

# GUIDELINES

For Preparation and Submittal of Proposals for the  
State Water Resources  
Competitive Grants Program

FY 2022 PROPOSALS  
DEADLINE: 5:00 p.m., Tuesday, March 1, 2022

Alabama Water Resources Research Institute  
ALFA Building  
961 S. Donahue Drive  
Auburn, AL 36849

TELEPHONE: (334) 844-1163

December  
2021

The AWRRI is the federally authorized and funded entity that encourages, facilitates, and assists multi-disciplinary water resources research at all Alabama universities. The purpose of the Institute program is to respond to identified water resources problems of the state and region and to encourage and broaden faculty participation in research and other scholarly pursuits. The AWRRI has an obligation to fund proposals having the best probability of producing meaningful results, and/or have good promise of follow-on funding. Such projects will directly benefit the researcher and their profession, and indirectly their students and the Institute's overall mission.

The AWRRI receives funding from the Geological Survey (USGS) of the U.S. Department of the Interior under Section 104 of P.L. 106-374, the Water Resources Research Act of 1984. Research proposals selected will be supported as projects in the State Water Resources Competitive Grants Program, subject to the approval of the USGS. Faculty members from any university or college in Alabama, public or private, are eligible to submit a research proposal to this program. You are invited to submit proposals for grants under this Announcement. There are some conditions which must be adhered to that are addressed in the following Guidelines.

***The intent of the State Program is to foster collaboration by two or more researchers at colleges and universities within Alabama. However, proposals submitted by a single researcher will receive the same consideration as one submitted by a team of researchers. Through this program, the Institute hopes to form partnerships between universities to address a broad range of water resources problems affecting the state and region.***

## GENERAL INFORMATION

1. **AVAILABLE FUNDING:** In 2022, the proposals may request up to \$25,000 (in Federal funds) and can focus on any of Alabama's water-priority areas as in past years. We anticipate the funding of at least 3 proposals in 2022. *Junior faculty members are encouraged to apply for this funding.* A junior faculty member is defined as an individual who has been in his/her tenure-track position less than seven years at a higher education institution in Alabama. Alabama Cooperative Extension specialists that have been in their current position less than seven years are also considered junior faculty members.
2. **SUBMITTAL DEADLINE: 5:00 p.m., Tuesday, March 1, 2022.** Your proposal must be received by the Alabama Water Resources Research Institute office by the above time/date to be available for review. Proposals received after the deadline will not be accepted for the FY 2022 program and will be returned to the researcher submitting the proposal.
3. **NOTIFICATION:** You will be notified as soon as possible regarding the status of your proposal.
4. **EVALUATIONS:** Proposals will be evaluated on the basis of:
  - a. **Relevance and Importance (15 points).** Does the proposal directly address research topics of significance to our state? If so, does it deal with a subject of particularly high importance to present and future water resources management programs? Does the proposal itself do a convincing job of describing the relevance and importance of the proposed research?
  - b. **Scientific/Technical Merit (40 points).** Does the proposal have potential to expand the fundamental knowledge in its specific area? Is it scientifically and technically sound? Are the investigators cognizant of past work? Is the proposal well written, organized, and complete?
  - c. **Feasibility (15 points).** Does the proposal demonstrate substantive and important collaboration among investigators? Are the objectives, methodologies, designs, and techniques adequate and completely described? What is the likelihood of success given the methods and time frame proposed? Is the budget reasonable and adequate for the work proposed? Will the expected results lend themselves to a more comprehensive proposal with additional funding?
  - d. **Professional Competence of the Investigators (10 points).** Are the qualifications of the investigators commensurate with the proposed research? Are the facilities and equipment adequate? If appropriate, have external cooperators been identified? Has the nature of such cooperation been described? Are the roles and advantages of

involving the different investigators clearly described?

- e. **Student Educational and Training Opportunities (10 points).** Does the proposal contain the opportunity for student participation (graduate and/or undergraduate)?
  - f. **Technology Transfer (10 points).** Does the proposal actively address the eventual transfer of results to user groups? Does it actively address the impact the results could have?
5. **PARTICIPATION RESTRICTIONS:** You may not participate in the program if you have failed to submit a technical completion report for any prior project in the AWRRI program.
  6. **PROGRAM FOCUS:** The purpose of the State Water Resources Research program is to address major state water resources problems by motivating and supporting research by qualified scientists from the State's colleges and universities.  
  
