# GIS-584: WATER MANAGEMENT WITH GIS (FORMERLY GEOG-584)

**Effective Term**
Fall 2023

**BOT Approval Date**
12/15/2022

**Discipline**
GIS - Geospatial Information Science

**Course Number**
584

**Course Title**
Water Management with GIS (formerly GEOG-584)

**Short Title**
GIS Water Management

**Credit Status (CB 04)**
D - Credit - Degree applicable

## Units

**Lecture Units**
3.00

**Total Units**
3.00

## Hours

**Lecture Contact Hours**
48-54

**Out of Class Hours Lecture**
96-108

**Total Contact Hours**
48 - 54

**Total Out of Class Hours**
96 - 108

**Total Student Learning Hours**
144 - 162

**Distance Education**
Yes

## Distance Education

**Distance Education Type**
Both Fully Online and Hybrid Online

**Fully Online Delivery Requirements:**
**a. Students must be notified via the college schedule of classes and the syllabus for the class if proctored tests are required for this course**

**b. Any planned face-to-face meetings, such as an orientation or study session, must be optional**
**c. The MSJC curriculum committee requires the use of accessible, asynchronous discussion as a component of every fully online course**

**Are you using publisher content?**

No

**Regular Substantive Interaction**

Instructor-to-student, student-to-student, and student-to-content contact shall be distributed in a manner that will ensure regular substantive interaction (RSI) is maintained not only weekly but also for the duration of the course. Instructor interactions should be equivalent in time, quality and consistency to the engagement students would receive in a face-to-face course—for example, through announcements, discussion participation, personalized feedback, video messages, or other instructional communications. Instructors are expected to be responsive to student inquiries within a 24-72 hour time frame excluding holidays. RSI will be maintained through a variety of methods: • Orientation - Students must be oriented to the online and face-to-face portions at the start of the course. • Announcements - Announcements using the course management system must be posted at least weekly to keep students current on course events, due dates, materials, etc. • Discussion Forums - Content-related discussion forums within the designated CMS will include appropriate instructor participation and will be initiated and maintained, with timely feedback provided. Instructors are required to monitor the discussions and related activities to provide guidance and direction. Open-ended discussion boards may be used to further learning and interaction. • MSJC Communication – Instructor will use MSJC-administered communication tools (such as email or the designated CMS communication tools) to regularly communicate with and provide ease of access to students. • Timely Feedback - Timely feedback on student work will be provided by the instructor, which may include comments and/or rubrics, within the Grades area of the designated CMS. • Scheduled Meetings – Hybrid and synchronous courses will meet at regularly scheduled times. ADA Compliance - All course interactions and content must be designed with accessibility in mind and meet ADA requirements.

**Additional Regular Substantive Interaction**

Distance Education accommodations include the regular and effective contact conditions required in the face to face environments; however, they are presented within the course management system, CMS. The CMS uses a number of accessible options for instructor/student and student/student contact including: Announcements/Bulletin Boards - Announcements using the course management system will be posted at least weekly to keep students current on course events, due dates, materials, etc. Chat Rooms - Chat rooms on course questions, various genres, and student reading groups will be utilized to give students a place to complete group work and work on group projects. Discussion Boards - Communication via discussion boards will be initiated and maintained, with timely feedback provided. At least two discussion forums a week should be utilized for students to have a forum for discussion about the content of the course. Teleconferencing - Teleconferencing between students and the instructor to discuss assigned essays and projects will take place via telephone, CCCconfer, or email. Office hours - Instructors will hold regular office hours online using discussion forums, instant messaging, telephone, etc. Scheduled Face-to-Face Meetings - Hybrid courses will meet at regularly scheduled times (at least 5 times per semester).

**Catalog Description**

This course enhances professional potential in the water industry. Water Science topics include hydrology concepts and common GIS applications. This course covers hydrology networks of rivers, streams, drainage basins, flooding, water utilities (surface, waste and drinking water utilities). Legal and ethical issues of water management are discussed. Professional certification, project collaboration and presentation, and networking at GIS events prepare students for entering a GIS profession in water-related industries. (formerly GEOG-584)

## Requisites

**Recommended Preparation**

| Recommended Preparation (note that students can enroll in the class even if they haven't take the recommended course) |
|---|
| GEOG-115. |

## Codes

**TOP Code (CB 03)**

2206.10* - *Geographic Information Systems

**CIP Code**

45.0702 - Geographic Information Science and Cartography.

