

# Long-Term Stewardship of Wetland Mitigation

Preliminary research on the long-term stewardship and viability of wetland mitigation banks in California Highlights From the Annual ELI-Stetson Wetlands Workshop

> Corps Regulation of Central Valley Farmers

Regulatory Challenges of Living Shorelines

# CONTENTS

SPECIAL FEATURE: ELI-STETSON WETLANDS WORKSHOP

### **Evaluating Long-Term Stewardship of Compensatory Mitigation Sites: Preliminary Findings From California** By JENNY THOMAS

**6** Eight years after the 2008 Compensatory Mitigation Rule clarified requirements for compensatory mitigation, the U.S. Environmental Protection Agency has begun reviewing the long-term stewardship of wetland mitigation banks. This article presents preliminary results from the evaluation of California's mitigation banks and a strategy for completing this review in other states across the country.

### Five Tips to Expedite the Regulatory Review Process for Conservation Easements

By B. Seth Johnson

**11** Through increased communication and coordination among all entities invovled in the compensatory mitigation process, the author provides several tips on securing site protection for conservation easements.

## Long-Term Stewardship Funding and Mitigation Industry Sustainability

By Greg DeYoung and Steve Moore

**13** By applying general industry life-cycle concepts to the wetlands mitigation banking industry, the authors provide insights into the development and future sustainability of the compensatory mitigation industry.

FEATURE ARTICLES

### The Expanding Regulation of Central Valley Farmers by the Sacramento Corps District

By B. Demar Hooper

**15** In the years following Borden Ranch Partnership v. U.S. Army Corps of Engineers, regulation of certain farming activities in jurisdictional wetlands has become unclear to farmers in California's Central Valley. This article analyzes the regulation of "deep ripping" in vernal pools under \$404 of the Clean Water Act.

### **Regulatory Issues for Implimenting Living Shorelines** By Jennifer E.D. O'Donnell

**19** The benefits of living shorelines over traditional manmade structures have been well known for decades, however, there still exists obstacles to its widespread use. Regulatory reform, better coordination among regulatory agencies, and improved perception can help remove barriers to living shorelines.

CONSERVATION

Do You Know Your Place? 24 Maka'ala Ka'aumoana

BRIEFS

#### In the Agencies

**26** *EPA* recently released the 2010 National Coastal Condition Assessment.

### In the Courts

**26** Circuit court dismissed recreational fishing groups' lawsuit against NMFS for failing to manage stocks of river herring and shad.

### In the News

**27** Recent study using a new prediction model indicated that up to four-fifth of world's wetlands at risk due to sea-level rise.

Background image: Strolling Fox at Edwin B. Forsyth National Wildlife Refuge. 2015 U.S. Ramsar Wetland Photo Contest. Photo credit: Kelly Hunt

## CONTRIBUTORS

**Greg DeYoung** serves as vice president for mitigation and conservation bank establishment in Westervelt Ecological Service's Western, Rocky Mountain, and Southeastern regions. His experience encompasses diverse wetland and upland projects contributing to the recovery of threatened species, including vernal pool invertebrates, the giant garter snake, the California red-legged frog, and the Central Valley steelhead and Chinook salmon. He holds a nM.S. in Planning from CSU Pomona and a B.S. in Environmental Biology. gdeyoung@westerveltecologicalservices.com

**B. Demar Hooper** is an environmental analyst-turned-attorney who has been practicing wetland law in California since 1985. He works exclusively with clients in the government-regulated community on environmental land use issues. In addition to working with Clean Water Act §404, he has expertise with the Federal Endangered Species Act, the National Environmental Policy Act, and the California Environmental Quality Act. demar@bdhooperlaw.com

**B.** Seth Johnson is a graduate of Cumberland School of Law and is currently pursuing an LL.M. in Environmental Law from the George Washington University Law School. He is admitted to the State Bar of Alabama and the District of Columbia Bar. He has been a regulatory attorney with the U.S. Army Corps of Engineers (the Corps), Jacksonville District, since 2010. Prior to joining the Corps, Mr. Johnson clerked with the U.S. Environmental Protection Agency, the Corps, and the Baldwin County Commission. sethjohnson80@gmail.com