The focus of our program is directed by those state priority areas addressed in **Attachment A**, which have been developed by the Institute's Council. Research proposals submitted to our program **MUST** be responsive to at least one of these priority areas. A project should not consist solely of conventional data collection, tabulation, analysis, or equipment development.
  7. **PERFORMANCE PERIOD:** Research projects supported by FY 2022 funds are anticipated to start September 1, 2022, and should be 12 months in duration. Projects designed to continue beyond that period must be supported by funds from subsequent fiscal year appropriations.
  8. **DISSEMINATION OF INFORMATION:** Although not required, FY 2022 projects are highly encouraged to plan to present project findings at the Alabama Water Resources Conference & Symposium held annually on the Alabama Coast in early September.
  9. **FUNDING:** Grants from FY 2022 funds will be limited to \$25,000 (in Federal funds) for a 12-month budget period. We anticipate funding at least 3 projects. Projects may be designed to run beyond the 12-month period, provided they contain a reportable element to be included in the Institute's annual report to the granting agency. Funding for subsequent years of a multi-year project **is not guaranteed** and continuation proposals for such projects will be evaluated along with all other proposals received each year. Evidence of satisfactory performance will be considered in evaluating continuation proposals.
  10. **COST SHARING:** The Federal authorizing legislation (P.L. 106-374) requires **at least one non-Federal dollar for each FY 2022 grant dollar to be met on each grant award.**
  11. **PROPOSAL SUBMISSION:** Email your proposal to the AWRRI, including a letter signed by your department head confirming cost sharing funds will be available if your proposal

is funded. **Please use 12-point, Times New Roman Font, and submit as a PDF.**

**Email proposals to Rachel McGuire: [rem@auburn.edu](mailto:rem@auburn.edu)**

### **CHARGES ALLOWABLE TO FEDERAL FUNDS**

- A. Costs will be allowable in accordance with 2 CFR Part 200-OMB Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards.
- B. This program is modestly funded and should not be perceived as a source of funds for acquisition of major equipment items. Non-expendable personal property (e.g., office furniture, and computers) **may not** be purchased with grant funds. Special purpose equipment used for research, scientific, or other technical activities may be proposed for purchase if each item is identified and justified and the acquisition cost is stated.
- C. The portion of benefits paid to individuals cannot exceed the proportion of their salaries paid from the grant.
- D. **INDIRECT COSTS MAY NOT BE CHARGED AGAINST THE FEDERAL GRANT FUNDS.** The Indirect Costs normally charged against Federal grant funds should be used to meet your cost sharing requirement. The U.S. Geological Survey will accept indirect cost rates approved by your university's cognizant auditing agency. Applicants must provide a copy of the approved Indirect Cost Rate Agreement or other approving documentation.
- E. Travel costs are allowable subject to the conditions established in OMB Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards and the travel regulations of your college or university. Travel outside the United States, its territories and possessions, and Canada is considered as foreign travel and requires advance written approval of our office and the U.S. Geological Survey.
- F. Project expenses may not be charged to the grant accounts prior to the official project start date.
- G. All FY 2022 funds must be spent or obligated within the twelve-month period of the project. **NO CARRY-OVER OF FUNDS OR EXTENSIONS WILL BE ALLOWED.**

# PROPOSAL CONTENT AND FORMAT

TITLE PAGE. (See sample, Attachment D)

The body of each proposal (excluding resumes) should be no longer than 20 pages and consist of the following 18 elements. The first 11 (A-K) constitute the synopsis (not to exceed two pages). **BEGIN A NEW PAGE WITH ELEMENT L.**

- A. Project Number. Leave blank - AWRRI will add the number.
- B. Title.
- C. Focus Category. Select a maximum of three, with the most preferred category first.
- D. Keywords. Select six to eight keywords in descending order of importance, separated by commas.
- E. Duration. Month/year to month/year. Use the actual beginning and ending dates.
- F. Fiscal Year 2022 Federal Funds.

Total	Direct	Indirect
-------	--------	----------
- G. Non-Federal Funds Allocated.