**Repeatability Code**

No

**Grading Option**
Letter grade OR P/NP

## Learning Objectives

**Learning Objectives**

| Learning Objective |
|---|
| 1. Analyze the elements of geospatial data quality, including geometric and thematic accuracy. |
| 2. Consider legal and ethical implications for water management. |
| 3. Appraise the difference between quality control and quality assurance. |
| 4. Critique data quality and integration problems likely to be associated with geospatial and attribute data acquired with legacy systems and processes. |
| 5.Develop hydraulic model of existing water system and analyze outcomes. Compare results and develop scenarios and recommendations for future improvements |
| 6. Relate trends in the water industry to geospatial technology and applications with considerations of Diversity, Equity and Inclusion. |
| 7. Plan a GIS model for basic analytical functions, including spatial measurement, data query and retrieval, vector overlay and raster map algebra. |
| 8. Evaluate geospatial data analysis of spatial relationships, such as distance, direction and topological relationships of adjacency, connectivity and overlap. |
| 9. Develop a geodatabase for spatial query of complex water-related features that includes address geocoding to solve a problem taking into account issue related to populations with differing ethnic, racial, religious, sexual orientation, age, gender and/or other diversity related groups. |
| 10. Prepare in-field data collection methods and model that is shared in the office through a cloud server. |

## Learning Outcome Information

**Course Learning Outcomes**

| Learning Outcome |
|---|
| 1. The student will independently adapt knowledge and experience about water resource management as sources of data to support theories to explain, or processes to solve each new challenge. |
| 2. The student will formulate, synthesize, and interpret water management geographically referenced data. |
| 3. The student will apply knowledge and skills of water management to the collection and interpretation of geospatial information. |
| 4. The student will exercise reflective thought concerning GIS solutions for water management and the safety of water resources for human use. |
| 5. The student will formulate, synthesize and interpret the capabilities, limitations, and features of a water management plan. |
| 6. The student will develop a water management plan which includes consideration of how water resources for considered and used by persons of different age, ethnic, racial, gender and/or socio-economic backgrounds. |
| 7. The student will analyze the capabilities, limitations, and features of water management related technology and equipment. |
| 8. The student will develop and foster empathy, expose variant interpretations, and exhibit diverse societal concerns when dealing with water resources as affecting diverse human populations with consideration of diversity, equity and inclusion. |

**Program Learning Outcomes**

| Learning Outcome |
|---|
| Integrate spatial thinking with applied technology to analyze physical and cultural patterns, and discuss trends and relationships. |
| Explore spatial relationships at different scales from local, regional to global. |
| Explain the interrelationship between humans and the physical environment. |
| Apply the scientific method to objective and subjective analysis of cultural and physical environments. |
| Appreciate different cultural and ethnic perspectives within the context of opportunities and challenges. |

**Institutional Learning Outcomes**

Communication: The student will effectively express and exchange ideas through listening, speaking, reading, writing, visual works, and other modes of interpersonal expression.
Critical Thinking: The student will analyze problems, gather and synthesize relevant information, evaluate ideas, information, and evaluate alternative points of view to create, innovate and implement effective solutions.
Information and Technology Literacy: The student will access, interpret, evaluate, and apply relevant information sources and digital media effectively, and in an ethical and legal manner.
Scientific Awareness: The student will apply the scientific method of inquiry to assess potential solutions for real-life challenges by employing science-based knowledge and methodologies in daily life.
Social Awareness: The student will recognize and analyze the interconnectedness of global, national, and local concerns, analyzing cultural, political, social, and environmental issues from multiple perspectives and appreciate similarities and differences among cultures.
Civic
Personal
and Professional Responsibility

## Content

**Course Lecture Content**

I. Introduction to Hydraulics and Hydrology Geo-computation and water resources
II. The Importance of Water to Human Civilizations
    A. Geographic diversity of resource use
    B. Perspective of socio-economic, political, ethnic diversity of human populations
III. A Brief History of GIS and Its Use in Water Resources Engineering
IV. Hydrologic Systems and Spatial Datasets
V. Hydrological processes in a watershed
VI. Fundamental spatial datasets for water resources planning: management and modeling studies
    A. Sources of data for developing digital elevation models
    B. Sensitivity of hydrologic models to DEM resolution
    C. Accuracy issues surrounding land use land cover maps
    D. Sensitivity of hydrologic models to LULC resolution
    E. Sources of data for developing soil maps
    F. Accuracy issues surrounding soil mapping
    G. Sensitivity of hydrologic models to soils resolution
VII. Water-Related Geospatial Datasets
    A. River basin, watershed, and sub-watershed delineations
    B. Streamflow and river stage data
    C. Groundwater level data
    D. Climate datasets
    E. Vegetation indices
    F. Soil moisture mapping
    G. Water quality datasets
    H. Monitoring strategies and needs
    I. Sampling techniques and recent advancements in sensing technologies
VIII. Data Sources and Models
    A. Digital data warehouses and repositories
    B. Software for GIS and geo-computations
    C. Software and data models for water resources applications
IX. Data Models for GIS
    A. Data types, data entry, and data models
    B. Categorization of spatial datasets
    C. Database structure, storage, and organization
    D. Data storage and encoding

