Maine Water Resources Research Institute
Senator George J. Mitchell Center for Sustainability Solutions
FY19 Water Resources Sustainability Research Grants (USGS 104b)
Request for Proposals

Critical Dates:

RFP Announcement:	Monday, June 25, 2018
RFP Information Session:	Monday, July 9, 2018 at 12 PM (Norman Smith Hall). Virtual options for participation are available. Contact carol.hamel@maine.edu. ***Please RSVP by 9am, Friday, July 6, 2018***
Concept/Pre-Proposal Due:	Wednesday, July 25, 2018 at 4 PM
Proposal Invitations:	Thursday, August 9, 2018
Full Proposals Due:	Wednesday, October 10, 2018 at 4 PM *See additional deadlines in RFP for UMaine PIs to meet ORA requirements*
Award Notification by:	Friday, November 30, 2018
Project Period:	Start date: March 1, 2019 End date: February 28, 2020

General Information: With funding from the U.S. Geological Survey's 104b program, the Maine Water Resources Research Institute (WRRI) in the Mitchell Center for Sustainability Solutions supports research and outreach to enhance the capacity for the sustainable management of water resources across the state. We request proposals for solutions-driven projects in which interdisciplinary research teams collaborate closely with stakeholders and provide support for undergraduate/graduate training.

This request for proposals from the Maine-USGS WRRI, a program of the Mitchell Center, constitutes the FY19 Maine grants program as authorized by the federal Water Resources Research Act of 1984 as amended. Please note that funding for the FY19 WRRI program is dependent on inclusion of the program in the FY19 federal budget.

Grant Period: Research proposals for projects up to 12 months in duration will be considered to occur in a project period of March 1, 2019 through February 28, 2020.

Grant Categories: Three categories of projects may be funded under this program:

1) *Research grants* are funded for up to $40,000, not including required match provided by the PI. A typical grant is approximately $25,000. There is no minimum award limit.
2) *Information transfer or environmental education grants* are typically funded in the range of $5,000 to $15,000, not including PI match.
3) *Seed grants* are funded for no more than $5,000, not including PI match. These grants are intended to be pilot projects or incubators for future research ideas or funding.

WRRI 104b PROGRAM OBJECTIVES:

The objectives of this federally sponsored program place special emphasis on the importance of research and education aimed at improving the nation's water supply. This focus is concordant with the Water Science Vision and Mission of the U.S. Geological Survey:

"*The USGS will provide unbiased knowledge of the Nation's water resources to support human well-being, healthy ecosystems, economic prosperity, and anticipate and help resolve impending water-resource conflicts and emergencies... The USGS Water Mission Area... will serve society through water-resource monitoring, assessment, modeling, and research to provide tools that managers and*

policymakers can use... Improvements are needed in the characterization and understanding of water quantity and water quality if we are to maintain our society and quality of life." USGS Circular 1383-G

The 104b program objectives also align with the mission and vision of the Mitchell Center (Attachment D, pg. 17). The Mitchell Center's intent is to foster innovative work to address intersections among the environmental, social, and economic dimensions of sustainability challenges through stakeholder-engaged, solutions-driven, interdisciplinary research.

RFP Objectives and Deliverables:

Pre-proposals must be related to freshwater resources, and focus on developing strong stakeholder partnerships and interdisciplinary collaboration that accelerate progress in understanding and solving sustainability problems via one or more of the following strategies:

- Identifying and overcoming key barriers in connecting scientific knowledge with societal actions to promote effective water resource management;
- Building upon past research to increase the delivery of decision-support systems and other tools that facilitate real-world problem-solving;
- Tackling sustainability problems that are highly relevant to place-based problems in Maine;
- Pursuing other research strategies to understand and solve sustainability problems in water resources.

All proposals must align with the WRRI's program objectives and the Mitchell Center's mission, vision, and approach (see p. 17), and demonstrate significant promise for securing external funding.

Eligibility:

1) *Team composition:* Federal guidelines for this USGS program require that principal investigators (PI) be faculty or regular staff of a four-year institution of higher education in Maine. Co-investigators are not required to meet this criterion.
2) *Interdisciplinarity*: Teams must include sufficiently diverse research expertise to match the multi-faceted nature of the proposed sustainability challenge.
3) *Stakeholder engagement:* Proposals will only be accepted for projects that include strong stakeholder participation to maximize the relevance and usability (*sensu* Clark et al. 2016) of research or information transfer products. Examples of active stakeholder participation include: identification of research needs, development of research goals, interpretation and use of research results.
4) *Project Scope:* Single investigator proposals will not be accepted – only team-based, interdisciplinary projects are eligible.
5) All PIs and co-PIs must be current on deliverables from any prior USGS Institute grants.
6) Federal employees cannot be PIs but can be included as co-investigators. Federal employees may not be supported by funds from these grants, but are encouraged to provide fiscal support for the project. Federal support cannot be counted as match.
7) This program supports water resources-related research. Projects primarily focusing on human health, specific biological organisms or communities (unless to be used as an indicator or wider application), oceanography, or exclusively marine issues are not eligible for this program under federal rules. Estuarine proposals that directly connect with freshwater flows are eligible for funding.