Total	Direct	Indirect
-------	--------	----------
- H. Name, University and City of Principal Investigator(s).
- I. Congressional District of University Performing the Research.
- J. Identification and Statement of the Major Regional Water Problem (2 paragraphs maximum) to be addressed by the project, including explanation of the need for the research. (Who wants it? Why?) NOTE: This will be a significant factor in scoring the proposal.
- K. Statement of the Results, Benefits, and/or Information expected to be gained during the initial performance period and by the end of the project, and how they will be used (2 paragraphs maximum). NOTE: This will be a significant factor in scoring the proposal.

**START A NEW PAGE HERE**

- L. Nature, Scope, and Objectives of the Research.
- M. Methods, Procedures, and Facilities.
- N. Related Research. Show by literature review and communication citations the similarities and differences of the proposed project to completed or on-going research on the same topic.
- O. Progress Review. **(Required only if you had a prior year project)**
- P. Investigator's Qualifications. Include resumes of all participating investigators. **No resume shall exceed three pages or list more than 15 pertinent publications.**
- Q. Training Potential. Estimate the number of graduate and/or undergraduate students, fields of study, graduation date, and degrees expected to result from participation in the project.
- R. Budget Form. Budget information should be included by cost categories on the attached budget form (Attachment B). Also provide a budget justification for items 4 through 8 on the budget form.
- (1) AWRRI grants from FY 2022 funds to support research projects will not exceed \$25,000 (in Federal funds). We anticipate funding at least 3 projects in 2022.
  - (2) Cost Sharing. Federal funds provided for the Institute program will be on a cost sharing basis of **one non-Federal dollar for each Federal dollar allotted**. This cost sharing basis must be reflected in the budget for each proposed project.
  - (3) Indirect Costs. Federal funds made available under this program **MAY NOT** be used for support of indirect costs **but may be used to meet part of your Cost Sharing requirement**.
  - (4) Staff Benefit Costs. Staff benefits include those employer contributions (employee insurance, pension plan, etc.) which are granted in accordance with established institutional employment policies. Federal funds may be used to support benefit costs in proportion to the extent that the salary or wages to which the benefits relate are also paid from Federal funds.
  - (5) Your budget should include funds for preparation and submittal of one copy of a final technical completion report and a two-page project synopsis for inclusion in the Institutes program report to the U.S. Geological Survey.

# MAJOR WATER RESOURCES PROBLEMS IN ALABAMA

Research projects funded in the Alabama Water Resources Research Institute's (AWRRI) program address those areas which constitute major problems not only with respect to Alabama's water resources, but also regional and national water resources concerns. Alabama experiences a multitude of water quality, quantity, and management problems which cannot all be addressed at once. Therefore, the AWRRI program focuses its research and information transfer efforts in specific areas. The major water resources problems in the State of Alabama (as adopted by the Water Resources Council) are listed below.

## 1. Environmental In-Stream Flows

- A. Water is a vital feature of Alabama's natural heritage. Fish and wildlife depend on water flowing in rivers and streams to sustain riparian vegetation and wetland areas and supply the bays and estuaries along the Gulf Coast with freshwater inflows. More than any other factor, the availability of water will determine the future of fish and wildlife in our state. Initially, all of the spring flows and stream and river flows in Alabama were available as environmental flows. That has changed dramatically as more and more water has been withdrawn for use by humans or appropriated for other uses (power generation, etc.). Fortunately, nature is adaptable and can tolerate reasonable reductions in flows as a result of human use. The big questions to be answered are how much those flows can be reduced without destroying our natural heritage and how do we make sure adequate flows are maintained.
- B. More research is needed on the role of instream flows in managing Alabama's water resources, determining the level of flows that are needed to maintain habitat and promote diverse and productive aquatic environments, and ways to protect the in-stream flows necessary for environmental integrity.

## 2. Groundwater Resources and Contamination

- A. There is a need to conduct research related to both the quantity and quality of ground water. The effects of land use practices on ground water quality should be investigated, including the effects of agricultural practices; urbanization; timber harvesting; and waste disposal. There is also a need to study the fate and transport of contaminants in the ground water and to develop improved methods for ground water remediation.
- B. Increased demands on ground water supplies from agricultural, industrial and municipal uses underscore a need for improved water management and conservation. This could involve the development of more efficient irrigation techniques, development of drought resistant grasses and plants, and studies to minimize water loss through evapotranspiration.