E. Data conversion

X. Global Positioning Systems (GPS) and Remote Sensing
- A. The global positioning system (GPS)
- B. Use of GPS in water resources engineering studies
- C. Workflow for GPS data collection

XII. Steps to effective GPS data collection and compilation
- A. Aerial and satellite remote sensing and imagery
- B. Data and cost of acquiring remotely sensed data
- C. Principles of remote sensing
- D. Remote sensing applications in water resources engineering and science
- E. Bringing remote sensing data into GIS

XIII. Data Quality, Errors, and Uncertainty
- A. Map projection, datum, and coordinate systems
- B. Projections in GIS software
- C. Errors, data quality, standards, and documentation
- D. Error and uncertainty
- E. Role of resolution and scale on data quality
- F. Role of metadata in GIS analysis

XIV. GIS Analysis: Fundamentals of Spatial Query
- A. Querying operations in GIS
- B. Structured query language (SQL)
- C. Raster data query by cell value
- D. Spatial join and relate

XV. Topics in Vector Analysis
- A. Basics of geo-processing (buffer, dissolve, clipping, erase, and overlay)
- B. Topology and geometric computations (various measurements)
- C. Proximity and network analysis

XVI. Topics in Raster Analysis

XVII. Terrain Analysis and Watershed Delineation

XVIII. Introduction to Water Resources Modeling

XVIII. Water Budgets and Conceptual Models

IXX. Statistical and Geo-statistical Modeling

XX. Decision Analytic and Information Theoretic Models 235
- A. Decision analytic models
- B. Information theoretic approaches
- C. Spatial data mining (SDM) for knowledge discovery in a database
- D. The trend of temporal data modeling in GIS

XXI. Considerations for GIS and Model Integration

XXII. Automating Geo-processing Tasks in GIS

XXIII. Case Studies in Hydrology
- A. The geography of water
- B. Understanding water
- C. Mapping water
- D. Defining and characterizing a stream
- E. Exploring hydrography datasets
- F. Designing a hydrography dataset
- G. The NHD in ArcGIS®
- F. The NHDPlus in ArcGIS
- G. The NHD on the web

F. Lidar- and IfSAR-derived elevation to define hydrography[a2]
G. The future of hydrography

XXIV. Water Utility

XXV. Resiliency and reliability

A. Accelerating a digital future
B. Moving from CAD to ArcGIS
C. Supporting efficiency across the organization
D Lead reduction program protects customers
E. Operational flexibility
F. Dashboards improve utility performance
G. Making business decisions with GIS
H. GIS touches each aspect of a utility's operations
I. Asset inspection app increases efficiency

XXVI. Safety and security

A. Reducing risks, increasing productivity
B. Faster service restoration after a major hurricane
C. Reducing accidental powerline contacts
D. Transformational damage assessment

XXVII. Customer care

Empowering workers and keeping customers informed
Online calculator boosts solar connections
GIS communication tools improve customer satisfaction
Tools to meet audience needs

XXVIII. History of Hydrologic Technologies

A. Database Integration
B. Automated Mapping
C. Facilities Management
D. Spatial Analysis
E. Technological Revolution

XXVIIII. Geographic Information Science

A. Mapping
B. Computerized Maintenance Management
C. Integrated Information Management
D. Project Visualization
E. Remote Sensing
F. Modeling
G. Facilities Planning
H. Emergency Response
I. Source Control
J. Development Monitoring System

XXIX. Data Capture

A. Raster and vector data
B. Data preview
C. Data acquisition
D. Data modification
E. Data conversion
F. Data entry and import

XXX. Design geodatabase structure

A. Organize feature classes

- B. Convert feature classes
- C. Choose subtypes
- D. Develop schema
- E. Design annotation

XXXI. Topology and geospatial analysis
- A. Query data
- B. Select data ranges
- C. Analyze spatial relationships
- D. Analyze data relationships

XXXII. Advanced Hydraulic analysis
- A. Terrain modeling
- B. Surface analysis
- C. Statistical models
- D. Watershed Analysis
- E. Forecast Water Demands
- F. Hypothesis testing

XXXIII. Project documentation
- A. Metadata
- B. File management
- C. Workflow documentation
- D. Record maintenance
- E. Analyze results
- F. Refine analysis

