Economic Impacts Associated with the Critical Habitat Designation for the Black Abalone

Final Economic Analysis Report
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Introduction

The purpose of this report is to identify and analyze the potential economic impacts associated with the designation of critical habitat for the black abalone. The analysis examines the potential impacts of restricting or modifying specific water or land uses or activities to avoid adverse modification or destruction of critical habitat.

The assessment and findings provided in this report inform the analysis of the economic impacts of designating each specific area considered for designation as critical habitat for black abalone. A separate Final Biological Report (NMFS 2011a) was prepared to analyze the biological conservation benefits of designating critical habitat within each specific area. To determine which areas to designate as critical habitat, the economic impacts, impacts to national security, and other relevant impacts of the designation were considered and the biological conservation benefits of designation were weighed against the benefits of exclusion (i.e., the economic, national security, and other relevant impacts that would be avoided if an area were excluded from the designation). This weighing process and analysis was documented in the Final ESA 4(b)(2) report (NMFS 2011b) to support NMFS' final critical habitat designation.

Approach

This analysis examines the state of the world with and without the designation of critical habitat for black abalone. The "without critical habitat" scenario represents the baseline for the analysis, considering habitat protections already afforded black abalone under its Federal listing and under other Federal, State, and local regulations, including protections afforded black abalone from critical habitat designated for other listed species, such as green sturgeon and West Coast salmon and steelhead. The "with critical habitat" scenario attempts to describe the incremental impacts associated specifically with the designation of critical habitat for black abalone. This analysis does provide an overview of costs that may be considered coextensive with the listing of black abalone and other baseline protections. The focus of the analysis, however, is determining the incremental costs, attributable to the critical habitat designation of black abalone.

To quantify the economic impacts of modifications to water and land uses that may result from this critical habitat designation, the analysis employs the following five steps:

- Define the geographic area for the analysis and identify the specific areas to be analyzed for purposes of this designation. The Final Biological Report (NMFS 2011a) that supports the black

abalone critical habitat designation describes how each of these specific areas meets the definition of critical habitat set forth in Section 3 of the Endangered Species Act (ESA).

- Identify activities that may affect black abalone primary constituent elements (PCEs; see NMFS 2011a) and therefore may incur an economic impact because of the black abalone critical habitat designation.
- Estimate the baseline level of protection afforded black abalone by area and activity type.
- For each potentially affected activity, establish the existing and expected level of the activity that may be affected by the black abalone critical habitat designation in each specific area.
- Estimate the potential economic impacts of the black abalone critical habitat designation by economic activity type and sum these impacts by area.

These steps are described in greater detail in Section 1 of this report.

Results

Seventeen categories of activities were identified as being potentially affected by the critical habitat designation for black abalone. Because a large degree of uncertainty exists with regard to future actions likely to be undertaken specifically for the conservation of black abalone and their habitat as a result of the black abalone critical habitat designation, this analysis presents a range of possible impacts. This range is based on low-end and high-end impact scenarios developed for seven activities: in-water construction; sand replenishment; National Pollutant Discharge Elimination System (NPDES) permitted activities; coastal urban development; sediment disposal activities associated with road maintenance, repair, and construction (previously called "side-casting"); agricultural activities (irrigation); and construction and operation of tidal and wave energy projects. These scenarios are discussed further in Section 2 of this report. The remaining activities (also discussed in Section 2 of this report), for which either data limitations precluded a quantitative assessment of economic effects or economic effects were not considered to be incurred as a result of the designation of this critical habitat, include: dredging and disposal of dredged material; agricultural activities (pesticide application and livestock farming); vessel grounding incidents and response; construction and operation of desalination plants; construction and operation of liquefied natural gas terminals; mineral and petroleum exploration and extraction; non-native species introduction prevention and management; kelp harvesting; oil and chemical spills and response; construction and operation of power plants; and activities that lead to global climate change.

The estimated annualized impacts by specific area are presented below in Table ES-1 for both the low-end and high-end scenarios as well as the mean, or midpoint, between the low- and high-end scenarios ("mid"). In the low-end scenario, annualized impacts by specific area varied from $0 to $42,000, with specific area 11 incurring the highest impacts. In the high-end scenario, annualized impacts by specific

area varied from $0 to $1,004,000 with specific area 7 incurring the highest impacts. Specific areas 10 and 8 had the highest number of activity types present (11 and 10 activities, respectively). Specific areas 6, 13, 14, 15, and 18 had the lowest impacts ($0), because the activities identified in these specific areas could only be discussed qualitatively. However, this does not mean that the black abalone critical habitat designation will not have any economic impacts in the specific areas in the future, but that data are not available at this time to quantify the potential economic impacts.

We focused on the potential incremental impacts beyond of the critical habitat designation, beyond the impacts that would result from the listing and jeopardy provision (under section 7 of the ESA) and other baseline protections for black abalone and its habitat. In some instances where it was difficult to exclude potential impacts that may already occur under the baseline, we used our best professional judgment to identify and estimate the incremental impacts of the critical habitat designation.. Appendix C tests the sensitivity of the assumptions in this analysis about the degree to which black abalone critical habitat, as opposed to existing Federal, state, and local regulations and regulations for other ESA-listed species and their critical habitat, drive the costs in particular areas.

As presented below in Table ES-1, the total estimated annualized economic impact for this designation if all specific areas were designated ranged from $169,000 to $4,083,000.[1] As discussed in more detail in the ESA Section 4(b)(2) Report (NMFS 2011b), one specific area (specific area 12, from Corona Del Mar to Dana Point) was excluded, because the benefits of excluding specific area 12 outweighed the benefits of including it in the designation. The total estimated annualized economic impacts for this designation with specific area 12 excluded range from $158,000 to $3,886,000. This cost range represents our estimate of the potential economic impacts based on the best available information regarding the Federal activities that may be affected by this critical habitat designation and the potential range of modifications that may be required to protect critical habitat.

[1] These estimates do not include the impacts to specific area 17 (San Nicolas Island) and specific area 20 (San

Table ES-1: Summary of Annualized Impacts by Specific Area[a/]

Area	Total Annualized Impacts			Activities with only a qualitative analysis (NOT included in the estimated costs)[b/]
	Low	Mid	High	
1	$3,000	$280,000	$556,000	Agricultural pesticide application
2	$15,000	$251,000	$487,000	Agricultural pesticide application and Non-native species introduction and management
3	$0	$222,000	$444,000	Agricultural pesticide application
4	$17,000	$228,000	$439,000	Agricultural pesticide application, Desalination plants, Non-native species introduction and management, and Oil/chemical spills and response
5	$0	$5,000	$10,000	Oil/chemical spills and response
6	$0	$0	$0	
7	$14,000	$509,000	$1,004,000	Agricultural pesticide application, Desalination plants, Kelp harvesting, and Oil/chemical spills and response
8	$9,000	$319,000	$629,000	Agricultural pesticide application, Vessel grounding, Desalination plants, Non-native species introduction and management, Kelp harvesting, and Oil/chemical spills and response
9	$5,000	$92,000	$180,000	Agricultural pesticide application, Desalination plants, Kelp harvesting, and Oil/chemical spills and response
10[c/]	$30,000	$456,000	$882,000	Agricultural pesticide application, Desalination plants, Mineral and petroleum exploration and extraction, Non-native species introduction and management and Kelp harvesting
11	$42,000	$113,000	$183,000	Non-native species introduction and management and Kelp harvesting
12	$12,000	$104,000	$197,000	Agricultural pesticide application, Desalination plants, Kelp harvesting, and Oil/chemical spills and response
13	$0	$0	$0	Kelp harvesting
14	$0	$0	$0	Kelp harvesting
15	$0	$0	$0	Kelp harvesting and Oil/chemical spills and response
16	$0	$18,000	$37,000	Agricultural pesticide application and Kelp harvesting
17	$1,000	$3,000	$6,000	Desalination plants and Kelp harvesting
18	$0	$0	$0	Kelp harvesting
19	$23,000	$98,000	$174,000	Desalination plants,Kelp harvesting, and Oil/chemical spills and response
20	$1,000	$2,000	$3,000	Kelp harvesting
Total[c/, d/]	$170,000	$2,131,000	$4,091,000	Agricultural pesticide application, Vessel grounding, Desalination plants, Mineral and petroleum exploration and extraction, Non-native species introduction and management, and Kelp harvesting

Notes:
a/ Section 2 of this report presents results of the analysis in more detail. Impact estimates are rounded to the nearest

thousand dollars.

b/ Activities that lead to global climate change (e.g., fossil fuel combustion) are also discussed qualitatively in this analysis and are recognized as potential threats to black abalone in all areas (see Section 2.16 of this report).

c/ While the costs attributed to the power plant in Specific Area 10 is the best known estimate, the costs for this activity are the least certain and thus have a lower level of confidence than the other costs found in this analysis.

d/ Totals are adjusted for double-counting of NPDES outfalls and acres of agricultural land that overlap multiple specific areas. See Sections 2.3 and 2.6 of this report for more details.

SECTION 1: FRAMEWORK FOR THE ANALYSIS

1.1 Introduction

The purpose of this report is to identify and analyze the potential economic impacts associated with the designation of critical habitat for the black abalone. The analysis examines the potential impacts of restricting or modifying specific water and land uses to avoid adverse modification or destruction of critical habitat. This chapter presents the framework applied to analyze the economic impacts of the critical habitat designation.

1.2 General Framework for the Economic Analysis

Similar to its analyses of critical habitat designations for West Coast salmon and steelhead, the Southern Distinct Population Segment (DPS) of North American green sturgeon, and the leatherback sea turtle (critical habitat proposed in January 2010), the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) is applying a cost-effectiveness framework to analyze the economic impacts of the designation of critical habitat for black abalone. This framework supports the Endangered Species Act (ESA) section 4(b)(2) decision-making process by allowing NMFS to compare an estimate of the economic "benefits of exclusion" against an indicator of the biological "benefits of designation" for any particular area.[2] For this analysis, the cost-effectiveness framework has been modified, given the general uncertainty about specific management actions likely to be undertaken.[3] This economic analysis addresses the "benefits of exclusion" portion of the weighing process, while the Final Biological Report and the Final ESA section 4(b)(2) Report address and compare our results to the "benefits of designation" for each particular area considered. These other reports also present more detailed information regarding presence of black abalone and identified PCEs in the specific areas considered for critical habitat designation.

Note: Information, where appropriate, was taken from the "Economic Impacts Associated with Potential Critical Habitat Designation for the Leatherback Sea Turtle" (2009), prepared by NMFS; the "Economic Analysis of the Impacts of Designating Critical Habitat for the Threatened Southern Distinct Population Segment of North American Green Sturgeon" (2009), prepared by Industrial Economics, Inc. for NMFS; and the "Final Economic Analysis of Critical Habitat Designation for Seven West Coast Salmon and Steelhead ESUs" (2005), prepared by NMFS.

[2] National Marine Fisheries Service (NMFS). *Final Economic Analysis of Critical Habitat Designation for 12 West Coast Salmon and Steelhead ESUs*. August 2005.

[3] Section 1.2.1 of this report is a reduced form of the framework discussion provided in the West Coast salmon critical habitat analysis by the Northwest Fisheries Science Center.

1.2.1 Benefit-Cost Analysis and Cost-Effectiveness Analysis

When economic activities have biological effects or other consequences for conservation, analyses of the impacts of regulating those activities can take a number of approaches. Two possible approaches are benefit-cost analysis and cost-effectiveness analysis. Each of these approaches has strong scientific support as well as support from the Office of Management and Budget (OMB) through its guidelines on regulatory analysis.[4] Each also has well-known drawbacks, both theoretical and practical, as discussed in the following section within the context of critical habitat designations.

Benefit-cost analysis (BCA) is the first choice for analyzing the consequences of a regulatory action such as a critical habitat designation, given the availability of sufficient information to support using this approach.[5] BCA is a well-established procedure for assessing the "best" course or scale of action, where "best" is that course which maximizes net benefits.[6] Because BCA assesses the value of an activity in net benefit terms, it requires that a single metric, most commonly dollars, be used to gauge both benefits and costs. Although the data and economic models necessary to estimate costs may be difficult or costly to gather and develop, expressing costs in dollars is straightforward for most regulatory actions. This is often the case for critical habitat designations, which have direct impacts on activities carried out, funded, or permitted by the Federal government. However, as discussed below, a large degree of uncertainty exists with regard to the potential economic impacts of the black abalone critical habitat designation. (Conceptually, the "benefits of exclusion," which is the language used in section 4(b)(2) of the ESA, are identical to the "costs of designation," and so estimates of these costs could be used in a benefit-cost framework).

Assessing the benefits of critical habitat designation in a BCA framework is straightforward in principle but much more difficult in practice. To the extent that the critical habitat provisions of the ESA increase the protections afforded the black abalone and their habitat, they produce real benefits to the species. In principle, these benefits can be measured first by a biological metric, and then by a dollar metric. A biological metric could take the form of the expected decrease in extinction risk, increase in the annual population growth rate, and so forth. A BCA would then use this metric to assess the state of the species with and without critical habitat designation. This assessment would reveal the biological impact of the designation, quantified in terms of the metric. However, the available data are insufficient to quantify the

[4] U.S. Office of Management and Budget. "Circular A-4," September 17, 2003, available at http://www.whitehouse.gov/sites/default/files/omb/assets/omb/circulars/a004/a-4.pdf.
[5] Ibid.
[6] Zerbe, R., and D. Dively, 1994. Benefit Cost Analysis in Theory and Practice, New York: HarperCollins.

benefits of designating critical habitat for black abalone, particularly with respect to discrete geographical areas.

Recognizing the difficulty of estimating economic values in cases like this one, OMB has recently acknowledged cost-effectiveness analysis (CEA) as an appropriate alternative to BCA:

> Cost-effectiveness analysis can provide a rigorous way to identify options that achieve the most effective use of the resources available without requiring monetization of all of the relevant benefits or costs. Generally, cost-effectiveness analysis is designed to compare a set of regulatory actions with the same primary outcome (e.g., an increase in the acres of wetlands protected) or multiple outcomes that can be integrated into a single numerical index (e.g., units of health improvement).[7]

Ideally, CEA quantifies both the benefits and costs of a regulatory action but uses different metrics for each. A common application of this method is to health care strategies, where the benefits of a strategy are quantified in terms of lives saved, additional years of survival, or some other quantitative, health-related measure.

In principle, conducting a CEA of critical habitat designation proceeds along the same lines identified above for BCA, except that the last step of assigning economic (dollar) values to biological benefits is not taken. Different configurations of critical habitat could be gauged by both metrics, with the cost-effectiveness (ratio of units of biological benefits to monetized cost) evaluated in each case. If alternatives have the same level of biological benefits, the most cost-effective is the one with the highest ratio of biological benefits to cost (either in the form of monetized costs or some other cost metric or cost ranking).

Standard CEA presumes that benefits and costs can be measured with a cardinal or even continuous measure. For critical habitat designations in general, however, constructing such a measure for biological benefits is problematic. Although protecting habitat for black abalone is likely to have benefits, it is not yet possible to quantify the benefits reliably with a single biological metric given the state of the science. In addition, there is general uncertainty about specific management actions likely to be undertaken on behalf of this species. Thus, applying CEA in its standard form is not possible.

[7] Ibid.

The alternative form of CEA being applied to the black abalone analysis is one that develops an ordinal measure of the benefits of critical habitat designation. Although it is difficult to monetize or quantify the benefits of critical habitat designation, it is possible to differentiate among specific areas based on their estimated relative importance to the conservation of black abalone (e.g., the quality of the habitat and level of support for black abalone recruitment and survival). For example, specific areas can be rated as having a high, medium, or low biological value. The output (a qualitative ordinal ranking) may better reflect the state of the science for the geographic scale considered here than a quantified output, and can be done with the available information.

The specific areas can be assessed using both their biological evaluation and economic impact assessments, so that areas with a high conservation value and lower economic impacts have a higher priority for designation, and areas with a low conservation value and higher economic impacts have a higher priority for exclusion. Again, these analyses are discussed in the Final Biological Report and the Final ESA section 4(b)(2) report for this rule.

By proceeding in order of these priorities (either in terms of designation or exclusion), the critical habitat will minimize, or at least (in practice) reduce, the overall economic cost of achieving any given level of conservation. This form of CEA has two limitations, one of which it shares with the standard form of CEA. First, because CEA does not evaluate benefits and costs in the same metric, the analysis cannot assess whether a given change has benefits that, in monetary terms, are greater than the costs. Although this analysis arrives at estimated economic impacts on a cost per area basis, a large degree of uncertainty exists with regard to these costs. However, because the biological values are classified into high, medium, and low values, the coarseness of the available cost information should suffice to produce an effective tool for weighing costs and benefits. A second limitation of the modified form of CEA is the inability to discern variation in benefits among those areas assigned the same conservation value (i.e., the same ordinal ranking). A likely outcome is that using the modified CEA will lead to an outcome with higher expected costs of achieving any given level of conservation than one produced with standard CEA or BCA. This limitation, however, should be compared to the greater feasibility of the modified CEA.

1.3 Impacts that are the Focus of this Analysis

This analysis examines the state of the world with and without the designation of critical habitat for the black abalone. The "without critical habitat" scenario represents the baseline for the analysis, considering habitat protections already afforded black abalone under its Federal listing and under other Federal, State, and local regulations, including protections afforded black abalone resulting from protections afforded other listed species, such as those for West Coast salmon and steelhead, delta smelt, green sturgeon, and

marine mammals. The "with critical habitat" scenario attempts to describe the incremental impacts associated specifically with the designation of critical habitat for the black abalone.[8] This analysis does provide an overview of costs that may be considered coextensive with the listing of black abalone and other baseline protections. The focus of the analysis, however, is to determine the incremental costs of the critical habitat designation.

The social welfare impacts of critical habitat designation generally reflect "opportunity costs" associated with the commitment of resources required to accomplish species and habitat conservation. For example, if a set of activities that may take place on a parcel of land is limited as a result of the designation or the presence of the species, and thus the market value of that land is reduced, this reduction in value represents one measure of opportunity cost. Similarly, the costs incurred by a Federal action agency to consult with NMFS under section 7 of the ESA represent opportunity costs related to black abalone conservation, as the time and effort associated with those consultations would have been spent on other endeavors absent the listing of the species or critical habitat designation.

At the guidance of OMB and in compliance with Executive Order 12866, "Regulatory Planning and Review," Federal agencies measure changes in economic efficiency in order to understand how society, as a whole, will be affected by a regulatory action. Economists generally characterize opportunity costs in terms of changes in producer and consumer surpluses (i.e., social welfare impacts) in affected markets.[9]

1.3.1 Baseline for the Economic Analysis

The first step in the economic analysis is to identify the baseline level of protection afforded the black abalone and their habitat. This section provides a description of the methodology used to identify baseline conditions and incremental impacts stemming from the designation of critical habitat for the black abalone.

The baseline for this analysis is the existing state of regulation prior to the designation of critical habitat that provides protection to the species' habitat under the ESA and other Federal, State and local laws and regulations. The baseline includes the protections of sections 7 and 9 of the ESA, and economic impacts

[8] We note that in instances where it was difficult to separate the incremental impacts from the baseline impacts, we used our best professional judgment to identify and estimate the incremental impacts of the designation.

[9] For additional information on the definition of "surplus" and an explanation of consumer and producer surplus in the context of regulatory analysis, see: Gramlich, Edward M. *A Guide to Benefit-Cost Analysis (2nd Ed.).* Prospect Heights, Illinois: Waveland Press, Inc., 1990; and U.S. Environmental Protection Agency, "Guidelines for Preparing Economic Analyses," EPA 240-R-00-003, September 2000, available at http://yosemite.epa.gov/ee/epa/eed.nsf/webpages/Guidelines.html.

resulting from these protections to the extent that they are expected to occur absent the designation of critical habitat for the species.

> Section 7 of the ESA, absent critical habitat designation, requires Federal agencies to consult with NMFS to ensure that any action they authorize, fund, or carry out are not likely to jeopardize the continued existence of any endangered or threatened species. The portion of the administrative costs of consultations under the jeopardy standard, along with the impacts of project modifications resulting from consideration of this standard, are considered baseline impacts.
>
> Section 9 of the ESA defines the actions that are prohibited by the Act. In particular, it prohibits the "take" of endangered species, where "take" means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."[10] The economic impacts associated with this section manifest themselves in sections 7 and 10 of the ESA.

The protection of listed species and habitat is not limited to the ESA. Other Federal agencies, as well as State and local governments, may also seek to protect the natural resources under their jurisdiction. If compliance with the Clean Water Act (CWA) or State environmental quality laws, for example, protects habitat for the species, such protective efforts are considered to be baseline protections and costs associated with these efforts are not quantified as impacts of the critical habitat designation. Many of the relevant existing regulations are discussed in Appendix B. As noted above, where uncertainty exists as to whether particular costs would have already occurred under the baseline, we used our best professional judgment to identify the incremental costs of the designation.

1.3.2 Types of Economic Impacts of Critical Habitat Designation

This analysis focuses on the incremental impacts of the critical habitat designation for black abalone. The purpose of the analysis is to determine the impacts on water and land uses from the designation of critical habitat that are above and beyond those impacts due to existing or planned conservation efforts being undertaken due to other Federal, State, and local regulations or guidelines.

When critical habitat is designated, section 7 of the ESA requires Federal agencies to insure that their actions will not result in the destruction or adverse modification of critical habitat (in addition to insuring that their actions are not likely to jeopardize the continued existence of the species). The added

[10] 16 U.S.C. 1532.

administrative costs of including consideration of critical habitat in ESA section 7 consultations and the additional impacts of implementing project modifications to protect critical habitat are the direct result of the designation of critical habitat. These costs are not in the baseline, and are considered incremental impacts of the critical habitat designation.

Incremental impacts may include the direct costs associated with additional effort for future consultations, reinitiated consultations, and new consultations occurring specifically because of the designation, and additional project modifications that would not have been otherwise required to avoid jeopardizing the continued existence of the species. Additionally, incremental impacts may include indirect impacts resulting from reaction to the potential designation of critical habitat, triggering of additional requirements under State or local laws intended to protect sensitive habitat, and uncertainty and perceptional effects on markets. The nature of these impacts is described in greater detail below.