### 3. **Surface Water – Quantity and Quality**

- A. Water quality concerns for surface water supplies include both point-source and non-point-source contamination. Studies are needed to develop techniques to correlate land use and pollution loads from agricultural, industrial and urban non-point sources and to determine the effects of BMP's on water quantity and quality. Studies are needed to evaluate the impacts of erosion/sedimentation on surface water quality and to correlate sediment characteristics to geology, slope, and land use. Attention should be given to determining the fate of metals in stream sediment and to the development of models for predicting sediment production and transport.
- B. Studies relating to the storage and conservation of surface water supplies are needed, including studies on the feasibility of off-stream storage of abundant winter/spring flows as opposed to conventional in-stream storage.
- C. Excessive enrichment of surface waters by nitrogen and phosphorus is a leading cause of water quality impairment nationally and in Alabama. Studies relating nutrient loading to biological responses and changes in aquatic communities are needed to understand how and at what levels nutrients adversely impact aquatic habitat and aquatic life.
- D. Studies relating to harmful algal blooms (HABs) and emerging contaminants such as perfluoroalkyl substances (PFAS) are needed in Alabama to investigate and forecast materializing threats to human and environmental health.

### 4. **Management**

- A. There is a critical need to develop a comprehensive water management plan for the State of Alabama that would permit effective use of both ground and surface water resources. Work is needed on the development of improved planning and management techniques and on improved legal and institutional arrangements for management of land and water resources. Investigations into how available technology could facilitate water resources management through improved access to real-time or near real-time information for water resource managers is also needed.
- B. Studies are needed to develop and refine water and wastewater treatment techniques, including cost-effective, low-technology water and wastewater treatment systems for individual and small community systems. Investigations into improved financial arrangements and alternatives for funding water and wastewater projects are also needed.
- C. Research is needed to address Alabama's infrastructure including, but not limited to, aging water supply systems (i.e., stormwater management, drinking water, and wastewater treatment), gray infrastructure (i.e., dams, seawalls, roads, and pipelines), and green infrastructure.

## **5. Hydrology, Climatology, Hydraulics, and Climate Resiliency**

Increasing demands on the State's water resources will place more and more importance on the development of improved weather and hydrologic forecasting techniques. Benefits, including improved management strategies and water conservation, will accrue from more reliable forecasts of precipitation and streamflow over short-term, intermediate, and long-term time periods. This category should include studies of precipitation and streamflow relationships; weather forecasting; climate modification; drought forecasting; meteorological processes linking atmospheric water, solar energy, water use by plants, and available soil moisture; hydrologic and hydraulic modeling and processes.

## **6. Coastal Water Research and Policy**

Numerous issues currently affect our state's coasts. Resilient coastal communities will need to initiate new efforts in coastal water research and policy to develop data-driven conservation plans that provide for the wise stewardship of our coastal natural resources and their accompanying, unique ecological complexes for future generations. This will require forging a nexus between extensive water policy knowledge and regional-specific hydrology, geology, geomorphology, biology, topography, and ongoing natural processes. The following categories of research are particularly relevant to Alabama's coastal areas:

- A. Research investigating coastal resource use policy issues including, but not limited to: coastal development, mineral resource exploration and extraction, commercial fishing, shoreline erosion, recreation, and/or transportation.
- B. Research investigating natural resource protection including, but not limited to: coastal biological productivity, water quality, water resources, wetlands, beach and dune protection, wildlife habitat protection, endangered species, and/or cultural resources protection.
- C. Research leading to more updated datasets and an expansion of our knowledge of the impacts of the range of natural freshwater inflows on the productivity and resiliency of Alabama's Mobile Bay estuary.
- D. Research investigating the emerging issue of sea level rise in coastal Alabama. Research may pertain to land use planning, habitat restoration project design and implementation, impacts to critical infrastructure and industry related to fishery and shipping services, predictive model design and implementation regarding storm surge, flood zone mapping, and sediment transport, or water quality and ecosystem function and services.