XXXIII. Model procedures
- A. Process modeling
- B. Flow charts of data and procedures
- C. Data integration and outcome
- D. Customized and automated processes

XXXIV. Dynamic Facilities Planning
- A. Emergency Response
- B. Asset Management
- C. Total Maximum Daily Loads
- D. Resource Management
- E. Model Integration
- F. Security Issues

XXXV. Presentation
- A. Audience identification
- B. Professional media
- C. Graphics and statistics
- D. Organization and clarity
- E. Share maps online
- F. Map portfolio

XXXVI. Geospatial Careers
- A. Professional Codes
- B. Ethics of Information Sharing
- C. Professional Certification
- D. Labor Market

XXXVII. Professional Participation
- A. Professional Conferences

B. Organization Membership
C. User Group Meetings
D. GIS Events
E. Community Service
F. Professional Networking

XXXVIII. Considerations of Diversity, Equity and Inclusion
A. Considerations of diverse population issues
B. Communicating and Working with LGBTQIA individuals and populations
C. Socio/Economic diversity of populations being served
D. Ethnic, religious and racial individuals and community responses to water management issues.

## Methods of Instruction

**Method**
Discussion

**Integration**
In-class discussion focuses on GIS methods and procedures for acquiring and integrating data for water management within various industries, including water districts, scientific research, planning and development, and flood control.

**DE Adaptations for MOI**
In-class discussion focuses on GIS methods and procedures for acquiring and integrating data for water management within various industries, including water districts, scientific research, planning and development, and flood control. Students will participate in class discussion by participating in asynchronous discussions using accessible features in the course management system. Students have access to the chat functions and group feature within the CMS to ask questions or provide insight.

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**Method**
Homework

**Integration**
Weekly practical applications focus on hydrology modeling, GIS database integration and automated data maintenance and management, and prepare students with critical thinking skills for problem-solving in real-world scenarios related to water management.

**DE Adaptations for MOI**
Weekly practical applications focus on hydrology modeling, GIS database integration and automated data maintenance and management, and prepare students with critical thinking skills for problem-solving in real-world scenarios related to water management. Weekly practical applications are presented by the instructor in a variety of different formats within the course management system. Student responses to these applications are submitted using various assignment submission functions within the course management system. All presentations and responses are in accessible formats.

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**Method**
Lecture

**Integration**
Lecture and demonstration on water management enforce GIS concepts and terms, water data acquisition and conversion, and hydrology data integration, methods and procedures in real scenarios.

**DE Adaptations for MOI**
Lecture and demonstration on water management enforce GIS concepts and terms, water data acquisition and conversion, and hydrology data integration, methods and procedures in real scenarios. Lectures and demonstrations are asynchronously presented in the course management system using a variety of formats. All presentations are done following accessibility guidelines.

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**Method**

Projects

**Integration**

Students work in management teams to design a decision support system for a specific water management problem, with phases for upgrade and maintenance of water industry assets, for which instructor input is provided at various stages, and the final project professionally presented to the class.

**DE Adaptations for MOI**

Students work in management teams to design a decision support system for a specific water management problem, with phases for upgrade and maintenance of water industry assets, for which instructor input is provided at various stages, and the final project professionally presented to the class. Students work in management teams organized within the course management system using the chat, conversation or group features to express their ideas learned from lecture and various group discussion. Students will participate in class discussions by participating in synchronous discussions using accessible video conferencing software. Asynchronous instructor input is provided, usually with 72 hours of submission, within the course management system at various phases to the group project. Management teams interact in discussion sessions organized within the course management system. Projects include a professional presentation submitted within the course management system. The project are open for critique and input by students and instructor in discussion forums in the course management system. A variety of format may be used, however, all presentation must be submitted within the course management system and must meet accessibility guidelines.

**Method**

Role Playing/Simulation

**Integration**

Role-playing/simulation exercises are designed to focus students' attention on the consideration of diversity and equity issues involved in the distribution of human population in the preparation for and response to water resource management issues. The instructor organizes students into role playing simulation exercises to discussed and evaluate a variety of socio-economic influences, ethnic and racial considerations, gender and sexual identity aspects, physical and mental characteristics, as well as LGBTQIA and other issues of diversity and equity that arising in water management scenarios.

**DE Adaptations for MOI**

Role-playing/simulation exercises are designed to focus students attention on the consideration of diversity and equity issues involved in the distribution of human population in the preparation for and response to water resource management issues. The instructor organizes students into role playing simulation exercises to discussed and evaluate a variety of: socio-economic influences, ethnic and racial considerations, gender and sexual identity aspects, physical and mental characteristics, as well as LGBTQIA and other issues of diversity and equity that arising in water management scenarios. Role Playing/Simulations are administered in the course management system and use a variety of accessibly presentation formats. These assignments are presented asynchronously within the CMS in a variety of accessible formats including Discussions, Chat rooms and Video presentations . All exercises are developed to meet accessibility guidelines.

