products of the project are an updated wetland inventory with a Level 1 functional assessment and documented methodology and user guide, a spreadsheet-based function calculator and all associated data forms and documentation needed to conduct a field-based wetland condition assessment. The output of the calculator provides scoring associated with individual function level of performance, the value derived from performance of these function, with additional metrics including roll-up scoring for function groups, wetland sensitivity evaluation and wetland stressor evaluation.

Example 3:

Project Title: STOCKBRIDGE-MUNSEE WETLAND FUNCTIONAL ASSESSMENT AND RESTORATION PRIORITIZATION PROJECT

Client: Stockbridge-Munsee Environmental Department

Project Manager:
Mr. Andrew Robertson

Completion Date:
April, 2014

Total Project Cost:
\$78,000

Client Contact:
Angela Waupochick
Hydrologist

N7689 Koan Tuk Dr.
Bowler, WI
(715) 793-4818

E-mail: angela.waupochick
@mohican-nsn.gov

Beginning in September 2012 and running through April 2014, this project included converting WWI wetland data to NWI wetland data and adding the LLWW hydrogeomorphic classification. It also involved ortho-rectifying historic imagery, identifying potential wetland restoration sites and creating a site list for the tribe to review and begin field investigations in order to plan and conduct wetland restorations.



Photos from the Stockbridge-Munsee project

This project was a collaborative process between GSS and representatives of the Stockbridge-Munsee Environmental Department (hydrologist and wetland specialist). The final GIS data, report, and metadata were delivered to the tribe at the completion of the project. Since receiving this data, the tribe has planned, funded, and completed several wetland restoration projects on tribal lands. GSS is now working with them on a website designed to share their successes, and for watershed-wide outreach on potential restoration and water quality awareness with local stakeholders (tribal and non-tribal).

Example43:

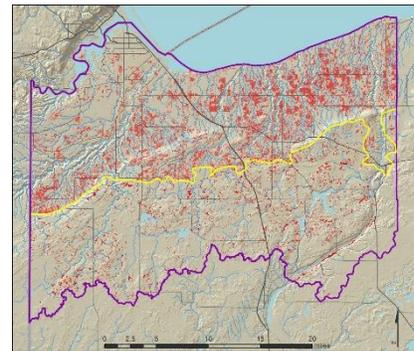
Project Title: A WATERSHED FRAMEWORK FOR THE ASSESSMENT OF WETLAND FUNCTIONS IN THE LAKE SUPERIOR BASIN OF DOUGLAS COUNTY, WISCONSIN

Client: Douglas County

Project Manager:	Completion Date:	Total Project Cost:
Mr. Andrew Robertson	5-20-2015	\$125,500.00

Client Contact:		
Christine Ostern Douglas County Conservationist	Douglas County (715) 395-1380	E-mail: Christine.Ostern@douglascountywi.org

Starting in 2012 and finishing in 2015, GSS collaborated with Douglas County and NOAA staff to complete a wetland functional assessment in the Lake Superior Basin of Douglas County, Wisconsin. GSS was a participant in many stakeholder meetings and led several technical committee meetings in this collaborative project. Ultimately, GSS created geospatial data products and GIS-based tools that supported the larger project which also involved stakeholder engagement and planning work. The technical committee included representatives from Douglas County Conservation Department, NOAA's Lake Superior Estuarine Research Reserve, Wisconsin Wetlands Association, Wisconsin Department of Natural Resources; U.S. Army Corps of Engineers, The Nature Conservancy, Northflow Inc., University of Wisconsin – Superior, University of Wisconsin extension, and University of Wisconsin – Madison.



GeoSpatial Services created several geospatial data deliverables for this project with the primary goals of informing the public and local-level planning participants on 1) predicted wetland functions of existing, mapped wetlands and 2) locations of potential wetland restoration (i.e., wetland re-establishment) opportunities in the Lake Superior Basin of Douglas County. Ultimately, GSS created NWI Plus wetland data from existing WWI data for the entire Lake Superior Basin in Douglas County and applied predicted functions to these data. In addition to existing wetland data and their predicted functions, data to indicate potential restoration opportunity locations were also created, these included: a potentially restorable wetland GIS dataset, a refined ditches and drainage path dataset, and potential restorable stream reaches.