## **7. Additional Alabama Priority for Water Resources Research and Development**

- A. Incorporation of Modern and/or Innovative Technologies and Strategies and Approaches in Water Monitoring

- Evaluating and utilizing “real-time” techniques to monitor and assess waterbodies.
- Exploring drone, satellite, and remote sensing technology to monitor and assess waterbodies and watershed conditions.
- Developing effective and efficient techniques to assess rivers and streams for sediment impairment.
- Developing cost-effective approaches to identify and characterize pathogen sources within a watershed.
- Developing innovative marketing strategies to fund U.S. Geological Survey gages in Alabama from both public and private entities.

#### B. Development of Comprehensive Water Resources Geodatabases and Meta-Analyses

- Developing a geodatabase of Alabama’s freshwater springs to include all existing physical, chemical, and biological data.
- Developing a geodatabase for structures that potentially create habitat fragmentation issues within Alabama’s rivers and streams.
- Developing a geodatabase of existing inter-basin transfers (IBTs) at the 12-digit Hydrologic Unit Code (HUC) scale.
- Developing a geodatabase of all existing withdrawals in Alabama for both ground and surface water.
- Providing meta-analyses on recently trending research topics such as dissolved oxygen, temperature, and flow impacts to aquatic life.

**BUDGET FORM**  
**ALABAMA WATER RESOURCES**  
**RESEARCH INSTITUTE**  
**PROJECT FISCAL YEAR 2022**

<b>PI Name &amp; University:</b>				
<b>Project Title:</b>				
Cost Category		Federal	Non-Federal (match)	Total
1. Salaries and Wages				
Principal Investigator(s)				\$0.00
Other Professional Staff				\$0.00
Graduate Student(s)				\$0.00
Undergraduate Student(s)				\$0.00
Total Salaries and Wages		\$0.00	\$0.00	\$0.00
2. Fringe Benefits				
	Rate (%)			
Principal Investigator(s)		0.00%		\$0.00
Other Professional Staff		0.00%		\$0.00
Graduate Student(s)		0.00%		\$0.00
Undergraduate Student(s)		0.00%		\$0.00
Total Fringe Benefits		\$0.00	\$0.00	\$0.00
3. Tuition				
Graduate Student(s)				\$0.00
Undergraduate Student(s)				\$0.00
Total Tuition		\$0.00	\$0.00	\$0.00
4. Supplies				\$0.00
5. Equipment				\$0.00
6. Services or Consultants				\$0.00
7. Travel				\$0.00
8. Other direct costs				\$0.00
9. Total direct costs		\$0.00	\$0.00	\$0.00
	Rate (%)			
10a. Indirect costs on federal share		0.00%	XXXXXXXXXX	\$0.00
10b. Indirect costs on non-federal share		0.00%	XXXXXXXXXX	\$0.00
11. Total estimated costs		\$0.00	\$0.00	\$0.00

Total Federal for grants - maximum of \$25,000

Total Non-Federal for grants - minimum of \$25,000

Total estimated costs for grants - \$50,000

**PI Name & Project Title:**

<p><b>Salaries and Wages for PIs.</b> Provide personnel, title/position, estimated hours and the rate of compensation proposed for each individual.</p>
<p>Federal:</p> <p>Non-Federal (match):</p>
<p><b>Salaries and Wages for Other Professionals.</b> Provide personnel, title/position, estimated hours and the rate of compensation proposed for each individual.</p>
<p>Federal:</p> <p>Non-Federal (match):</p>
<p><b>Salaries and Wages for Graduate Students.</b> Provide personnel, title/position, estimated hours and the rate of compensation proposed for each individual. (Other forms of compensation paid as or in lieu of wages to students performing necessary work are allowable provided that the other payments are reasonable compensation for the work performed and are conditioned explicitly upon the performance of necessary work. Also, note that tuition has its own category below and that health insurance, if provided, is to be included under fringe benefits.)</p>
<p>Federal:</p> <p>Non-Federal (match):</p>
<p><b>Salaries and Wages for Undergraduate Students.</b> Provide personnel, title/position, estimated hours and the rate of compensation proposed for each individual. (Other forms of compensation paid as or in lieu of wages to students performing necessary work are allowable provided that the other payments are reasonable compensation for the work performed and are conditioned explicitly upon the performance of necessary work. Also, note that tuition has its own category below and that health insurance, if provided, is to be included under fringe benefits.)</p>
<p>Federal:</p> <p>Non-Federal (match):</p>