Direct Impacts

The direct incremental impacts of a critical habitat designation stem from the consideration (under an ESA section 7 consultation) of the potential for destruction or adverse modification of critical habitat. Direct incremental impacts of a critical habitat designation include: 1) the administrative costs of conducting ESA section 7 consultations; and 2) implementation of any project modifications requested by NMFS through an ESA section 7 consultation to avoid destruction or adverse modification of critical habitat.

Direct Impacts: Administrative ESA Section 7 Consultation Costs

Parties involved in ESA section 7 consultations for black abalone include NMFS, a Federal action agency (the Federal agency that funds, authorizes, or carries out the program or project), and in some cases, a non-Federal entity (e.g., state or local governmental agency or private entity) involved in the project or activity. NMFS could also serve as the Federal action agency, in which case the consultation would be conducted internally between regions, divisions, or offices. While consultations are required for activities that involve a Federal nexus and may affect the species, regardless of whether critical habitat is designated, the designation may increase the effort for consultations where the project or activity in question may destroy or adversely modify critical habitat. Administrative efforts for consultation may therefore result in both baseline and incremental impacts.

The geographic scope of the critical habitat designation being considered and the nature of the available data preclude unit-by-unit accounting of these costs. First, a single consultation can cover more than one

project. While the majority of consultations cover a single project, the exceptions are important. For example, programmatic consultations determine how a type or types of projects, not the projects themselves, can be modified to ensure they comply with section 7 of the ESA. As a result, these consultations can cover large numbers of projects. While programmatic consultations are likely to be more costly, the cost per project is likely to be significantly lower than the per-project cost for non-programmatic consultations. For that reason, applying a constant per-project cost estimate would significantly inflate the estimated level of consultation costs. Moreover, when multi-project consultations occur, they are likely to cover a wide geographic scope and thus may overlap with multiple specific areas. This makes it difficult to attribute those consultation costs to a specific area. Due to the uncertainties regarding the specific location, type, and frequency of future consultations, the current analysis does not project the total administrative costs associated with this designation.

For contextual purposes, Table 1.3-1 presents generalized per-consultation administrative costs of consultations. In general, three different scenarios associated with the designation of critical habitat may trigger incremental administrative consultation costs:

- **Additional effort to address adverse modification in a new consultation -** New consultations taking place after critical habitat designation may require additional effort to address critical habitat issues above and beyond the listed species issues. In this case, only the additional administrative effort required to consider critical habitat is considered an incremental impact of the designation.
- **Re-initiation of consultation to address adverse modification -** Consultations that have already been completed on a project or activity may require re-initiation to address critical habitat. In this case, the costs of reinitiating the consultation, including all associated administrative and project modification costs are considered incremental impacts of the designation.
- **Incremental consultation resulting entirely from critical habitat designation -** Critical habitat designation may trigger additional consultations that may not occur absent the designation (e.g., for an activity for which adverse modification may be an issue, while jeopardy is not (*i.e.*, a determination has been made that the activity has no effect on the species), or consultations resulting from the new information about the potential presence of the species provided by the designation). All associated administrative and project modification costs of incremental consultations are considered incremental impacts of the designation.

The administrative costs of these consultations vary depending on the specifics of the project. One way to address this variability is to show a range of possible costs of consultation. Table 1.3-1 provides estimated consultation costs representing effort required for all types of consultation, including those that consider

both adverse modification and jeopardy, in 2010 dollars. To estimate the fractions of the total administrative consultation costs that are baseline and incremental, the following assumptions were applied:

- Costs associated with an incremental consultation (one occurring because of the designation of critical habitat) would be attributed wholly to critical habitat;
- Incremental costs of a re-initiation of a consultation because of the critical habitat designation are assumed to be approximately half the cost of the original consultation that considered only jeopardy. This assumes that re-initiations are less time-consuming as the groundwork for the project has already been considered in terms of its effect on the species;
- Efficiencies exist when considering both jeopardy and adverse modification at the same time (e.g., in staff time saved for project review and report writing), and therefore incremental administrative costs of considering adverse modification in consultations that will already be required to consider jeopardy result in the least incremental effort of these three consultation categories, roughly half that of a re-initiation.

Importantly, the estimated costs represent the midpoint of a potential range of impacts to account for variability regarding levels of effort of specific consultations.

Table 1.3-1: Example Range of Incremental Administrative Consultation Costs, Per Consultation (2010$)

Consultation Type	Service	Federal Agency	Third Party	Biological Assessment	Total Costs
Incremental consultation resulting entirely from critical habitat designation					
Technical Assistance	$1,000	n/a	$1,000	n/a	$2,000
Informal	$2,000	$3,000	$2,000	$2,000	$10,000
Formal	$5,000	$6,000	$4,000	$5,000	$20,000
Programmatic	$16,000	$14,000	n/a	$6,000	$36,000
Re-initiation of consultation to address adverse modification					
Technical Assistance	$1,000	n/a	$1,000	n/a	$1,000
Informal	$1,000	$2,000	$1,000	$1,000	$5,000
Formal	$3,000	$3,000	$2,000	$3,000	$10,000
Programmatic	$8,000	$7,000	n/a	$3,000	$18,000
Additional effort to address adverse modification in a new consultation					
Technical Assistance	$1,000	n/a	$1,000	n/a	$1,000
Informal	$1,000	$1,000	$1,000	$1,000	$3,000
Formal	$1,000	$2,000	$1,000	$1,000	$5,000
Programmatic	$4,000	$3,000	n/a	$1,000	$9,000

Adapted from the IEc (2009).
Note: 1. IEc analysis of full administrative costs is based on data from the Federal Government Schedule Rates, Office of Personnel Management, 2007, and a review of consultation records from several U.S. Fish and Wildlife Service field offices across the country conducted in 2002.
2. Totals may not sum due to rounding. Estimates are rounded to the nearest thousand dollars. If under $1,000, the estimate was rounded up to $1,000.
3. Estimates reflect average hourly time required by staff.

Direct Impacts: ESA Section 7 Project Modification Impacts

ESA section 7 consultations considering critical habitat may also result in additional project modification recommendations specifically addressing potential destruction or adverse modification of critical habitat. For consultations that consider jeopardy and destruction/adverse modification, and for re-initiations of past consultations to consider critical habitat, the economic impacts of project modifications undertaken to avoid or minimize destruction/adverse modification are considered incremental impacts of the critical habitat designation. For consultations that are forecast to occur specifically because of the designation (incremental consultations), impacts of all associated project modifications are assumed to be incremental impacts of the designation. As stated above, in some cases the project modifications undertaken to address jeopardy to the species would be similar to those undertaken to address impacts on critical habitat and are difficult to separate. In those cases, we used our best professional judgment to estimate the incremental impacts of the critical habitat designation by identifying those impacts that are more closely associated with critical habitat.

Indirect Impacts

The designation of critical habitat may, under certain circumstances, affect actions that do not have a Federal nexus and thus are not subject to the provisions of section 7 of the ESA. Indirect impacts are those unintended changes in economic behavior that may occur outside of the ESA, through other Federal, State, local, or private actions, but that are caused by the designation of critical habitat. Below, common types of indirect impacts that may be associated with the designation of critical habitat are identified. These types of impacts are not always considered incremental. If these types of conservation efforts and economic effects would occur regardless of the critical habitat designation, they are appropriately considered baseline impacts.

Indirect Impacts: Other State and Local Laws

Under certain circumstances, critical habitat designation may provide new information to a State or local government about the sensitive ecological nature of a geographic region, potentially triggering additional economic impacts under other State or local laws. In cases where these impacts would not have been triggered absent the critical habitat designation, they are considered indirect, incremental impacts of the designation.

Indirect Impacts: Additional Indirect Impacts

In addition to the indirect effects noted above, project proponents, land managers and landowners may face additional indirect impacts, including the following:

- **Time Delays -** Both public and private entities may experience incremental delays for projects and other activities due to requirements associated with the need to reinitiate the ESA section 7 consultation processes and/or compliance with other laws triggered by the designation. To the extent that delays result from the designation, they are considered indirect, incremental impacts of the designation.
- **Regulatory Uncertainty** - NMFS conducts each ESA section 7 consultations on a case-by-case basis and issues a biological opinion on formal consultations based on species-specific and site-specific information. As a result, government agencies and affiliated private parties who consult with NMFS under section 7 of the ESA may face uncertainty concerning whether project modifications will be recommended by NMFS and what the nature of these modifications will be. This uncertainty may diminish as consultations are completed and additional information becomes available on the effects of critical habitat on specific activities. Where information suggests that regulatory uncertainty stemming from the designation may affect a project or economic behavior, associated impacts are considered indirect, incremental impacts of the designation.

- **Stigma -** In some cases, the public may perceive that a critical habitat designation may result in limitations on private property uses above and beyond those associated with anticipated project modifications or regulatory uncertainty. Public attitudes about the limits or restrictions that critical habitat may impose can cause real economic effects, regardless of whether such limits are actually imposed. All else equal, a property that is adjacent to critical habitat may have a lower market value than an identical property that is not adjacent to the boundaries of critical habitat due to perceived limitations or restrictions. The converse may also be true. As the public becomes aware of the true regulatory burden imposed by critical habitat, the impact of the designation on property markets may decrease. To the extent that potential stigma effects on markets are probable and identifiable, these impacts are considered indirect, incremental impacts of the designation.

These potential impacts are not explicitly addressed in this analysis, but were considered during the development of cost estimates.

1.4 Approach to Analysis

To quantify the economic impacts of modifications to land and water uses that result from the critical habitat designation, the analysis employs the following five steps:

1. Define the geographic area for the analysis, and identify the specific areas to be analyzed for purposes of this designation. The final rule to designate critical habitat and the Final Biological Report (NMFS 2011a) analyze how each of these areas meets the definition of critical habitat set forth in Section 3 of the ESA.
2. Identify activities (e.g., NPDES-permitted facilities or tidal-wave projects) that may affect black abalone primary constituent elements (PCEs) and therefore may incur an economic impact because of the black abalone critical habitat designation.
3. Estimate the baseline level of protection afforded black abalone habitat by area and activity type.
4. For each type of activity, establish the existing and expected level of the activity that may be affected by the black abalone critical habitat designation in each specific area.
5. Estimate the potential incremental economic impacts of the black abalone critical habitat designation by activity type and sum by specific area.

These steps are described in greater detail below.

1.4.1 Define Geographic Study Area

The geographic area for this analysis spans from the Del Mar Landing Ecological Reserve to Dana Point in California, including several offshore islands (NMFS 2011a). NMFS has divided this geographic area into 20 specific areas to be considered for critical habitat designation, as listed below and shown in

Figures 1.4-1, 1.4-2, and 1.4-3. The final rule to designate critical habitat for black abalone and the Final Biological Report (NMFS 2011a) describe how each of these specific areas meets the definition of critical habitat. Within each of the 20 specific areas, the area considered for designation as critical habitat includes the rocky habitat from the mean higher high water (MHHW) line onshore to 6 meters depth offshore (relative to the mean lower low water (MLLW) line), including the marine waters above the rocky benthos:

- **Area 1:** From Del Mar Landing Ecological Reserve to Bodega Head
- **Area 2:** From Bodega Head to Point Bonita
- **Area 3:** Farallon Islands
- **Area 4:** From the southern point at the mouth of San Francisco Bay to Moss Beach
- **Area 5:** From Moss Beach to just north of Pescadero State Beach
- **Area 6:** Año Nuevo Island
- **Area 7:** From just north of Pescadero State Beach to Natural Bridges State Beach
- **Area 8:** From Pacific Grove to Prewitt Creek
- **Area 9:** From Prewitt Creek to Cayucos
- **Area 10:** From Montaña de Oro State Park to just south of Government Point
- **Area 11:** Palos Verdes Peninsula from the Palos Verdes/Torrance border to Los Angeles Harbor
- **Area 12:** From Corona Del Mar State Beach to Dana Point
- **Area 13:** San Miguel Island
- **Area 14:** Santa Rosa Island
- **Area 15:** Santa Cruz Island
- **Area 16:** Anacapa Island
- **Area 17:** San Nicolas Island*
- **Area 18:** Santa Barbara Island
- **Area 19:** Catalina Island
- **Area 20:** San Clemente Island*

* We note that San Nicolas Island and San Clemente Island were proposed for designation (see proposed rule (75 FR 59900; September 28, 2010)), but were determined to be ineligible for designation under section 4(a)(3)(B) of the ESA, based on benefits provided to black abalone under the revised San Nicolas Island Integrated Natural Resources Management Plan (INRMP) (approved in May 2011) and the amended 2002 San Clemente Island INRMP (amended in June 2011) (see final ESA section 4(b)(2) Report (NMFS 2011b) for more details). The results of the economic analysis for these two specific areas are included in this report for informational purposes.

Figure 1.4-1: Specific Areas Considered for Designation as Black Abalone Critical Habitat, Specific Areas 1-8.

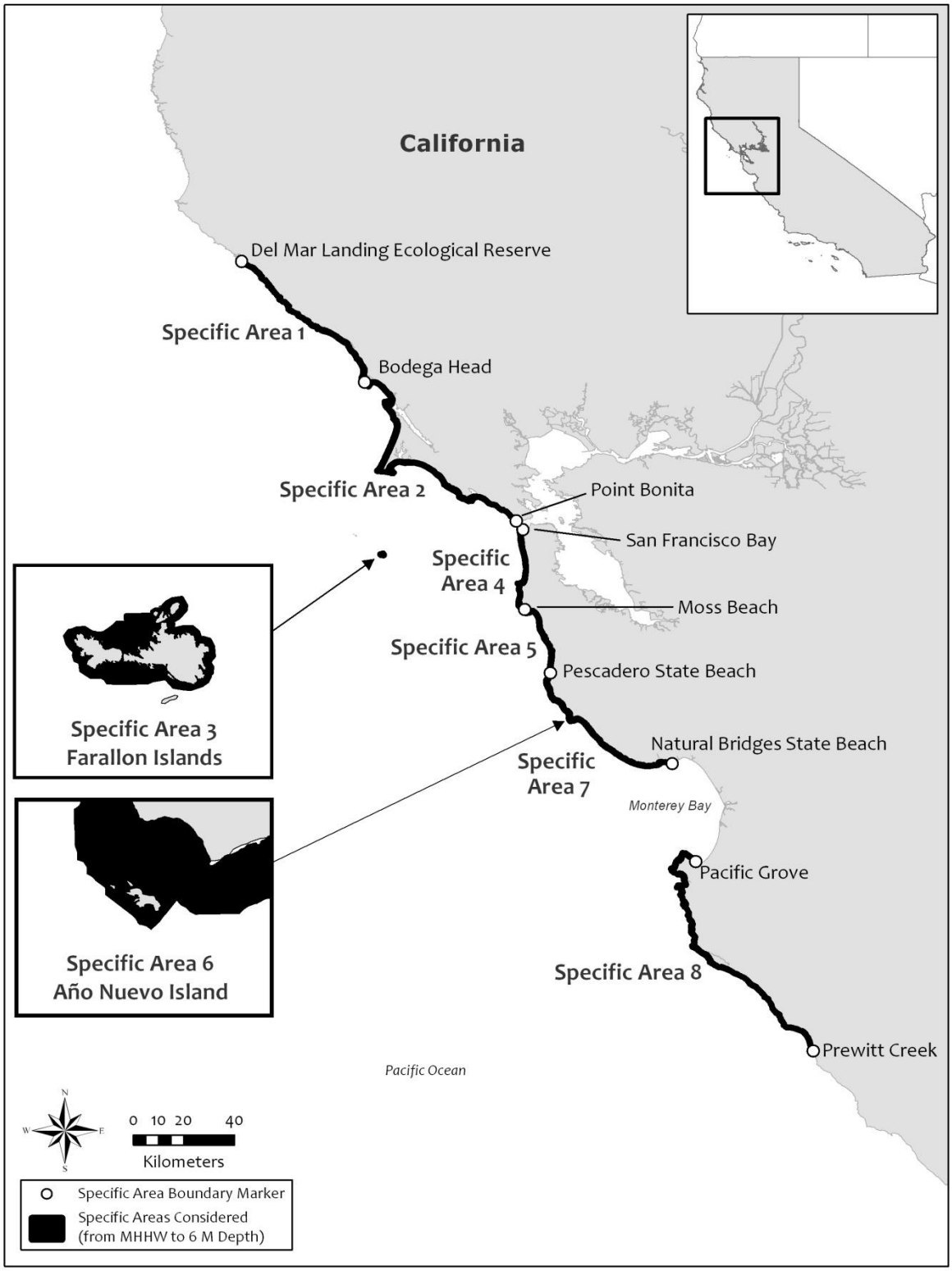
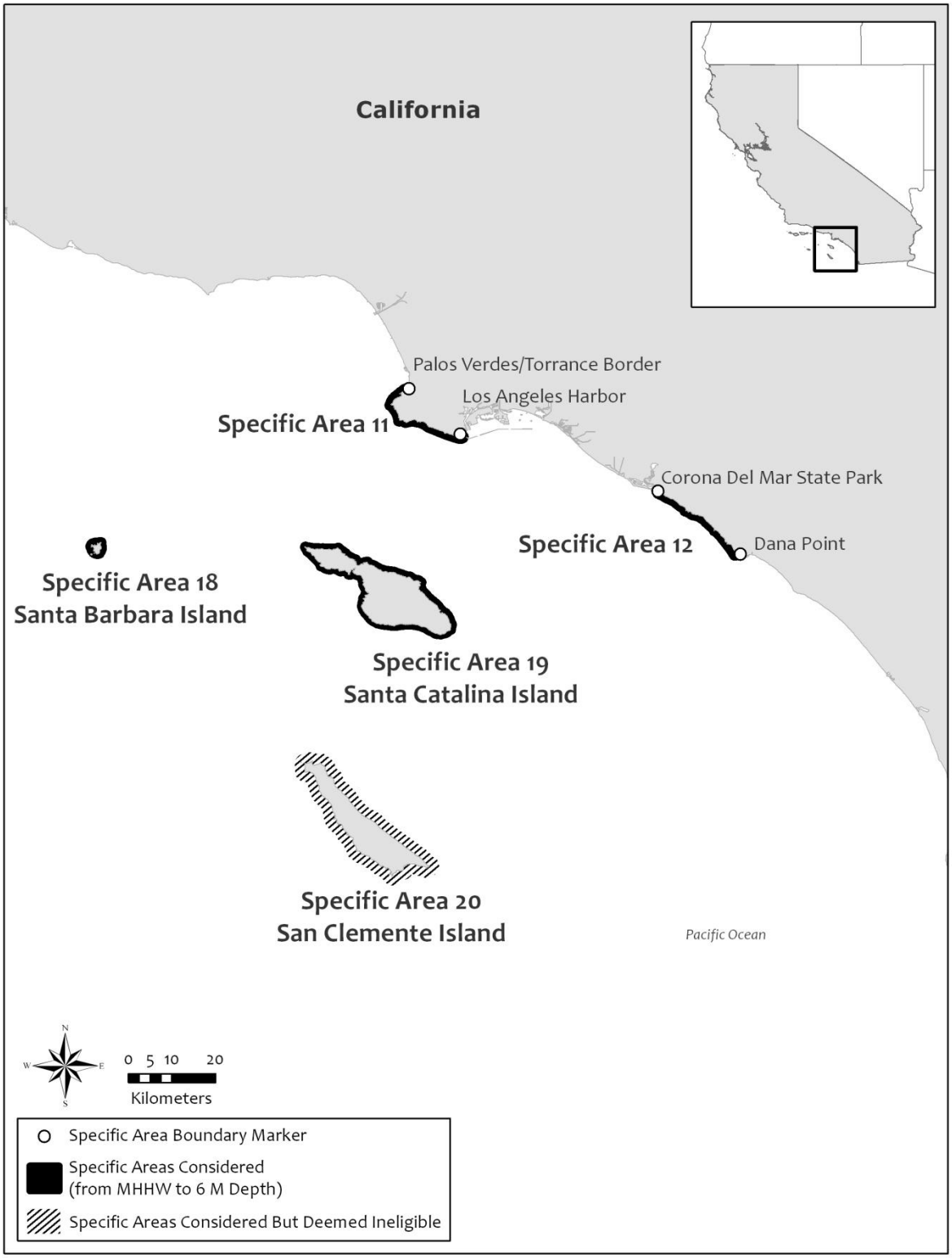


Figure 1.4-2: Specific Areas Considered for Designation as Black Abalone Critical Habitat, Specific Areas 9, 10, 13, 14, 15, 16, and 17.

Figure 1.4-3: Specific Areas Considered for Designation as Black Abalone Critical Habitat, Specific Areas 11, 12, 18, 19, and 20.



For most categories of activities analyzed in this economic report, the boundaries of these 20 specific areas make up the geographic study area for the economic analysis. Certain categories of activities, however, may not occur within the boundaries of these 20 specific areas, but may still have an effect on these specific areas and, thus, be affected by the designation of black abalone critical habitat. These categories of activities include NPDES-permitted facilities (point source pollution may runoff into nearshore coastal marine waters) and agricultural activities (such as pesticide application, irrigation, and livestock farming). A different geographic study area was defined for the analysis of economic impacts to these categories of activities, to include activities that occur outside of the boundaries of the 20 specific areas, but that may still be affected by the designation.

Previous critical habitat designations have defined the geographic study area for such activities based on a fixed distance from the boundaries of the occupied specific areas. For example, the proposed leatherback sea turtle critical habitat designation considered activities occurring within 1 mile (low economic impact estimate) and 5 miles (high economic impact estimate) of the MLLW line along the outer coast. For black abalone, however, information is lacking to determine the appropriate distance from the specific area boundaries within which activities may be affected by the critical habitat designation. Instead, this analysis defined the geographic study area for NPDES-permitted facilities and agricultural activities by using standard watershed units as mapped by the U.S. Geological Survey (USGS) and described by ten-digit, fifth-field hydrologic unit codes (referred to in this report as HUC5s, or "watersheds") and by twelve-digit, sixth-field hydrologic unit codes (referred to in this report as HUC6s, or "subwatersheds"). In one area, standard watershed units described by eight-digit, fourth-field hydrologic unit codes (referred to in this report as HUC4s, or "cataloguing units") were used. It is important to note that each HUC4 consists of two or more HUC5s, which each consists of two or more HUC6s. Thus, the HUC6s are the base unit in this analysis. Below is a description of the step-wise approach used to define the geographic study area for these two categories of activities.