Digitized ditches

Example 5:

Project Title: NWI UPDATE AND LANDSCAPE LEVEL WETLAND FUNCTIONAL ASSESSMENT FOR THE ST. CROIX HEADWATERS WATERSHED, WISCONSIN

Client: US Army Corps of Engineers

Project Manager:

Mr. Andrew Robertson

Completion Date:

March, 2012

Total Project Cost:

\$110,000

Client Contact:

Mr. Elliot Stefanik
Project Manager

US Army Corps of Engineers
(651) 290-5260

E-mail:
ElliotL.Stefanik@usace.army.mil

For several recent projects, GSS has been working with a variety of public and private partners on the incorporation of wetland functional assessment and performance level determination into mapping, classification, long term monitoring and protection projects. Partners in these projects include various state natural resource departments (WI, IA, NM and IL), local citizen-based watershed organizations, conservation districts, The Nature Conservancy and federal agencies (USACE, USFWS, and USFS).

Since 2009, GSS has been working with the Wisconsin DNR to design such a program in the St. Croix River headwaters. In this watershed, GSS has provided:

- three time stamps of aerial photo-based wetland delineation (1948, 1992 and 2008);
- wetland classification for each polygon and each year using NWI, WWI, and LLWW codes;
- a correlation table of wetland type to wetland function which supports the Wisconsin Wetland Rapid Assessment Methodology;
- the establishment of statistically sound status and trends monitoring plots intensified from the USFWS and EPA NWCA monitoring programs;
- and liaison with special interest groups (Friends of the St. Croix Watershed) to build community-based awareness and support for watershed management.



Photo from the St. Croix project

Other Recently Awarded/In Progress Wetland Mapping Projects

West-wide Wetland and Riparian Area Mapping

GSS has been collaborating with The Bureau of Land Management (BLM) for the past 3 years to create a comprehensive wetland and riparian inventory that captures the extent and status of these ecosystems across BLM administered lands and more in the Western U.S.

This inventory will provide a basis for understanding the health of wetland and riparian ecosystems. In addition, this effort will inform the investigation of wetland status, condition, and trend across much of the U.S.

Current work is in seven western states and Alaska. GSS mapping in the west spans BLM lands, U.S. Forest Service lands, as well as projects which map all-lands in a given project area. Work in Alaska exceeds 27 million acres for the BLM (GSS has additional projects in AK, not listed here).

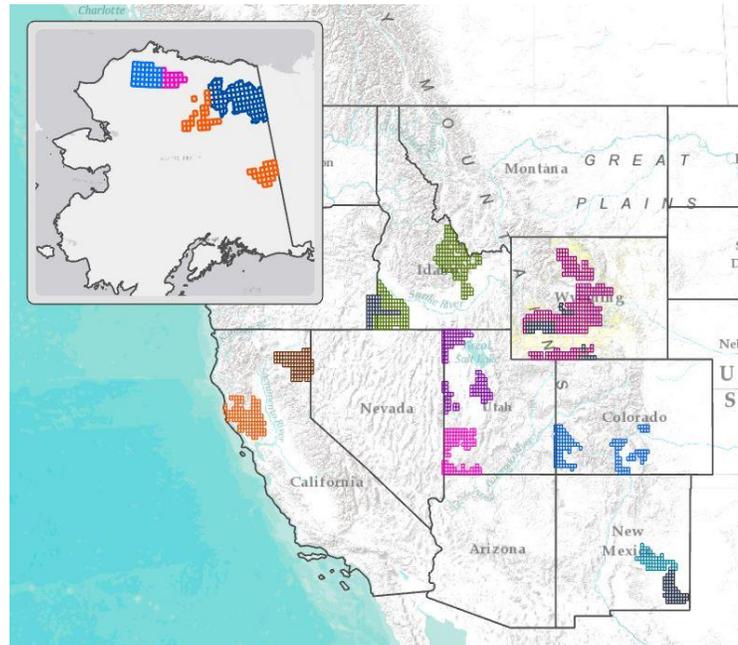


Figure 11. Current BLM Wetland Mapping Projects.

Spatial Data Visualization

GSS believes that the value of data is defined by its accessibility and presentation. If end-users cannot access the data they need or understand the data in front of them, the job is not complete. When it comes to data accessibility, GSS takes steps to ensure that any data provided is clean and easy to access; from organized databases, appropriate attribution, or even metadata standards set by the FGDC.

Jemez Mountains, New Mexico Story Map

GSS created an Esri Story Map to highlight the wetland and riparian area delineation and classification work that was completed in the Jemez Mountains study area located in north-central New Mexico.

Follow this link to view the Jemez map: [Click Here](#)

National Wetland Inventory Update for Minnesota – Southern, Northwest Areas and Statewide Quality Assurance and Quality Control

Client: Minnesota Department of Natural Resources

Completion Date: March 2019 Project Cost: \$1,750,000

Beginning in September 2012 and running through January 2019, these two mapping initiatives included two project areas (Southern and Northwest) covering 57 Minnesota counties and the management of over 50 analysts and technicians over the seven-year period. First, a NWI and NWIPlus polygon layer was created using Esri ArcGIS 10.3. A broad classification of wetland type and simplified plant community classification was then populated through automated modeling. A second dataset, Public Waters Inventory (PWI), was delineated within the NWI data by updating linears into well-defined, polygonal watercourses.

