

Table 2. Resources and Research Needs

TOPIC	EXISTING RESOURCES	RESEARCH NEEDS
Mechanisms of Wetland Loss		
General	<ul style="list-style-type: none"> ▪ “Scientific Assessment of Coastal Wetland Loss, Restoration, and Management in Louisiana” (Journal of Coastal Research, Special Issue No. 20, Boesch, D.F., Josselyn, M.N., Mehta, A.J., Morris, J.T., Nuttle, W.K., Simenstad, C.A., Swift, D.J.P., 1994) 	<ul style="list-style-type: none"> ▪
Submergence (Eustatic Sea Level Rise, Subsidence, Loss of Sediment Sources)	<ul style="list-style-type: none"> ▪ Study of Gulf Coast subsidence (http://coastal.er.usgs.gov/gc-subsidence/) 	<ul style="list-style-type: none"> ▪ Improved techniques for quantifying the relative contribution of the various mechanisms that cause submergence will produce better response methods.
Erosion (Waves, Currents, Storms)	<ul style="list-style-type: none"> ▪ “Preliminary Evaluation of Critical Wave Energy Thresholds at Natural and Created Coastal Wetlands” (USACE ERDC TN-WRP-HS-CP-2.2) ▪ “Estimating Wave Tolerance of <i>Spartina alterniflora</i> in Coastal Alabama” (Journal of Coastal Research 21(3):453-463, 2005) 	<ul style="list-style-type: none"> ▪ Limited methods exist for estimating erosion of cohesive soils. ▪ Guidance on erosion thresholds / wave tolerance for vegetation is limited. ▪ Ability to estimate sediment transport and erosion rates is limited.
Water Quality Degradation (Pollution, Salinity, Turbidity)	<ul style="list-style-type: none"> ▪ 	<ul style="list-style-type: none"> ▪
Anthropogenic (Dredging / Excavating, Filling)	<ul style="list-style-type: none"> ▪ 	<ul style="list-style-type: none"> ▪
Global Warming / Atmospheric Change	<ul style="list-style-type: none"> ▪ “Greenhouse Effect and Sea Level Rise: A Challenge for this Generation” (http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/SHSU5BUMJZ/\$File/greenhouse.pdf) 	<ul style="list-style-type: none"> ▪
Planning and Design Guidelines for Wetlands Construction		
Planning, Design, and Construction Techniques for Wetlands Creation and Restoration	<ul style="list-style-type: none"> ▪ “Wetlands Engineering Handbook” (USACE ERDC/EL TR-WRP-RE-21) (http://el.ercd.usace.army.mil/wetlands/pdfs/wrpre21/wrpre21.pdf) ▪ “Wetland Shoreline Protection and Erosion Control” (USACE WRP TN HS-RS-3.1) ▪ “Shoreline and Channel Erosion Protection: Overview of Alternatives” (USACE WRP TN HS-RS-4.1) ▪ “Wetlands Engineering: Design Sequence for Wetlands Restoration and Establishment” (USACE WRP TN WG-RS-3.1) ▪ “Review of Coastal Habitat Creation, Restoration and Recharge Schemes” (ABP Southampton Report No. R.909, 1998) ▪ “The Dos and Don’ts of Wetland Construction” (Environmental Concern Inc., 2002) ▪ “The fishery value of salt marsh restoration projects” (Journal of Coastal Research, SI 40:37-50, 2005) ▪ “Approaches to Coastal Wetland Restoration: Northern Gulf of Mexico” (R.E. Turner and B. Streever, SPB Academic Publishing, 2002) ▪ “Design Manual, Constructed Wetlands and Aquatic Plan Systems for Municipal Wastewater Treatment” (U.S. Environmental Protection Agency, EPA/625/1-88/022, September 1988) ▪ “Wetlands,” 2nd Edition (Mitsch and Gosselink, Van Nostrand Reinhold, 1993) 	<ul style="list-style-type: none"> ▪ Existing guidelines are relatively general and only cover basic information. ▪ Limited guidelines for assessment of wetlands value versus construction cost. ▪ Where are they, where should they be constructed; existing versus needed location. ▪ How to deal with invasive species – weed control, predator control, addressing real or perceived nuisances (mosquitoes, snakes, etc.)
Numerical Modeling Tools	<ul style="list-style-type: none"> ▪ Hydrodynamic Circulation and/or Flow Models (RMA2, RMA10, EFDC, MIKE21, MIKE11, TELEMAC2D, GEMSS, M2D, ADCIRC, HVEL2D, etc.) ▪ Sediment Transport Models (SED2D, RMA4, etc.) 	<ul style="list-style-type: none"> ▪
Geotechnical Assessments	<ul style="list-style-type: none"> ▪ “Engineering Properties of Wetland Soils” (USACE TN SG-RS-1.2) 	<ul style="list-style-type: none"> ▪ Develop better guidelines for geotechnical sampling, testing, and analysis of engineering properties