Within each of the 20 specific areas, we first identified the watersheds and subwatersheds that border and drain directly into coastal rocky habitats. We defined two different geographic study areas to obtain a "low" economic impact estimate (hereafter, "low buffer") and a "high" economic impact estimate (hereafter, "high buffer"). For the low buffer, the geographic study area included the HUC6s that border and drain directly into coastal rocky habitat within each of the 20 specific areas. For the high buffer, the geographic study area included the HUC6s within the HUC5s that border and drain directly into coastal rocky habitats within each of the 20 specific areas.

We then identified watersheds and subwatersheds that do not border and drain directly into coastal rocky habitats within the 20 specific areas, but that are located close enough that discharge from the watershed or subwatershed could potentially affect coastal rocky habitats. To identify these watersheds and subwatersheds, we used data on the plume extent of coastal California rivers. In a study of flood output from 110 coastal California watersheds in 1998 (an El Niño year), the average plume extent into nearshore waters was found to be 30 km out from the coast.[11] This average plume extent of 30 km is reasonable for a river about the size of the Santa Clara River (with a drainage basin of 4,178 km^2)[12] during storm events.[13] Using this information, we identified all coastal rivers along the coast of California with a drainage area of at least 3,000 km^2 that occur within 30 km of coastal rocky habitat within the 20 specific areas. The coastal rivers included were (the drainage area of the river and the specific areas that may be affected are listed in parentheses):

- The Pajaro River (3,393 km^2; specific area 7 – from just north of Pescadero State Beach to Natural Bridges State Beach, and specific area 8 – from Pacific Grove to Prewitt Creek);
- The Salinas River (10,952 km^2; specific area 7 – from just north of Pebble Beach to Natural Bridges, and specific area 8 – from Pacific Grove to Prewitt Creek);
- The Santa Maria River (4,815 km^2; specific area 10 – from Montaña de Oro to just south of Government Point);
- The Santa Clara River (4,178 km^2; specific area 16 – Anacapa Island); and
- The Santa Ana River (4,381 km^2; specific area 12 – from Corona del Mar State Beach to Dana Point).

For the high buffer, the geographic study area included the HUC6s within the HUC5s around the mouths of the rivers listed above. Thus, the geographic study area for each of the 20 specific areas included: (a) for the low buffer, the HUC6s that border and drain directly into coastal rocky habitats within the specific areas; and (b) for the high buffer, the HUC6s within the HUC5s that border and drain directly into coastal rocky habitat, as well as those that border the mouths of coastal rivers with a drainage area of at least 3,000 km^2 and that are within 30 km of coastal rocky habitats within the specific areas.

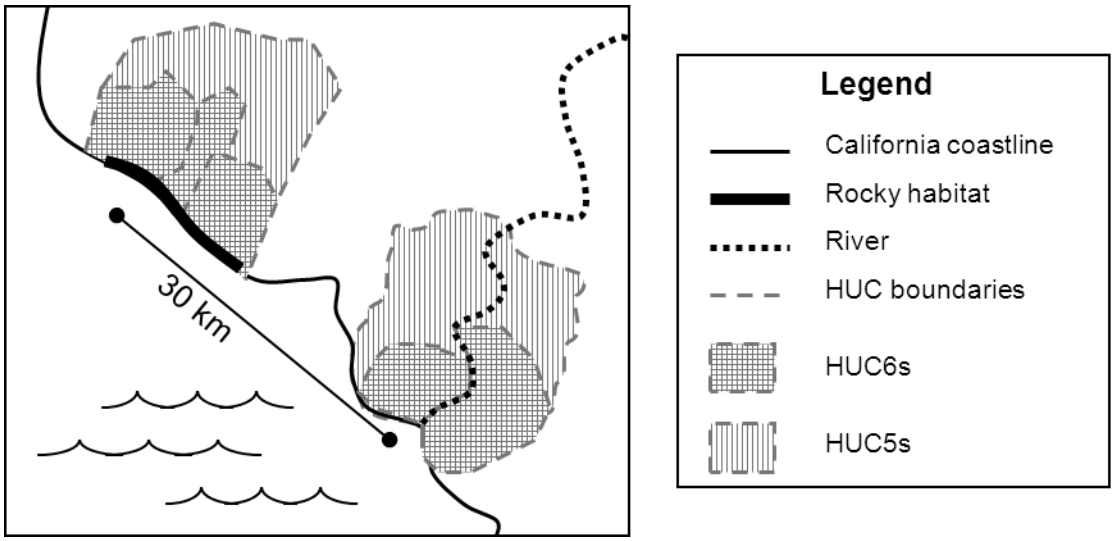
Finally, the San Francisco Bay (including the south bay and extending up to where the Napa River flows into the bay) and surrounding areas (specific areas 2, 3, and 4) were treated as unique cases. The San Francisco Bay plume extends out from the mouth of the bay to as far as the Gulf of the Farallones[14], and

[11] Mertes and Warrick 2001.
[12] Willis and Griggs 2003
[13] Personal communication with J. Warrick, USGS, on May 12, 2010
[14] Hurst and Bruland 2008.

may affect the PCEs (e.g., rocky habitats) within specific area 2 (from Bodega Head to Point Bonita), specific area 3 (the Farallon Islands), and specific area 4 (from the southern point at the mouth of San Francisco Bay to Moss Beach). Several watersheds drain into San Francisco Bay and out into nearshore coastal waters. In order to account for all of the watersheds draining into San Francisco Bay, we considered all of the HUC6s making up the HUC5s that border and drain directly into San Francisco Bay, for the high buffer only. For the high buffer, the geographic study area included all of the HUC6s within the HUC5s bordering San Francisco Bay. Thus, the geographic study area for specific areas 2, 3, and 4 included: (a) for the low buffer, the HUC6s that border and drain directly into coastal rocky habitats within the specific areas; and (b) for the high buffer, the HUC6s within the HUC5s that border and drain directly into coastal rocky habitats within the specific areas, as well as those that border San Francisco Bay.

Figure 1.4-4 illustrates how the geographic study area was defined for the analysis of economic impacts on NPDES-permitted facilities and agricultural activities. The coastline for an occupied specific area is depicted below. For the low buffer, the geographic study area for this specific area consists of the HUC6s that border and drain directly into coastal rocky habitat. For the high buffer, the geographic study area for this specific area consists of the HUC5 (encompassing the HUC6s) that border and drain directly into coastal rocky habitat, as well as the HUC5 that borders the mouth of the river (note that for clarity, not all of the HUC6s within the HUC5s are depicted in the illustration).

Figure 1.4-4: Illustration of Geographic Study Area Defined for NPDES-permitted Facilities and Agricultural Activities.



1.4.2 Identify Economic Activities That May Affect PCEs

Joint NMFS-U.S. Fish and Wildlife Service (USFWS) regulations at 50 CFR 424.12(b) state that in determining what areas are critical habitat, the agencies "shall consider those physical and biological features that are essential to the conservation of a given species and that may require special management considerations or protection." Features to consider may include, but are not limited to:

(1) Space for individual and population growth, and for normal behavior;

(2) Food, water, air, light, minerals, or other nutritional or physiological requirements;

(3) Cover or shelter;

(4) Sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and generally;

(5) Habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

ESA regulations also require agencies to "focus on the principle biological or physical constituent elements" (hereafter referred to as "Primary Constituent Elements" or PCEs) within the specific areas considered for designation. NMFS identified five PCEs essential for the conservation of black abalone in marine waters of the U.S. West Coast (see the Final Biological Report (NMFS 2011a) for more information on the PCEs):

1. *Rocky substrate*. Suitable rocky substrate includes rocky benches formed from consolidated rock of various geological origins (e.g., igneous, metamorphic, and sedimentary) that contain channels with macro- and micro- crevices or large boulders (greater than or equal to 1 m in diameter) and occur from MHHW to a depth of -6 m relative to MLLW. All types of relief (high, medium and low; 0.5 to greater than 2 m vertical relief)[15] support black abalone and complex configurations of rock surfaces likely afford protection from predators, direct impacts of breaking waves, wave-born projectiles, and excessive solar heating during daytime low tides. Black abalone typically occupy the middle intertidal zones, although in some areas black abalone may predominately occupy the high or low intertidal zones. Local variation exists, depending on conditions such as the level of wave exposure and where drift kelp (an important food resource for black abalone) may be accumulating at particular locations. Leighton (1959) found evidence for ontogenetic shifts in depth distribution among juvenile abalone on the Palos Verdes Peninsula. Juvenile black abalone (10-30 mm) were found at mid-intertidal depths on undersides of rock providing clear beneath-rock open space while juveniles in the 5-10 mm size range were found at higher intertidal zones in narrow crevices and in depressions abraded into rock surfaces by the intertidal chiton, *Nutallina californica* (Reeve, 1847). Black abalone observed at greater depths (3-6 m)

typically were mature adults. California contains approximately 848.5 miles (1365.5 km) of consolidated rocky coastline and 599.3 miles (964.5 km) or 70 percent of it falls within the specific areas originally considered in this critical habitat designation.

2. *Food resources*. Abundant food resources including bacterial and diatom films, crustose coralline algae, and a source of detrital macroalgae, are required for growth and survival of all stages of black abalone. From post-larval metamorphosis to a size of about 20 mm, black abalone consume microbial and possibly diatom films[16] and crustose coralline algae. At roughly 20 mm black abalone begin feeding on both attached macrophytes and pieces of drift plants cast into the intertidal zone by waves and currents. The primary macroalgae consumed by juvenile and adult black abalone are giant kelp (*Macrocystis pyrifera*) and feather boa kelp (*Egregia menziesii*) in southern California (i.e., south of Point Conception) habitats, and bull kelp (*Nereocystis leutkeana*) in central and northern California habitats (i.e., north of Santa Cruz), although *Macrocystis* and *Egregia* may be more prominent than *Nereocystis* along the central California coast between Point Conception and Santa Cruz. Southern sea palm (*Eisenia arborea*), elk kelp (*Pelagophycus porra*), stalked kelp (*Pterygophora californica*), and other brown kelps (*Laminaria sp.*) may also be consumed by black abalone.
3. *Juvenile settlement habitat*. Rocky intertidal and subtidal habitat containing crustose coralline algae and crevices or cryptic biogenic structures (e.g., urchins, mussels, chiton holes, conspecifics, anemones) is important for successful larval recruitment and juvenile growth and survival of black abalone less than approximately 25 mm shell length. The presence of adult abalone may facilitate larval settlement and metamorphosis, because adults may: (1) promote the maintenance of substantial substratum cover by crustose coralline algae by grazing other algal species that could compete with crustose coralline algae; and/or (2) outcompete encrusting sessile invertebrates (e.g. tube worms and tube snails) for space on rocky substrates thereby promoting the growth of crustose coralline algae and settlement of larvae; and/or (3) emit chemical cues necessary to induce larval settlement.[17] Increasing partial pressure of CO_2 may decrease calcification rates of coralline algae, thereby reducing their abundance and ultimately affecting the survival of newly settled black abalone.[18] Laboratory experiments have shown that the presence of pesticides (e.g., dichlorodiphenyltrichloroethane (DDT), 2,4-dichlorophenoxyacetic acid (2,4-D), methoxychlor, dieldrin) interfered with larval settlement of abalone because the chemical cues

[15] Wentworth 1922.
[16] Leighton 1959, Leighton and Boolootian 1963, and Bergen 1971.
[17] Miner *et al*. 2006, Toonen and Pawlik 1994
[18] Feely *et al*. 2004, Hall-Spencer *et al.* 2008

emitted by coralline algae and its associated diatom films which trigger abalone settlement are blocked[19], and the pesticide oxadiazon was found to severely reduce algal growth.[20]

4. *Suitable water quality*. Suitable water quality includes temperature, salinity, pH, and other chemical characteristics necessary for normal settlement, growth, behavior, and viability of black abalone. The biogeographical water temperature range of black abalone is from 12 to 25ºC, but they are most abundant in areas where the water temperature ranges from 18 to 22ºC.[21] There is increased mortality due to withering syndrome (WS) during periods following elevated sea surface temperature.[22] The critical habitat review team (CHRT) did not consider the presence of the bacteria that causes WS when evaluating the condition of this PCE because it is thought to be present throughout a large portion of the species' current range (greater than 60 percent), including all coastal specific areas as far north as San Mateo County, California, as well as at Bodega Head (though not found in a sample collected from Point Reyes in 2009) and the Farallon Islands.[23] Instead, the CHRT relied on sea surface temperature information to evaluate water quality in terms of disease virulence, recognizing that elevated sea surface temperatures are correlated with increased rates of WS transmission and manifestation in abalone. Elevated levels of contaminants (e.g., copper, oil, polycyclic aromatic hydrocarbon (PAH) endocrine disrupters, persistent organic compounds (POC)) can cause mortality of black abalone. In 1975, toxic levels of copper in the cooling water effluent of a nuclear power plant near Diablo Canyon, California, were associated with abalone mortalities in a nearshore cove that received significant effluent flows.[24] As mentioned above for the *Juvenile settlement habitat* PCE, laboratory experiments have shown that the presence of some pesticides interfered with larval settlement of abalone[25] and severely reduced algal growth.[26] The suitable salinity range for black abalone is from 30 to 35 parts per thousand (ppt), and the suitable pH range is 7.5 - 8.5. Ocean pH values that are outside of the normal range for seawater (i.e., pH less than 7.5 or greater than 8.5; http://www.marinebio.net/marinescience/02ocean/swcomposition.htm) may cause reduced growth and survivorship in abalone as has been observed in other marine gastropods.[27] Specifically, with increasing uptake of atmospheric CO_2 by the ocean, the pH of seawater becomes more acidic, which may decrease calcification rates in marine organisms and result in negative impacts to black abalone

[19] Morse *et al.* 1979a
[20] Silver and Riley 2001
[21] Hines *et al.* 1980
[22] Raimondi *et al*. 2002
[23] Pers. comm. with Jim Moore, CDFG, on June 8, 2011
[24] Shepherd and Breen 1992, Martin *et al.* 1977
[25] Morse *et al.* 1979a
[26] Silver and Riley 2001

in at least two ways: (1) disrupting an abalone's ability to maintain and grow its protective shell; and/or (2) reducing abundance of coralline algae (and associated diatom films and bacteria), a calcifying organism that may mediate settlement through chemical cues and support and provide food sources for newly settled abalone.[28]

5. *Suitable nearshore circulation patterns*. Suitable circulation patterns are those that retain eggs, sperm, fertilized eggs, and ready-to-settle larvae enough so that successful fertilization and settlement to suitable habitat can take place. Nearshore circulation patterns are controlled by a variety of factors including wind speed and direction, current speed and direction, tidal fluctuation, geomorphology of the coastline, and bathymetry of subtidal habitats adjacent to the coastline. Anthropogenic activities may also have the capacity to influence nearshore circulation patterns (e.g., intake pipes, sand replenishment, dredging, in water construction, etc.). These factors, in combination with the early life history dynamics of black abalone, may influence retention or dispersal rates of eggs, sperm, fertilized eggs, and ready-to-settle larvae.[29] Given that black abalone gamete and larval durations are relatively short, larvae have little control over their position in the water column, and ready-to-settle larvae require shallow, intertidal habitat for settlement, forces that disperse larvae offshore (i.e., by distances on the order of greater than tens of kilometers) may decrease the likelihood that they will successfully settle to suitable habitats. However, retention of larvae inshore due to bottom friction and minimal advective flows near kelp beds (the "sticky water" phenomenon[30]) may increase the likelihood that larvae will successfully settle to suitable habitats.

NMFS then identified 17 categories of activities that may have an effect on one or more of the five PCEs described above. These "activities" may require modification to avoid destruction or adverse modification of black abalone critical habitat. These activities include the operation of some facilities, such as coastal power plants that draw in marine waters and discharge heated effluent, where modifications may be required as a result of this designation. The following are the categories of activities assessed in this analysis:

- Dredging and disposal of dredged material
- In-water construction
- Sand replenishment
- NPDES-permitted activities (point source discharges)

[27] Shirayama and Thornton 2005
[28] Feely *et al*. 2004, Hall-Spencer *et al.* 2008
[29] Siegel *et al.* 2008
[30] Wolanski and Spagnol 2000, Zeidberg and Hamner 2002

- Coastal urban development
- Sediment disposal activities associated with road maintenance, repair, and construction (previously called “side-casting”)
- Agriculture (including pesticide application, irrigation, and livestock farming)
- Oil & chemical spills and response
- Vessel grounding incidents and response
- Power plants (construction and operations)
- Desalination plants (construction and operations)
- Tidal and wave energy projects (construction and operations)
- Liquefied natural gas (LNG) projects (construction and operations)
- Mineral and petroleum exploration and extraction
- Non-native species: prevention and management
- Kelp harvesting
- Activities that lead to global climate change (e.g., fossil fuel combustion)

Using GIS and other spatial analysis tools, this analysis first assesses the level of current and expected activities for each affected industry. The analysis then scales this level of activity to the number of projects expected to be affected annually by the black abalone critical habitat designation (e.g., the number of in-water construction projects).

1.4.3 Estimate the Baseline Level of Protection Afforded Black Abalone

If the critical habitat rule goes into effect, activities affecting black abalone may require modification to avoid destruction or adverse modification of critical habitat. This analysis aims to understand the economic impacts of avoiding adverse impacts to black abalone critical habitat over and above other baseline protections that may already be in place. Because of the close relationship in terms of management requirements under the ESA for a species and its critical habitat, protections for black abalone itself may provide the strongest baseline protections to black abalone critical habitat. In addition, protections already in place for areas designated as National Marine Sanctuaries and critical habitat for other ESA listed species may also provide a level of baseline protection for black abalone critical habitat. The following sections provide additional detail regarding baseline protections that are provided by National Marine Sanctuaries and critical habitat designations for other ESA-listed species to black abalone critical habitat. In addition, a number of regulations, laws, and initiatives have been created specifically to address human-induced impacts on marine species and their habitats. These are summarized in Appendix B. Specific regulations and laws are discussed in more detail in Section 2 of this report for each category of activity analyzed.

National Marine Sanctuaries

There are three National Marine Sanctuaries (NMS) along the California coast: (1) the Gulf of the Farallones National Marine Sanctuary (GFNMS), which spans from Bodega Rock to Rocky Point, California (specific areas 2 and 3); (2) the Monterey Bay National Marine Sanctuary (MBNMS), which runs from Rocky Point to Cambria, California (specific areas 4-9); and (3) the Channel Islands National Marine Sanctuary (CINMS) which is made up of San Miguel Island (specific area 13), Santa Rosa Island (specific area 14), Santa Cruz Island (specific area 15), Anacapa Island (specific area 16), and Santa Barbara Island (specific area 18). Both the GFNMS and CINMS prohibit: exploring for, developing, or producing minerals within the Sanctuary, discharging or depositing of any materials into the Sanctuary; and drilling into, dredging, constructing or placing any structure or material into the Sanctuary.[31] The GFNMS also prohibits: oil and gas exploration; oil tankers, barges, and other merchant and cargo vessels; introducing or otherwise releasing from within or into the Sanctuary an introduced species; and anchoring and deserting a vessel within the Sanctuary.[32] The MBNMS prohibits exploring for, developing, or producing oil and gas. The MBNMS restricts the alteration of or construction on the seafloor and the discharging or depositing of any materials into the Sanctuary.[33]

Salmon and Steelhead Critical Habitat

Salmon and steelhead critical habitats are almost exclusively riverine and do not overlap with the areas being considered for designation as black abalone critical habitat. However, some modifications to upland and riverine activities (e.g., restrictions to pesticide use) may affect water quality and prey in the areas being considered for designation as critical habitat for black abalone. The degree and extent of effects are unknown. Because of the high visibility and regional importance of salmon and steelhead species, numerous protections have already been undertaken on behalf of these species. For example, a critical habitat analysis for salmon and steelhead examined nearly 1,100 consultation actions over three years, or approximately 370 actions annually for salmon and steelhead species. These actions were authorized, funded, or carried out by nearly 30 Federal agencies in addition to NMFS.[34] In another example, the California Habitat Restoration Project Database, a database created in 1999 to capture and maintain data about habitat restoration projects in California benefiting anadromous fish, currently contains nearly

[31] Complete list found at: Channel Islands National Marine Sanctuary. *Regulations and Restrictions*. Accessed in May 2010 at: http://channelislands.noaa.gov/drop_down/reg.html.
[32] Gulf of the Farallones National Marine Sanctuary Accessed in May 2010 at: http://farallones.noaa.gov/.
[33] Marine Conservation Biology Institute. *Monterey Bay National Marine Sanctuary*. Accessed in May 2010 at: http://www.mcbi.org/what/what_pdfs/Monterey_Bay.pdf.
[34] National Marine Fisheries Service. *Final Economic Analysis of Critical Habitat Designation for Seven West Coast Salmon and Steelhead ESUs*. Long Beach, CA, August 2005.

3,000 projects, of which 2,400 are completed and 600 are ongoing.[35] As described above, a number of other initiatives have been undertaken to address human induced impacts on anadromous species, many of which are summarized in Appendix B.

Green Sturgeon Critical Habitat

Green sturgeon critical habitat includes marine waters within 60 fathoms depth along the U.S. West coast. Thus, consultations on this species may overlap with the specific areas being considered for designation as black abalone critical habitat. NMFS identified several activities that may affect green sturgeon critical habitat in marine coastal waters, including dredging, in-water construction, NPDES, agricultural pesticide application, power plants, desalination plants, and tidal and wave energy projects (73 FR 52084 September 8, 2008). These categories of activities have also been identified as activities that may affect the specific areas being considered for designation as black abalone critical habitat. It also is worth noting that all of the approximately 20 completed formal consultations that address impacts to green sturgeon to date also address impacts to one or more listed salmon and/or steelhead species. Salmonid species included in green sturgeon consultations to date have largely been located in Northern California.