## Methods of Evaluation

**Method**

Class Participation

**Integration**

In-class participation in discussions and participation in other formats, are graded for integration of GIS terms and concepts commonly used in the water industry, understanding of applications of water management for various industries, critical thinking and added value to the in class participation exercises and discussions.

**DE Adaptations for MOE**

In-class participation in discussions and participation in other formats, are graded for integration of GIS terms and concepts commonly used in the water industry, understanding of applications of water management for various industries, critical thinking and added value to the in class participation exercises and discussions. Students participate in these forums asynchronously using accessible functions within the course management system. Students may participate in synchronous discussions using accessible video conferencing software. Class participation assignments are submitted within the CMS. Participation assignments are graded with an assessment rubric, designed and distributed to students within the CMS, specifically designed for each assignment. Rubrics require students to provide a demonstrated understanding of water management related GIS concepts and terms and implementation

of hydrology models and procedures for a variety of industries. Class participation is evaluated in relationship to content applicable to the subject matter and appropriateness of response to classmates within the CMS. Feedback is provided to students usually within 72 hours of submission of the assignment.

**Method**

Exams/Tests

**Integration**

Tests use a variety of question formats to assess understanding of GIS terms and concepts related to water management, hydrology applications with GIS, automation for water analysis, and upgrading and maintaining assets.

**DE Adaptations for MOE**

Tests use a variety of question formats to assess understanding of GIS terms and concepts related to water management, hydrology applications with GIS, automation for water analysis, and upgrading and maintaining assets. Tests are administered in the course management system and use a variety of question formats. Tests are taken asynchronously within the CMS. All tests are developed to meet accessibility guidelines. The testing criteria maybe multiple-choice, true/false, short answer or essay questions and will be graded using the online grading system within the CMS. Feedback will be provided based on the instructor's grading feedback policy via the grade book, chat, or other accessible video conferencing tools. Instructor will provide feedback within, 72 hours, after the due date.

**Method**

Group Projects

**Integration**

Students participate individually and as part of a work group, acting as a management team, proposing water management solutions during its various stages of preparation. These solutions are presented to the class for comment and critique. Projects are assessed based on a rubric designed to measure student performance on the various levels of project design, development and presentation.

**DE Adaptations for MOE**

Students participate individually and as part of a work group, acting as a management team, proposing water management solutions during its various stages of preparation. These solutions are presented to the class for comment and critique. Projects are assessed based on a rubric, available to students within the CMS, designed to measure student performance on the various levels of project design, development and presentation. Students may be organized into management teams in discussion groups with the course management system. Student participate asynchronously and/or in synchronously arranged accessibly meetings to develop their projects. Finished projects are presented to the class within the course management system, in a variety of written and presentation formats which may include accessible embedded videos, in an asynchronous discussion forum which is available for input by other students and instructor. Instructions for completing the assignment are posted in the assignments or group discussions area in the CMS. Instructor feedback is provided based on the instructor's grading feedback policy via the grade book, chat, or other accessible video conferencing tools within the CMS.

**Method**

Homework

**Integration**

Homework includes weekly practical application assignments for water management with GIS. Assignments are graded for performance and demonstrated comprehension of GIS methods and procedures for acquiring and integrating hydrology data, and ability to manipulate and manage hydrology related features. Assignments are assessed by the instructor using rubrics that measures student ability to integrate geospatial concepts from lecture and demonstrations. Homework may include summaries of various reading assignments, including bibliographic information, and pertinent applicable GIS information. Assignments are assessed using rubrics that measure student completion of the homework activities and their ability to integrate the homework assignment into the geospatial concepts from lecture and demonstrations.

**DE Adaptations for MOE**

Homework includes weekly practical application assignments for water management with GIS. Assignments are graded for performance and demonstrated comprehension of GIS methods and procedures for acquiring and integrating hydrology data, and ability to manipulate and manage hydrology related features. Assignments are assessed by the instructor using rubrics that measures student ability to integrate geospatial concepts from lecture and demonstrations. Homework may include summaries

of various reading assignments, including bibliographic information, and pertinent applicable GIS information. Assignments are assessed using rubrics that measure student completion of the homework activities and their ability to integrate the homework assignment into the geospatial concepts from lecture and demonstrations. Homework is submitted and graded asynchronously, following individually develop rubrics, within the course management system. All homework assignments are designed to be accessible to students using the course management system. Any assignments outside of the course management systems will be in an accessible format.