<p><b>Fringe Benefits for PIs.</b> Provide the overall fringe benefit rate applicable to each category of employee proposed in the projects. Note: include health insurance here, if applicable.</p>
<p>Fringe Benefit Rate for PIs = Federal:</p> <p>Non-Federal (match):</p>
<p><b>Fringe Benefits for Other Professionals.</b> Provide the overall fringe benefit rate applicable to each category of employee proposed in the projects. Note: include health insurance here, if applicable.</p>
<p>Fringe Benefit Rate for PIs = Federal:</p> <p>Non-Federal (match):</p>
<p><b>Fringe Benefits for Graduate Students.</b> Provide the overall fringe benefit rate applicable to each category of employee proposed in the projects. Note: include health insurance here, if applicable.</p>
<p>Fringe Benefit Rate for Graduate Students = Federal:</p> <p>Non-Federal (match):</p>
<p><b>Fringe Benefits for Undergraduate Students.</b> Provide the overall fringe benefit rate applicable to each category of employee proposed in the projects. Note: include health insurance here, if applicable.</p>
<p>Fringe Benefit Rate for Undergraduate Students = Federal:</p> <p>Non-Federal (match):</p>
<p><b>Tuition for Graduate Students.</b> Provide time &amp; amount. In-state or Out-of-state tuition?</p>
<p>Federal:</p> <p>Non-Federal (match):</p>
<p><b>Tuition for Undergraduate Students.</b> Provide time &amp; amount. In-state or Out-of-state tuition?</p>

Federal:

Non-Federal (match):

**Supplies.** Indicate separately the amounts proposal for laboratory and field supplies followed by a breakdown of the supplies in each category.

Laboratory supplies (itemized list):

Field supplies (itemized list):

**Equipment.** Identify non-expendable personal property having a useful life of more than one (1) year and an acquisition cost of more than \$5,000 per unit. If fabrication of equipment is proposed, list parts and materials required for each, and show costs separately from the other items. A detailed breakdown is required.

Detailed breakdown:

**Services or Consultants.** Identify the specific tasks for which these services, consultants, or subcontracts would be used. Provide a detailed breakdown of the services or consultants to include personnel, time, salary, supplies, travel, etc. A breakdown is required for each cost.

Detailed breakdown for each cost:

**Indirect Costs.** Provide negotiated indirect (“Facilities and Administration”) cost rate.

Indirect Cost Rate (F&A) =



Project  
Proposal for  
Water Resources Research Institute  
Program under  
Section 104, Water Resources Research Act of  
1984 to the  
Alabama Water Resources Research Institute

in support of the  
Research Proposal

TITLE IN ALL CAPS

by

John/Mary Doe  
Principal Investigator  
Academic Rank  
Department Name  
School or College  
Name University  
Name  
Email  
Address  
Telephone  
Date

Sample Format for Synopsis Portion of Research Proposal\*

RESEARCH PROPOSAL

A. Project Number: *(to be inserted by AWRRRI)*

B. Title:

C. Focus Category: List a maximum of three categories, with the most preferred category first

D. Descriptors: List descriptor words, separated by commas.

E. Duration: From \_\_\_\_\_ To \_\_\_\_\_

F. Federal Funds:

Total	Direct	Indirect
-------	--------	----------

G. Non-Federal Funds:

Total	Direct	Indirect
-------	--------	----------

H. Principal Investigator(s), University, and City:

I. Congressional District:

J. Water Problem and Need for Research:

K. Expected Results, Benefits, Information, etc.:

\*Note: Synopsis may be single spaced and is limited to two pages. Please use letters and titles as shown on this sample.