Many measures were taken to ensure the quality and accuracy of these wetland datasets. Nine week-long and several day trips of field observations were made; taking pictures and recording hydrologic conditions, soil types, and vegetation for wetland validation. This allowed for the development of aerial photo interpretation conventions, coupled with a well-defined set of technical procedure guidelines for outlining delineation processes. The final data received a number of QAQC reviews for upland to wetland boundaries, attributes, and precision of line work. The entire geodatabase was then processed using the USFWS NWI schema tools and verified for topology with continual and rigorous reviews by the MN DNR and their technical advisory committee.



Minnesota study areas mapped by GSS.



Field Validation Checksite of Forested Floodplain on the Mississippi River in Minnesota.

Minnesota LLWW Model and Statewide QAQC

In July 2019, GSS completed the finalization and delivery of wetlands data from all project areas across the state to the MN DNR, including the Metro, Southern, Northeast, North-central, and Northwest. Final details of polishing up the data included edge-matching all coincident wetlands along adjacent project boundaries, reviewing attribute consistency for class, sub-class, water regime, and special modifier, reviewing upland/wetland boundaries and linework, developing and running a model to automate all NWIPLUS classifications across the state, locating additional issues and creating tools and solutions to fix those errors, hosting technical advisory meetings, creating exported layers to symbolize based on attribute or particular error, building a Web application to display QAQC findings, and running finalization tools and scripts to prepare the data for delivery.

The MN DNR held weekly meetings with a technical advisory committee consisting of members from their staff and GSS, Minnesota Pollution Control Agency, and other local and regional participants with vested interest in a high-quality, statewide wetland dataset. Each week, project status was reported and completed tasks were verified. Newly discovered issues were documented and an order of prioritization and estimated time to completion was stated. The data was housed in an Enterprise database for more efficient management and higher security. The wetland data was displayed for all of the technical committee review and comment through a Web map application designed and implemented by GSS. A 2.4 million polygon dataset with NWI, PWI, NWIPlus, wetland type, and community description was delivered to the MN DNR's specifications.

Additional Services Available *(Not included as tasks in this proposal.)*

GIS Data Hosting

Data hosting can require a large and well-developed technological infrastructure (e.g., servers with large memory capacity and backup/restoration strategies), as well as staff time for administrative and maintenance tasks. GSS can provide, or help our partners to develop, the sharing of GIS data between organizations or on the web.

Spatial Data Visualization

GeoSpatial Services believes that part of the value and utility of data can be defined by its accessibility and presentation. If end-users cannot access the data they need or understand the data in front of them, then we have not quite done our job as GIS professionals.

The GSS team can assist in developing web sites or applications that can help share GIS data and information. This could include making information available within an organization or to a wide range of public stakeholders. Web sites and applications can include interactive maps for presenting geospatial data or query tools, and/or allowing users to access local environmental information (e.g., water quality, soils, climate, and land use). Developing web products starts with a needs assessment to clearly identify each project's objectives, target audience, and the most suitable technology (software programs, etc.).

Development and Delivery

GeoSpatial Services can help clients develop and deliver different visualizations of data and information, ranging from traditional hard-copy maps or posters, to interactive online maps. Our team has experience working with ArcGIS Online, a cloud-based Esri mapping platform that allows users to share maps and associated information over the web. GSS has also created "Story Maps", a new Esri web application that combines maps, multimedia elements, and a story to guide users through an experience that provides education and outreach.

Data Management

GeoSpatial Services maintains a secure data management and information technology infrastructure. All computer servers and data storage devices are housed in locked data closets and personal computers reside in locked and alarmed offices. A data management plan is in place and includes secure on-site and off-site storage for both full and incremental backups.

Andrew G. Robertson R.P.F.

Executive Director, GeoSpatial Services



📍 Winona, MN

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☎ 507.457.8746

EXPERTISE

- Project Management
- Strategic Planning
- Watershed Plan Development

EDUCATION & CERTIFICATIONS

Post-graduate Study, Forest Management

University of Toronto | Toronto, Ontario, Canada

BS, Environmental Studies

University of Waterloo | Waterloo, Ontario, Canada

Forest Technician Diploma

Sault College of Applied Arts and Technology | Sault Ste. Marie, Ontario, Canada

MEMBERSHIPS

Chair of Alaska Wetlands Technical Workgroup

Association of State Wetlands Managers - Board of Directors

New Mexico Wetlands Technical Advisory Committee

Sustain Winona ISO 14001 Partnership

President-Elect Society of Wetland Scientists - North Central Chapter

SUMMARY OF QUALIFICATIONS

A dynamic senior manager and exceptional communicator with extensive leadership experience in the application environmental management systems and information technology solutions in support of business sustainability and fiscal performance. Results oriented with proven abilities in negotiating and managing partnerships, providing strategic direction, motivating technical and professional teams, interacting with stakeholders, and establishing priorities in rapidly changing environments.