	<ul style="list-style-type: none"> ▪ “Engineering Description of Wetland Soils” (USACE WRP TN SG-RS-1.1) ▪ “Soils Handling Techniques and Equipment for Wetlands Restoration and Establishment” (USACE WRP TN SG-RS-3.1) ▪ EPA Sediment Sampling Techniques (http://clu.in.org/programs/21m2/sediment/) 	for soft cohesive soils.
Biological Assessments	<ul style="list-style-type: none"> ▪ (See “Monitoring and Assessment Protocols” above) 	▪
Hydraulics / Hydrology	<ul style="list-style-type: none"> ▪ “Effects of Vegetation on Hydraulic Roughness and Sedimentation in Wetlands” (USACE WRP TN SD-CP-2.2) ▪ “Design Guidelines for Tidal Channels in Coastal Wetlands” (Philip Williams & Associates, LTD, 1995) ▪ “Guidelines for Vegetative Erosion Control on Wave-Impacted Coastal Dredged Material Sites” (USACE TR D-90-13) ▪ “Geotextile Tube Structures for Wetlands Restoration and Protection” (USACE WPR TN HS-RS-3.2) 	<ul style="list-style-type: none"> ▪ Limited methods exist for estimating wave attenuation and transmission across vegetation. ▪ Limited methods exist for estimating scour / erosion of cohesive soils.
Chemical Testing (Toxicity and Nutrients)	<ul style="list-style-type: none"> ▪ (See “Evaluation of Sediment Quality and Quantity” Below) ▪ 	▪
Permitting / Regulatory	<ul style="list-style-type: none"> ▪ “Environmental Guidelines for Aquatic, Nearshore and Upland Confined Disposal Facilities for Contaminated Dredged Material” (PIANC Report of WG 5, 2002) 	▪
Dredging	<ul style="list-style-type: none"> ▪ “Wetlands Ecology and Management, Special Issue: Salt Marshes Created from Dredged Material” (W.J. Streever, editor, Kluwer Academic Publishers, Vol. 8, No. 5, Oct 2000) 	▪
Planting / Harvesting	<ul style="list-style-type: none"> ▪ “Engineering Specification Guidelines for Wetland Plant Establishment and Subgrade Preparation” (USACE TR WRP-RE-19) (http://el.ercd.usace.army.mil/wetlands/pdfs/wrpre19.pdf) 	▪
Wetlands and Watershed Management	<ul style="list-style-type: none"> ▪ Conservation and Rational Use of Wetlands, Strategic Spanish Management Policy (in Spanish) (http://www.mma.es/conserv_nat/planes/plan_humed/plan_humed.htm) 	<ul style="list-style-type: none"> ▪ Management of wetlands impacts on mercury methylation process.
Beneficial Use of Dredged Material		
Guidelines for Development of Life Cycle Dredged Material Management Plans	<ul style="list-style-type: none"> ▪ “Life-Cycle Analysis of Mid Bay and Poplar Island Projects, Chesapeake Bay, Maryland” (ERDC/CHL TR-05-12) (http://libweb.wes.army.mil/uhtbin/hyperion/CHL-TR-05-12.pdf) 	▪
Evaluation of Sediment Quality and Quantity	<ul style="list-style-type: none"> ▪ USACE Center for Contaminated Sediments (http://el.ercd.usace.army.mil/dots/ccs/) ▪ EPA Contaminated Sediment in Water (http://www.epa.gov/waterscience/cs/) ▪ California State Water Resources Control Board (http://www.waterboards.ca.gov/bptcp/techinfo.html) ▪ “Handbook on Sediment Quality” (Water Environment Federation, 2002) (http://www.wef.org) ▪ “Contaminated Sediments in Ports and Waterways – Cleanup Strategies and Technologies” (National Research Council, NAS, 1997) 	<ul style="list-style-type: none"> ▪ Practical guidance on estimation of “cut/fill” ratios as a function of dredging, transportation, and placement techniques is limited. ▪
Policies	<ul style="list-style-type: none"> ▪ 	▪
Regional Sediment Management	<ul style="list-style-type: none"> ▪ 	▪
Dredging Methods	<ul style="list-style-type: none"> ▪ USACE Dredging Operations Technical Support (http://el.ercd.usace.army.mil/dots/) 	<ul style="list-style-type: none"> ▪ Innovative dredged material placement techniques. ▪ Treatment technologies for and/or isolation of contaminated sediments.
Total Maximum Daily Loads (TMDLs) for Sediment	<ul style="list-style-type: none"> ▪ “Protocol for Developing Sediment TMDLs,” 1st Edition (USEPA, October 1999) (http://www.epa.gov/owow/tmdl/techsupp.html) 	▪
Dredging Permits	<ul style="list-style-type: none"> ▪ 	▪