**Method**

Role-playing/Simulation

**Integration**

Role-playing/simulation exercises are designed to focus students attention on the consideration of diversity and equity issues involved in the distribution of human population in the preparation for and response to water resource management issues. Issues discussed include: socio-economic influences, ethnic and racial considerations, gender and sexual identity aspects, physical and mental characteristics, as well as LGBTQ and other issues of diversity and equity that arising in disaster management. Simulations are graded on a rubric which includes consideration of populations being evaluated, authenticity of roles simulated, evaluation summary.

**DE Adaptations for MOE**

Role-playing/simulation exercises are designed to focus students attention on the consideration of diversity and equity issues involved in the distribution of human population in the preparation for and response to water resource management issues. Issues discussed include: socio-economic influences, ethnic and racial considerations, gender and sexual identity aspects, physical and mental characteristics, as well as LGBTQ and other issues of diversity and equity that arising in disaster management. The simulation exercises are instructor-moderate and require individual students to not only develop a simulation but to comment on other students' simulations. Simulations are submitted within the course management system. Students respond to simulation scenarios in the online course management system. Student evaluations are completed using discussion forums. Simulations are graded on a rubric which includes consideration of populations being evaluated, authenticity of roles simulated, evaluation summary. Within the graded assignments option, the instructor provides responses and constructive evaluation of the exercises within the course management system. Responses are shared with students usually within 72 hours of the completion of the role-playing simulation exercises.

## Assignments

**Assignment Type**

Writing

**In-class and/or outside of class**

Outside of class

**Formative or Summative**

Formative

**Assignment**

Prepare a proposal that clearly states the purpose or intent of your subpart of the collaborative group project. Provide details about how you will acquire, prepare, build or analyze your part of the project, i.e. acquire data or create application. Identify the type of map, graph, report or combination of deliverables and how they will be validated. Prepare a diagram of the workflow procedures and iterative steps taken to determine those procedures. Submit your 500 word proposal for instructor approval and grading prior to working on the group project.

**How assignment will be adapted in online format**

Prepare a proposal that clearly states the purpose or intent of your subpart of the collaborative group project. Provide details about how you will acquire, prepare, build or analyze your part of the project, i.e. acquire data or create application. Identify the type of map, graph, report or combination of deliverables and how they will be validated. Prepare a diagram of the workflow procedures and iterative steps taken to determine those procedures. Submit your 500 word proposal for instructor approval and grading prior to working on the group project. Assignment will be submitted within the course management system. Assignment must conform to accessibility guidelines. Feedback will be provided based on the instructor's grading feedback policy via tools in the CMS such as the grade book, chat, or other accessible video conferencing software usually within 72 hours of of being submitted.

**Assignment Type**
Reading

**In-class and/or outside of class**
In-class
Outside of class

**Formative or Summative**
Formative

**Assignment**
Research the impact a specific water management issue or event including population data collection and analysis, might have on diverse groups of human populations specifically recognizing historically marginalized groups of people. The assignment should focus on GIS applications and methods, problem-solving and decision support systems, for preparation and response to water resource issues. Using the information gathered by the research effort, describe and presents to the class a simulation of how a defined disaster might affect one or more specifically identified diverse human population groups. Summarize various readings, include bibliographic information and pertinent applicable GIS information. Present the simulation to the class and lead a discussion as to how the collection and interpretation of the data might be perceived by members of different populations.

**How assignment will be adapted in online format**
Research the impact a specific water management issue or event including population data collection and analysis, might have on diverse groups of human populations specifically recognizing historically marginalized groups of people. The assignment should focus on GIS applications and methods, problem-solving and decision support systems, for preparation and response to water resource issues. Using the information gathered by the research effort, describe and presents to the class a simulation of how a defined disaster might affect one or more specifically identified diverse human population groups. Summarize various readings, include bibliographic information and pertinent applicable GIS information. Present the simulation to the class, within the appropriate submission tab in the course management system and lead a discussion as to how the collection and interpretation of the data might be perceived by members of different populations. Assignments are presented, detailed, explained, and submitted in the course management system. Simulations are presented asynchronously to the class in a variety of format, including accessible video. Students lead asynchronous discussions as to how the collection and interpretation of the data might be perceived by members of different populations. All assignment must meet accessibility requirements. Evaluation and feedback are submitted to students within the CMS usually within 72 hours of submission of the assignment.