Proposal & Review Process:

1. *Pre-Proposal:* All interested applicants must submit a four-page pre-proposal explaining their project idea by July 25, 2018 at 4 PM. Please utilize the format below and email to Ruth

Hallsworth at hallsworth@maine.edu. We strongly encourage interested researchers to attend the RFP information session on Monday, July 9 from noon – 1pm.

2. *Evaluation:* A review committee representing the Mitchell Center, the USGS New England District, and other pertinent experts will evaluate the submitted pre-proposals for relevance to the program's mission, vision and objectives. Invitations for full proposal submission will be announced by August 9. Full proposal format requirements are included below, with full proposals due by 4 PM on October 10, 2018.
3. *Selection:* The review committee will evaluate the submitted full proposals. The WRRI Director will then consult with members of the Research Advisory Committee to make final award selections. Notification will be made no later than November 30, 2018.
4. *Award Period:* The award period for these projects begins March 1, 2019 and all project components must be completed by February 28, 2020.
5. *Support level*: It is anticipated that in FY19 $60,000 will be available for research and information transfer projects. Applicants are encouraged to leverage matching sources of funding whenever possible. Final project reports will be due by April 30, 2020.

Questions regarding this RFP should be directed to WRRI Director David Hart (david.hart@maine.edu) or Mitchell Center Strategic Program Manager Ruth Hallsworth (hallsworth@maine.edu).

Fiscal Guidelines:

Proposal budgets must reflect a $2 non-federal match for each federal dollar requested. This means that a federal request of $20,000 will result in a research project with at least a $60,000 total project cost. The match may include fringe benefits and indirect costs, as well as direct costs. Contact Ruth Hallsworth (hallsworth@maine.edu) for specific guidance on match. Overhead (indirect) costs are not permitted to be charged on the federal funding request in this program, although the match may include those indirect costs that are not charged on federal dollars. An Excel budget template is available. Please contact Ruth Hallsworth for a copy of the template.

The congressional authorizing language in the Water Resources Research Act specifically refers to the "training of future water resource professionals." Therefore, preference is given to projects for which student participation and training is a substantial part of the effort. All projects must include a training component for students, and typically will fund a graduate assistantship or undergraduate stipend. The recommended minimum monthly graduate stipend rate is $1,689 ($15,200/9 months). PIs are urged to provide tuition in the 'other' budget line. Tuition does not generate IDC match. Please note that partial payment of health insurance premiums is required for UMaine graduate students.

Base-funded faculty PIs should prioritize student support, not their own salary. Rarely are projects funded that request more than one week per year in faculty salary.

PRE-PROPOSAL FORMAT

The pre-proposal has two parts: 1) technical document (3 pages); and 2) sustainability concept document (1 page). It should be set in 12-point type with one-inch margins on all sides. The document must be entirely self-contained and self-explanatory; no cover letter is allowed. The following technical document structure is highly recommended as it follows the format for a full proposal:

Technical Document (3 page limit)

- Project title PIs and affiliations (include contact information for the lead PI)
- Project dates and duration
- Agency funds requested
- Proposed match and source of funds
- Project synopsis (one paragraph – provided in 3rd person, present tense, lay-friendly text for publication purposes)
- Problem Statement
- Objectives (bulleted)
- Methods outline
- Impact of project (one paragraph)
- Expected deliverables (bulleted)
- Qualifications of investigators (one paragraph; no CVs)

Sustainability Concepts (1 page limit)

1. What sustainability problem does the proposed research address?
2. Who are the relevant project stakeholders, what kind of stakeholder engagement has already occurred, and how do you plan to strengthen their participation?*
3. What is the status of your plans for creating a research team with sufficient interdisciplinary breadth to address the problem?
4. How do you plan to identify and implement a solution to this problem?

* Full proposals will be required to include details on stakeholder participation at each stage of the project. Letters from stakeholders describing their commitment to participation will also be required.