Maka'ala Ka'aumoana is the director of the Hanalei Watershed Hui, a community-based, nonprofit focused on community stewardship of natural and cultural resources. She led efforts to implement the Hanalei American Heritage River Program, the Hanalei Watershed Action Plan, the Makai (Ocean) Watch program, and other local programs. She also produces the annual Hanalei Moon and Tide Calendar. She was the Wetlands Community Leader awardee at the 2015 National Wetlands Awards. kaaumoana@gmail.com **Steve Moore** serves as finance manager for Westervelt Ecological Services. He has over 30 years of experience in various aspects of financial and operational management. In his role, he is responsible for all aspects of business planning and financial reporting for Westervelt's mitigation and conservation banks, turnkeys, and service contracts for the Western, Southeastern, and Rocky Mountain regions. He holds an M.B.A. from the University of Michigan and a B.S. in Management from Renesselaer Polytechnic Institute. smoore@westerveltecologicalservices.com

Jennifer E.D. O'Donnell is a principal engineer with Coastal Ocean Analytics, a coastal engineering and applied science firm focused on coastal, estuarine, and ocean environments. She is also an associate research professor in the Department of Marine Sciences, University of Connecticut, and an affiliated faculty member of the Connecticut Institute for Resilience and Climate Adaptation. Her areas of expertise are coastal processes, shoreline protection, and the design and implementation of sustainable solutions to problems in coastal and nearshore environments. She has a Ph.D. in Engineering from Cambridge University, an M.S. of Civil Engineering in Coastal Engineering from the University of Delaware, and a B.S.E. in Civil Engineering from Duke University. jodonnell@coastaloa.com

Jenny Thomas is an economist with the U.S. Environmental Protection Agency's Wetlands Division in Washington, D.C. Her work focuses on environmental benefits analysis as well as the financial and policy issues involved in mitigation banking and inlieu fee mitigation. She has an M.S. in Applied Economics from Johns Hopkins University, a graduate certificate in Environmental Management from Johns Hopkins, and a B.A. in Economics from the University of Michigan. thomas.jenny@epa.gov



# The Expanding Regulation of Central Valley Farmers by the Sacramento Corps District

In the years following Borden Ranch Partnership v. U.S. Army Corps of Engineers, regulation of certain farming activities in jurisdictional wetlands has become unclear for farmers in California's Central Valley. This article analyzes the regulation of "deep ripping" in vernal pools under §404 of the Clean Water Act.

### By B. Demar Hooper

■ ifteen years ago, California farmers were forced to acknowledge that the 2001 Borden Ranch Partnership v. U.S. Army Corps of Engineers<sup>1</sup> case required Clean Water Act (CWA) §404 compliance when deep ripping occurred in "jurisdictional wetlands."<sup>2</sup> In practice, agricultural activities that did not involve deep ripping remained exempt from §404 as "normal farming activities." In recent years, however, the U.S. Army Corps of Engineers (the Corps) and the U.S. Environmental Protection Agency (EPA) in California have increasingly moved toward greater regulation of any plowing (discing, chiseling, harrowing, etc.) in regulated wetlands. For farmers, this increased regulation has led to expensive and time-consuming Corps investigations with the potential of fines and enforcement actions hanging over farmers' heads. This article explores the regulatory authority being cited for the agencies' position, and the implications for agricultural practices.

Although agency regulations and most of the cases cited herein apply throughout the country, the California focus is attributable to the geologic and soil properties of "vernal pools," an unusual wetland type found along the edges of the California Central Valley, the roughly 400-milelong feature running from Redding to Bakersfield, and the source of most of California's agricultural bounty. According to the EPA website:

Vernal pools are seasonal depressional wetlands that occur under the Mediterranean climate conditions of the West Coast and in glaciated areas of northeastern and midwestern states. They are covered by shallow water for variable periods from winter to spring, but may be completely dry for most of the summer and fall.<sup>3</sup>

Farm properties throughout California's Central Valley, including those with vernal pools, are routinely plowed or disced to prepare for planting, to aerate, to minimize erosion, for firebreaks, and for numerous other agricultural reasons. For decades since the 1972 passage of the CWA, plowing at existing farms has been considered exempt as "normal farming." The recent trend to require §404 permit authorization for plowing is therefore of great concern to farmers.