RELEVANT EXPERIENCE: FIELD

US Bureau of Land Management - BLM-NOC West-side Wetland and Riparian Mapping Assessment

Principal Investigator | 2016 to Present

This project is addressing the need for a comprehensive wetland and riparian inventory that captures the extent and status of these wetland and riparian ecosystems across BLM administered lands in the Western U.S. and Alaska. Through a collaborative effort, mapping methods are being developed, refined, and implemented to facilitate the creation of a consistent, west-wide wetland and riparian inventory. This inventory will help provide a basis for understanding land health and management of BLM lands through four fundamental areas of functioning wetland and riparian ecosystems. These four fundamental areas cover: properly functioning watersheds, compliant state water quality standards, habitats restored or maintained for federal threatened and endangered species and others, and the maintenance of ecological processes that sustain healthy biotic populations and communities. In addition, this effort will inform the investigation of wetland status, condition, and trend across much of the U.S. The primary project goals are to: 1) complete a review of existing or ongoing wetland and riparian mapping efforts; 2) co-develop, with BLM staff, a proposed mapping methodology; and 3) complete pilot area wetland/riparian mapping in order to test proposed methods.

Hewlett Foundation - Modeling Federally Protected Waters and Wetlands

Principal Investigator | 2017 to 2019

Worked in collaboration with project sponsors and partners, to spatially compare and contrast the extent of regulatory protection for Waters of the United States under different jurisdictional scenarios. Starting with current digital wetland inventory and functional assessment databases, this project uses GIS technology to model permanent waters and wetlands that are included or excluded from regulatory jurisdiction under three scenarios: the Kennedy test, the Scalia test, and the 2015 Clean Water Rule. New assessment techniques are employed to establish connectivity between surface water features and identify where a "significant nexus" exists. The data from this analysis will be used as the basis for commentary on proposed changes to the Clean Water Rule under the new Executive Order.

RELEVANT EXPERIENCE: FIELD

US Fish and Wildlife Service – Wetland and Hydrography Mapping of USFWS Refuge Lands in Alaska

Project Manager | 2002 to Present

GeoSpatial Services has been working with USFWS Region 7 NWI Program staff for several years on the research and development of refined mapping protocols for wetland (NWI) and hydrographic (NHD EDH) inventory in Alaska. The focus of these cooperative efforts has been on the technical analysis of new imagery and collateral spatial data, including elevation models, soils and field based vegetation mapping, to support the application of wetland mapping protocols at a variety of spatial scales. USFWS staff initiated this evaluation of available imagery sources, current collateral data, and related mapping software to determine how effective their integration might be in expediting NWI program objectives in Alaska. NWI staff and GSS researchers defined mapping guidelines and protocols for test areas in and near the Bering Land Bridge National Preserve (BELA) of the Seward Peninsula, within the Yukon Delta National Wildlife Refuge (YDNWR) near Hazen Bay, and for select portions of the Bristol Bay Watershed. Research activities were later expanded to include study areas on Kodiak Island including portions of the Kodiak National Wildlife Refuge (KNWR) in the Karluk River Watershed and the Buskin River watershed adjacent to Kodiak City. Research progress is still on-going in the Selawik National Wildlife Refuge, which partially straddles the Arctic Circle and the Alaska National Wildlife National Wildlife Refuge (ANWR).

Amigos Bravos - Identifying Key Wetland Complexes using GIS Queries and Analysis within the Amigos Bravos Area of Interest

Principal Investigator | 2014 to 2017

This project utilized wetland mapping available from the New Mexico Environment Department (NMED), Surface Water Quality Bureau (SWQB) that GeoSpatial Services had recently completed to identify and prioritize important headwater wetland complexes across their area of interest. Amongst other applications, the results for this mapping exercise would be used to provide input to the U.S. Forest Service planning process on the Carson and Santa Fe National Forests. GeoSpatial Services conducted GIS-based query or analysis exercises to identify key wetlands or wetland complexes within the National Forests that can be targeted for preservation, restoration and/or enhancement. Each of these queries resulted in an individual map layer containing the specified wetland features. A normalized scoring system was used to identify those key wetland complexes that provide multiple combinations of ecological functions at a high significance level. The results of the project were delivered as an online interactive series of maps.