Budget description/justification (one paragraph)
Budget outline:

Cost Category	**Program Funds**	**Non-Federal Match**
Salaries/Wages		
Students (no fringe benefits)		
Fringe benefits @ (rate)		
Supplies		
Equipment		
Services		
Travel		
Other (e.g. tuition)		
Total Direct Costs		
IDC on Program $		
IDC on Match		
Total Request		

FULL PROPOSAL FORMAT

Full Proposal Review, Ranking Criteria, and Selection Process

Invited research proposals will be reviewed by at least three peer reviewers.

The proposal submission procedure for this program is a two-step process:

Step I: Prior to submission to the Mitchell Center, full proposals must be processed through your institution's standard procedure for proposals to be submitted to federal agencies.

UMaine Researchers: PIs **must** follow the Office of Research Administration's Proposal Submission Policy and Timeline. Proposals must be fully approved by ORA and have completed routing through PARS before Step II can be completed. Following is a list of deadlines that follow ORA guidelines:

Intent to submit	Thursday, August 9
First draft budget, justification, abstract	Tuesday, Sept. 18
Approval of budget, justification. PARS routing initiated.	Tuesday, Sept. 25
Working draft of full application for review	Tuesday, October 2
Final version of application. PARS approval completed.	Thursday, October 4
Completed sub-recipient commitment forms	Thursday, October 4

Non-UMaine Researchers: PIs **must** email the following documents to hallsworth@maine.edu by **October 10, 2018**:

- Scanned copy of the signature paperwork that follows your institution's standard procedure for proposals submitted to Federal agencies
- Scanned copy of the completed UMaine sub-recipient commitment form (available from https://umaine.edu/ora/)

Step II: The complete electronic copy of the proposal must be submitted by the PI to http://niwr.net* no later than **4 PM** on **October 10, 2018**. Proposal text, investigator information and budget information are entered directly on the NIWR.net web page.
* USGS is planning to introduce a new online submission site for proposals later this year. We will update PIs of any changes as soon as we have information available.

Once the peer-review process has been completed, final project selection will be based on consultation with the Mitchell Center's Research Advisory Committee comprised of expert stakeholders. PIs should pay careful attention to the proposal evaluation criteria used by reviewers and the selection panel:

- Degree to which the proposed research addresses a key challenge for the sustainable management of water resources in Maine (15%)
- Scientific and technical merit as judged by peer reviews. (20%)
- Impact – the potential of the project to deliver progress towards solutions and benefit stakeholders. (25%)
- Stakeholder involvement (required). (15%)
- Student involvement (required). (10%)
- Total budget request and cost-effectiveness of the project, including leveraging of external dollars. (5%)
- Likelihood of obtaining continued support for the project. (10%)

Please refer to the fiscal guidelines for information on prioritizing student support.

Reviewers
Reviewers will be selected by the Director of the Maine WRRI.

Research proposal
The following information is entered on-line at http://NIWR.net. New investigators must register under Maine at NIWR.net to obtain access to the site. Enter ERAS subsystem for (104B) System proposal.

Executive summary:
1. Title
2. Focus categories (see Attachment A)
3. Keywords (see Attachment B)
4. Project duration is one year, project start date may be as early as March 1, 2018
5. Agency funding requested
6. Matching funds provided
7. PI names and affiliations (with full contact information for the lead PI)
8. Congressional district (first or second Maine)
9. Abstract
10. Budget (use format provided))
11. Budget justification (one page maximum)

The information above is entered on-line at NIWR.net. Text can be cut-and-pasted.

Main body of proposal (numbered starting with page 1)
12. Title
13. Statement of critical regional or state water problem
14. Statement of results and benefits
15. Nature, scope, and objectives
16. Methods, procedures, and facilities available
17. Summary of closely related research (related activities for IT proposals)
18. Student training
19. Statement of government involvement
20. Expected deliverables, including information dissemination plan for all proposals, a bulleted list is preferred
21. References cited

The text should be formatted in 12 point type with one inch margins on all sides.
Sections 12 through 21 must fit on 8 pages.

22. Narrative statement of investigators qualifications
23. CVs/Resumes (maximum two pages per investigator)
24. Letters of participation (not just letters of support) from stakeholders. Letters must include a commitment by the stakeholder to participate actively in the project. Examples of participation include: identification of research needs, development of research goals, interpretation and use of research results.

We strongly recommend that PIs read the fiscal guidelines before preparing proposal budgets.

NOTIFICATION AND AWARD PERIOD
Proposed projects may be up to 12 months in duration and may begin as early as March 1, 2019. Projects must be completed by February 28, 2020. No-cost extensions may be requested on a case-by-

case basis. Final funding decisions will be announced by November 30, 2018, and are dependent upon federal budget completion.