Proposed Leatherback Sea Turtle Critical Habitat

Critical habitat for the leatherback sea turtle is currently proposed within marine waters out to the 2,000 meter depth contour along the U.S. West coast. Thus, consultations on this species may overlap with the specific areas being considered for designation as black abalone critical habitat. NMFS identified several activities that may affect the proposed leatherback critical habitat in marine coastal waters, including NPDES-permitted activities, agricultural pesticide application, oil spills, power plants, desalination plants, and tidal and wave energy projects (75 FR 319; January 5, 2010). These categories of activities have also been identified as activities that may affect the specific areas being considered for designation as black abalone critical habitat. Protections for the proposed leatherback critical habitat may provide some baseline protection once it is finalized. However, since it has not yet been finalized, it does not provide any baseline protections at this time.

1.4.4 Establish Existing/Expected Level of Economic Activity Likely to be Affected by Critical Habitat

After establishing the level of baseline protections that exist, the analysis then assesses the number of current and expected actions likely to be affected by the critical habitat designation for black abalone for

[35] Fish barrier data is available from the Calfish program, a cooperative effort headed by CDFG Wildlife and Habitat Data Analysis Branch and CDFG NCNCR Information Services Branch. Accessed on August 21, 2007 at: http://www.calfish.org/.

each potentially affected category of activity in each specific area being considered for designation. This level of future activity was developed using GIS data and other published data on existing, pending, or future actions (e.g., Federal Energy Regulatory Commission (FERC) permit license data for LNG projects). The number of projects requiring modifications to avoid impacts to black abalone critical habitat may be under or overstated, due to uncertainties regarding: 1) which particular projects will in fact take place in the specific areas; and 2) which projects the Federal action agencies will consider to potentially adversely affect black abalone critical habitat. Where possible, the analysis is conservative, i.e., more likely to overestimate impacts rather than understate them. For example, although three desalination plants exist in the specific areas, seven are currently proposed. Although there is uncertainty regarding whether the proposed desalination plants will be approved and constructed, the analysis takes a conservative approach and assumes that all of these projects move forward to the construction phase and may result in project modifications to avoid adverse effects on black abalone critical habitat.

However, data limitations are real, and we recognize that all potential future projects within the timeframe for this analysis may not be captured by existing data. Missing data on real future projects would lead to underestimates of future projects that may require consultation regarding black abalone critical habitat. We also recognize that because black abalone and other listed species, particularly Southern DPS green sturgeon, occur in the specific areas being considered for designation, a portion of affected future projects would be expected to undertake conservation efforts that are protective of black abalone critical habitat regardless of this rule. Thus, after estimating the number of projects potentially required to undertake conservation efforts, we then applied a scaling factor (the "incremental score") to more accurately represent the portion of the project modifications that would be affected by the black abalone critical habitat over and above the existing baseline. For example, a power plant in black abalone critical habitat may be required to implement conservation measures to address the effects of its effluent on water temperature, but, due to the listing of black abalone, some portion of those measures may already be implemented absent the critical habitat designation for black abalone.

In order to determine the incremental scores associated with any possible change to activities, we considered the existing protections in each specific area. Information on various regulations that are believed to contribute to existing protections is summarized in Appendix B of this report. For some specific areas and activities, NMFS has already engaged in ESA section 7 consultations and thus we were able to consider the information and conservation measures included in those consultations. Laws in place to conserve and protect marine resources include the Coastal Zone Management Act and various state regulations along with regulations promulgated by the three National Marine Sanctuaries within the

specific areas. Critical habitat for green sturgeon has recently been designated in nearshore waters along much of the U.S. West coast and changes to activities necessary to protect green sturgeon critical habitat may yield benefits to black abalone critical habitat in these areas of overlap. Further, whether or not ESA-listed species, critical habitat, or marine mammals protected under the MMPA may be present in the specific areas was taken into consideration. While protection afforded to ESA-listed species may not directly affect black abalone critical habitat, they may provide indirect benefits. Table 1.4-1 outlines the basis for the incremental scoring which relies on the combination of the following criteria: existing Federal, state, and local standards and regulations (e.g., the regulations within the boundaries of a National Marine Sanctuary) and overlap with other critical habitats. Refer to Table 3-4 for a summary of scores for all specific areas being considered for designation. The incremental scores applied within each specific area and for each activity are discussed in more detail in Section 2 of this report in the analysis of each category of activity. Appendix C provides a summary of the annualized impacts without the incremental scores, as a sensitivity analysis of the application of the incremental scores on the estimated annualized impacts.

Table 1.4-1: Incremental Score Based on Combination of Existing Regulations

Score	Existing Federal, state, and local standards and regulations	Overlap with other critical habitats
0.1	High	Some overlap with critical habitats for other NMFS species, however, needs of the species differ slightly.
0.2	High	No overlap
0.5	Moderate	Similar costs used in economic analyses for other critical habitat designations, in which 100% of the costs were attributed to critical habitat for the exact same activities analyzed; however, the needs of the species differ greatly.
1.0	Some to none	No overlap

1.4.5 Estimate Potential Economic Impacts by Specific Area

For each potentially affected activity, we identify project modifications that may be necessary to avoid destruction or adverse modification of the specific areas being considered for designation as black abalone critical habitat. Because a large degree of uncertainty exists with regard to future actions likely to be undertaken specifically to avoid destruction or adverse modification of black abalone critical habitat, this analysis begins by estimating the economic impacts of likely management actions that may be taken for black abalone and its habitat, as well as other listed species.

1.4.6 Calculate Total Impacts by Specific Area

To create a total impact estimate for each specific area being considered for designation, we multiplied the number of affected projects by the annualized costs per project and the incremental score for each specific area and activity type, then summed these estimated costs across all activities within each specific area. This process is summarized in the following equation:

$$C_U = \sum_i N_{i,U} * C_{i,U} * I_{i,U}$$

Where

C_U = Total annualized economic impacts (costs) for specific area 'U' (*2010 dollars*)

$N_{i,U}$ = Annual number of affected projects for activity 'i' in specific area 'U'

$C_{i,U}$ = Annualized economic impacts (costs) on activity 'i' in specific area 'U' (*2010 dollars*)

$I_{i,U}$ = Incremental impact of black abalone critical habitat on activity 'i' in specific area 'U' (*0.1 – 1.0*)

In almost all cases, a range of possible modification costs is presented. Because the data sources for the cost estimates do not constitute a random sample, an average over the range of estimated costs cannot be

used as the "representative" estimate. This analysis therefore assumes that the endpoints of the range represent the minimum and maximum values of a symmetric cost distribution, and uses the midpoint of the range as the representative cost estimate. The final estimates of the total impacts by specific area are presented in Section 3 of this analysis.

1.4.7 Discount Rate

OMB Circular A-94 states that a 7 percent discount rate should be used as a base-case for regulatory analysis to approximate the marginal pre-tax rate of return on an average investment in the private sector in recent years (before 1992).[36] OMB Circular A-4 adds that estimates using a 3 percent discount rate should also be provided for regulatory analyses.[37] Thus, this analysis provides present discounted values using discount rates of 3 and 7 percent. Given the present low interest rate environment, we consider the present values discounted at 3 percent to better reflect current economic conditions. Appendix D presents a sensitivity analysis of our assumptions by comparing the present values discounted at 3 and 7 percent with those discounted at 2.1 percent.

We also note that in the draft economic analysis report, the annualized impacts were incorrectly labeled as having been discounted at 7 percent within the report and at 3 percent in the sensitivity analysis (Appendix D). The discount rates were only used to calculate present values and were not applied to calculate annualized impacts. In this final report, we have removed the text "discounted at 7 percent" and "discounted at 3 percent" from the tables that present annualized impacts. In addition, we have revised Appendix D to remove the tables of annualized impacts from Appendix D and to include only the table of present discounted values (comparing values discounted at 3, 7, and 2.1 percent).

1.4.8 Analytical Time Frame

This analysis estimates impacts based on activities that are reasonably foreseeable, including activities that are currently authorized, permitted, or funded, or for which proposed plans are currently available to the public. In general, the time frame over which data are available to project land and water uses in the study area is 20 years. In most cases, therefore, the analysis estimated economic impacts from 2010 to 2029 (20 years from the expected year of a critical habitat designation).

1.5 Report Organization

The remainder of this report proceeds through two sections and several appendices, including:

[36] U.S. Office of Management and Budget. 1992. "Circular A-94: Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs." October 29, 1992. Accessed at: http://www.whitehouse.gov/omb/assets/a94/a094.pdf.

[37] U.S. Office of Management and Budget. 2003. "Circular A-4." September 17, 2003. Accessed at:

- Section 2 describes the 17 categories of activities that may require modification to avoid destruction or adverse modification of black abalone critical habitat.
- Section 3 discusses the results of the analysis by specific area and activity. These results are derived from the activity counts and related cost estimates presented in earlier sections.
- Appendix A summarizes threats to black abalone critical habitat identified by NMFS.
- Appendix B summarizes laws and regulations that may provide baseline protection to black abalone critical habitat.
- Appendix C provides a sensitivity analysis testing the degree to which black abalone critical habitat drives the costs in particular specific areas.
- Appendix D tests the sensitivity of the discount rate by applying a 2.1 percent discount rate.
- Appendix E presents a Final Regulatory Flexibility Analysis.
- Appendix F analyzes energy impacts.

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http://www.whitehouse.gov/sites/default/files/omb/assets/omb/circulars/a004/a-4.pdf.

SECTION 2: ECONOMIC IMPACTS BY ACTIVITY

NMFS identified 17 categories of economic activity that may require modification to avoid destruction or adverse modification of black abalone critical habitat. This section describes each activity in terms of the potential effects on black abalone habitat, extent of occurrence within the specific areas being considered for designation as black abalone critical habitat, specific baseline protections that may apply to black abalone critical habitat, and the potential economic impacts of conservation efforts for black abalone critical habitat. We note that future projects in many of the categories of activities identified may be proposed in, and may affect, any of the specific areas considered for designation. However, this analysis focuses on the projects for which we currently have information (i.e., the number of proposed projects within a specific area) to estimate the economic impacts of designation.

We conducted a quantitative assessment for nine of the 17 categories of activities, presenting specific cost estimates for each activity type. These seven categories of activities were: in-water construction, sand replenishment, NPDES-permitted activities (point source pollution), coastal urban development, sediment disposal activities associated with road maintenance, repair, and construction (previously called "side-casting"), agricultural activities (irrigation), , and construction and operation of tidal and wave energy projects. The remaining ten categories of activities (plus a subset of the agricultural activities) were discussed qualitatively due to uncertainty regarding project modifications and lack of cost data. These ten categories of activities were: dredging and disposal of dredged material, agricultural activities (pesticide application and livestock farming), oil and chemical spills and response, construction and operation of power plants (involving water withdrawal from and discharge to marine coastal waters), vessel grounding incidents and response, construction and operation of desalination plants, construction and operation of LNG projects, mineral and petroleum exploration and extraction, non-native species introduction and management, kelp harvesting, and activities that lead to global climate change. Where quantitative impact estimates are presented, they are rounded to the nearest thousand dollars (note that estimates less than a thousand dollars were rounded up to $1,000).

2.1 Economic Impacts of Critical Habitat Designation on Dredging and Disposal of Dredged Material, and In-water Construction Projects

2.1.1 Description of Threat

NMFS identified dredging and disposal of dredged material as a potential threat to the essential features of black abalone critical habitat. While there are currently no identified dredging and disposal activities

within the boundaries of the specific areas considered for designation as critical habitat for black abalone, the activity is still identified as a potential concern.[38] This activity may affect the *rocky substrate* and *water quality* PCEs. For harbors, dredging and disposal typically occurs off sandy habitats and may not affect black abalone habitat. Dredging that occurs near coastal rocky habitats, however, may cause increased sedimentation onto rocky substrate. In addition, a variety of harmful substances, including heavy metals, oil, TBT, PCBs and pesticides, can be effectively absorbed into the seabed sediments. The dredging and disposal processes can release these contaminants into the water column, affecting water quality, and making them available to be taken up by animals and plants, which could cause morphological or reproductive disorders.[39]

NMFS has identified in-water construction or alteration activities (excluding dredging and disposal of dredged material, because this is addressed as a separate category of activities) as a potential threat to the essential features identified for black abalone critical habitat in four specific areas: Areas 10, 17, 19, and 20. In-water construction activities include: coastal armoring, pier construction, pile driving, and the construction and maintenance of jetties, harbors, and other large in-water structures, that may cause increased sedimentation or affect wave action along the coast. These activities may affect the *rocky substrate*, *food resources, settlement habitat*, and *nearshore circulation pattern* PCEs. During construction or maintenance of in-water structures, increased sedimentation can smother or scour adults and juveniles as well as interfere with feeding and larval settlement.[40] Artificial structures may affect intertidal communities by providing stepping-stones between populations, resulting in range extensions for species with limited dispersal distances.[41] The presence of in-water structures may affect black abalone habitat by affecting the distribution and abundance of other intertidal invertebrate species or the distribution and abundance of algal species that provide food for abalone. Changes in algal communities could also affect settlement of larval abalone (believed to be influenced by coralline algae). Artificial structures, like breakwaters, may also alter the physical environment by reducing wave action and modifying nearshore circulation and sediment transport.[42] Construction of coastal defense structures (such as breakwaters) to protect against flooding or to prevent coastal erosion is likely to increase over the next decades in response to sea level rise or the increased frequency of storms.[43]

[38] Note that this is looking at dredging/disposal as the main activity, and does not include dredging/disposal activities that occur as part of other activities. For example, dredging/disposal may occur as part of in-water construction and the costs would be included in the estimated costs for those activities.
[39] ABP Research R512 1995
[40] Airoldi 2003
[41] Thompson et al. 2002
[42] Martins et al. 2009
[43] Thompson et al. 2002

2.1.2 Regulatory Environment & Extent of Activity

The Federal nexus for these types of projects may be through the permitting or funding provided by the U.S. Army Corps of Engineers (USACE), Navy, US Air Force, and National Marine Sanctuaries (NMS) permits (required in sanctuaries). The USACE issues permits pursuant to Section 10 of the Rivers and Harbors Act of 1899 (RHA), and Section 404 of the Clean Water Act (CWA), among several others.[44] Although in-water construction projects are commonly undertaken by private or non-Federal parties, in most cases they must obtain a USACE permit. The USACE must then consult with NMFS under section 7 of the ESA.

Section 10 of the RHA requires approval prior to the accomplishment of any work in or over navigable waters of the United States, or which affects the course, location, condition or capacity of such waters. Typical activities requiring RHA Section 10 permits are:

- Construction of piers, wharves, bulkheads, marinas, ramps, floats, intake structures, and cable or pipeline crossings.

Section 404 of the CWA requires approval prior to discharging dredged or fill material into the waters of the United States. Typical activities requiring CWA Section 404 permits are:

- Depositing of fill or dredged material in waters of the U.S. or adjacent wetlands.
- Site development fill for residential, commercial, or recreational development.
- Construction of revetments, groins, breakwaters, levees, dams, dikes, and weirs.
- Placement of riprap and road fills.

The purpose of the CWA Section 404 program is to insure that the physical, biological, and chemical quality of our nation's water is protected from irresponsible and unregulated discharges of dredged or fill material that could permanently alter or destroy these valuable resources.

For this analysis, the location and frequency of dredging projects within the specific areas was based on the USACE awarded dredging contracts advertised by the USACE from Fiscal Year 2000 to 2009.[45] However, most of the dredging projects in California take place in rivers or in bays, to allow for vessels with deep drafts to safely navigate or maneuver. These types of areas are not being considered for

[44] U.S. Army Corps of Engineers. Permits for Navigational Dredging: Ports, Marinas, Refineries, Private Residences and Disposal of Dredged Material. Accessed in April 2010 at: http://www.spn.usace.army.mil/Permits/dredging_work_permits.html.
[45] USACE. *Navigation Data Center, U.S. Waterway Data: Dredging Information System*. Accessed in March 2010 at: http://www.ndc.iwr.usace.army.mil/data/datadrg.htm.

designation. Thus, these data indicate that there are currently no dredging and disposal activities occurring in the specific areas.

In-water construction activities are prevalent throughout the California coast in the specific areas. While the specific locations of future in-water construction activities are not known, this analysis assumes that a reasonable proxy for understanding the location of future actions can be found in past actions. That is, this analysis identifies the location of in-water construction projects within the specific areas using the latitude and longitude of historic USACE section 10 jurisdictional determinations (JDs), which are believed to contain the bulk of relevant projects for this analysis. Approved and preliminary JDs are tools used by the USACE to help implement Section 404 of the CWA and Sections 9 and 10 of the RHA. Data containing approved and preliminary JDs were collected from the San Francisco and Los Angeles USACE Districts. The San Francisco District only had latitude and longitude data available for the year 2009, whereas the Los Angeles District had latitude and longitude data for the years 2004 to 2009. To adjust for temporal differences in the data, the annual level of projects that may require modifications was estimated by dividing the level obtained from each district's data by the number of years covered by that district's dataset. These data are presented in Table 2.1-1.

Table 2.1-1: Approximate Location and Estimated Annual Level of In-water Construction Projects by Specific Area

Area	Average Annual Number of JDs
10	0.6
17	0.2
19	0.4
20	0.2
Total	1.4

2.1.3 Impacts of Critical Habitat Designation on Dredging and Disposal of Dredged Material and In-water Construction Projects

Black abalone critical habitat could impose modifications to dredging and disposal of dredged material activities, such as:

- Restrictions on the spatial and temporal extent of dredging activities and the deposition of dredge spoil; and
- Requirements to monitor the effects of dredge deposition on black abalone habitat.

Modifications related to other in-water construction activities include:

- Bank stabilization measures; and
- More natural erosion control.

Table 2.1-2 summarizes potential per project costs (in 2010 dollars) for modifications to dredging and disposal activities and to in-water construction activities resulting from the critical habitat designation for black abalone. These costs are based on the estimated costs reported in the economic report for the salmon and steelhead critical habitat designation.[46] The modifications considered in the economic analysis for the salmon and steelhead critical habitat designation may be similar, or identical, to those that could be required to protect black abalone critical habitat.

Table 2.1-2: Potential per Project Costs of Implementing Conservation Efforts for Dredging and In-water Construction Projects (2010$)

Specific Actions	Sub-Activity	Per Project Annualized Costs		
		Low	Mid	High
Dredging	Dredging	$46,000	$114,000	$183,000
In-water Construction	Bank stabilization	$5,000	$8,000	$12,000

Note: Adapted from NMFS, Final Economic Analysis of Critical Habitat Designation for Seven West Coast Salmon and Steelhead ESUs, Long Beach, CA, August 2005. Adjusted to 2010 dollars using the U.S. Bureau of Economic Analysis, National Economic Accounts, National Income and Product Accounts table, 2010.

Existing Federal, state, and local standards and regulations appear to offer a moderate level of baseline protection for black abalone critical habitat. As discussed in section 2.1.2 above, in-water construction projects are subject to review by the USACE under the CWA and RHA. In addition, this analysis assumes that conservation measures undertaken for green sturgeon critical habitat may provide an additional baseline level of protection for black abalone critical habitat where habitats coexist. The level of protection provided by overlap with green sturgeon critical habitat would be low, however, because black abalone and green sturgeon have different habitat needs, which would likely be met by different types of modifications. Therefore, this analysis assumes that approximately 50 percent of impacts are attributable to black abalone critical habitat (see Section 1.4.4 of this report regarding the basis for incremental scores). Appendix C provides a sensitivity analysis for these assumptions, providing estimates assuming that black abalone critical habitat is responsible for the generation of all project modification costs for all projects.

[46] NMFS. 2005. Final Economic Analysis of Critical Habitat Designation for Seven West Coast Salmon and Steelhead ESUs. Long Beach, CA, August 2005.

2.1.4 Summary of Economic Impacts to Dredging and Disposal of Dredged Material and In-water Construction Projects by Area

We did not identify any dredging and disposal activities within the boundaries of the specific areas. Therefore, NMFS was unable to present a quantitative assessment of the potential impacts to dredging and disposal activities for this analysis.

Table 2.1-3 presents a summary of potential impacts to in-water construction activities.

Table 2.1-3: Summary of Economic Impacts to In-water Construction Projects by Specific Area

Area	Activity Count (Estimated Annual Number of Projects)	Incremental Score	Total Annualized Costs		
			Low	Mid	High
10	0.6	0.5	$1,000	$3,000	$4,000
17	0.2	0.5	$1,000	$1,000	$1,000
19	0.4	0.5	$1,000	$2,000	$2.000
20	0.2	0.5	$1,000	$1,000	$1,000
Total			$3,000	$6,000	$8,000

2.2 Economic Impacts of Critical Habitat Designation on Sand Replenishment

2.2.1 Description of Threat

NMFS has identified sand replenishment (or beach nourishment) as a potential threat to the essential features identified for black abalone critical habitat in four specific areas: specific areas 2, 4, 7, and 11. This activity may affect the *rocky substrate* PCE.

Sand replenishment activities involve the placement of large amounts of sand in the supralittoral and intertidal zones. The amount of sand flowing from the supralittoral zone into the intertidal zone can be substantial, ranging anywhere from centimeters to more than a meter.[47] Sand movements could directly impact intertidal organisms by smothering or scouring.[48]

2.2.2 Regulatory Environment & Extent of Activity

Sand replenishment activities involve dredging sand from a source location and placing it at another location. Thus, sand replenishment activities have the same federal nexus as identified above for dredging and disposal activities. The USACE is responsible for administering Section 404 permits under the CWA, which are related to sand replenishment activities (see Section 2.1.2 of this report regarding Section 404 permit requirements).

[47] USACE. "Chapter 4: Environmental Effects of Beach Nourishment Projects." Accessed at: http://www.saw.usace.army.mil/coastal/ShoreProtectionBenefits_Part2.pdf.
[48] Littler et al. 1983.

For this analysis, the location and frequency of sand replenishment projects within the specific areas is based on the USACE awarded dredging contracts advertised by the USACE from Fiscal Year 2000 to 2009, where the class of work is identified as "beach nourishment."[49] These data are shown in Table 2.2-1.