OTHER RELEVANT EXPERIENCE:

Mr. Robertson's extensive project management history demonstrates significant GIS experience in the natural resource arena with primary software tools.

- Designated as Principal Investigator for a variety of Cooperative Ecosystem Study Unit spatial data development projects for the National Park Service in Alaska. This experience included the Co-Principal Investigator role for Natural Resource Condition Assessments for Denali and Klondike Gold Rush National Parks.
- Acted as project manager for multi-year initiative to map National Wetland Inventory across 9.3 million acres of Alaska's North Slope Region. Included coordinating and participating in two seasons of arctic field work staged from Barrow, AK.
- Coordinated projects to develop and implement orthorectification and digital mapping techniques for the creation of landcover and National Wetlands Inventory mapping across various National Parks in Alaska including Wrangell St. Elias, Glacier Bay, and Kenai Fjords.
- Worked as lead project manager on the development of a SSURGO-based spatial soils database for the modeling of stress, corrosion and cracking across a major national petroleum pipeline network.
- Participated as project manager on a multi-phase, multi-year project to convert over 1.6 million acres of Wisconsin Wetland Inventory from hardcopy aerial photo delineations to an ArcGIS spatial database.
- Coordinated multiple National Wetland Inventory mapping projects in Montana that resulted in the development of a spatial wetlands database covering over 1.5 million acres.
- Lead an ArcIMS development team that focused on the creation of a state-wide internet based soils mapping and decision support application for the Minnesota Board of Soil and Water Resources.
- Designed and implemented digital forest inventory and forest management programs for industrial forestry companies.
- Provided business needs assessment, business process analysis and database design services for a variety of forest products industry and public sector clients.
- Provided enterprise GIS design, implementation and management.
- Collected and managed spatial data for use in the environmental impact assessment of power transmission facilities.

- Participated as a forestry and GIS specialist in the organization and delivery of community based public information sessions for new facility development.
- Developed environmental data management systems for watershed planning and management. Developed project maps and tabular output for shoreline management plans on the Great Lakes.
- Worked with Canadian First Nations communities to implement GIS technology and create updated maps and applications. Created customized GIS programs in AML and Avenue which modeled and analyzed community data. Trained First Nation and Aboriginal community members in the use of GIS and GPS software.
- Provided benchmark testing for the evaluation and implementation of softcopy photogrammetry software for forest inventory.
- Coordinated the mission planning and execution of various aerial photography and satellite image acquisition projects for natural resource data collection.
- Participated in the design and implementation of ISO 14001 based environmental management systems for industrial forestry clients.
- Supervised, trained, and allocated work to GIS professional staff in a variety of public sector organizations and private sector companies.
- Member of the ESRI Forestry Geodatabase Data Model design group working to develop a standardized forestry data model for ArcGIS.
- Created, edited, and updated maps and figures with ESRI software for detailed forest management plans, general forest development plans and annual operating plans.
- Participated in the design and development GIS training programs for the Ontario Ministry of Natural Resources.
- Acted as a technical advisor and student supervisor to a variety of technical Colleges for the development and curriculum design of GIS Technologist educational programs.
- Conducted hydrographic surveying for nautical charting of the Northwest Passage in the Canadian High Arctic.
- Conducted field surveys to collect data for mapping. Data collection from GPS, hard copy maps, air photos, and satellite imagery. Created, updated and edit GIS maps using ArcInfo software.

SELECT PUBLICATIONS

Zou, Z.; DeVries, B.; Huang, C.; Lang, M.W.; Thielke, S.; McCarty, G.W.; Robertson, A.G.; Knopf, J.; Wells, A.F.; Macander, M.J.; Du, L. Characterizing Wetland Inundation and Vegetation Dynamics in the Arctic Coastal Plain Using Recent Satellite Data and Field Photos. *Remote Sens.* 2021, 13, 1492. <https://doi.org/10.3390/rs13081492>

Anderson, J. C., Good, K. R., Maffitt, B. L., Robertson, A. G., Rokus, D. D., 2018. Mapping and Classification of Wetlands for Protection: Northeastern New Mexico Highlands and Plains. Saint Mary's University of Minnesota.

Richtman, C. M., J. C. Anderson, A. G. Robertson, D. D. Rokus. 2016. Description of Existing Wetland Resources in the St. Croix River Headwaters Watershed. Saint Mary's University of Minnesota.