Award Requirements

Projects receiving WRRI funding are required to provide the following items:

1. Final report (due April 30, 2020). If a no-cost extension is requested, an interim report is due on April 30, 2020 with a final report due on April 30, 2021.
2. Oral or poster presentation at Maine Sustainability & Water Conference.
3. One page summary of proposed project for lay audience (due March 2019).
4. One page report of project results for lay audience (due April 2020).

Attachment A
Focus Categories

Category	Abbreviation
Acid Deposition	ACD
Agriculture	AG
Climatological Processes	CP
Conservation	COV
Drought	DROU
Ecology	ECL
Economics	ECON
Education	EDU
Floods	FL
Geomorphological and Geochemical Processes	G&G
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

Attachment B

Keywords

Note: The keywords describe areas of interest as related to water; e.g., "Cooling" refers to water as used in cooling; "Fertilizers" implies the effect of fertilizers on water characteristics, etc.

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. Brackish Water
35. Brines

C

36. Cartography
37. Channels
38. Chemigation
39. Chlorination
40. Climate
41. Cloud Sending
42. Coastal Engineering
43. Coastal Zone
44. Computers
45. Conflict Management

46. Conjunctive Use
47. Conservation
48. Contaminant Transport
49. Conveyance Systems
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 Systems
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. Evaporatranspiration

F

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

G

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

133. Isotopes

K

134. Karst Hydrology

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
157. Numerical Analysis
158. Nutrients

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. Power Plants
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

206. Rivers

207. Runoff

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 Systems

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-Groundwater Relationships

242. Suspended Sediments

243. Synthetic Hydrology

244. Synthetic Organics

245. Systems Analysis

246. Systems Engineering

T

247. Thermodynamics

248. Tidelands

249. Time-Series Analysis

250. Tourism

251. Toxic Substances

252. Trace Elements

253. Trace Organics

254. Tropics

U

255. Underground Storage Tanks

256. Unsaturated Flow

257. Urban Drainage

258. Urban Hydrology

259. Urban Planning

260. Urban Water Systems

V

261. Viruses

W

262. Waste Disposal

263. Wastewater

264. Wastewater Irrigation

265. Wastewater Treatment

266. Water Chemistry

267. Water Demand

268. Water Harvesting

269. Water Law

270. Water Levels

271. Water Quality

272. Water Quality Control

273. Water Quality Management

274. Water Quality Modeling

275. Water Quality Monitoring

276. Water Quality Standards

277. Water Resources Development

278. Water Reuse

279. Water Rights

280. Water Softening

281. Water Treatment

282. Water Treatment Facilities

283. Water Use Data

284. Water Use Efficiency

285. Water Use Monitoring

286. Watershed Management

287. Waves

288. Weather Data Collection

289. Weather Forecasting

290. Weather Modification

291. Weeds

292. Well Hydraulics

293. Wetlands

294. Wildlife Management

Z

295. Zooplankton

296. Zoning

Attachment C
Federal Authorization Requirements

The Water Resources Research Act Amendments of 2006 (42 USC §§10301-10309) reauthorized the Water Resources Research Institutes' program through 2011. Special emphasis was placed on the importance of research and education aimed at improving the nation's water supply. This new focus suggests that the Water Research Institutes should ensure that their assessments of performance provide evidence that the Institutes are accomplishing statutory purposes.

Under this reauthorization each institute shall-

(1) plan, conduct, or otherwise arrange for competent applied and peer-reviewed research that fosters

(A) improvements in water supply reliability;

(B) the exploration of new ideas that

(i) address water problems or

(ii) expand understanding of water and water-related phenomena;

(C) the entry of new research scientists, engineers, and technicians into water resources fields; and

(D) the dissemination of research results to water managers and the public.

(2) Reports

The Secretary shall report to Congress annually on coordination efforts with other Federal departments, agencies, and instrumentalities under paragraph (1). As part of the annual budget submission to Congress, the Secretary shall also provide a crosscut budget detailing the expenditures on activities listed under subsection (a)(1) and a report which details the level of applied research and the results of the activities authorized by this Act, including potential and actual –

(A) increases in annual water supplies;

(B) increases in annual water yields;

(C) advances in water infrastructure and water quality improvements; and

(D) methods for identifying, and determining the effectiveness of, treatment technologies and efficiencies.