**Assignment Type**
Writing

**In-class and/or outside of class**
In-class
Outside of class

**Formative or Summative**
Summative

**Assignment**
Research, evaluate and develop a water resource management plan for an issue in which you might personally be involved. Be sure to include how someone of your own age, ethnic, racial, gender and/or socio-economic background would respond to the hypothetical scenario; and how you might respond differently if you were (or are) a member of a historically recognized marginalized group of people. The assignment should focus on GIS applications and methods, problem-solving and decision support systems, for preparation and response to a hypothetical disaster, emergency, public safety/crime or catastrophe. Summaries of research used, including bibliographic information and pertinent applicable GIS information shall be included in the plan.

**How assignment will be adapted in online format**
Research, evaluate and develop a water resource management plan for an issue in which you might personally be involved. Be sure to include how someone of your own age, ethnic, racial, gender and/or socio-economic background would respond to the hypothetical scenario; and how you might respond differently if you were (or are) a member of a historically recognized marginalized group of people.. The assignment should focus on GIS applications and methods, problem-solving and decision support systems, for preparation and response to a hypothetical disaster, emergency, public safety/crime or catastrophe. Summaries of research used, including bibliographic information and pertinent applicable GIS information shall be included in the plan. The assignment is presented, detailed, explained, and submitted in the course management system. The assignment is assessed within the CMS

using rubrics that measure student completion of the writing activity and their ability to integrate the assignment into the geospatial concepts from lecture and demonstrations. All submissions are in accessible formats. Instructor feedback is given to students usually within 72 hours of submission.

**Assignment Type**

Other

**In-class and/or outside of class**

In-class
Outside of class

**Formative or Summative**

Summative

**Assignment**

Access data on a water resource of interest to a specific geographical region. Import pertinent vector and raster data into ArcGIS Pro and design and develop an operational map that explains the water resource and its relationship to the geographical area and human population concerns represented in the distribution of the resource. The data presented should be based on the geospatial concepts from lecture and demonstrations.

**How assignment will be adapted in online format**

Access data on a water resource of interest to a specific geographical region. Import pertinent vector and raster data into ArcGIS Pro and design and develop an operational map that explains the water resource and its relationship to the geographical area and human population concerns represented in the distribution of the resource. The data presented should be based on the geospatial concepts from lecture and demonstrations. The assignment is presented, detailed, explained, and submitted in the course management system in the form of a GIS story map. The map(s), explanations and summaries of various reading assignments are presented, including bibliographic information and pertinent applicable GIS information and submitted in the course management system in accessible formats. All aspects of the assignment must meet accessibility requirements. The assignments are assessed by the instructor using rubrics that measure student completion of the reading, organization of data, and writing activity as well as their ability to integrate the data into a story map using ArcGIS Pro software tools. Feedback is usually provided within 72 hours of submission of the assignment

## Course Materials

**Textbooks**

Hohl, Pat (2021). Delivering Water and Power. GIS for Utilities. ISBN.9781589486751

Gribbin, John E. (2014) Introduction to Hydraulics & Hydrology: With Applications for Stormwater Management

**Other Resources**

Armstrong, Lori (2011). Hydraulic Modeling and GIS ESRI. ISBN: 9781589483019

Simley, Jeff (2018). GIS for Surface Water: Using the National Hydrography Dataset ESRI Press. ISBN: 978-1589484795

**Open Educational Resources**

Lyon G. JOhn, GIS for Water Resources and Watershed Management - free .pdf
https://sites.google.com/a/kb.books-now.com/droscommoham36/9786610157273-77ciaconGEimtu61
Dixon, B., Uddameri, V. GIS and Geocomputing for Water Resources Science and Engennering .pdf,
https://sites.google.com/a/lh.books-now.com/en472/9781118354131-61haerecGEprotet32

## Class Size Information

**Class Size**

40

**Class Size Category**

A - Lecture/discussion 40

## Diversity and Inclusion

**Explain how diversity and inclusion(e.g., gender, culture/race, sexuality, etc.) is infused into the course.**

Emphasis is placed on the articulation of how contributions to the discipline of Geospatial Science offer student's opportunities to foster empathy, expose variant interpretations, and exhibit diverse societal concerns represented the geographic distribution of humans especially as encountered in the use and management of water resources. The course operates with a foundational intention of diversity and inclusion and it has been seen in recent disasters that these issues are extremely important considerations that must be dealt with effectively. Included in the objectives, is the necessity of teaching diverse content from multicultural and intersectional perspectives across all aspects of the course content. Emphasis is placed on the articulation of how water management data is collected and analyzed to contribute to the discipline of geospatial science. The course content is designed to align objectives with and to create opportunities for students from a variety of backgrounds to hone new skills while acknowledging and honoring their diverse, existing knowledge base. The course emphasizes the need to investigate not only geophysical aspects of water resources but to consider the human geospatial distribution, as well as the socio-cultural perspective as it pertains to race, gender identity, sexual orientation, and cultural differences. Students are expected to consider cultural, economic, political, and gender-based positioning in developing assignments affecting how water resources are managed. Assignments are formatted to allow students to reflect on their cultural frame of reference and to investigate their personal perspectives as to the geospatial aspects of the communities to which they associate. As an example students are required to research the impact a specific water management issue or event including population data collection and analysis, might have on diverse groups of human populations. Using the information gathered by the research effort, students describe and present how a defined disaster might affect one or more specifically identified diverse human population groups.