[49] USACE. *Navigation Data Center, U.S. Waterway Data: Dredging Information System*. Accessed in March 2010 at: http://www.ndc.iwr.usace.army.mil/data/datadrg.htm.

Table 2.2-1: Approximate Location and Estimated Annual Level of Sand Replenishment Projects by Specific Area

Area	Estimated Annual Number of Projects
2	0.2
4	0.1
7	0.3
11	0.1
Total	0.7

2.2.3 Impacts of Critical Habitat Designation on Sand Replenishment

Black abalone critical habitat could impose modifications to sand replenishment activities, such as:[50]

- Requiring the monitoring of water quality (turbidity) during and after the project.
- Placing a buffer around pertinent areas within critical habitat and requiring that sand replenishment projects work around these buffers.
- Ensuring any dredge discharge pipelines are sited to avoid coastal rocky habitat.
- Constructing training dikes to help retain the sand at the receiving location, which should minimize movement of sand into coastal rocky habitats.

It is unknown how many of the modifications listed above would be applied to future sand replenishment projects and to what extent. For example, depending on the location and magnitude of a sand replenishment project, there may be minor, major, or no modifications required for the location of dredge discharge pipelines. Because there is much uncertainty regarding the modifications, the cost estimates are based on requiring biological and shoreline monitoring during and after the project. This modification is most likely to be required for all future projects.

The following table provides cost estimates for biological and shoreline monitoring related to sand replenishment projects, in 2008 dollars (adjusted to 2010 dollars). Biological monitoring includes beach profiles and limited biological surveys before construction, turbidity monitoring during construction, and beach profiles and limited biological surveys for approximately 6 years after construction. Shoreline monitoring includes: beach monitoring along transects, aerial photos, and lagoon closure and maintenance records.

[50] Applicable modifications were taken from San Diego Association of Governments (SANDAG) and U.S. Department of the Navy. 2000. Final Environmental Impact Report/Environmental Assessment for the San Diego Regional Beach Sand Project. Available online at: http://www.sandag.org/uploads/publicationid/publicationid_592_1356.pdf.

Table 2.2-1: Cost Estimates for Monitoring of Sand Replenishment Projects

Project Type	Per Project, 6 Year Cost[51]
Biological: Pre and Post Project Monitoring (2008$)	$250,000
Shoreline: Pre and Post Project Monitoring (2008$)	$600,000
Total	$850,000
Total (2010$)	$860,000
Annual Cost	$143,000
Source: Cost estimates taken from SANDAG and Moffatt & Nichol, "Feasibility Study: San Diego Regional Beach Sand Replenishment Project," August 2007 and personal communication with Shelby Tucker, SANDAG on April 14, 2010.	

In the absence of specific information about the extent of the regulatory baseline for black abalone, project modification costs for sand replenishment activities are assumed to be attributable to the black abalone critical habitat designation. Conservation measures undertaken for green sturgeon critical habitat may provide an additional baseline level of protection (under dredging) for black abalone critical habitat where habitats coexist. However, black abalone and green sturgeon have different habitat needs, and thus, different types of modifications would be considered to meet those needs. For example, pre- and post-project monitoring within rocky intertidal areas may be required to address impacts on black abalone critical habitat, whereas other modifications would be required for green sturgeon. Thus, this analysis assumes that approximately 100 percent of impacts would be attributable to black abalone critical habitat.

2.2.4 Summary of Economic Impacts to Sand Replenishment by Area

Table 2.2-2 presents a summary of potential impacts to sand replenishment activities.

Table 2.2-2: Summary of Economic Impacts to Sand Replenishment Activities by Specific Area

Area	Estimated Annual Number of Projects	Incremental Score	Total Annualized Impacts
2	0.2	1.0	$29,000
4	0.1	1.0	$14,000
7	0.3	1.0	$43,000
11	0.1	1.0	$14,000
Total			$100,000

[51] These costs are per project and project monitoring (pre, during and post construction) lasts about 6-6.5 years: 6 months-1 year for pre-construction, 6 months for construction, and 5 years for post-construction monitoring.

2.3 Economic Impacts of Critical Habitat Designation on National Pollutant Discharge & Elimination System (NPDES) Permitted Activities

2.3.1 Description of Threat

NMFS has identified NPDES-permitted activities (point source discharge), as a threat to black abalone critical habitat in 14 specific areas: specific areas 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 16, 17, and 19. This activity may affect the *food resources* and *water quality* PCEs.

Point source discharges may affect the water quality of receiving waters through the introduction of contaminants such as heavy metals, additional nutrients (which may lead to eutrophication), and increased water temperature. Exposure to heavy metals can affect growth of marine organisms, either promoting or inhibiting growth depending on the combination and concentrations of metals. Bays, inlets, or estuaries are more likely to be affected due to higher residence times, and thus high concentration, of metals. There is little information, however, on how rocky intertidal and subtidal communities may be affected by exposure to heavy metals.[52] The discharge of additional nutrients may affect food resources by causing light levels to be reduced to levels too low to support *Macrocystis* germination and growth. Eutrophication occurs around southern California sewage outfalls where phytoplankton crops and primary production exceed typical levels and approach values characteristic of upwelling periods. Finally, increased water temperatures may affect the health of black abalone by increasing the risk of an outbreak of withering syndrome.

2.3.2 Regulatory Environment & Extent of Activity

Under the NPDES program, the Environmental Protection Agency (EPA) sets pollutant-specific limits on the point source discharges for major industries and provides permits to individual point sources that apply to these limits. According to a 2001 Memorandum of Agreement between the EPA, NMFS, and the USFWS, the EPA has provided States and Tribes authority over their CWA permitting when appropriate.[53]

Although development and implementation of State water quality standards are subject to an ESA section 7 consultation between NMFS and the EPA, as an added precaution, NMFS may review each individual NPDES permit application to confirm that listed species are not adversely affected by water quality impacts. If the proposed permit does not appear to meet State water quality standards, NMFS may object

[52] Crowe et al. 2000.

[53] U.S. Environmental Protection Agency, Department of the Interior, and the Department of Commerce, Memorandum of Agreement Between the Environmental Protection Agency, Fish and Wildlife Service and National Marine Fisheries Service Regarding Enhanced Coordination Under the Clean Water Act and Endangered Species Act; Notice, Federal Register Vol. 66, No. 36, February 22, 2001.

to issuance of the permit, and the State may ask the applicant to alter the permit to meet the standards. Although the State Agencies themselves issue the vast majority of NPDES permits, the EPA issues federal NPDES permits for tribal lands and for any discharges into federal ocean waters beyond state boundaries.

The NPDES contains general and individual permits. General permits cover multiple facilities within a specific category, whereas individual permits are tailored for a specific discharge and analyzed on a case-by-case basis. The EPA developed a major/minor classification system for individual industrial and municipal NPDES permits to provide an initial framework for setting permit issuance priorities during the first and second rounds of NPDES permit issuance. Major permits almost always have the capability to impact receiving waters if not controlled. Minor permits may or may not adversely impact receiving waters if not controlled. There are approximately 65,000 dischargers in the United States which have been issued NPDES permits. Currently, 7,500 of these are termed "major" permits, due to size or composition of wastewater or both. The remainder are termed "minor" permits.[54]

Table 2.3-1 presents the number of current NPDES permits for outfalls within the high and low buffers (outlined in Section 1.4.1 of this report). NPDES-permitted outfalls are facilities holding permits to discharge municipal and industrial wastes to surface water. While these numbers represent active past and present permit locations, we assume the general pattern of permitting locations is likely to continue into the future.

[54] U.S. Environmental Protection Agency, Office of Water. "National NPDES Minor Permit Issuance Strategy," Office of Water Enforcement and Permits, Permits Division, Technical Support Branch. January, 1986.

Table 2.3-1: Estimated Number of Minor and Major NPDES-permitted Facilities, by buffer* and specific area

	Minor		Major	
Area	Low buffer	High buffer	Low buffer	High buffer
1	0	4	0	0
2	1	23	0	19
3	0	22	0	19
4	0	22	3	22
5	0	1	0	1
7	3	6	1	4
8	1	4	1	4
9	2	2	0	1
10	0	2	2	7
11	16	50	8	11
12	1	2	2	5
16	0	1	0	2
17	1	1	0	0
19	0	0	2	2
Total	25	93	19	56

*Note: For an explanation of the high and low buffers, see Section 1.4.1 of this report. Totals are adjusted for double-counting of outfalls that overlap multiple specific areas.
Source: US EPA Water Discharge Permit Compliance System (PCS)

Section 403 of the CWA requires that NPDES permits for dischargers into the territorial seas, the contiguous zone and the oceans be issued in compliance with EPA's guidelines for determining the degradation of marine waters. Changes to the NPDES regulations on September 1, 1983 also provide that the EPA's Regional Administrator shall issue general permits covering discharges from offshore oil and gas facilities within the Region's jurisdiction. Ocean discharge guidelines set forth criteria for determinations of unreasonable degradation and irreparable harm which must be addressed prior to the issuance of a NPDES permit. Some factors considered in a determination of unreasonable degradation are: The composition and vulnerability of biological communities which may be exposed to such pollutants including threatened or endangered species, the importance of receiving water area to the surrounding biological community including forage areas and migratory pathways, the existence of special aquatic sites including marine sanctuaries and refuges, etc., and marine water quality criteria developed pursuant to Section 304(a)(1) of the CWA.[55]

[55] U.S. Environmental Protection Agency. "The NPDES Permitting Process for Oil and Gas Activities on the Outer Continental Shelf." June 18, 1985.

2.3.3 Impacts of Critical Habitat Designation on NPDES-permitted Activities

Black abalone critical habitat could impose modifications to State Water Quality Standards that result in modifications and costs to NPDES-permitted facilities in order to comply with the standards. However, specific changes to standards to protect black abalone critical habitat, and the resulting project modifications to comply with those standards at NPDES-permitted facilities, are unknown at this time. In general, California's State Water Quality Standards approved by the EPA provide a level of protection for black abalone critical habitat by setting standards for various aspects of water quality, including temperature, chemicals, and pH. If changes were imposed due to black abalone critical habitat, the goals would likely be to reduce the concentrations/levels/types of toxins discharged into the environment, especially in areas surrounding kelp, and to maintain water temperatures in receiving waters.

Although there have been no formal consultations regarding water quality issues associated with black abalone to date, a number of such consultations have occurred with regard to other species that can be used to estimate the potential modifications and associated costs that may result from the black abalone critical habitat designation. NMFS has consulted with EPA on various aspects of its approval of State Water Quality Standards, including development of Total Maximum Daily Loads (TMDLs), review of non-temperature related Water Quality Standards, and clean-up of Superfund sites.

In general, the only project modification resulting from consultation for salmon or steelhead species pertained to water temperature controls. While NPDES-permitted facilities have always been required to adhere to certain temperature criteria associated with effluent discharge, the EPA's 2003 guidance for temperature water quality standards has led to stricter standards where salmon and steelhead are known to spawn or rear. As a result, this analysis focuses on costs associated with the temperature criteria.

The EPA issued guidance to States and tribes in 2003 on the development of temperature criteria deemed protective of salmon and steelhead. As a result, NPDES-permitted facilities in the Pacific Northwest are required to ensure effluent discharge does not raise the temperature in receiving waters above site-specific minimum temperature standards.[56]

This analysis estimates that if modifications to pollution discharge operations are required to comply with the temperature control criteria, NPDES-permitted facilities may identify and employ a number of temperature control procedures through Temperature Management Plans (TMPs). Temperature control

procedures used at NPDES-permitted facilities can include process optimization (identifying management procedures that could be altered to reduce thermal loads to waste streams), re-use of effluent to reduce the volume of discharge, storing heated wastewater, and installing treatment technology to reduce temperatures. The analysis estimates the operations and maintenance (O&M) costs and capital expenditures necessary to comply with the temperature control criteria, with the assumption that facilities would first employ low cost controls and then consider more costly controls if needed.

Using EPA data, major facilities are assumed to require significant capital expenses to comply with the temperature criteria, while minor facilities are assumed only to require O&M expenditures. This analysis assumes that minor facilities will incur costs of $0 to $15,100 annually (in 2010 dollars) to comply with temperature control criteria, while major facilities will incur $5,800 to $37,700 annually in O&M costs.[57] In addition, major facilities are assumed to incur capital costs of $47,140 annually.[58] Based on EPA's sample of facilities all costs are assumed to incur uniformly over a 20-year period.

Existing Federal, state, and local standards and regulations appear to offer the black abalone critical habitat a high level of baseline protection. As stated above, states are required to set Water Quality Standards that address different components of water quality, including acceptable levels of water temperature, pollutants, and pH. These standards are subject to approval by the EPA and implemented through the NPDES permitting program. The existing California Water Quality Standards provide a level of protection for black abalone critical habitat. In the future, changes may be required to address concerns specific to black abalone critical habitat, but at this time we cannot identify what changes may be required. In addition, this analysis assumes that conservation measures undertaken for green sturgeon critical habitat may also offer some additional baseline protections. Therefore this analysis assumes that approximately 10 percent of impacts in areas where green sturgeon critical habitat is present may be attributable to black abalone habitat. In cases where green sturgeon critical habitat is not present, approximately 20 percent of impacts are attributed to black abalone critical habitat. Appendix C of this report provides a sensitivity analysis for these assumptions, providing estimates assuming that black abalone critical habitat is responsible for the generation of all project modification costs for all projects.

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[56] U.S. Environmental Protection Agency. Region 10 Guidance For Pacific Northwest State and Tribal Temperature Water Quality Standards. EPA 910-B-03-002, April 2003. Available online at: www.epa.gov/r10earth/temperature.htm.

[57] This analysis applied EPA's economic impact assessment to estimate modification costs for NPDES-permitted facilities. See NMFS August, 2005 for more information.

[58] Science Applications International Corporation. 2003. Economic Analysis of the Proposed Water Quality Standards Rule for the State of Oregon. EPA No. 68-C-99-252; Adjusted to 2009 dollars using the U.S. Bureau of Economic Analysis, National Economic Accounts, National Income and Product Accounts table, 2009.

2.3.4 Summary of Economic Impacts to NPDES-permitted Facilities by Specific Area

Tables 2.3-2 and 2.3-3 present a summary of our findings regarding the potential economic impacts to minor and major NPDES-permitted facilities as a result of this designation. While NMFS consults on all federal and tribal permits, it does not necessarily consult on every state permit; however, for purposes of this analysis we assumed consultation on all permits. Therefore, these estimated costs are likely to be an overestimate of the true costs.

For both minor and major NPDES-permitted facilities, specific areas 2, 3, 4, and 11 all rank in the top four as having moderate to high economic impacts. For minor facilities, specific area 11 is estimated to have the highest economic impacts, followed by specific areas 3, 2, and 4. For major facilities, specific area 3 is estimated to have the highest economic impacts, followed by specific areas 4, 2, and 11. This is mainly due to the large number of facilities identified in these specific areas, compared to the other specific areas.

Table 2.3-2: Summary of Economic Impacts to Minor NPDES-permitted Facilities by Specific Area

Area	Low buffer	High buffer	Incremental Score	Total Annualized Costs		
				Low	Mid	High
1	0	4	0.1	$0	$3,000	$6,000
2	1	23	0.1	$0	$17,000	$35,000
3	0	22	0.2	$0	$33,000	$66,000
4	0	22	0.1	$0	$17,000	$33,000
5	0	1	0.1	$0	$1,000	$2,000
7	3	6	0.1	$0	$5,000	$9,000
8	1	4	0.1	$0	$3,000	$6,000
9	2	2	0.1	$0	$2,000	$3,000
10	0	2	0.1	$0	$2,000	$3,000
11	16	50	0.1	$0	$38,000	$76,000
12	1	2	0.1	$0	$2,000	$3,000
16	0	1	0.2	$0	$2,000	$3,000
17	1	1	0.2	$0	$2,000	$3,000
Total*				$0	$77,000	$154,000

*Note: Totals are adjusted for double-counting of outfalls that overlap multiple specific areas.

Table 2.3-3: Summary of Economic Impacts to Major NPDES-permitted Facilities by Specific Area

Area	Low buffer	High buffer	Incremental Score	Total Annualized Costs		
				Low	Mid	High
2	0	19	0.1	$0	$81,000	$161,000
3	0	19	0.2	$0	$161,000	$322,000
4	3	22	0.1	$16,000	$101,000	$187,000
5	0	1	0.1	$0	$4,000	$9,000
7	1	4	0.1	$5,000	$20,000	$34,000
8	1	4	0.1	$5,000	$20,000	$34,000
9	0	1	0.1	$0	$4,000	$9,000
10	2	7	0.1	$11,000	$35,000	$59,000
11	8	11	0.1	$42,000	$68,000	$93,000
12	2	5	0.1	$11,000	$27,000	$42,000
16	0	2	0.2	$0	$17,000	$34,000
19	2	2	0.2	$21,000	$28,000	$34,000
Total*				$111,000	$337,000	$563,000

*Note: Totals are adjusted for double-counting of outfalls that overlap multiple specific areas.

2.4 Economic Impacts of Critical Habitat Designation on Coastal Urban Development

2.4.1 Description of Threat

NMFS has identified coastal urban development as a potential threat to the essential features identified for black abalone critical habitat in eight specific areas: specific areas 2, 4, 7, 8, 10, 17, 19, and 20. Coastal urban development activities that may affect black abalone habitat include residential and commercial development. These activities may affect the *rocky substrate, food resources*, and *settlement habitat* PCEs.

The main concern is the increased sediment load that may result from urbanization of the coast and of watersheds (i.e., increased transport of fine sediments into the coastal zone by runoff). In addition, construction of coastal armoring is often associated with coastal urban development to protect structures from wave action or to prevent erosion (see "in-water construction" in Section 2.1 of this report). There has been little study of the effects of increased sedimentation on rocky shoreline communities.[59] Increased sedimentation may affect settlement of larvae and propagules by covering up settlement habitat as well as affecting the growth of encrusting coralline algae,[60] thought to be important for settlement. Increased sedimentation may also affect feeding by covering up food resources, altering algal communities (including algal communities on the rocky reef and the growth of kelp forests that supply drift algae), and

[59] Airoldi 2003

altering invertebrate communities (affecting biological interactions). Ephemeral and turf-forming algae were found to be favored in rocky intertidal areas that experience intermittent inundation.[61] Sedimentation may also reduce the amount of habitat available for black abalone. For example, in a study on San Nicolas Island, black abalone "dominated areas where rock contours provided a refuge from sand deposition."[62] Take-related effects include smothering or scouring of adult and juvenile black abalone.

2.4.2 Regulatory Environment & Extent of Activity

The most common Federal nexus for residential and related development activities is the requirement for a USACE permit for construction or expansion of stormwater outfalls, discharge or fill of wetlands, flood control projects, bank stabilization, and in-stream work.

Coastal urban development is prevalent throughout the California coast within the specific areas. While the specific locations of future coastal development activities are not known, this analysis assumes that a reasonable proxy for understanding the location of future actions is past actions.

Identifying the location and extent of wetlands on a parcel of land is essential to the planning process of development projects, whether that project is for the construction of a single family home, a residential subdivision, or a commercial development.[63] This process is known as USACE jurisdictional determinations (JDs). This analysis identifies the location of coastal development projects within the specific areas using the latitude and longitude of historic USACE section 10 (of the RHA) and 404 (of the CWA) JDs, which are believed to contain the bulk of relevant projects that may impact black abalone habitat (see Section 2.1.2 of this report for a detailed description of the data used). These data are presented in Table 2.4-1.

[60] See Steneck et al. 1997, cited in Airoldi 2003
[61] Airoldi 1998, cited in Thompson et al. 2002
[62] Littler et al. 1983, cited in Airoldi 2003
[63] USACE. 2000. Public Notice: Jurisdictional Determinations. Accessed in May 2010 at: http://www.nap.usace.army.mil/cenap-op/regulatory/jd.htm.

Table 2.4-1: Approximate Location and estimated average level of Coastal Urban Development Projects by Specific Area

Area	Average Number of JDs from 2004-2009
2	5
4	1
7	3
8	1
10	0.8
17	0.2
19	0.6
20	0.2
Total	11.8

2.4.3 Impacts of Critical Habitat Designation on Coastal Urban Development

Black abalone critical habitat could impose modifications on coastal urban development activities such as requiring:

- Stormwater pollution prevention plans;
- Permanent stormwater site plans; and
- Stormwater best management practice (BMP) operations and maintenance.

Per project modification costs were based off of estimated costs for the maintenance of erosion and sediment control BMPs (to be borne in a single year) for 1-acre commercial development, 10-acre commercial development, and 10-acre residential development. The low scenario represents costs associated with 1-acre commercial development. The high scenario represents costs associated with 10-acre commercial and residential development. These cost estimates were based on information from the Washington Department of Ecology.[64] All potential project modification costs were aggregated and applied as the average project cost to each project.

Existing Federal, state, and local standards and regulations appear to offer the black abalone critical habitat a moderate level of baseline protection. For example, existing regulations would most likely already require most projects to implement measures to minimize erosion and sediment input into water bodies. Sanctuary regulations prohibit the discharge of materials within its boundaries that may harm sanctuary resources. However, the designation of black abalone critical habitat may require additional

[64] Herrera Environmental Consultants, Inc. 2001. Cost Analysis: Washington Department of Ecology, Year 2001 Minimum Requirements for Stormwater Management in Western Washington. Prepared for the Washington State

modifications specifically for the protection of black abalone habitat. Therefore, this analysis assumes that approximately 50 percent of impacts are attributable to black abalone habitat. Appendix C provides a sensitivity analysis for these assumptions, providing estimates assuming that black abalone critical habitat is responsible for the generation of all project modification costs for all projects.

2.4.4 Summary of Economic Impacts to Coastal Urban Development by Specific Area

Table 2.4-2 below presents a summary of potential impacts to coastal urban development activities.