Projects funded by the Maine Water Resources Research Institute must produce results that coincide with one or more of these performance metrics:

<u>Applied and Practical Research</u>

4) "applied water supply research"

5) "applied and peer-reviewed research"

6) "quality and relevance of its water research"

7) "address water problems"

8) "effectiveness at producing measured results"

Education

9) "entry of new research scientists, engineers, and technicians into water resources fields"

Outreach

10) "dissemination of research results to water managers and the public"

11) "potential and actual increases in annual water supplies"

Water Supply (Quantity)

12) "applied water supply research"

13) "potential and actual increases in annual water yields"

14) "expand understanding of water and water related phenomena"

Water Quality

15) "potential and actual advances in water quality improvements"

Water Supply Reliability

16) "improvements in water supply reliability"

Water Infrastructure and Technology

14. "potential and actual advances in water infrastructure improvements"

15. "methods for identifying and determining the effectiveness of treatment technologies and efficiencies"

Attachment D
Senator George J. Mitchell Center for Sustainability Solutions
Maine Water Resources Research Institute

Mission, Vision, and Approach

Mitchell Center Mission:
The mission of the Mitchell Center is to be a leader and valued partner in understanding and solving societal problems related to the growing challenge of sustainable development (i.e. improving human well-being while protecting the environment).

Mitchell Center Vision:
The vision of the Mitchell Center is to connect knowledge with action to create a brighter environmental, social, and economic future in and beyond Maine.

Mitchell Center Approach:
The Mitchell Center's general approach to sustainability science: (i) is problem-driven and focused on deriving and testing solutions based on scientific knowledge; (ii) uses interdisciplinary research teams to analyze the dynamic, coupled interactions between natural and human systems; and (iii) stresses early, active and ongoing engagement with diverse stakeholders.

Key Publications and other Resources for Preparing Effective Research Proposals

General Sustainability Science Resources

Clark, W. C., van Kerkhoff, L., Lebel, L., & Gallopin, G. C. (2016). Crafting usable knowledge for sustainable development. *Proceedings of the National Academy of Sciences*, *113*(17), 4570-4578. http://www.pnas.org/content/113/17/4570.abstract.

Hart, D.D. et al. (2016). Mobilizing the power of higher education to tackle the grand challenge of sustainability: Lessons from novel initiatives. *Elementa: Science of the Anthropocene*, 4: 000090. doi: 10.12952/journal.elementa.000090

Kates, R.W. et al. (2001). Sustainability Science. Science 292(5517), 641-642.

Matson, P., Clark, W. C., & Andersson, K. (2016). *Pursuing sustainability: a guide to the science and practice*. Princeton University Press.

Miller TR. 2015. *Reconstructing sustainability science: Knowledge and action for a sustainable future.* New York: Routledge.

PNAS Sustainability Science Web Page - Access to PNAS publications and links to other relevant websites. http://www.pnas.org/site/misc/sustainability.shtml

Understanding and strengthening connections between knowledge and action

Cash, D.W., Clark, W.C, Alcock, F., Dickson, N.M., Eckley, N., Guston, D.H., Jager, J., and R.B. Mitchell. 2003. Knowledge systems for sustainable development. PNAS 100(14): 8086-8091. http://www.pnas.org/content/100/14/8086.full.pdf

Hart, D. D., K. P. Bell, L. A. Lindenfeld, S. Jain, T. R. Johnson, D. Ranco, and B. McGill. 2015. Strengthening the role of universities in addressing sustainability challenges: the Mitchell Center for Sustainability Solutions as an institutional experiment. *Ecology and Society* **20**(2):4. http://dx.doi.org/10.5751/ES-07283-200204

Jacobs, K. et al. 2002. Connecting Science, Policy, and Decision-making: Agencies. NOAA Climate Program Office. http://leopoldleadership.stanford.edu/sites/default/files/Jacobs_2001-02_Connecting.Science.Decisionmaking.pdf

Pielke, R. et al. 2010. Usable Science: A Handbook for Science Policy Decision Makers. Science Policy Assessment and Research on Climate. http://sciencepolicy.colorado.edu/research_areas/sparc/outreach/sparc_handbook/index.html

Rowe, A. and K. Lee. 2012. Linking knowledge with action. A report to the Packard Foundation. https://www.packard.org/wp-content/uploads/2014/04/Linking-Knowledge-with-Action_DEC-2012.pdf

van Kerkhoff, L. and L. Lebel. 2006. Linking knowledge and action for sustainable development. Annu. Rev. Environ. Resourc 31: 445-477. http://arjournals.annualreviews.org.prxy4.ursus.maine.edu/doi/pdf/10.1146/annurev.energy.31.102405.170850