**Describe how assignments, instruction, evaluation, course content, and interactions are contextualized for diverse learners promoting an equitable course.**

Students contextualize how water resource management relates to their representation of the diversity of human populations. The course emphasizes the need for students to considered their own learning styles while investigating not only geophysical aspects of dealing with water management but as well the socio-cultural perspective, as it pertains to race, gender identity, sexual orientation, and cultural differences. Students explore how their own diverse learning styles contribute to the analysis, design and implementation of water resource management planning. Students are encouraged to consider factors representing their personal cultural, economic, political, and gender-based positioning in developing assignments affecting the geospatial distribution of human activities especially as they relate to water resource supplies, uses and management. Students are urged to consider not only how "time and place" have affected their own methods of inquiry but how their own interpretation of "historical context" is used to capture a deeper personal connections to the socio-historical forces and the geospatial distribution of humans as it relates to dealing with water resources.

## Interactions

**Explain how the course will incorporate student-to-student interaction.**

Students are encouraged to work together in "water resource teams" to solve water resource issues related geospatial problems using geospatial information and digital data applications. Student are required to participate in weekly student to student discussion sessions on topics related to the course materials. Class activities, lectures and assignments are learning and assessment environments in which the classroom community can bring in their own cultural experiences in addition to practicing the application of new concepts from diverse socio-cultural perspectives. Students work in the water resource teams to solve problems related to hypothetical events. In distant education course environments student to student interactions take place asynchronously in a variety of accessible formats within the course management systems. Open "discussions" are available within the course management system to promote student to student interaction outside the course required assignments.

**Explain how the course will incorporate instructor-to-student interaction.**

The instructor facilitates instructor to student interactions by encouraging and requiring students to reflect on course topics and articulate an understanding of the material to the instructor and other students. Instruction is designed to include "water resource teams" that have intensive instructor student one-on-one instruction in the use of the GIS data collection applications and software to manage water resources. To better support a diverse range of learners, instructors are encouraged to incorporate formative and summative active learning strategies in the assignments which promote students to ask questions and get clarification of examples from the instructor. For distance education formats, instructor to student interaction is facilitated by asynchronous, accessible format, discussion within the course management system communication options.

**Explain how the course will incorporate student-to-content interaction.**

Student to content interaction is incorporated in lecture presentations and assignments as well as weekly and semester projects. Students are required to apply lecture content to the application assignments. Students are introduced to content in the lecture portion of the class and interact with the content in many ways including researching relevant information, summarizing lecture presentations, taking short quizzes, participating in discussions, project development and semester examinations. Assignments require students to produce individualized water management plans using information discussed and developed in lecture. These

plans represent a variety of data presentations all of which include mapping and data analysis of specific geospatially related water management questions; what resources are being explored; who (the diversity of populations) are impacted by the resources; where the resources are congregated and the historical data influencing the geospatial distributions of the affected populations. For distance education formats, student to content interaction is facilitated by asynchronous information, lectures, video presentations and discussion within the course management system communication options. All distance education formats meet accessibility guidelines.

**Explain how the course will incorporate student-to-self interaction (metacognitive).**

The goal is to support students in connecting their personal and professional experiences with the terms and concepts presented in the course and to validate the student's life experience by seeing themselves in the use of the material and assignment requirements. Class activities, reading, lecture, discussions and student disaster management plans encourage and allow students to explore various personal interpretations and understandings of their individual relationships to the geospatial organization of catastrophe management related to their own diversity, socio-economic status, gender, ethic-racial background and other aspects of their own identity and history. The instructor works with individual students both in their capacity as students and/or in their professional roles or preparation for professional roles in water resource management. Through readings, lectures, activities, and discussions, students are encouraged to explore connections between course content and societal concerns to demonstrate how water resource management skills can be a vehicle for
analyzing the contemporary socio-economic impact of water resources on human populations. The instructor works with students to emphasize that the analytical and critical thinking skills they hone by analyzing water resource scenarios in the class have broad applications in real life situations beyond the classroom. For distance education formats, student to self interaction is facilitated by accessible asynchronous information, lectures, video presentations and discussion specifically designed to encourage student self reflection and incorporation of the material within the course management system communication options.

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