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Coastal Adaptation Policy Brief

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Riprap

Introduction

Riprap is a type of shoreline armoring structure that consists of stacks of large boulders and smaller rock fill, designed to mitigate wave impact and prevent erosion. These structures are often placed parallel to the shoreline in front of a cliff or along a beach to prevent further erosive events and wave overtopping during large storms. Because of its design, riprap requires the most space of all the armoring strategies and, therefore, leads to the largest placement loss.[1]

Riprap is the most common armoring strategy on California's coastline.[2] Its popularity stems from the fact that riprap requires less engineering expertise to design and construct than seawalls or revetments.[3] To successfully deflect wave impacts and protect coastal development, riprap must be built with heavy enough rocks to remain stable, tall enough to withstand overtopping, wider than it is tall by a 2:1 ratio, and constructed in such a way that wave scour will not remove the sand beneath it.[4]

Riprap could be a suitable engineered protection strategy in an area where the coastline near critical assets is eroding from wave energy. Riprap is a particularly popular strategy in emergency situations. The availability of rock, space for construction, and planning and engineering resources are all relevant considerations for riprap placement.[5]

Tradeoffs

Riprap protects a very localized region in the short term. For private property owners and public entities, adequately-constructed riprap can protect structures from storm surge and flooding impacts. For local governments, permitting riprap (or other protective structures) may ensure that the property tax revenue generated by some of that community's highest value properties is sustained. Regardless of these positive attributes, longer-term effects of any coastal armoring project should be analyzed.

The construction and maintenance costs and comparisons with similar protective structures is another consideration. Riprap tends to cost between $1,200 and $4,000 per foot to construct, based on the characteristics listed above.[6] Additionally, maintenance costs per year can range from 2-15% of the initial cost per foot.[7] These figures reflect two realities. First, riprap is often susceptible to wave scouring and, during extreme storm events, rock dislodgement which requires replacement. Some of these concerns can be alleviated by the construction of a more durable protection structure, such as a revetment—a carefully engineered shoreline protection structure similar to riprap that utilizes a durable filter cloth or cemented base—instead.[8] Second, much of the riprap that protects the California coast was not adequately constructed because it was placed during an emergency.[9] Because homeowners can quickly place riprap, it is frequently chosen when a large storm event or storm season is anticipated. In these scenarios, project specification recommendations and design principles are often not adequately considered.[10]

1 Gary Griggs et al., Living with the Changing California Coast 112 (Gary Griggs et al. eds., 2005).

2 *Id.* ("Riprap protects more of California's coastal property (roughly 65 miles) than any other type of armor.").

3 *Id.* at 114 (explaining that "a revetment is a more carefully engineered and constructed rock structure" than riprap).

4 *Id.* at 113.

5 *Id.*

6 *Id.* at 112.

7 Rebecca Stamski, The Impacts of Coastal Protection Structures in California's Monterey Bay National Marine Sanctuary 11-13 (2005), *available at* http://aquaticcommons.org/2325/1/stamski.pdf.

8 Megan M. Herzog & Sean B. Hecht, *Combatting Sea Level Rise in Southern California: How Local Governments Can Seize Adaptation Opportunities While Minimizing Legal Risk*, 19 Hastings W.-Nw. J. Envtl. L. & Pol'y 463, 472 n.41 (2013).

9 Griggs et al., *supra* note 1, at 150 ("A significant amount of permit activity for shoreline structures occurs under emergency or extreme winter conditions. Studies . . . illustrate how most of the new and extended riprap on beaches was placed during two significant storm events: the El Niño years of 1978-79 and 1982-83.").

10 *Id.*

Often, hastily deployed riprap can cause geophysical and ecological problems. Like all armoring, patchwork placement leads to the "peninsula effect"—in which an armored area stays protected while either side erodes away.[11] These erosive events might then prompt neighboring property owners to protect their own property, perpetuating a cycle of armoring that has occurred on the California coast in recent decades. This escalation negatively affects ecological processes in the area. For instance, sessile (non-mobile, rock-clinging) tidal species depend upon the porosity, dampness, and heat content of the substrates on which they settle. Likewise, introducing non-native rocks to an area can negatively impact these coastal population dynamics.[12]

Riprap protective structure projects in California have focused limited attention on design and project impact mitigation techniques.[13] This hastiness is partly a result of the time constraints of a real emergency. It is also representative of reactive rather than proactive community planning—waiting until a threat is imminent to act to protect an area.[14]

Legal Considerations

Constructing a protective riprap structure requires a coastal development permit (CDP), except in the limited circumstances where an emergency necessitates protection in the face of a disaster.[15] The California Coastal Commission (CCC) retains jurisdiction over most areas where riprap would be feasible and suitable.[16] Accordingly, an applicant would need to seek a CDP directly from the Commission.[17]