### WHAT IS HAPPENING AT THE SACRAMENTO CORPS DISTRICT?

The Corps' Sacramento District territory includes the Central Valley of California, most of Nevada, Utah, and western Colorado. The U.S. Court of Appeals for the Ninth Circuit, whose jurisdiction includes California, held in Borden Ranch that when deep ripping destroys underlying impervious soil or rock layers that create surface wetland conditions, CWA §404 requires Corps authorization.<sup>4</sup> At Borden Ranch, the ripping was done with "four- to sevenfoot long metal prongs . . . dragged through the soil." The opinion specifically noted that, "The ripper gouges through the restrictive layer," and that "activities that destroy the ecology of a wetland are not immune from the Clean Water Act merely because they do not involve the introduction of material brought in from somewhere else." The court agreed with the Corps' allegation that the Plaintiff "has essentially poked a hole in the bottom of protected wetlands . . . by ripping up the bottom layer of soil," so that "the water that was trapped can now drain out." The decision said nothing, however, about less-intrusive agricultural operations in which soil penetration is substantially less than four feet.

In *Borden Ranch*, the deep ripping was apparently the first such land alteration. Both the Corps and EPA, however, have initiated enforcement—administrative and civil litigation—where the farmer defendants claimed that the land had been previously ripped, sometimes for decades. In an Environmental Appeals Board (EAB) administrative decision,<sup>5</sup> the EAB held that "over twenty acres of wetlands persisted on Respondent's farm fields at the time of his deep ripping, despite the fact that the prior landowner had deep ripped the wetlands previously." In another case, EPA sued a farming company for deep ripping land despite numerous deep ripping episodes having occurred from the 1950s into the 1980s.6 The agencies appear perfectly comfortable



rization. Finally, the letters contain a list of requested information about the activity and an admonition to provide that information "within 30 days of the date of this letter," and that the information "may be provided in any enforcement that results action from this investigation . . . ." Unfortunately, the letter-of-inquiry approach is not tied to any Corps procedural requirements. Once the farmer provides that information, there is no clear date

without §404 autho-

Image 1: Aerial photo of the Sacramento Valley showing inundated farmland after a storm, January 2005. Photo Credit: B. Demar Hooper.

with the paradoxical concept that sometimes deep ripping destroys wetlands, and sometimes it does not.

Despite these extensions of the Borden Ranch decision to properties having already been deep ripped, the Corps has generally continued to treat plowing and discing as exempt from §404 when they were part of an "established farming operation." That traditional position appears to be eroding in the Sacramento District Corps office. Citing regulatory ambiguity about what constitutes an "established" farming operation, the Sacramento District Corps office claims that reliance on the exemption requires essentially uninterrupted farming. In the District's interpretation, failure to plow annually means that farming is no longer "ongoing," and therefore bars reliance on the "farming exemption." Such simple plowing and discing across wetlands is therefore subject to \$404 authority. Based on its conclusion, any soil-disrupting activity in jurisdictional wetlands results in a discharge and, without §404 authorization, is prohibited by the CWA.

Over a dozen examples have occurred up and down the Central Valley. In some cases, they are formal enforcement actions initiated with Corps "cease and desist" letters. In many other cases, the Corps procedure is novel, involving "letters of inquiry" generally explaining that the Corps has received a report of unauthorized activity, and requesting information regarding that activity. The letters explain that the Corps "has opened an investigation" to determine whether the activity should be regulated and occurred for Corps resolution of the matter, so it can stay unsettled for years. In the meantime, ongoing farming activities such as crop financing and property transactions are seriously constrained. The Corps has even notified potential buyers that an investigation is underway. The only time limit on the process is the five-year statute of limitations for initiating §404 enforcement litigation.

The implications for California farmers are daunting. Farmers face a perilous choice between expense and delay to secure permits, or Corps enforcement proceedings, with attendant penalties, if they choose to plow without first consulting the Corps. Is the Sacramento District Corps office merely applying a reasonable interpretation to the regulations? Or is it abusing its discretion by regulating beyond the scope of its authority?

### WHAT DO THE REGULATIONS SAY?

The Corps' policy on "farming exemption" is set out in regulation under the title "Discharges not requiring permits."<sup>7</sup> The first category of activities "not prohibited by or otherwise subject to regulation under section 404" is "Normal farming, silviculture and ranching activities," which include "plowing, seeding, cultivating, minor drainage, and harvesting for the production of food, fiber, and forest products, or upland soil and water conservation practices . . ." On its face, this provision declares that CWA §404 does not apply to normal farming activities, including plowing.