Kilkus, K. R., G. C. Bernatz, A. G. Robertson, B. W. Drazkowski, C. E. Lee, E. J. Iverson, and J. C. Knopf. 2011. Denali National Park and Preserve: Natural Resource Condition Assessment. Natural Resource Report NPS/NRSS/WRD/NRR—2011/424. National Park Service, Fort Collins, Colorado

G. C. Bernatz, A. G. Robertson, B. W. Drazkowski, E. J. Iverson, and J. C. Knopf. 2011. Klondike Gold Rush National Historic Park: Natural Resource Condition Assessment. Natural Resource Report NPS/NRSS/WRD/NRR—2011/423. National Park Service, Fort Collins, Colorado.

Drazkowski, B. , K. J. Stark, M. R. Komp, G. Bernatz, D. Brown, C. Richtman, C. Lee, A. Robertson, and K. Slifka. 2011. Wrangell-St. Elias National Park and Preserve, Natural Resource Condition Assessment. Natural Resource Report NPS/NRSS/WRD/NRR—2011/406. National Park Service, Fort Collins, Colorado.

Robertson, A.G. 1998. Business process analysis and data modeling using developer 2000: a small step back for a major leap forward. GIS '98/ Resource Technology '98 Conference, Toronto, Ontario.

Robertson, A.G. 1996. Rehabilitating upland terrestrial habitat in the humber river watershed - a GIS approach. Prepared for the Canadian Wildlife Service and Environment Canada.

Robertson, A.G. and Donald Parkinson. 1995. GIS - a decision support technology for shoreline management planning in the great lakes. GIS '96 Conference, Vancouver, British Columbia.

Kevin M. Benck

Senior GIS Analyst, GeoSpatial Services



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EXPERTISE

- GIS Analysis
- Data Analysis
- Data Management
- Ecological/Habitat Assessments
- Project Delivery

EDUCATION & CERTIFICATIONS

MS, Business Intelligence and Data Analytics (Dec 2019)

Saint Mary's University of Minnesota | Minneapolis, MN

BA, Environmental Studies

Doane University | Crete, NE

MEMBERSHIPS

MN ArcGIS User Group

ESRI ArcHydro User Community

SUMMARY OF QUALIFICATIONS

A senior GIS Analyst with over a 20-year background water resources and engineering/environmental consulting. Adapt at applying GIS technologies and assessment methodologies to a both aquatic and terrestrial habitats. Results-oriented professional with proven abilities to assume any role in a project, from leadership to a supporting role.

RELEVANT EXPERIENCE: FIELD

Shakopee Mdewakanton Sioux Community - Wetland Program Expansion and Refinement

Project Manager | 2019 to Present

GeoSpatial Services was contracted by The Shakopee Mdewakanton Sioux Community Land and Natural Resources Department (SMSC) to support their effort to refine and implement a wetland program plan. This project intends to identify and implement appropriate monitoring and assessment strategies to inform management objectives, and incorporate traditional ecological knowledge into science-based wetland condition assessments. The project utilized traditional GIS mapping and automated machine learning techniques to create a wetland and surface water inventory and historical wetland mapping. This data was incorporated into a combined Level 1 and Level 2 wetland condition and ecological function assessment developed specifically for the SMSC. This assessment is to be used to help identify appropriate monitoring strategies, identify high value wetland resources for protection, and identify degraded wetland resources for enhancement and/or restoration. The second phase of the project covers the development of interactive communication tools to disseminate the wetland mapping, condition/assessment results and to communicate the science and concepts behind the data. Additional efforts to create an online portal that the SMSC can use to communicate all aspects of the wetland program plan are underway.

Three Affiliated Tribe's - Wetland Program Plan Development for the Fort Berthold Indian Reservation

Project Manager | 2018 to Present

GeoSpatial Services was contracted by The Three Affiliated Tribe's Environmental Division (TAT) to support them in their effort to develop a comprehensive Wetland Program Plan for the Fort Berthold Community. This project intends to develop the administrative, programmatic, legal and regulatory framework that will allow them to assess, monitor, control, and protect the health, of their wetland resources. The first stage of this project completed a comprehensive landscape level (EPA Level 1) inventory and functional assessment of existing wetlands and surface water resources. The information contained in the inventory and functional assessment is highly technical in nature requiring advanced knowledge in wetland science and geographic information system techniques in order to accurately inform the decision-making process. The second phase of the project will be the development of online, interactive communication tools that will disseminate the mapping, functional assessment results and to communicate the science and concepts behind the data. Wetlands are being mapped according to the FGDC Wetland Mapping Standard using the best available aerial and satellite imagery. Surface hydrology will be mapped using existing NHD and elevation model

derived flow networks. Wetland ecological functions and values will be assessed using hydrogeomorphic mapping methods and available functional correlation tools.