The Coastal Act allows construction of shoreline protection structures like riprap for existing structures, while requiring that new development be built in such a way so as not to require protective structures.[18] The Coastal Act further mandates that riprap is only allowed when mitigation measures ensure that it is the least environmentally-damaging, feasible alternative.[19] This requirement allows the CCC the breadth to include that certain conditions be met in exchange for a CDP to construct a protective structure. These conditions have included materials and discharge construction plans, sensitive habitat mitigation, and temporal expirations of permits to reconsider their effects at a later date, amongst others.[20]

Legal battles sometimes challenge the unpermitted riprap, usually placed by private property owners without consultation with the CCC or a local government.[21] Unpermitted structures can be particularly problematic for local governments, because they are difficult and costly to remove, and because they can cause public access and aesthetic issues.[22]

11 Molly Loughney Melius & Margaret R. Caldwell, 2015 California Coastal Armoring Report: Managing Coastal Armoring and Climate Change Adaptation in the 21st Century 9 (2015).

12 Stamski, *supra* note 7, at 11-12.

13 Jesse Reiblich & Eric H. Hartge, *The Forty-Year-Old Statute: Unintended Consequences of the Coastal Act and How They Might Be Redressed*, 36 Stan. Envtl. L.J. 63, 81 (2016).

14 *Id.* at 81-83.

15 Cal. Pub. Res. Code § 30600(a)-(e).

16 Cal. Pub. Res. Code § 30601.

17 Cal. Pub. Res. Code § 30601.

18 Cal. Pub. Res. Code § 30235; Cal. Pub. Res. Code § 30253(b). There has been debate over what "existing" in the Coast Act means, however. Cal. Coastal Comm'n, Sea Level Rise Policy Guidance 165 (2015) ("Read together, the most reasonable and straight-forward interpretation of Coastal Act Sections 30235 and 30253 is that they evince a broad legislative intent to allow shoreline protection for development that was in existence when the Coastal Act was passed, but avoid such protective structures for new development now subject to the Act."); *see also generally* Todd T. Cardiff, *Conflict in the California Coastal Act: Sand and Seawalls,* 38 Cal. W. L. Rev. 255 (2001).

19 Cal. Pub. Res. Code § 30235. This requirement is also in line with the California Environmental Quality Act's provisions requiring feasible mitigation measures to be incorporated into all state-permitted construction activities to substantially lessen the adverse effects said project would have on the environment. Cal. Pub. Res. Code §§ 21000-06.

20 *See, e.g.*, California Coastal Commission, Summary of Staff Recommendation Application Number 5-06-160 (2006), *available at* https://documents.coastal.ca.gov/reports/2006/11/Th15c-11-2006.pdf.

21 *See* Cal. Coastal Comm'n Coastal Staff Report TH 11A, Development Permit Application No. 2-02-028 (Half Moon Bay Golf Links Seawall) (2005), *available at* https://documents.coastal.ca.gov/reports/2005/7/Th11a-7-2005.pdf; Barry Parr, *Half Moon Bay Golf Course to Remove Controversial Seawall*, Coastsider, June 9, 2005, http://coastsider.com/%20site/news/half_moon_bay_golf_course_will_remove_controversial_seawall.

22 Griggs et al., *supra* note 1, at 150.

Examples

Riprap has been used by federal, state, and private parties to protect areas from encroaching seas. The State of California recently constructed 900-feet of riprap to protect an access road and parking lot on Surf Beach at San Onofre State Park. This project is being challenged by the Surfrider Foundation for failing to enact a long-term protection plan, instead focusing on a short-term fix like riprap.[23]

Areas of Santa Cruz are so armored with riprap in front of private homes that it is now difficult to notice the natural features of the coastline.[24] Broad Beach in the City of Malibu features extensive riprap as well, but has caused such high degrees of passive erosion that a beach restoration plan has been needed to mitigate its effects.[25]

Researchers

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23 Mandy Sackett, *Why the Temporary Seawall at San Onofre State Beach Should Not Become Permanent*, Surfrider, https://www.surfrider.org/coastal-blog/entry/why-the-temporary-seawall-at-san-onofre-state-beach-should-not-become-perma (last visited Aug. 17, 2017).

24 Ranger Gaudinski, *The Huge Boulders Along the Santa Cruz Shoreline: A Common Coastal Story*, Mobile Ranger, http://www.mobileranger.com/santacruz/the-huge-boulders-along-the-santa-cruz-shoreline-a-common-coastal-story/ (last visited Aug. 17, 2017).

25 Emily Sawicki, *Broad Beach Residents Sued Over Beach Restoration Project*, The Malibu Times, Apr. 7, 2016, http://www.malibutimes.com/news/article_f4da9d1c-fc24-11e5-a769-3300ec937d2f.html.

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