The regulations clarify that this exempt category only applies to "established (i.e., on-going) farming."8 Although the regulation does not specifically define "established,", it does define when an operation is no longer established: "An operation ceases to be established when the area on which it was conducted has been converted to another use or has lain idle so long that modifications to the hydrological regime are necessary [emphasis added] to resume operations." This implies that farmers do not need to plow their property annually to keep the exemption. Factors such as drought, unfavorable market prices, simple crop rotation or periodically leaving fields fallow are part of normal farming. Once farming has begun at a property, the exemption applies unless the interruption of farming lasts so long that no further agricultural activity can occur without modifying the hydrological regime.

That clarification leads to the question: What constitutes a modification to the hydrological regime? Fortunately, the agencies have already spoken on this issue. The Corps and

EPA issued a memorandum on May 3, 1990, regarding "Clean Water Act Regulatory Program and Agricultural Activities."<sup>9</sup> It includes an extensive analysis and discussion of "normal farming." The memorandum explains that hydrological modifications are "modifications to the surface or groundwater flow."

The solution to this quandary

therefore comes down to whether plowing or discing modifies surface or groundwater flow. Many farming activities *do* modify surface or groundwater flow. For example, land grading or planing changes elevation contours to reroute surface flows. Farmers often create "V-ditches" in their fields to direct drainage, thereby modifying flows. As discussed above, federal case law has established that deep ripping can break underground hydrologic barriers, modifying groundwater flow from lateral to vertical.

Simple plowing and discing, however, are not designed to have any of the above results. They make micro-topographic changes by lofting soil in place with de minimus effect on surface flows, either flow direction or flow quantity. This is because vernal pool wetlands in California agricultural fields are depressional and frequently located on essentially flat topography where they temporarily detain rainfall. As a result, most of these wetlands have minimal or no discernable flow. Similarly, surface plowing is not deep enough to disrupt underlying restrictive soils such as "hardpan" or "claypan," and therefore has no effect on groundwater flow. Applying the Corps' own regulations and memoranda, plowing and discing do not result in hydrological modifications, and thus do not trigger the farming exemption's "established operation" clause when they occur after periods of non-use. The 1990 memorandum supports this conclusion, noting that, "the resumption of agricultural production in areas laying fallow as part of a normal rotational cycle are considered to be part of an established operation and would be exempted under \$404(f)."

The most that the Sacramento Corps may reasonably argue is that plowing on wetlands that have never before been plowed or farmed does not qualify for the farming exemption. As the EPA website explains, "Activities that bring a wetland into farming production where the wetland has not previously been used for farming [emphasis added] . . . require a permit."<sup>10</sup> That is a difficult case to make in most parts of California. Before the arrival of European settlers, California grasslands were dominated by native perennial bunchgrass. Historic farming after

1848 statehood (plowing and planting grain crops) eliminated bunchgrass and replaced it with Mediterranean annual plants, such as Italian ryegrass and oats. In the late 1800s, wheat dominated California farmland and was grown throughout the state, but particularly in the Central Valley.<sup>11</sup> Put another way, sites that are not dominated by native

bunchgrass were almost certainly historically farmed. If simple plowing would now allow the reestablishment of agricultural production, that activity appears to fall squarely under the farming exemption.

It's difficult to see any defensible reason for the Sacramento District Corps to initiate \$404 enforcement actions for plowing in wetlands that have been previously farmed. The Sacramento District may be the only Corps district in the nation that has adopted this approach, but, nonetheless, is holding firmly to its interpretation despite the lack of clear regulatory authority, and without regard to its own historic approach of treating plowing in wetlands as exempt. There are certainly no new regulations relevant to normal farming that would lend support for these recent investigations and enforcement actions.

An additional area of concern for California farmers involves Corps regulation of new uses of former ricegrowing land. Some of the Sacramento District's "investigation" letters have been sent to owners of former rice land. Rice land must be relatively flat, and able to hold

"An additional area of concern for California farmers involves Corps regulation of new uses of former rice-growing land." irrigation water throughout the six-month growing season. Water demand depends on soil permeability, varying from site to site. In the Sacramento Corps' view, if underlying soils are sufficiently tight to allow rice growing, the site must be wetland. Conversions of rice land to orchard, where deep ripping is required, are particularly suspect to the Corps. Thus, the absence of scientifically described "hydric" soils on former rice land has not stopped such Corps investigations.