Wisconsin Department of Natural Resources - Nemadji River Watershed Habitat Assessment using LiDAR

Project Manager | 2017 to 2018

GeoSpatial Services was contracted by the Wisconsin Department of Natural Resources to identify priority habitat restoration and protection sites in the Nemadji River watershed, through the use of GIS analysis and data development techniques utilizing highly accurate LiDAR (Light Detection and Ranging) data. This project relied on input from a stakeholder group to provide guidance and input on the watershed's priorities, needs, and threats and stressors. The project's goal was to create a decision support system that can provide information that can lead to management actions that inform selection, implementation, and potentially monitor best management practices associated with the potential for slowing the flow and/or increased storage capacity.

SELECT PUBLICATIONS & CONFERENCE PRECEDINGS

Benck, K., and F. Davis Anderson. 2021. Development of a Rapid Assessment of Wetland Condition for the Shakopee Mdewakanton Sioux Community. Saint Mary's University of Minnesota, Winona, Minnesota, and Shakopee Mdewakanton Sioux Community Land and Natural Resources Department, Prior Lake, Minnesota.

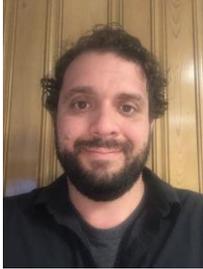
Benck, K. M., K. Allen, A. J. Nadeau, H. Hutchins, A. M. Davis, and A. Robertson. 2017. Natural resource condition assessment: Obed Wild and Scenic River. Natural Resource Report NPS/OBED/NRR—2017/1554. National Park Service, Fort Collins, Colorado.

Benck, K. M., K. Allen, A. J. Nadeau, L. Meinke, A. M. Davis, S. Gardner, M. Randerson, and A. Robertson. 2017. Fossil Butte National Monument: Natural resources condition assessment. Natural Resource Report NPS/FOBU/NRR—2017/1394. National Park Service, Fort Collins, Colorado.

Halsey, K., M. Halsey, and K. M. Benck. 2011. EcoMetrix Method: Measuring change in ecosystem performance at a site scale. Parametrix, Inc., Portland, Oregon.

Michael D. Knudson

GIS Technician, GeoSpatial Services



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EXPERTISE

- Project Management
- Watershed Research
- Environmental Monitoring

EDUCATION & CERTIFICATIONS

MS, Earth System Science and Policy
University of North Dakota | Grand
Forks, North Dakota, USA

BS, Natural Resource Management
University of Minnesota | Crookston,
Minnesota, USA

Professional Activities

**Volunteer instructor for the Northern
Prairie Plants, Native Plant
Communities, and Management
Workshop – Santee Prairie SNA
August 23-24, 2016**

**NDSU Extension Agriculture and
Natural Resource Program Leadership
Team Member - 2016**

**Chair of NDSU Extension Innovation
Team - 2016**

**North Dakota Certified Crop Advisor
2015-2016**

**East Grand Forks and Grand Forks
Chamber Leadership Program – 2015**

SUMMARY OF QUALIFICATIONS

An environmental scientist and educator with a diversity of experience in environmental monitoring and integration of geographic information systems. Detail oriented with data production and quality assurance for use in decision support applications applied in watershed planning. Proven leadership abilities in project management, collaborative working environments, developing process efficiencies, and motivating and mentoring staff.

RELEVANT EXPERIENCE: FIELD

International Water Institute – Hydrologic conditioning of digital elevation model (DEM) for use in watershed planning – Environmental monitoring of watershed pollution loads – Watershed education programming
GIS and Monitoring Specialist | 2016 to 2019

This work addressed the decision support and environmental monitoring needs for local watershed managers in the Red River Basin of the North. This involved creation of inputs and processing of Prioritize, Target, and Measure Application (PTMApp) in collaboration with Houston Engineering, Inc. Specifically, hydrologic conditioning of digital elevation model (DEM) for HUC8 watersheds. Hydrologic conditioning involves an iterative process of editing breach lines through analysis of flow direction, non-contributing depressions and watershed delineations. Additional inputs include raster datasets such as land use, precipitation, SSURGO soils, RUSLE factors, and travel time. PTMApp is used by practitioners to provide the technical bridge between the general description of the types of strategies in a local water plan and the identification of implementable on-the-ground Best Management Practices (BMPs) and Conservation Practices (CPs).

Water quality monitoring for Minnesota's Watershed Pollution Load Monitoring Network (WPLMN). Monitoring hydrographs to determine sampling frequencies and calculating loads using the FLUX32 software application. Monitoring Flood Damage Reduction (FDR) projects in natural and mitigated landscapes. Including deployment of continuous water quality monitoring equipment and completion of rapid floristic quality assessments (rFQAs) in remote areas. Coordinate watershed education programs to engage youth and adults in water quality monitoring, macroinvertebrate sampling, and river recreating.