Table 2.4-2: Summary of Economic Impacts to Coastal Urban Development Projects by Specific Area

Area	Activity Count (Estimated Annual Number of Projects)	Incremental Score	Total Annualized Costs		
			Low	Mid	High
2	5	0.5	$5,000	$20,000	$36,000
4	1	0.5	$1,000	$4,000	$7,000
7	3	0.5	$3,000	$12,000	$21,000
8	1	0.5	$1,000	$4,000	$7,000
10	0.8	0.5	$1,000	$3,000	$6,000
17	0.2	0.5	$1,000	$1,000	$1,000
19	0.6	0.5	$1,000	$2,000	$4,000
20	0.2	0.5	$1,000	$1,000	$1,000
Total			$12,000	$48,000	$85,000

2.5 Economic Impacts of Critical Habitat Designation on Sediment Disposal Activities Associated with Road Maintenance, Repair, and Construction

2.5.1 Description of Threat

NMFS has identified sediment disposal activities associated with road maintenance, repair, and construction activities (called "side-casting" in the draft economic analysis (NMFS 2010)) as a potential threat to the essential features identified for black abalone critical habitat in two specific areas: specific areas 7 and 8. These activities may affect the *rocky substrate*, *food resources*, and *settlement habitat* PCEs.

The sediment disposal activities of concern involve the management and disposal of excess sediments generated from road maintenance, repair, and construction activities (primarily along California State Route 1, or Highway 1), with the material being placed in approved disposal areas and managed using methods (e.g., compaction and revegetation) to minimize the movement of sediment into the marine

Department of Transportation and Washington State Department of Ecology. August 30, 2001. 107 pp. Available online at: http://www.ecy.wa.gov/programs/wq/stormwater/herrera.html.

environment. Such sediment disposal activities may increase the likelihood of landslides and result in road failures and other earth movements. The main concern with these sediment disposal activities is the increased likelihood of sediment input into rocky intertidal and subtidal habitats. Potential effects on black abalone critical habitat would be similar to those described above for coastal urban development (i.e., effects on larval settlement habitat, reductions or changes to food resources, inundation of rocky habitat).[65]

2.5.2 Regulatory Environment & Extent of Activity

Currently, the only known federal nexus is for projects occurring within or adjacent to the MBNMS and thus requiring a MBNMS permit or approval authority and, in some cases, a permit from the USACE. Sanctuary regulations prohibit discharge of materials within its boundaries, as well as outside its boundaries if the material may enter the sanctuary and harm sanctuary resources.[66] However, under certain circumstances, a permit may be obtained from the MBNMS to allow for a prohibited activity. Caltrans has been approved for three permits relevant to sediment disposal activities associated with road maintenance, repair, and construction.[67]

Waddell Bluffs Talus Disposal

Waddell Bluffs Talus Disposal activities occur in specific area 7. Caltrans has requested to place up to 30,000 cubic yards of sediment, transported from the base of Waddell Bluffs across California Highway 1, onto the beach below for dispersal by oceanic processes. Sediment is deposited on the beach using tracked and wheeled earth-moving equipment. The placement of rock debris over the embankment is expected to further protect the Waddell beach parking lot/vista point from wave erosion. The MBNMS permit for these activities is effective from October 2010 to December 2015[68].

Basin Complex Fire Debris Material Management

Caltrans holds two permits from the California Coastal Commission and County of Monterey for Basin Complex Fire Debris Material Management, located in specific area 8. Caltrans is interested in placing the debris (generated from the combined influence of fire and wet weather) seaward of California Highway 1 in several locations along the Big Sur coast, in Monterey County. This project is part of the Basin Complex Fire Emergency Response Projects. In response to the Basin Complex Fire (which

[65] Ibid.

[66] MBNMS. *Resource Protection Issues: Landslide Disposal*. MBNMS Resource Management Issues. Accessed at: http://montereybay.noaa.gov/resourcepro/resmanissues/landslide.html

[67] Data obtained through personal communication with Erica Burton, National Ocean Service, on March 2010.

[68] MBNMS Permit Report, dated February 3, 2011. Available online at: http://montereybay.noaa.gov/sac/2011/110210/020311permits.pdf.

occurred during July and August 2008) in Big Sur, emergency projects are proposed at numerous locations along Highway 1 to protect the highway facility and traveling public from threats associated with debris flow and rock fall from areas denuded by the fire. Projects consist of installing temporary (until the watershed is recovered, approximately 5 years) debris flow barriers upstream from identified culvert inlets and construction of permanent rock fall drapery and temporary barriers at the toe of identified rocky cut slopes. The MBNMS permit authorizing these projects is effective from July 2010 to September 2013[69].

2.5.3 Impacts of Critical Habitat Designation on Sediment Disposal Activities Associated with Road Maintenance, Repair, and Construction

Black abalone critical habitat could impose modifications to sediment disposal activities associated with road maintenance, repair, and construction, such as the requirement to[70]:

- Haul away (or store locally) excess material from road maintenance activities, rather than placing the material at disposal sites;
- Place excess material at a stable site at a safe distance from coastal rocky habitats; or
- Use of mulch or vegetation to stabilize the material.

In their public comments, Caltrans provided cost estimates for the Waddell Bluffs Talus Disposal project and Basin Complex Fire Emergency Response Projects. Below are the cost breakdowns, by project[71]:

Waddell Bluffs Talus Disposal

Assuming the disposal site is Monterey Regional Waste Management Department facility located in Marina, CA, and the material is hauled using 5 axle semi end dumps with a capacity of 18.25 cubic yards, the cost per yard hauled is estimated to be $8.76 per cubic yard per hour. Haul time is estimated to be 3 hours (round trip), making the cost $26.28 per cubic yard. A cost of $8 per cubic yard, was also given, to estimate the cost to place the material on the beach seaward of California Highway 1. This makes the project modification cost (i.e., to haul away material rather than place the material on the beach) $18.28 per cubic yard.

[69] MBNMS Permit Report, dated March 31, 2011. Available online at: http://montereybay.noaa.gov/sac/2011/110421/033111permits.pdf.
[70] See "Spoil disposal" info under "Road maintenance", Coast Property Owners Association. *Road maintenance*. Accessed at: http://www.cpoabigsur.org/Community/Road_Maintenance/Road_Maintenance_Main.html. Adapted from Weaver and Hagans 1994.

Basin Complex Fire Debris Material Management

Caltrans provided a range of cost estimates for this project. If material is hauled using 3 axle semi end dumps with a capacity of 7 cubic yards, the cost per yard hauled is estimated to be $17 per cubic yard per hour. If material is hauled using 5 axle semi end dumps with a capacity of 18.25 cubic yards, the cost per yard hauled is estimated to be $9 per cubic yard per hour. The location of the material source and destination is unknown, but it is safe to assume at least one hour (round trip). In some cases, however, the haul time may take 2-3 hours (round trip). Using the cost estimate of $8 per cubic yard to place the material seaward of California Highway 1, this makes the project modification cost (i.e., to haul away material rather than place the material seaward of California Highway 1) range anywhere from $1 to $43 per cubic yard.

Existing standards and regulations (specifically, regulations within the MBNMS) appear to offer the black abalone critical habitat a moderate to high level of baseline protection. As stated above, MBNMS regulations prohibit the discharge of materials within its boundaries, as well as outside its boundaries if the material may enter the sanctuary and harm sanctuary resources. Permits for discharges may be obtained, however, under certain circumstances. Therefore this analysis assumes that approximately 50 percent of impacts in areas that overlap the MBNMS may be attributable to black abalone habitat. Appendix C of this report provides a sensitivity analysis for these assumptions, providing estimates assuming that black abalone critical habitat is responsible for the generation of all project modification costs for all projects.

2.5.4 Summary of Economic Impacts to Sediment Disposal Activities Associated with Road Maintenance, Repair, and Construction by Specific Area

Table 2.5-1 below presents a summary of potential impacts to sediment disposal activities associated with road maintenance, repair, and construction. Specific area 7 is the only specific area that we can attribute quantitative impacts, since the cubic yards for specific area 8 is unknown.

Table 2.5-1: Summary of Economic Impacts to Sediment Disposal Activities Associated with Road Maintenance, Repair, and Construction by Specific Area

Area	Number of Cubic Yards	Incremental Score	Total Annualized Costs
			High
7	30,000	0.5	$274,000
8*	N/A	0.5	N/A
Total			$274,000

[71] Public comments by Jay Norvell, Division Chief, Division of Environmental Analysis, MS 27, Department of Transportation, November 23, 2010.

* Note that costs cannot be quantified for specific area 8, because the historical data used did not provide the number of cubic yards in this specific area. This does not mean that there will be no costs in the future.

2.6 Economic Impacts of Critical Habitat Designation on Agricultural Activities

2.6.1 Description of Threat

NMFS has identified agricultural activities as a potential threat to black abalone critical habitat in 10 specific areas: Specific areas 1, 2, 3, 4, 7, 8, 9, 10, and 12. These activities include irrigation, pesticide application, and livestock farming. Agricultural activities may affect the *water quality*, *rocky substrate*, *food resources*, and *larval settlement habitat* PCEs.

Soil erosion from intensive irrigated agriculture or livestock farming in areas adjacent to the coast can cause increased sedimentation into rocky intertidal and subtidal habitats (see Section 2.4 on coastal urban development in this report for a description of the potential effects of sedimentation).[72] Thus, it is reasonable to assume that there may potentially be adverse impacts to black abalone and their habitat in nearshore waters receiving sediment input from lands where intensive agricultural irrigation or livestock farming activities occur.

Regarding agricultural pesticides, laboratory experiments showed that the presence of pesticides (those examined in the study were DDT, methoxychlor, dieldrin, and "2,4-D") interfered with larval settlement, but had a much lesser effect on survival of larvae.[73] In addition, pesticide use can have effects on blue and green algae, including herbicide contamination of water that could severely reduce algal growth[74]; however, these studies focused on the impacts of agricultural pesticides in streams.[75] The concentration of agricultural pesticides that flows into coastal marine waters and rocky habitats is unknown, as is the concentration at which negative effects on larval settlement habitat and marine algal growth occur. Thus, the potential effects of agricultural pesticides on black abalone habitat are uncertain and discussed qualitatively rather than quantitatively.

[72] Morse, D.E., N. Hooker, H. Duncan, and L. Jensen. 1979a. "Y-aminobutyric acid, a neurotransmitter, induces planktonic abalone larvae to settle and begin metamorphosis." Science 204:407-410.
[73] Morse, D.E., N. Hooker, L. Jensen, and H. Duncan. 1979b. "Induction of larval abalone settling and metamorphosis by y-aminobutyric acid and its congeners from crustose red algae: II: Applications to cultivation, seed-production, and bioassays; principal causes of mortality and interference." Proceedings of the World Mariculture Society 10:81-91.
[74] Note that effects on brown algae are still unknown.
[75] Silver, J. and Riley, B. 2001.

2.6.2 Regulatory Environment & Extent of Activity

Irrigation

Operation of the Federal water projects is subject to consultation under section 7 of the ESA. Federal water projects include flood control activities, pumping plants, water diversions (i.e., for irrigation), water intake structures, and fish screen projects. Any water supplier providing water via contract with U.S. Bureau of Reclamation (USBR) or using infrastructure owned or maintained by the USBR is subject to consultation under section 7 of the ESA. Projects associated with privately owned diversions may require a Federal permit from the USACE under sections 401 or 404 of the Clean Water Act.[76]

Pesticide Application

Under the ESA, the EPA must consult with the USFWS and NMFS to ensure that the registration of products under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) complies with section 7 of the ESA. Historically, there were few consultations analyzing the impacts of product registration on anadromous species. In July 2002, a federal court ordered EPA to consult with the USFWS and NMFS to ensure that the registration of 37 pesticide active ingredients under the FIFRA complies with section 7 of the ESA. In January 2004, the EPA was enjoined from authorizing the application of a set of pesticides within certain distances from "salmon-supporting waters."[77] The EPA was required to consult with NMFS concerning possible adverse effects of pesticide applications on salmon and steelhead protected under the ESA. The court imposed two types of restrictions on application of pesticides covered in the lawsuit. For aerial applications, no pesticides can be applied within 100 yards of "salmon-supporting waters"; for ground applications, the distance is 20 yards.[78] Although unknown at the present time, given the primarily marine environment inhabited by black abalone and the uncertainty regarding the concentration of pesticides that may be introduced to these habitats from agricultural applications, the protections for salmon-supporting waters would likely be adequately protective of black abalone critical habitat.

Livestock Farming

A Federal nexus exists for all management activities relevant to livestock farming occurring on Federal lands. Activities conducted by the Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) are wide-ranging, but include fuel reduction activities, road construction, road obliteration, and road maintenance, maintenance of recreation facilities, fisheries programs, timber sales, permitting of

[76] NMFS 2007. Final Economic Analysis of Critical Habitat Designation for the Oregon Coast coho ESU.
[77] Washington Toxics Coalition, et al. v. EPA, C01-0132 (W.D. WA), 22 January 2004.
[78] Ibid.

livestock farming,[79] and permitting of various use permits.

Spatial Scope

This analysis uses spatial soil data to determine the amount of farmland used for agricultural activities. The data consisted of three types of farmland: prime farmland, farmland of statewide importance, and farmland of local importance. Prime farmland is defined as land that has been used for irrigated agricultural production at some time during the four years prior to collection and has certain soil attributes determined by the USDA. Farmland of statewide importance is defined as land that has been used for irrigated agricultural production at some time during the four years. Farmland of Local Importance is defined as land of importance to the local agricultural economy as determined by each county's board of supervisors and a local advisory committee.[80] Therefore, the high range cost estimates include all farmland acres identified (for all farmland types) and the low range cost estimates were calculated by taking the high range cost estimate multiplied by 25 percent to account for the definition of the farmland identified (i.e., these estimates were based on data across four years, thus, the high range cost estimate included the total costs across four years and the low range cost estimate included the costs for one year, or 25% of the high range cost estimate). In addition, each of the farmland types were identified within 20 and 100 yards from a waterbody (i.e., a stream or river) within the low and high buffers, respectively, (outlined in Section 1.4.1 of this report) for each of the areas considered for designation. Table 2.6-1 presents the acres of agricultural land used in the production of crops.

[79] The consultation history indicates that NOAA Fisheries consults on livestock farming on Federal lands, but does not consult on similar activities on private or other non-Federal lands. The reason for this is that livestock farming on non-Federal lands rarely needs a Federal permit, and thus does not have a Federal nexus.

[80] California Department of Conservation. FMMP - Important Farmland Map Categories Accessed in May 2010 at: http://www.conservation.ca.gov/dlrp/fmmp/mccu/Pages/map_categories.aspx.

Table 2.6-1: Estimated Acres of Prime Farmlands, Farmlands of Statewide Importance, and Farmlands of Local Importance by Specific Area

Area	within 20 yard buffer of streams/shoreline in the low buffer	within 100 yard buffer of streams/shoreline in the high buffer
1	441	4,988
2	1,352	7,568
3	0	1,848
4	54	6,596
7	710	20,751
8	306	19,386
9	662	5,608
10	2,237	22,576
12	113	5,054
Total*	5,875	74,676

*Note: Totals are adjusted for double-counting of acres that overlap multiple specific areas.
Source: USDA NRCS Soil Survey Geographic Database (SSURGO)

Livestock farming activities also occur within the specific areas. However, in order to be considered for this analysis, the activity must be located within federal lands. There is only one federal livestock farming land located along the California coast. The Stornetta Public Lands were donated to the Bureau of Land Management (BLM) in 2004. Approximately 1,000 acres are used for livestock farming north and west of Highway 1 in Mendocino County, CA. However, Mendocino County is not considered in this analysis. Therefore, we did not identify any livestock farming lands that potentially affect black abalone critical habitat.

2.6.3 Impacts of Critical Habitat Designation on Agricultural Activities

Black abalone critical habitat could impose modifications to agricultural activities, such as:

- For irrigated agriculture
    - Planning appropriate ground cover, through modifications such as those listed in Table 2.6-2.
- For livestock farming
    - Fencing riparian areas;
    - Placing salt or mineral supplements to draw cattle away from rivers;
    - Total rest of allotments when possible; and
    - Frequent monitoring.

Because the effects of agricultural pesticides on black abalone habitat are uncertain, it is unknown whether the critical habitat designation would impose additional modifications on agricultural pesticide

application. As described above, this analysis assumes that the court-ordered injunction restricting pesticide use in areas surrounding salmon- and steelhead-supporting waters will provide protection for black abalone critical habitat. In addition, NMFS has now completed consultations under section 7 of the ESA on the registration of 6 of 37 pesticide active ingredients that were part of the litigation – chlorpyrifos, malathion and diazinon in a biological opinion dated November 18, 2008[81] and carbaryl, carbamate and methomyl in a biological opinion dated April 20, 2009.[82] NMFS concluded that the registration of these pesticides was likely to jeopardize most listed salmon populations and was likely to adversely modify critical habitat. NMFS identified reasonable and prudent alternatives that included, among other things, no-application buffers of up to 1,000 feet for aerial applications and up to 500 feet for ground applications. Thus, restrictions have already been placed on the application of pesticides by the courts and in biological opinions issued by NMFS to protect ESA-listed salmonids and their critical habitat, including no-application buffers ranging from 60 ft to 1000 ft[83] around salmonid habitats where NMFS concluded jeopardy or destruction or adverse modification to designated critical habitat for ESA-listed Pacific salmonids. The purpose of these buffers is to reduce pesticide exposure to ESA-listed salmonids and their habitat, which would also reduce pesticide exposure to black abalone and their habitat along the coast.

Table 2.6-2 summarizes potential per project costs (in 2010 dollars) for modifications to agricultural activities resulting from critical habitat designation for black abalone. Because the number of farmland acres that will require such modifications is highly speculative, this analysis assumes that all acres will be subject to the following costs.

[81] NMFS. 2008. Endangered Species Act Section 7 consultation and biological opinion: Environmental Protection Agency registration of pesticides containing chlorpyrifos, diazinon, and malathion. NOAA NMFS Endangered Species Division of the Office of Protected Resources, Silver Spring, MD. 484 pp.
[82] NMFS. 2009b. Endangered Species Act section 7 consultation and biological opinion: Environmental Protection Agency registration of pesticides containing carbaryl, carbofuran, and methomyl. NOAA NMFS Endangered Species Division of the Office of Protected Resources, Silver Spring, MD. 609 pp.
[83] Washington Toxics Coalition, *et al.* v. EPA, No. 04-35138 (W.D. WA), 22 January 2004.

Table 2.6-2: Potential per Project Costs of Implementing Conservation Efforts for Agricultural Activities (2010$)

Activity	Typical Project Modifications	Estimated Costs
Irrigated Agriculture	Conservation crop rotation, underground outlets, land smoothing, structures for water control, subsurface drains, field ditches, mains or laterals, and toxic salt reduction.	$30 per acre[1]
Livestock farming	Fencing riparian areas, placing salt or mineral supplements to draw cattle away from rivers, total rest of allotments when possible, and frequent monitoring.	$32 per acre[2]

Notes:
[1] Based off of a 1992 USDA cost estimate for water management systems for erosion control, practice SP35. Source: U.S. Environmental Protection Agency. "Polluted Runoff (Nonpoint Source Pollution): Irrigation Water Management." Accessed at: http://www.epa.gov/owow/nps/MMGI/Chapter2/ch2-2f.html, last updated on January 2010. Adjusted to 2010 dollars.
[2] Costs for livestock farming are based on costs of modifications resulting from critical habitat designations from the salmon and steelhead species economic report. These modifications may be similar, or identical, to those that could be requested for black abalone.

Existing protections regarding pesticide application for ESA-listed salmonids and their designated critical habitat may provide a high level of baseline protection for black abalone critical habitat. However, in the case of irrigated agriculture, approximately 100 percent of impacts are attributed to black abalone critical habitat, assuming that black abalone critical habitat is responsible for the generation of all project modification costs.

2.6.4 Summary of Economic Impacts to Agricultural Activities by Specific Area

Table 2.6-3 presents a summary of potential impacts to agricultural irrigation within the low and high buffers. In all scenarios, specific area 10 is estimated to have the highest impacts. This is due to the large number of acres of potentially affected farmland identified for this specific area.

Table 2.6-3: Summary of Economic Impacts to Agricultural Irrigation by Specific Area

Area	Estimated Acres of Farmland*		Incremental Score	Total Annualized Impacts		
	within 20 yard buffer of streams/shoreline in the low buffer	within 100 yard buffer of streams/shoreline in the high buffer		Low	Mid	High
1	441	4,988	1.0	$3,000	$76,000	$150,000
2	1,352	7,568	1.0	$10,000	$119,000	$227,000
3	0	1,848	1.0	$0	$28,000	$55,000
4	54	6,596	1.0	$1,000	$99,000	$198,000
7	710	20,751	1.0	$5,000	$314,000	$623,000
8	306	19,386	1.0	$2,000	$292,000	$582,000
9	662	5,608	1.0	$5,000	$87,000	$168,000
10	2,237	22,576	1.0	$17,000	$347,000	$677,000
12	113	5,054	1.0	$1,000	$76,000	$152,000
Total**				$44,000	$1,142,000	$2,240,000

* Estimated acres include Prime Farmland, Farmland of Statewide Importance, and Farmland of Local Importance
**Note: Totals are adjusted for double-counting of acres that overlap multiple specific areas.

2.7 Economic Impacts of Critical Habitat Designation on Oil and Chemical Spills and Response

2.7.1 Description of Threat

NMFS has identified oil and chemical spills and response activities as a potential threat to the essential features in all of the specific areas being considered for designation. The best available data indicate that past spills have occurred within or in waters adjacent to the following nine specific areas: specific areas 2, 4, 5, 7, 8, 9, 12, 15, and 19. Response activities may affect the *rocky substrate*, *food resources*, *settlement habitat*, and *water quality* PCEs.

The effects of oil spills vary from no discernable differences to widespread mortality of marine invertebrates over a large area and reduced densities persisting a year after the spill.[84] Oil spill response activities may be as destructive, or more destructive, than the oil spill itself. Oil spill response may involve application of toxic dispersants (although less toxic dispersants have been developed in recent years) and the use of physical cleaning methods such as the use of high pressure and/or high temperature water to flush out oil.[85] The use of dispersants and physical cleaning methods may affect black abalone directly or affect food resources (i.e., the algal community). In experimental studies, effects on limpets and decreases in barnacle cover were greater in oil and oil/dispersant plots compared to control and

[84] Crowe et al. 2000.
[85] Ibid.

dispersant only plots.[86] Chemical spills could also affect food resources, if the chemicals kill algae or affect algal growth.