California farmers are hopeful that Corps Headquarters will step in to resolve this issue. Farmers and farm advocacy groups throughout the nation meanwhile are watching nervously in fear that this approach will spread to other Corps districts. So far, despite apparent Sacramento District innovations, Corps Headquarters has indicated it will not step in until a site-specific matter has worked through the District and the South Pacific Division levels. Until then, Headquarters intends to give its Districts broad discretion. In the meantime, California wetland consultants and practitioners should evaluate proposed agricultural land use conversions carefully, particularly if deep ripping is required. Evidence of past ripping will not protect farmers from Corps or EPA enforcement if those agencies believe that jurisdictional wetland still remains.

More invidious is the potential for enforcement for simple discing, even when U.S. Department of Agriculture (USDA) offices have identified crop allocations on the property. Risk seems highest for previously delineated property. Even when delineations are decades old and have expired, or were performed without the benefit of analysis from recent U.S. Supreme Court decisions such as *Rapanos v. United States*<sup>12</sup> or even *Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers*,<sup>13</sup> the Corps is likely to use those old delineations as baseline wetland information. Where cropping has been interrupted for whatever reason, the Corps is more likely to consider that farming is no longer "ongoing," and thus activities may not rely on the farming exemptions.

Prudent measures in those situations involve preparing what amounts to a private "administrative record," documenting the extent and continuity of farming practices and carefully analyzing whether any remaining wetland features meet the *Rapanos* "significant nexus" test. In normal cases, property due diligence for agricultural land focuses on soil productivity and, where appropriate, suggestions for reducing drainage or tight soils to increase crop production. Such recommendations rely on USDA resources and site chemical testing. As important as these factors may be, the regulatory oversight of the Corps and EPA are now additional factors to be considered before consummating a sale.

### CONCLUSION

While the issues discussed above appear to be limited to California (at least for now), the Corps and EPA have, at a national level, issued additional-and sometimes inconsistent—regulatory guidance addressing ripping and related agricultural land manipulation. In attempting to regulate non-ripping soil manipulation, a joint agency memorandum listing exempt agricultural activities was published in 2014 in connection with the new "waters of the United States" (WOTUS) rule.<sup>14</sup> It listed plowing as exempt, but noted that the exemption did not extend to deep ripping or to chiseling. Chiseling only occurs to depths of from one to two feet, but was grouped with deep ripping as not eligible for exemption. Subsequent federal court actions have stayed the effect of the WOTUS rule,15 and so, for now, that expansion of *Borden Ranch* lacks regulatory authority. It does indicate, however, the direction that the Corps and EPA prefer to take.

The agencies have not always pursued the regulatory expansion described above. In contrast to that direction, a 1996 Corps memorandum regarding CWA exemptions for deep ripping activities in wetland described circumstances:

. . . where activities such as deep-ripping and related activities are a standard practice of an established on-going farming operation. For example, in parts of the Southeast, where there are deep soils having a high clay content, mechanized farming practices can lead to the compaction of the soil below the soil surface. It may be necessary to break up, on a regular although not annual basis, these restrictive layers. . . . Such activities. . . can sometimes occur to depths greater than 16 inches.<sup>16</sup>

The guidance essentially found deep ripping exempt for a geographic segment of the United States (the Southeast), rather than simply identifying criteria by which this guidance could be applied to any American location. Central Valley farmers would be pleased to explain the similarities of their soils with those in the Southeast, but the Corps and EPA remain convinced that Central Valley soils underlain by clay do not qualify for exemption regardless of how often they have been previously deep ripped. Farmers throughout the country will be watching this California issue develop. If the Sacramento District approach is endorsed by Corps Headquarters, watch for its extension into a field near you.