## FOCUS CATEGORIES

## ATTACHMENT E CON'T.

ACID DEPOSITION	ACD
AGRICULTURE	AG
CLIMATOLOGICAL PROCESSES	CP
CONSERVATION	COV
DROUGHT	DROU
ECOLOGY	ECL
ECONOMICS	ECON
EDUCATION	EDU
FLOODS	FL
GEOMORPOLOGICAL PROCESSES	GEOMOR
GEOCHEMICAL PROCESSES	GEOCHE
GROUNDWATER	GW
HYDROGEOCHEMISTRY	HYDGEO
HYDROLOGY	HYDROL
IRRIGATION	IG
LAW, INSTITUTIONS, AND POLICY	LIP
MANAGEMENT AND PLANNING	M&P
METHODS	MET
MODELS	MOD
NITRATE CONTAMINATION	NC
NON POINT POLLUTION	NPP
NUTRIENTS	NU
RADIOACTIVE SUBSTANCES	RAD
RECREATION	REC
SEDIMENTS	SED
SOLUTE TRANSPORT	ST
SURFACE WATER	SW
TOXIC SUBSTANCES	TS
TREATMENT	TRT
WASTEWATER	WW
WATER QUALITY	WQL
WATER QUANTITY	WQN
WATER SUPPLY	WS
WATER USE	WU
WETLANDS	WL

## KEYWORDS/DESCRIPTORS

### A.

1. Acid Deposition
2. Acid Rain
3. Activated Carbon
4. Activated Sludge
5. Adsorption and Exchange
6. Aeration
7. Agriculture
8. Algae
9. Alkaline Scale
10. Anaerobic Treatment
11. Animal Waste
12. Aquaculture
13. Arid Climates
14. Aquatic Plants
15. Aquifer Characteristics
16. Aquifer Parameters
17. Atmospheric Models
18. Atmospheric Processes

### B.

19. Bacteria
20. Basalt Hydrology
21. Base Flow
22. Bays
23. Beaches
24. Benefit-cost Analysis
25. Benthos
26. Biodegradation
27. Bioindicators
28. Biological Control
29. Biological Treatment
30. Biomonitoring
31. Biotechnology
32. Birds
33. Boating
34. Blackish Water
35. Brines

### C.

36. Cartography
37. Channels
38. Chemigation
39. Chlorination
40. Climate
41. Cloud Seeding
42. Coastal Engineering
43. Coastal Zone
44. Computers
45. Conflict Management
46. Conjunctive Use
47. Conservation
48. Contaminant Transport
49. Conveyance System
50. Cooling

51. Crop Water Use

52. Crustaceans

### D.

53. Dairy Waste Management
54. Dams
55. Data Analysis
56. Data Storage and Retrieval
57. Decision Models
58. Demand Management
59. Denitrification
60. Desalination
61. Developing Countries
62. Disinfection
63. Distillation
64. Distribution System
65. Drainage
66. Drilling
67. Drought
68. Dynamic Programming

### E.

69. Earth Dams
70. Economics
71. Ecosystems
72. Education
73. Energy Budget
74. Energy Use and Conservation
75. Environmental Sanitation
76. Epidemiology
77. Estuaries
78. Estuarine Modeling
79. Eutrophication
80. Evaporation
81. Evapotranspiration

### F.

82. Fertilizers
83. Fish Ecology
84. Fisheries
85. Flood Control
86. Flood Plan Management
87. Fluid Flow
88. Fluid Mechanics
89. Fungicides

### G.

90. Geochemistry
91. Geographic Information
92. Geomorphology
93. Geophysics
94. Geothermal Power
95. Glaciers
96. Great Lake

97. Groundwater Hydrology
98. Groundwater Management
99. Groundwater Modeling
100. Groundwater Movement
101. Groundwater Quality
102. Groundwater Recharge

### H.

103. Hazardous Waste
104. Health Effects
105. Heat Budget
106. Heavy Metals
107. Herbicides
108. History
109. Hydraulic Structures
110. Hydraulics
111. Hydrobiology
112. Hydrogeology
113. Hydrologic Models
114. Hydropower
115. Hypothermia

### I.

116. Ice
117. Impoundments
118. Indian Water Issues
119. Industrial Wastewater
120. Infiltration
121. Information Dissemination
122. Insecticides
123. Insects
124. Institutional Relationships
125. Instream Flow
126. Interbasin Transfers
127. Invertebrates
128. Ion Exchange
129. Irrigation
130. Irrigation Management
131. Irrigation Scheduling
132. Irrigation System
133. Isotopes