2.7.2 Regulatory Environment & Extent of Activity

The United States Coast Guard (USCG) has the authority to respond to all oil and hazardous substance spills in coastal waters and deepwater ports, while the EPA has the authority to respond to spills occurring in inland waters. The EPA and the USCG oversee the Oil Pollution Prevention regulations promulgated under the authority of the Federal Water Pollution Control Act. Among other issues, these regulations address requirements for Spill Prevention, Control and Countermeasure Plans and Facility Response Plans for offshore and onshore oil producers and carriers. The Facility Response Plans are submitted to the USCG for the transportation-related portion of the facility and to EPA for the non-transportation portions. The National Oil and Hazardous Substances Pollution Contingency Plan (or National Contingency Plan) is the Federal government's guideline for responding to both oil spills and hazardous substance releases. Regional Response Team IX (RRT-IX) is a formal organization of tribal, state and federal agencies as defined by the National Contingency Plan. Co-chaired by the EPA and the USCG, RRT-IX is responsible for ensuring that state and federal resources are available when needed for emergency response within the states of Arizona, California, and Nevada and the 146 tribal nations, and that the multi-agency relationships and coordination systems exist to support these emergency response efforts (The Regional Contingency Plan for federal region IX).[87]

NOAA's Emergency Response Division (ERD), which is part of NOAA's Office of Response and Restoration, facilitates spill prevention, preparedness, response, and restoration at national and local levels. Information on present and past spills and summary documents are provided on their website and serve as a communications tool to various responders and federal and local planners (http://www.incidentnews.gov). The ERD has responded to nearly every major marine spill in the United States over the last 25 years.

In 2001, an "Inter-agency Memorandum of Agreement (MOA) Regarding Oil Spill Planning and Response Activities under the FWPCA's National Oil and Hazardous Substances Pollution Contingency Plan and the Endangered Species Act" was signed by NOAA, USFWS, EPA, and USCG. The purpose of the MOA is to increase cooperation and understanding among agencies involved in ESA compliance at

[86] Crothers, J. H. 1983. Field experiments on the effects of crude oil and dispersant on the common animals and plants of rocky seashores. Marine Environmental Research 8:215-239. *Cited in*: Crowe et al. 2000.
[87] California Department of Fish and Game. *The Regional Contingency Plan for federal region IX*. Accessed at: http://www.dfg.ca.gov/ospr/response/acp/marine/2005RCP/RCP102405.pdf.

every stage in oil spill planning and response. The MOA outlines procedures to streamline the ESA compliance process before, during, and after an incident.

In November 2003, NOAA issued a programmatic biological opinion to EPA and USCG that addressed most response actions undertaken by these agencies to limit or prevent oil discharges and their effects on listed species and their habitats in the Pacific Northwest. This consultation included such species as salmon species, whale species, and the Steller sea lion. The consultation found that many oil spill response activities could be treated programmatically, but that some actions which were "less predictable" were identified as potentially requiring individual consultation.[88]

The USCG records indicate that nationally, 95 percent of historical oil spills are spills of less than 1,000 gallons.[89] "Major" spills are 10,000 gallons or more. "Serious" spills are 25-10,000 gallons.[90] National data from 1992-2001 on oil spills is presented in Table 2.7-1. The data shows that the number of spills and amount of oil spilled has generally decreased since 1997.

Table 2.7-1: U.S. National Oil Spill Data, 1992-2001

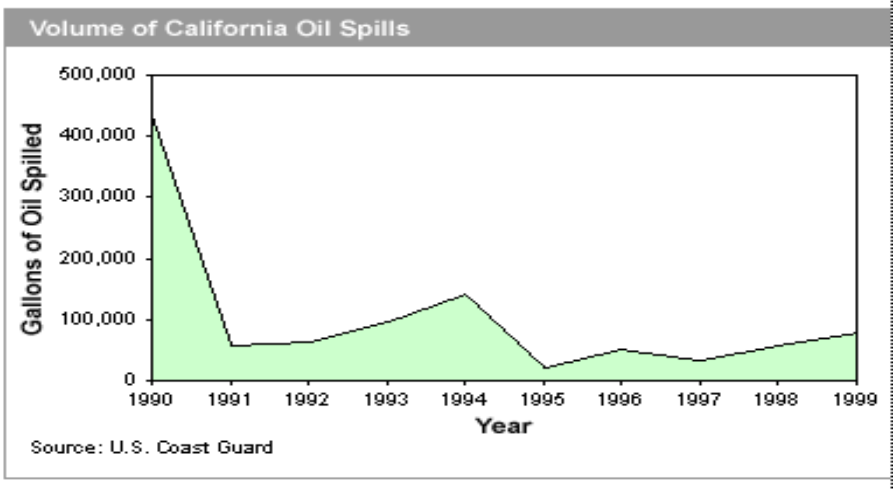
Year	Number of Spills	Gallons Spilled
1992	708	1,585,955
1993	618	2,060,422
1994	662	3,945,487
1995	505	1,899,525
1996	521	3,146,931
1997	395	1,019,809
1998	436	798,832
1999	367	1,315,204
2000	353	838,044
2001	253	501,045

Source: U.S. Coast Guard (USCG). "Oil Spill Response Research & Development Program, A Decade of Achievement." U.S. Coast Guard Research & Development Center, Groton, CT 06340-6048, Report No. CG-D-07-03. Accessed at: http://www.environmental-research.com/erc_reports/ERC_report_11.pdf.

In California, total gallons of oil spills have been less than 100,000 gallons per year from 1995-1999 (see Figure 2.7-1).

[88] NMFS. 2003. Endangered Species Act Section 7 Programmatic Formal Consultation and Magnuson- Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Oil Spill Response Activities Conducted Under the Northwest Area Contingency Plan (NWACP), November 6, 2003.
[89] NMFS. 2006. *Economic Impacts Associated with Potential Critical Habitat Designation for the Southern Resident Population of Killer Whales*. November 7, 2006.
[90] Puget Sound Water Quality Action Team. *State of the Sound 2004*. Accessed on June 9, 2009, at: http://www.psparchives.com/publications/puget_sound/sos/04sos/PSATSOS2004.pdf.

Figure 2.7-1: Volume of California oil spills (1990-1999)[91]



The Office of Spill Prevention and Response (OSPR) was created after the Exxon Valdez spill in Prince William Sound, Alaska, in 1989 and another large vessel spill (300,000 gallons of crude oil) off of Southern California in 1990. OSPR has the California Department of Fish and Game's public trustee and custodial responsibilities for protecting, managing, and restoring the State's fish, wildlife, and plants. It is one of the few State agencies in the nation that has both major pollution response authority and public trustee authority for wildlife and habitat. This mandate ensures that prevention, preparedness, restoration, and response will provide the best protection for California's natural resources.

Incident data were obtained from NOAA's Office of Response and Restoration for years 2000-2009. Note that these data only include incidents that NOAA worked on. Through personal communication with the Office of Response and Restoration,[92] NMFS was informed that this dataset does not include all incidents, but only those that involved NOAA's participation. NOAA's involvement in spill response activities is decided on a case-by-case basis based on several factors, including the size and location of the spill, the feasibility of response activities, and the potential for impacts to NOAA trust resources.

Spill incident data were plotted by integrating latitude and longitude information with GIS to determine how many past incidents occurred in each specific area. Each data entry was then examined to decipher if it was an actual spill or potential spill and how many gallons of oil, or harmful chemicals, were associated

[91] Natural Resource Defense Council (NRDC). *Oil Spills*. Accessed at: http://www.nrdc.org/greengate/wildlife/oilf.asp, on September 15, 2008.
[92] Personal communication with Jordan Stout, NOAA ORR, and Mathew Dorsey, NOAA ORR, on September 20 and 21, 2011, via email with Susan Wang, NMFS.

with it. An example of a potential spill is one where a vessel carrying diesel sank, but no diesel or chemicals leaked from the sunken vessel. An average of gallons spilled per incident was calculated for both actual and potential incidents in each specific area. Some entries did not have number of gallons available. For these entries, an average was taken for entries that did specify gallons and applied to the missing entries. These averages were then multiplied by the number of incidents (actual and potential), by specific area, to get the total amount of oil and chemicals that did spill, and potentially could have spilled, over the 10-year period. These totals were then divided by 10 years to get an annual estimated gallons spilled per specific area. These data are shown in Table 2.7-2.

Table 2.7-2: Estimated Number of Gallons Spilled per Year by Specific Area

Area	Actual	Actual + Potential
4	140	350
5	70	70
7	0	200
8	0	140
9	0	70
12	0	1
15	0	40
19	0	180
Total	210	1,051

Most of the spills documented were within 20 miles of the coast. Spills considered for this analysis incorporated all spills no matter the distance offshore, due to the possibility of the spill reaching the coast. Causes for the spills ranged from collisions (rare), vessel groundings[93], vessel capsizing, oil platforms, and "mystery spills." While such spills are monitored, in nearly all cases, no response to the oil and chemical spill was mounted due to size, location (i.e., little risk to shoreline or marine resources), rapid dissipation or evaporation, or weather.

These data show the actual and potential extent of oil spills that NOAA responded to within each specific area from the years 2000 to 2009. As stated above, these data include all medium and large oil spill incidents, but may not include all small incidents. When taken cumulatively, however, these small incidents may add up to the size of a large spill. For example, the National Park Service provided data showing that small oil spills associated with vessel wrecks have resulted in at least 700 gallons of spilled oil in the Point Reyes National Seashore (in Specific Area 2) from 1995 through 2005.[94]

[93] Impacts of vessel groundings are discussed more in-depth in section 2.8.

[94] Unpublished data on small vessel wrecks and small oil spills in the Point Reyes National Seashore, sent via email from Jeffrey Cross, National Park Service, on September 12, 2011, to Melissa Neuman (NMFS) and other recipients at the National Park Service and NMFS.

2.7.3 Impacts of Critical Habitat Designation on Oil and Chemical Spills and Response

Designation of black abalone critical habitat could result in modifications to oil and chemical spill response and cleanup activities to protect critical habitat features. For example, oil/chemical spill response plans may need to be revised to ensure that black abalone critical habitat areas are identified as sensitive areas where response activities should focus to protect from oil and chemical impacts. Methods that may be used to keep oil/chemical spills from coming onshore include the use of boom, dispersants, *in situ* burning, or Clean Seas boats. The designation of black abalone critical habitat may result in additional surveys to be conducted during and after spill response activities, to monitor the impacts of the spill and spill response activities on critical habitat. The designation of black abalone critical habitat could also influence the placement of proposed and future oil/chemical platforms (i.e., away from black abalone habitats), in order to minimize the risk of spills to critical habitat.

Impacts from modifications are difficult to quantify due to the unpredictability of oil and chemical spills and the incident-specific nature of spill response activities. Each spill is unique and the response is determined based on factors such as the type of oil involved, the sea state, the availability of mechanical or chemical materials to prevent oil from coming onshore, and the risk to resources. The existence of black abalone critical habitat in an area may affect decision-making regarding how to respond. However, those effects would be difficult to predict because black abalone critical habitat would be one of many factors that are weighed. Also, response activities that would be protective of black abalone critical habitat may be the same as what would already be considered for other resources at risk. For example, measures (e.g., mechanical recovery, boom, dispersants) to minimize the amount of oil that impacts the shoreline in black abalone critical habitat may already be considered due to the presence of black abalone and other sensitive resources in the area. Also, shoreline assessments and nearshore water quality monitoring during and after a spill response may already be a part of the response plan due to the presence of black abalone and/or other sensitive resources in the area, regardless of the presence of black abalone critical habitat.

In the draft economic report developed in support of the proposed black abalone critical habitat designation, a range of cost estimates for the cleanup of oil spills was calculated using "cleanup cost factor modifiers" presented by Etkin.[95] This model includes various attributes to describe an oil spill,

[95] Etkin, D. 2000. Worldwide analysis of marine oil spill cleanup cost factors. Environmental Research Consulting, Winchester, MA. June 2000.

which include: location (i.e., USA), oil type, spill size, location type (i.e., nearshore or offshore), primary cleanup method, and shoreline oiling.

The draft economic analysis presented a range of estimated costs for oil/chemical spill cleanup activities within each specific area. The "low scenario" cost estimate represented the spill cleanup costs (per gallon of oil or chemicals spilled) associated with reported incidents that did have a spill, whereas the "high scenario" cost estimate represented the spill cleanup costs (per gallon of oil or chemicals spilled) associated with both actual and potential incidents (Table 2.7-2).

The estimated costs were then adjusted using the incremental score to determine the incremental impacts of the black abalone critical habitat designation. Because existing Federal, state, and local standards and regulations appear to offer the black abalone critical habitat a high level of baseline protection, the draft economic analysis assumed that approximately 20 percent of spill response costs were attributable to black abalone habitat. The draft economic analysis on the economic impacts to oil and chemical spill response activities was based on the following assumptions: (a) the designation of black abalone critical habitat would likely restrict or modify the type of responses taken in a spill incident (e.g., limiting response methods to the use of boom, employing more Clean Seas vessel to minimize the amount of oil that comes onshore); (b) we are able to predict these restrictions or modifications; and (c) these restrictions or modifications would be different from what would already be required if black abalone critical habitat were not designated, such that additional burdens and costs would be incurred, making up 20 percent of the total spill response costs. Also, the draft economic analysis stated that the existence of black abalone critical habitat could increase the number of responses by requiring a response where it was not required before.

As stated above, the National Park Service provided additional data regarding small boat wrecks and associated oil spills in the Point Reyes National Seashore (specific area 2). In evaluating how to incorporate the new information, we obtained additional information from NOAA regarding spill response activities that led us to re-consider how the critical habitat designation may modify the response to spill incidents. The additional information obtained led us to conclude that there is great uncertainty regarding how the designation may affect spill response activities, because of the unpredictability of incidents, the incident-specific nature of response strategies, and the baseline protections provided by strategies already in place for other sensitive resources (including black abalone). Historical data show that past spill events often resulted from vessel groundings or collisions, which are difficult to predict and thus are subject to emergency consultation under section 7 of the ESA. In addition, the decision of

whether to respond, as well as how to respond, to a spill varies on a case-by-case basis depending on specific factors associated with a spill (e.g., the location, size, type of oil, sea state). A consultation under section 7 of the ESA can modify a Federal agency's action, but cannot compel an agency to take an action it normally would not take. As described above, it is uncertain how the existence of black abalone critical habitat may modify spill response activities. The presence of black abalone critical habitat in an area may result in prioritizing that area for shoreline protection (e.g., by the use of mechanical recovery methods, deployment of boom, or application of dispersants to keep oil offshore) or requiring shoreline assessments and nearshore water quality monitoring during and after the spill. However, these response activities would likely already be considered or required due to the presence of black abalone and/or other sensitive resources in the area. Thus, the presence of black abalone critical habitat may have little effect on spill response activities. Given these uncertainties regarding how black abalone critical habitat may affect spill response activities, we determined that a quantitative analysis of the economic impacts on oil and chemical spill response activities is not feasible at this time. This analysis is limited to a qualitative discussion of the potential impacts of the critical habitat designation on spill response activities, until we are able to obtain data (e.g., information from future incidents on how the presence of black abalone critical habitat affects spill response activities) to inform a quantitative analysis.

2.7.4 Summary of Economic Impacts to Oil and Chemical Spills and Response by Specific Area

In our proposed rule and draft economic analysis report, we made the assumption that if critical habitat for black abalone were designated, then the USCG may be restricted to certain response strategies and that these responses would be different from what the USCG would normally conduct if black abalone critical habitat were not designated. We also stated that the USCG may be more likely to launch a spill response if a response was not already going to be conducted. Based on that assumption, we provided a quantitative estimate of the economic impacts of the designation to oil and chemical spill response activities. Upon further consideration, however, based on existing spill response strategies, many of the strategies that would be considered for protection of black abalone critical habitat may already be considered for the protection of other sensitive resources. Until more information is available from future spill events and response activities, it is difficult to determine the incremental impacts of this designation on spill response activities. Recognizing these uncertainties, we revised the analysis to a qualitative discussion of the potential impacts on spill response activities. We note that working with the relevant state and Federal agencies on spill response plans may be the most effective way to address concerns regarding the potential impacts of these activities on critical habitat. NMFS has become more involved in spill response activities in California and plans to actively work with the USCG and OSPR to incorporate black abalone critical habitat information into California's Area Contingency Plans (ACPs), which

provide guidelines and information to be used during a spill response, and to identify strategies to protect critical habitat during spill response activities.

2.8 Economic Impacts of Critical Habitat Designation on Vessel Grounding and Response

2.8.1 Description of Threat

NMFS has identified vessel grounding and response activities as a potential threat to the essential features identified for black abalone critical habitat. Due to the uncertainty of the nature of vessel groundings, potential impacts can affect all specific areas. However, the available vessel grounding data show that past incidents have occurred in two specific areas: specific areas 2 and 8. This activity may affect the *rocky substrate, food resources, settlement habitat*, and *water quality* PCEs.

Vessel grounding and response can affect the rocky substrate and have substantial effects on the environment, ranging from minor displacement of sediment to catastrophic damage to reefs. Wave activity may also cause the vessel to roll excessively and do more damage to the ocean floor. Another potential impact of ship grounding is the risk of invasion by foreign species attached to the ship's hull into a local environment (impacts are discussed more in-depth in Section 2.14 of this report). The wreck of an ocean-going vessel can result in large masses of steel distributed over substantial areas of seabed, particularly in high energy, shallow water environments. The wreckage may be a chronic source of dissolved iron. Elevated levels of iron may effect water quality and result in an increase of opportunistic algal blooms. Oil leaking from a grounded vessel is also a concern; however, this is already covered under the oil spill section (see Section 2.7 of this report).

2.8.2 Regulatory Environment & Extent of Activity

The USCG has the authority to respond to all oil and hazardous substance spills in the offshore/coastal zone, while the EPA has the authority to respond in the inland zone (see Section 2.7.2 of this report for more details). The USCG was mandated by the Oil Pollution Act of 1990 to make participation in the Vessel Traffic Service (VTS) mandatory.[96] The purpose of a Vessel Traffic Service (VTS) is to provide active monitoring and navigational advice for vessels in particularly confined and busy waterways. They encompass a wide range of techniques and capabilities aimed at preventing vessel collisions, rammings, and groundings in the harbor, harbor approach, and inland waterway phase of navigation.[97]

[96] U.S. Department of Homeland Security, Navigation Center. History of Vessel Traffic Services. Accessed at: http://www.navcen.uscg.gov/mwv/vts/history.htm, on May 2010.
[97] U.S. Department of Homeland Security, Navigation Center. Vessel Traffic Services. Accessed at: http://www.navcen.uscg.gov/mwv/vts/vts_home.htm, on May 2010.

It is difficult to estimate the total number of nuisance vessels, due to changing conditions (i.e., new groundings of some vessels and re-floating of others).[98] Incident data were obtained from NOAA's Office of Response and Restoration for years 1999-2009. Note that these data only include incidents that NOAA worked on. There is only one reported vessel grounding, located in specific area 8, between the years 1999-2009.[99] In response to the proposed rule, the National Park Service provided additional information on nine vessel grounding incidents in the Point Reyes National Seashore (located within specific area 2) that occurred between the years1995 and 2005.[100] The available information on vessel grounding incidents in specific areas 2 and 8 is summarized below.

Specific Area 2

Between the years 1995 and 2005, nine vessel grounding incidents involving small vessels have been recorded in the Point Reyes National Seashore.[101] The vessels ranged in size from 15 to 68 feet. All of the incidents occurred within or adjacent to (within 5 km of) proposed black abalone critical habitat. At least three of the nine incidents resulted in the discharge of oil into the marine environment, with a total of at least 700 gallons of oil released.

Specific Area 8

In September 2001, the NOAA SSC was notified by MBNMS staff of a 45' fishing vessel aground on the rocks about 7 nm south of Pfieffer Point, on the Big Sur coast (USCG district 9). At the time, no other information was known about the type or amount of product onboard the vessel. First light observations did indicate a rainbow sheen about 150 feet by 1/2 nm long in the vicinity of the vessel.[102] Any damage to rocky substrate or the ocean floor is unknown.

2.8.3 Impacts of Critical Habitat Designation on Vessel Grounding and Response

Black abalone critical habitat could impose modifications on vessel grounding and response activities, such as:

- Requiring best management practices (BMP) for oil spill and debris clean-up to reduce trampling;

[98] Boring and Zelo (2008).
[99] There are records of three capsized vessels and one vessel adrift, but no records that these vessels grounded within rocky habitat.
[100] Unpublished data on small vessel wrecks and small oil spills in the Point Reyes National Seashore, sent via email from Jeffrey Cross, National Park Service, on September 12, 2011, to Melissa Neuman (NMFS) and other recipients at the National Park Service and NMFS.
[101] Ibid.
[102] NOAA, NOS Office of Response and Restoration. ResponseLINK. Assessed in May 2010 at: https://responselink.orr.noaa.gov/login.

- Education of USCG, NMS biologists, and others involved in clean-up to raise awareness of black abalone and black abalone habitat.

Existing standards and regulations (specifically, regulations within the NMS) appear to offer the black abalone critical habitat a high level of baseline protection. Therefore, this analysis assumes that approximately 20 percent of impacts in areas that overlap a NMS may be attributable to black abalone habitat. In cases outside of a NMS, approximately 100 percent of impacts are attributed to black abalone habitat. Appendix C of this report provides a sensitivity analysis for these assumptions, providing estimates assuming that black abalone critical habitat is responsible for the generation of all project modification costs for all projects.

2.8.4 Summary of Economic Impacts to Vessel Grounding and Response by Specific Area

While data on vessel grounding incidents are available for two specific areas, the extent of the impact is unknown. This analysis was unable to determine specifically how this threat would be alleviated for the specific areas. Due to such uncertainty, NMFS was unable to present a quantitative assessment for possible vessel grounding and response modifications for this analysis.

2.9 Economic Impacts of Critical Habitat on Power Plants

2.9.1 Description of Threat

NMFS has identified the operation of coastal power plants (specifically those that take in and discharge water from the ocean) as a potential threat to black abalone critical habitat in one specific area: specific area 10. This activity may affect the *water quality* PCE, through the power plant's use of coastal waters for cooling and subsequently discharging heated water back into the marine environment.