Endnotes on page 24

Thomas, continued from page 10

#### Endnotes

- 1. Federal Water Pollution Control Act, 33 U.S.C. §§1251 et seq. (1972).
- 2. 33 U.S.C. §1344 (1972).
- 3. Compensatory Mitigation for Losses of Aquatic Resources, 33 C.F.R. §332.4(c) (11) (2008).
- 4. 33 C.F.R. §332.7(d)(1)-(3) (2008).
- 5. Regulatory In-lieu Fee and Bank Information Tracking System (RIBITS), U.S. ARMY CORPS OF ENGINEERS, *at* https://ribits.usace.army.mil.
- 6. Forrest Vanderbilt et al., *The Mitigation Rule Retrospective: A Review of the 2008 Regulations Governing Compensatory Mitigation for Losses of Aquatic Resources*, U.S. ARMY CORPS OF ENGINEERS INSTITUTE OF WATER RESOURCES (2015), *available at* http://www.iwr.usace.army.mil/Portals/70/docs/iwrreports/2015-R-03.pdf.
- 7. *Id.* 8. Sherry Teresa, *The Demise of the Environmental Trust*, ECOSYSTEM MARKETPLACE (2015), *available at* https://www.eli.org/sites/default/files/docs/events/6.3.13%20
- ILF%20Webinar/The\_Demise\_of\_The\_Environmental\_Trust.pdf.
- 9. Westervelt Ecological Services, LLC. Bank Enabling Instrument Grasslands Mitigation Bank (2015).
- 10. Public Notices: *Updated BEI and CE Templates*, U.S. ARMY CORP OF ENGINEERS (Oct. 2015), *available at* http://www.spd.usace.army.mil/Missions/Regulatory/ PublicNoticesandReferences/tabid/10390/Article/620773/updated-bei-and-ce-templates.aspx.

11. Personal Communication with Greg DeYoung, Vice President of Westervelt Ecological Services, LLC, (Nov. 10, 2015).

Hooper, continued from page 18

#### Endnotes

1. Borden Ranch Partnership v. U.S. Army Corps of Engineers, 261 F.3d 810 (9th Cir. 2001).

- 2. Federal Water Pollution Control Act, 33 U.S.C. §§1251 et seq. (1972).
- 3. Vernal Pools, U.S. Environmental Protection Agency (Nov. 17, 2015), at
- http://www.epa.gov/wetlands/vernal-pools. 4. *Borden Ranch Partnership*, 261 F.3d 810 (9th Cir. 2001), *aff'd by an equally divided Court*, 537 U.S. 99 (2002) (mem.).
- 5. In re Veldhuis, 11 E.A.D. 194 (EAB 2003), available at http://yosemite.epa.gov/ oa/EAB\_Web\_Docket.nsf/Decision-Date/43F22ED645DDB5D585257069005F7 D99/\$File/veldhuis.pdf.
- 6. United States v. Anchordoguy, et al., 2:13-cv-00848 (E.D. Cal. Nov. 7, 2014). 7. 33 C.F.R. §323.4.
- 8. 33 C.F.R. §323.4(a)(1)(ii).
- 9. Memorandum from the U.S. Environmental Protection Agency and U.S. Army Corps of Engineers to the field on "Clean Water Act Section 404 regulatory Program and Agricultural Activities" (May 3, 1990), *available at* http://www.usace.army.mil/ Portals/2/docs/civilworks/mous/cwaag.pdf.
- 10. *Exemptions to Permit Requirements*, U.S. ENVIRONMENTAL PROTECTION AGENCY, *at* http://www.epa.gov/cwa-404/exemptions-permit-requirements.
- 11. Alan L. Olmstead & Paul W. Rhode, *The Evolution of California Agriculture:* 1850-2000, in California Agriculture: Dimensions and Issues 1-28 (Jerome B. Siebert ed., 2004).
- 12. Rapanos v. United States, 547 U.S. 715 (2006).
- 13. Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers, 531 U.S. 159 (2001).
- 14. 79 Fed. Reg. 22276 (Apr. 21, 2014).
- 15. U.S. Court of Appeals for the Sixth Circuit, In re: ENVIRONMENTAL PRO-TECTION AGENCY AND DEPARTMENT OF DEFENSE FINAL RULE; "CLEAN WATER RULE: DEFINITION OF WATERS OF THE UNITED STATES," 80 FED. REG. 37054 (JUNE 29, 2015), October 9, 2015.
- 16. Memorandum from the U.S. Army Corps of Engineers to the field on "Applicability of Exemptions Under Section 404(f) to 'Deep-Ripping' Activities in Wetlands" (Dec. 12, 1996), *available at* http://www.usace.army.mil/Portals/2/docs/civilworks/ RGLS/rgl96-02.pdf.