University of Minnesota, Crookston – Geographic information systems applications and environmental land use planning

Teaching Specialist | 2016 to 2017

Developed and administered undergraduate courses and multiple independent undergraduate studies for the following courses:

Geographic Information Systems (GIS) Applications – Advanced principles of and applications for GIS. Examining the nature and accuracy of geographic information and methods of data acquisition, storage, modeling, and digital map display. Using ArcGIS software and geographic information to explore processes of spatial analysis, decision support, and geographic visualization.

Environmental Land Use Planning – Ecological, economical, legal, social and political factors which influence land use decisions. Compare and contrast planning methods and community engagement and their relevance to land use planning. Explaining the roles of agencies and programs which guide or regulate land use. Emphasis on land use planning for watersheds.

RELEVANT EXPERIENCE: FIELD

NDSU Extension Service – Grand Forks County

Agriculture and Natural Resource Extension Agent | 2014 to 2016

Developed and delivered educational programs on issues relative to production agriculture such as water quality, drainage management, soil health, pesticide stewardship, and geographic information systems. Networking with stakeholders to identify needs and develop programs addressing those needs. Worked directly with landowners to disseminate NDSU agricultural research and develop conservation practices to optimize agricultural production and resource conservation. This included developing field maps for landowners and organizing educational events in collaboration with landowners and conservation agencies. Member of the Agriculture and Natural Resource Program Leadership team and served as Chair of the NDSU Extension Innovation Team. Collaborated on additional programming effort in areas such as horticulture, community vitality, and 4-H youth development.

White Earth Tribal Community College – Research mentoring for the NASA Research Experiences for Undergraduates

Graduate Teaching Intern (GTI) | 2013 to 2014

Mentored students through the NASA Research Experiences for Undergraduates (REU). Research involved water quality monitoring and database development for the watersheds within the White Earth Community. Along with remote sensing of wild rice extent on lakes for the development of new harvest permitting method. Objectives were to enhance student experiences in scientific research and geographic information systems. This was achieved through the analysis of geographic information and integration of environmental monitoring data. Collaborated with tribal, state, and federal stakeholders.

University of North Dakota – Department of Earth System Science and Policy

Graduate Research Assistant (GRA) | 2011 to 2014

Processed aerial and satellite imagery for the Upper Midwest Aerospace Consortium (UMAC) for products such as: Landsat TM5, Airborne Environmental Research Observation Camera (AEROCam), and International Space Station Agricultural Camera (ISSAC). Provided leadership in development of procedure manuals, communicating procedure changes, data management, and quality assurance.

North Dakota Game and Fish Department – An evaluation of historical mule deer fawn recruitment in North Dakota

Imagery Consultant | 2012 to 2013

Performed geo-rectification of historical aerial photographs and digitized vegetation change for a comprehensive mule deer habitat assessment in western North Dakota.

MN Pollution Control Agency – MN GreenCorps, Green Infrastructure

AmeriCorps Member | 2010 to 2011

Enhanced community awareness of water quality issues through community service events, public presentations, and media. Designed and installed raingardens. Used geographic information systems to inventory and map storm sewer infrastructure. Collaborated with local watershed district to monitor water quality of runoff through storm sewers during storm events.

SELECT PUBLICATIONS & CONFERENCE PRECEDINGS

Knudson, M. D., J. A. VanLooy, M. J. Hill (2015). A Habitat Suitability Index (HSI) for the Western Prairie Fringed Orchid (*Platanthera praeclara*) on the Sheyenne National Grassland, North Dakota, USA. *Ecological Indicators*

Proulx, R. A., M. D. Knudson, A. Kirilenko, J. A. VanLooy, and X. Zhang (2013). Significance of Surface Water in the Terrestrial Water Budget: A Case Study in the Prairie Coteau Using GRACE, GLDAS, Landsat, and Groundwater Well Data. *Journal of Water Resource Research (WRR)*

Knudson, M. D., A. F. Wick, T. M. DeSutter, and C. Heglund (2015). Salinity Management, Cover Crops and Tile Drainage: Research and Demonstration Site in Grand Forks County, North Dakota. *Synergy in Science: Partnering for Solutions Conference*, November 15-18, Minneapolis, MN. Poster Presentation

Knudson, M.D. (2013). Defining Habitat Parameters of the Western Prairie Fringed Orchid. *North Dakota GIS Users Conference*, September 10-13, Grand Forks, ND. Poster Presentation

Thalacker, R., M. D. Knudson, W. F. Jensen, and B. C. Rundquist, (2014). Measuring Juniper Expansion in the North Dakota Badlands using Aerial Photos. North Dakota Chapter of The Wildlife Society Annual Meeting, February 12-14, Mandan, ND. Poster Presentation