### K.

134. Karst Hydrology

### L.

135. Lagoons
136. Lakes
137. Land Use
138. Landscape Management
139. Land-Water Interactions
140. Law
141. Leaching

- M.**  
142. Marketing  
143. Marinas  
144. Marine Resources  
145. Marshes  
146. Mathematical Models  
147. Membranes  
148. Microclimatology  
149. Mineralogy  
150. Mining  
151. Model Studies  
152. Moisture Uptake  
153. Mountain Lakes/Streams  
154. Multiple-Objective Planning
- N.**  
155. Navigation  
156. Nitrogen
- O.**  
159. Oil-Water Interfaces  
160. Open Channels  
161. Operation Research  
162. Optimization  
163. Organic Compounds  
164. Osmosis  
165. Oxidation  
166. Ozonation
- P.**  
167. Perched Water Table  
168. Percolation  
169. Pest Management  
170. Pesticides  
171. Phosphorus  
172. Photosynthesis  
173. Phreatophytes  
174. Physical Chemistry  
175. Planning  
176. Plant Growth  
177. Plant Pathology  
178. Plant Stress  
179. Plant-Water Relationships  
180. Policy Analysis  
181. Pollutants  
182. Pollution Control  
183. Ponds  
184. Port Facilities  
185. Powerplants  
186. Public Health  
187. Pumps
- R.**  
188. Rainfall  
189. Rainfall-Runoff Models  
190. Rainfall-Runoff Processes  
191. Range Management  
192. Recreation  
193. Reefs  
194. Regulatory Permits  
195. Remote Sensing  
196. Reservoir Management  
197. Reservoir Modeling  
198. Resource Development  
199. Resource Planning  
200. Reverse Osmosis  
201. Riparian Vegetation  
202. Risk Analysis  
203. Risk Management  
204. River Basin Development  
205. River Beds
- S.**  
208. Saline Soils  
209. Saline-Freshwater Interfaces  
210. Salinity  
211. Sanitary Landfills  
212. Saturated Flow  
213. Seawater  
214. Sedimentation  
215. Seismology  
216. Septic Tanks  
217. Sewer System  
218. Shellfish  
219. Shipping  
220. Shore Birds  
221. Shore Protection  
222. Sludge  
223. Snow  
224. Socioeconomic Issues  
225. Soil Chemistry  
226. Soil Erosion  
227. Soil Microbiology  
228. Soil Physics  
229. Soil-Water Relationships  
230. Solar Energy  
231. Solute Transport  
232. Springs  
233. Statistics  
234. Stochastic Hydrology  
235. Stochastic Processes  
236. Storm Water Management  
237. Streams  
238. Subsidence  
239. Subsurface Drainage  
240. Surface Drainage
241. Surface-Ground Relationships  
242. Suspended Sediments  
243. Synthetic Hydrology  
244. Synthetic Organics  
245. Systems Analysis  
246. System Engineering
- T.**  
247. Thermodynamics  
248. Tidelands  
249. Time-Series Analysis  
250. Tourism  
251. Toxic Substances  
252. Trace Elements  
253. Trace Organics  
254. Tropics
- U.**  
258. Urban Hydrology  
259. Urban Planning  
260. Urban Water System
- V.**  
261. Viruses
- W.**  
262. Waste Disposal  
262. Wastewater  
263. Wastewater Irrigation  
264. Wastewater Treatment  
265. Water Chemistry  
266. Water Demand  
267. Water Harvesting  
268. Water Law  
269. Water Levels  
270. Water Quality  
271. Water Quality Control  
272. Water Quality Management  
273. Water Quality Modeling  
274. Water Quality Monitoring  
275. Water Quality Standards  
276. Water Resources Development  
277. Water Reuse  
278. Water Rights  
279. Water Softening  
280. Water Treatment  
281. Water Treatment Facilities

- |      |                         |      |                            |           |                     |
|------|-------------------------|------|----------------------------|-----------|---------------------|
| 282. | Water Use Data          | 287. | Weather Data<br>Collection | 293.      | Wildlife Management |
| 283. | Water Use Efficiency    | 288. | Weather Forecasting        | <b>Z.</b> |                     |
| 284. | Water Use Monitoring    | 289. | Weather Modification       | 294.      | Zooplankton         |
| 285. | Watershed<br>Management | 290. | Weeds                      | 295.      | Zoning              |
| 286. | Waves                   | 291. | Well Hydraulics            |           |                     |
|      |                         | 292. | Wetlands                   |           |                     |