#### O'Donnell, continued from page 22

- Douglass, S.L. & Pickel, B.H. 1999. Tide Doesn't Go Out Anymore—The Effect of Bulkheads on Urban Bay Shorelines. *Shore & Beach* 67(2-3):19-25.
- Dugan, J.E. et al. 2008. Ecological effects of coastal armoring on sandy beaches. *Marine Ecology* 29:160-70.
- Duhring, K.A. 2006. Overview of Living Shoreline Design Options for Erosion Protection on Tidal Shorelines, *in* Management, Policy, Science, and Engineering of Nonstructural Erosion Control in the Chesapeake Bay: Proceedings of the 2006 Living Shoreline Summit, Coastal Resources Commission Publication No. 08-164, pp. 13-18.
- Feagin, R.A. et al. 2009. Does vegetation prevent wave erosion of salt marsh edges? Proceedings of the National Academy of Sciences 106(25):10109-13.
- Gedan, K.B. et al. 2011, The Present and Future Role of Coastal Wetland Vegetation in Protecting Shorelines: Answering Recent Challenges to the Paradigm. *Climatic Change* 106:7-29.
- Guannel, G. et al. 2015. Integrated modeling framework to quantify the coastal protection services supplied by vegetation, *Journal of Geophysical Research: Oceans* 120:324-45.
- Hardaway, C.S., Jr. et al. 2010. Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments. Virginia Institute of Marine Science, College of William and Mary, 112 pp.
- National Research Council (NRC), Board on Natural Disasters. 1999. Mitigation emerges as major strategy for reducing losses caused by natural disasters. *Science* 284:1943-47.
- National Research Council (NRC), 2007. Mitigating Shore Erosion Along Sheltered Coasts. The National Academies Press, Washington, D.C. 208 pp.
- National Research Council (NRC), 2014. Reducing coastal risk on the East and Gulf Coasts. The National Academies Press, Washington, D.C. 208 pp.
- O'Donnell, J.E.D. (2016). Living Shorelines: A Review of Literature Relevant to New England Coasts. Journal of Coastal Research, (in press).
- Pinsky, M. L. et al. 2013. Quantifying wave attenuation to inform coastal habitat conservation. *Ecosphere* 4(8):95.
- Ray-Culp, M., 2007. A Living Shoreline Initiative for the Florida Panhandle: Taking a Softer Approach. *National Wetlands Newsletter* 29(6):9-11, 19.
- Rhode Island's Coastal Resources Management Council Shoreline Change Special Area Managment, *at* http://www.beachsamp.org.
- Roberts, S. 2008. The National Academies Report on Mitigating Shore Erosion Along Sheltered Coasts, *in* Management, Policy, Science, and Engineering of Nonstructural Erosion Control in the Chesapeake Bay: Proceedings of the 2006 Living Shoreline Summit. Coastal Resources Commission Publication No. 08-164, pp. 3-6.
- Scyphers, S.B. et al. 2011. Oyster Reefs as Natural Breakwaters Mitigate Shoreline Loss and Facilitate Fisheries. *PLoS ONE* 6(8):e22396.
- Seitz, R. et al. 2006. Influence of shallow-water habitats and shoreline development on abundance, biomass, and diversity of benthic prey and predators in Chesapeake Bay. *Marine Ecology Progress Series* 326:11-27.
- Shepard, C.C. et al. 2011. The Protective Role of Coastal Marshes: A Systematic Review and Meta-analysis. *PLoS ONE* 6(11):e27374.
- Sutton-Grier, A.E. et al. 2015. Future of our coasts: The potential for natural and hybrid infrastructure to enhance the resilience of our coastal communities, economies and ecosystems. *Environmental Science & Policy* 51:137-48.
- Thomas-Blate, J.C. 2010. Living Shorelines: Impact of Erosion Control Strategies on Coastal Habitats. Atlantic State Marine Fisheries Commission, *available at* http://www.asmfc.org/uploads/file/hms10LivingShorelines.pdf.
- U.S. Army Corps of Engineers (USACE). 2002. Issuance of Nationwide Permits; Notice. Federal Register, Vol 67, No. 10, pp. 2020-80.
- U.S. Army Corps of Engineers (USACE). 2015. North Atlantic Coast Comprehensive Study: Resilient Adaptation to Increasing Risk, Main Report. Brooklyn, New York, 116 pp., *available at* http://www.nad.usace.army.mil/Portals/40/ docs/NACCS/NACCS\_main\_report.pdf.
- U.S. Army Corps of Engineers (USACE). 2012. Regional Sediment Management Program (RSM), *at* http://rsm.usace.army.mil.
- U.S. Environmental Protection Agency (EPA). 2015. National Estuary Program (NEP), *at* http://water.epa.gov/type/oceb/nep/index.cfm.