Project Monitoring		
Case Studies	▪	▪ Critical analysis of successes and failures
Success Standards	▪ ?	▪ There is a growing interest in applying the beneficial use of dredged material and wetlands restoration to solve environmental problems, yet little agreement exists on what constitutes successful projects. Lack of agreed-upon, standard criteria for judging ecological and economic success impedes progress of science and practice. Simple metrics and assessment protocols should be developed as standards for measuring performance and success.
Projects Databases	<ul style="list-style-type: none"> ▪ National Estuaries Restoration Inventory (https://neri.noaa.gov) ▪ National Wetlands Inventory (http://www.nwi.fws.gov) ▪ National River Restoration Science Synthesis (NRRSS) Database (http://www.nrrss.umd.edu) ▪ Case Studies for Beneficial Uses of Dredged Material, U.S. Army Corps of Engineers, Dredging Operations Technical Support Program http://el.erdc.usace.army.mil/dots/budm/budm.html 	▪ Develop project databases for beneficial use of dredged material and wetlands restoration including such information as location, cost, size, goals, date(s), sponsor(s), and whether or not project was monitored.
Monitoring and Assessment Protocols	<ul style="list-style-type: none"> ▪ "National Guidebook for Application of Hydrogeomorphic Assessment of Tidal Fringe Wetlands" (USACE TR WRP-DE-16) (http://el.erdc.usace.army.mil/wetlands/pdfs/wrpde16.pdf) ▪ "Expanding Wetland Assessment Procedures: Linking Indices of Wetland Function with Services and Values" (USACE ERDC/EL TR-00-17) (http://el.erdc.usace.army.mil/wetlands/pdfs/trel00-17.pdf) ▪ "Wildlife community habitat evaluation using a modified species-area relationship" (USACE Technical Report WRP-DE-12) (http://el.erdc.usace.army.mil/wetlands/pdfs/wrpde12.pdf) ▪ "Floristic index for establishing assessment standards: A case study for northern Ohio" (USACE TR WRP-DE-8) (http://el.erdc.usace.army.mil/wetlands/pdfs/wrpde8.pdf) 	▪ Without adequate project monitoring, many opportunities to learn from successes and failures, and thus to improve future practice, are being lost.
Quality Assurance	▪	▪
Indicators and Stressors	▪	▪
General Resources		
Journals	<ul style="list-style-type: none"> ▪ <i>Journal of Coastal Research</i> (http://www.cerf-jcr.org) ▪ <i>Restoration Ecology</i> (http://www.ser.org/content/journals.asp) ▪ <i>Ecological Restoration</i> (http://www.ser.org/content/journals.asp) ▪ <i>Ecological Restoration Management</i> (http://www.ser.org/content/journals.asp) ▪ <i>Ecological Engineering</i> (http://www.elsevier.com/wps/find/journaldescription.cws_home/522751/description#description) 	▪
Textbooks	<ul style="list-style-type: none"> ▪ Mitsch, W.J., and Gosselink, J.G. 2000. <i>Wetlands</i>, John Wiley and Sons, Inc., 920 p. ▪ Day, J.W., Jr., Hall, C.A.S., Kemp, W.M., and Yanez-Arancibia, A. 1989. <i>Estuarine Ecology</i>, Ch. 5, "Intertidal Wetlands: Salt Marshes and Mangrove Swamps," John Wiley and Sons, Inc., p. 188-225. 	▪
Informational Publications	<ul style="list-style-type: none"> ▪ U.S. Environmental Protection Agency's Watershed Outreach Documents (http://www.epa.gov/owow/watershed/outreach/documents/) ▪ 	▪
Conferences	<ul style="list-style-type: none"> ▪ Restore America's Estuaries (http://www.estuaries.org) ▪ Coastal Sediments 07 (http://www.asce.org/conferences/cs07/index.cfm) 	▪
Workshops	<ul style="list-style-type: none"> ▪ "Partnerships and Opportunities in Wetland Restoration," Proceedings of a Workshop, Seattle, Washington, April 16-17, 1992, Environmental Protection Agency. 	▪
Technical Support	<ul style="list-style-type: none"> ▪ Dredging Operations Technical Support (DOTS) Program of the US Army Corps of Engineers (http://el.erdc.usace.army.mil/dots/) 	▪

GIS and Mapping	<ul style="list-style-type: none">▪ U.S. Fish and Wildlife Service “Geotract” mapping tool for viewing land use/land cover, land ownership, National Wetlands Inventory, streams, roads, railroads, political boundaries, EPA point sources, mines, dams, and when available Habitat Conservation Plans bounds. (http://mapper.tat.fws.gov/imf/imf.jsp?site=geotract)▪ National Oceanic and Atmospheric Administration's Coastal Protection and Restoration Division has developed numerous Watershed Database and Mapping Projects that combine a standard database structure, database-mapping application (Query Manager), and GIS data. Using these elements, sediment contaminant concentrations, toxicity and tissue data, natural resources, and potential habitat restoration projects can be overlaid on a watershed's features and land uses, and displayed on maps at flexible spatial scales. (http://archive.orr.noaa.gov/cpr/watershed/watershedtools.html)	<ul style="list-style-type: none">▪
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