Coastal power plants that take in and discharge water from the ocean (e.g., using once-through cooling systems) may affect black abalone habitat by discharging thermal effluent (the potential entrainment of larval abalone in water intake systems is a take-related concern addressed by provisions of the ESA other than critical habitat). The Diablo Canyon Nuclear Power Plant (DCNPP) was identified in the proposed rule as the only plant located within any of the occupied specific areas that uses a once-through cooling system The DCNPP is located in specific area 10. The DCNPP is owned and operated by the Pacific Gas and Electric Company (PG&E), and is a nuclear-powered, steam-turbine power plant with a rated output of 2,200 MW of electricity. The power plant draws in seawater from a constructed intake cove through a cooling water system to provide cooling for power plant operations. The cooling water is returned to the ocean via a stair-step weir structure that opens on the eastern end of Diablo Cove. The DCNPP discharges

1,704,000 gallons per minute (gpm) of sea water into Diablo Cove. Low-volume wastes generated at the plant are combined with the water used for once-through cooling and also discharged into Diablo Cove and out into the Pacific Ocean.[103] The discharge water temperature is about 11°C greater than the ambient water temperature, with a maximum daily mean discharge temperature of 28.7°C or 84°F.[104] In order to control biofouling at the DCNPP, part of an auxiliary salt water system may be taken out of service and filled with "firewater" (approximately 40,000 gallons), which will be discharged. This takes place approximately once per month for approximately nine hours. Effects on the receiving water, etc., are being monitored. In addition, the plant may discharge low levels of chemical wastes, low-level radioactive wastes (treated and sampled for compliance with discharge limits), and storm-water runoff. Leakages could occur from operation, maintenance, and testing. The plant has a spill prevention control and countermeasure plan.

The elevated temperature of the discharged water may increase the virulence of withering syndrome in black abalone (elevated water temperatures have been shown to exacerbate the symptoms of this disease[105]). Thermal effluent may also facilitate the introduction and growth of non-native species (discussed in more detail in Section 2.14 of this report). In addition, thermal plumes may increase turbidity and sedimentation in the receiving waters and increase toxicity of pollutants in the effluent (waters may be chlorinated to reduce fouling or may be contaminated with heavy metals eroded from the cooling pipes).[106] Additional concerns include an increased potential for oil spills with increased barge traffic during maintenance and construction activities, and the potential for soot discharged into the air to settle on intertidal habitats.

2.9.2 Regulatory Environment and Extent of Activity

The Nuclear Regulatory Commission regulates commercial nuclear power plants and other uses of nuclear materials, such as in nuclear medicine, through licensing, inspection, and enforcement of its requirements. The California Energy Commission has multiple duties, such as: licensing thermal power plants 50 megawatts or larger and planning for and directing state response to energy emergencies.
In addition, the State Water Resources Control Board (SWRCB) has been delegated authority to implement the Federal Clean Water Act (CWA). Section 316(a) of the CWA requires the thermal component of a discharge be limited, taking into account the interaction of this thermal component with other pollutants, to assure the protection and propagation of balanced, indigenous populations of shellfish,

[103] Tetra Tech Inc. 2008.
[104] Tenera 1999.
[105] Friedman et al. (1997); Tenera (1999).
[106] Crowe et al. 2000.

fish, and wildlife in the receiving water. California State's Water Quality Control Plan for the control of temperature in coastal waters requires that elevated temperature effluent from existing discharges, such as the DCNPP's discharge, "shall comply with limitations necessary to assure protection of the beneficial uses and areas of special biological significance."[107]

In addition, Section 316(b) of the CWA requires that the location, design, construction, and capacity of cooling water intake structures, such as for DCNPP, must reflect the best technology available to protect aquatic life for large power utilities through the 316(b) Phase II regulation, promulgated in 2004. In 2007, EPA suspended the requirements of the 316(b) Phase II regulation because of the decision issued by the U.S. Court of Appeals for the Second Circuit, Riverkeeper, Inc. v. EPA, 475 F.3d 83 (2nd Cir. 2007). In November 2010, EPA signed a Settlement Agreement with Riverkeeper regarding rulemaking dates for EPA to set technology standards for cooling water intake structures for existing facilities under Section 316(b) of the CWA. EPA agreed to propose standards by March 14, 2011, and after considering public comments, to take final action by July 27, 2012. On March 11, 2011, the parties agreed to an amendment to the settlement agreement to extend the date for the proposed rule to March 28, 2011.

The State of California has adopted a "Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling,"[108] which establishes clear standards to implement the Clean Water Act in a consistent manner and thereby reduce the harmful effects associated with the cooling water intakes on life in the ocean and estuaries. Although entrainment is addressed by provisions of the statute other than critical habitat, these studies are relevant because a reduction in intake will result in an equivalent reduction in outflow, which contributes to addressing the 316(a) thermal discharge requirement.

This policy requires that DCNPP comply with standards set forth by the state by 2024.[109] As a result of this requirement, PG&E (owner and operator of the DCNPP) is conducting an evaluation to assess compliance alternatives to once-through cooling for the DCNPP , including: (a) closed-cycle cooling systems; (b) inshore mechanical intake fine mesh screening systems; (c) offshore modular wedgewire or similar exclusion screening systems; (d) relocation of the initial intake to an offshore intake; (e) deep water offshore intake for the point of initial intake to piping/conveyance systems; (f) variable speed

[107] State Water Resources Control Board (SWRCB). Water Quality Control Plan for the control of temperature in the coastal and interstate waters and enclosed bays and estuaries of California. Available online at: http://www.swrcb.ca.gov/water_issues/programs/ocean/docs/wqplans/thermpln.pdf
[108] SWRCB. 2010. Statewide water quality control policy on the use of coastal and estuarine waters for power plant cooling. October 1, 2010. Available online at: http://www.swrcb.ca.gov/water_issues/programs/ocean/cwa316/docs/policy100110.pdf.
[109] Ibid.

cooling water pumping systems; and (g) source water substrate filtering/collection systems (e.g., shoreline sand well collection systems, benthic substrate filtration collection system).[110] This evaluation is required by the SWRCB to assess the feasibility and costs associated with potential compliance alternatives. This evaluation is tentatively scheduled to begin in January 2012 and be completed in October 2013. It will be conducted in cooperation with the SWRCB and is expected to evaluate all of the alternatives to develop a plan for compliance with CWA requirements, irrespective of the fact that some technologies may have been determined infeasible in prior studies. The results of the evaluation will be used by the SWRCB and PG&E to develop a plan for compliance at the DCNPP.

2.9.3 Impacts of Critical Habitat Designation on Power Plants

In the proposed black abalone critical habitat rule and draft economic analysis report, we stated that the designation of critical habitat for black abalone could result in modifications to power plant operations. Based on the information available, we had estimated a range of economic impacts to the DCNPP as a result of the black abalone critical habitat designation. The low cost scenario was based on the costs associated with requiring compliance with the temperature control criteria for major NPDES facilities, which are explained in Section 2.3.3 of this report. The high cost scenario was based off of a 2008 report prepared for the California Ocean Protecton Council (OPC)[111] that provided an analysis of the costs and burdens required to retrofit the DCNPP with closed-system wet cooling towers.[112] Taking into account baseline protections under Federal, state, and local regulations, we had attributed 50 percent of the impacts to black abalone critical habitat. In the proposed rule, the estimated economic impacts ranged from $26,500 to approximately $150 million, and we noted that the high cost estimate was likely an overestimate of costs, because there may be less costly and more feasible actions that could be taken to avoid or minimize effects on black abalone habitat. Since the proposed rule, we have obtained additional information from the EPA and the SWRCB that have led us to revise the analysis of economic impacts to the DCNPP. As a result of these revisions, we have concluded that the black abalone critical habitat designation is not likely to have incremental economic impacts on the DCNPP (i.e., the revised estimated

[110] SWRCB. 2011. Scope of Work report by the Review Committee to oversee special studies for the nuclear-fueled power plants using once-through cooling, October 1, 2011. Accessed on October 7, 2011 at: http://www.waterboards.ca.gov/water_issues/programs/ocean/cwa316/rcnfpp/docs/draft_report093011.pdf

[111] Tetra Tech Inc. 2008. California's Coastal Power Plants: Alternative Cooling System Analysis. Prepared for the Californai Ocean Protection Council.

[112] Note: The report focuses on the use of alternative technology that would reduce and avoid entrainment and impingement of marine organisms. While the use of this alternative technology would also address effects on habitat (thermal effluent and water quality), much of the costs could be attributed to compliance with other existing regulations, including protections under the ESA-listing of black abalone.

economic impact is zero). The additional information received and revisions leading to this conclusion are provided below.

In order to address the high level of uncertainty associated with the estimated economic impacts to the DCNPP in our proposed rule, we investigated alternative methods that could be feasibly employed to minimize or eliminate the effects of thermal effluent. We also sought out information from the EPA and the SWRCB to increase certainty regarding baseline protections provided to the habitat under existing regulations. The additional information obtained led us to revise our analysis for the DCNPP.

Further investigation of potential modifications to DCNPP suggested there is a high degree of uncertainty regarding the economic and technical feasibility of the modifications originally considered. Conclusions regarding several modifications are subject to the outcomes of studies planned for 2012 (discussed above). In our proposed rule, we considered low cost modifications associated with compliance with NPDES permitting requirements (i.e., temperature control criteria), including alterations to plant operations to reduce the intake of water and thus the amount of water discharged. However, additional information provided by the EPA indicated that such modifications are not applicable to the DCNPP. Altering operations to reduce water intake when the facility is not producing power would not work at the DCNPP, because it is a nuclear power plant and needs to take in water for cooling purposes even when the plant is not producing power. Thus, the low cost modifications analyzed in the proposed rule are considered to be infeasible based on the best available information.

In our proposed rule, we also considered the high cost modification of retrofitting DCNPP from a once-through cooling system to a closed-cycle cooling system. While this option may address the issue of thermal effluent by reducing the volume of heated water that is discharged, it would not directly address the effects of thermal effluent. Further, a study conducted by the Central Coast Regional Water Quality Control Board (Central Coast RWQCB) in 2005 concluded that closed-cycle cooling systems would not be feasible for the DCNPP, because the massive physical area required for the cooling towers does not exist near the DCNPP.[113] Although the report prepared for the OPC in 2008 stated that retrofitting to a closed-cycle cooling system is feasible, it also noted that the location and layout of existing structures at the DCNPP "complicates the identification of suitable areas in which to place cooling towers" and acknowledges that considerations outside the scope of the study may limit the practicality or overall

[113] California Regional Water Quality Control Board, Central Coast Region. 2011. Staff report for regular meeting of September 9, 2005. Prepared on August 19, 2005. Accessed on October 7, 2011 at: http://www.waterboards.ca.gov/centralcoast/water_issues/programs/diablo_canyon/docs/09_09_05_staff_report/item15_staffreport.pdf.

feasibility of a wet cooling tower retrofit at the DCNPP.[114] Hence the feasibility of a wet cooling tower retrofit at the DCNPP is questionable.

Other options that more directly address the issue of thermal effluent and that would likely be associated with lower costs include the use of helper cooling towers, in which water is cooled prior to discharge, but not re-circulated, thus reducing the costs compared to closed-system cooling towers, and the re-routing of the heated discharge further offshore, rather than discharging directly into Diablo Cove.[115] The feasibility of installing helper cooling towers has not yet been evaluated, nor will it be considered in the study planned by PG&E. Therefore, the feasibility of this modification remains uncertain. Similar to closed-system wet cooling towers, the use of helper cooling towers may be constrained by limited space in the area around the DCNPP, depending on the size of the towers that would need to be constructed. In addition, the 2005 Central Coast RWQCB study concluded that moving discharge structures offshore is not feasible for the DCNPP, given the bathymetry of the habitat, which is steep, rocky, and rapidly drops off in depth offshore. Therefore, these two potential modifications are considered to be infeasible based on the best available information.

Based on this additional information, we have determined that neither the low costs (associated with altering power plant operations to reduce water intake and discharge, in compliance with temperature control criteria) nor the high costs (associated with retrofitting the DCNPP with closed-system wet cooling towers) analyzed in the proposed rule can be reasonably expected to be incurred due to the black abalone critical habitat designation. In addition, we note that regulations under the CWA provide a high level of baseline protection for black abalone critical habitat. Under Section 316(a) of the CWA, the DCNPP would already be required to take measures to address the effects of the facility's discharge on water quality. Therefore, we determined that it is unlikely that the designation of critical habitat would require modifications above and beyond what would already be required under the existing regulations.

[114] Tetra Tech Inc. 2008. California's Coastal Power Plants: Alternative Cooling System Analysis. Prepared for the California Ocean Protection Council.
[115] Personal communication with Paul Shriner, EPA, via phone call with Susan Wang, NMFS, on October 4, 2011.

2.9.4 Summary of Economic Impacts to Power Plants by Specific Area

As stated above, upon further consideration of the potential modifications that may be required as a result of this critical habitat designation and the baseline protections already provided under existing regulations, we revised our economic analysis for power plants. The best available information indicates that both the low cost modification of altering the power plant's operations to reduce water intake and discharge, and the high cost modification of retrofitting the power plant with closed-system wet cooling towers, are infeasible. In addition, the high level of baseline protections provided under the CWA make it highly unlikely that additional modifications beyond those already required under existing regulations would result due to this critical habitat designation. Therefore, we conclude that the black abalone critical habitat designation is not likely to result in incremental impacts to the cost of operating the DCNPP.

2.10 Economic Impacts of Critical Habitat Designation on Desalination Plants

2.10.1 Description of Threat

NMFS has identified the construction and operation of desalination plants as a potential threat to black abalone habitat in 8 specific areas: specific areas 4, 7, 8, 9, 10, 12, 17, and 19. The construction and operation of desalination plants may pose a threat to black abalone critical habitat by affecting *water quality*.

Hyper-saline water is generated as a byproduct of the desalination process and is generally about twice as saline (ranging from 46 and 80 ppt) as the ambient seawater (usually around 33 ppt).[116] Discharge of this hyper-saline water results in increased salinity and fluctuating salinity conditions that may affect sensitive organisms near the outfall. The impacts of brine effluent are generally more severe in rocky substrate than on sandy seafloor habitats.[117] However, more research is needed on the tolerance level of black abalone for different salinities. Other effects of the discharge on water quality include increased turbidity, concentration of organic substances and metals contained in the feed waters, concentration of metals picked up through contact with the plant components, thermal pollution, and decreased oxygen levels.[118] Entrainment and impingement of black abalone larvae may also occur from water intake at desalination plants, but this is primarily a take issue.

[116] MBNMS. *Resource Management Issues: Desalination*. MBNMS Resource Management Issues. Accessed at: http://montereybay.noaa.gov/resourcepro/resmanissues/desalination.html.
[117] Ibid.
[118] Ibid.

2.10.2 Regulatory Environment & Extent of Activity

The construction and operation of desalination plants requires multiple permits from Federal, state, and local agencies. Source water permits may be required from the USACE for the construction of new intake (or discharge) pipes. Potable water permits under the Safe Drinking Water Act would be required from the State for any plant producing drinking water. Finally, NPDES permits would be required for wastewater discharge.[119] Authorization by the Sanctuaries may be required for discharge into Sanctuary waters or for installation of structures on or beneath the ocean floor within the Sanctuary.[120]

The USCG is responsible for approving structures in navigable waters, such as intake and outfall pipelines, to ensure they don't adversely affect navigation. The USCG may also require buoys or markers to be maintained over the structures. The applicant may also be required to submit information about the structures to include on nautical charts.

A desalination facility may require a Section 404 permit under the CWA from the USACE if it involves placing fill in navigable waters, and a Section 10 permit under the RHA if the proposal involves placing a structure in a navigable waterway. Facilities may require review from NMFS and/or USFWS for their potential effects on endangered, threatened, or other sensitive species. They may also require review for effects on essential fish habitat (EFH), protected marine mammals, and migratory birds. Other permits may also be required from agencies such as the Federal Bureau of Reclamation, the EPA (e.g., NPDES permit), and the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE; formerly called Minerals Management Service or MMS).

The available consultation data upon which we based our analysis does not indicate that NMFS or the USFWS has consulted on past desalination projects regarding impacts on listed marine species. Further, existing desalination plants do not appear to have implemented measures to manage the discharge of hypersaline effluent for human protection or otherwise, to date. Discharges from desalination plants are subject to CWA requirements, but because there is no past consultation history, it is not clear whether CWA requirements adequately address hypersaline effluent in marine waters for black abalone habitat.

There are three existing coastal desalination plants located within the specific areas (see Table 2.10-1). One of these plants is not currently operating and another is unknown. Because water produced via

[119] National Research Council 2008

[120] Monterey Bay National Marine Sencturary (MBNMS). *Resource Management Issues: Desalination*. MBNMS Resource Management Issues. Accessed at: http://montereybay.noaa.gov/resourcepro/resmanissues/desalination.html.

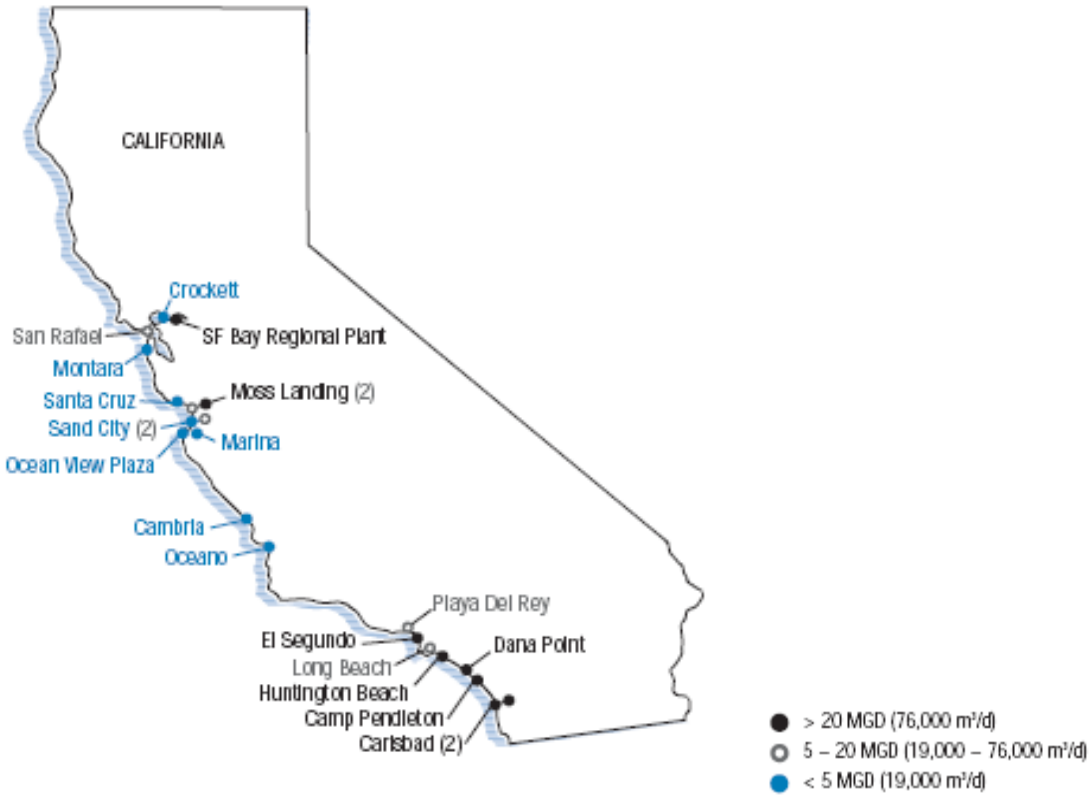
desalination tends to be more expensive than water from other sources, the operating status of a plant is highly dependent on prevailing drought conditions and local water prices. As water from other sources becomes scarce, desalination becomes a more viable source of drinking water, and desalination plants may be brought online. Seven additional desalination plants have been proposed but have not yet been constructed (see Table 2.10-1 and Figure 2.10-1). Generally, the proposed plants have greater capacities than existing plants, suggesting that these plants may produce a greater quantity of hypersaline effluent. Similar to LNG terminals and tidal and wave energy projects, it is unclear how many projects may ultimately reach construction stage.

Table 2.10-1: List of Desalination Plants by Specific Area[121]

Area	Project Name/(Ownership)	Capacity (MGD)	Status
Existing			
8	Monterey Bay Aquarium/(Non-profit)	0.04	Active
17	U.S. Navy/Nicholas Island/(Government)	0.02	Not known
19	Santa Catalina Island/(Public)	0.1	Inactive
Proposed			
4	Montara Water and Sanitary District	N/A	
7	City of Santa Cruz	2.5-4.5	
8	Monterey Peninsula Water Management District	7.5	
8	Ocean View Plaza	0.05	
9	Cambria Community Services District/(Department of the Army)	0.4	
10	Arroyo Grande/Grover Beach/(Ocean Community Services District)	1.9	
12	Municipal Water District of Orange County	25	

[121] Cooley et al. 2006. Desalination, with a grain of salt: A California perspective.

Figure 2.10-1: Proposed Desalination Plants in California (2006)



Source: Cooley, Heather, Peter H. Gleick, and Gary Wolff. 2006. Desalination, with a Grain of Salt: *A California Perspective*. Pacific Institute for Studies in Development, Environment, and Security. Accessed at: www.pacinst.org/reports/desalination/desalination_report.pdf on March 24, 2010.

2.10.3 Impacts of Critical Habitat Designation on Desalination Plants

Black abalone critical habitat could impose modifications to the construction and operation of desalination plants, such as:

- Requiring the use of brackish groundwater as a feed water source or certain technologies (injection wells, percolation galleries, open ocean disposal structures with diffusers) to dilute brine.[122]
- Requiring co-location with existing coastal power plants, to use the warmed power plant cooling water as the feedwater for the desalination plant. Another advantage is a reduction of the power plant discharge thermal plume.[123]

[122] MBNMS. *Resource Management Issues: Desalination*. MBNMS Resource Management Issues. Accessed at: http://montereybay.noaa.gov/resourcepro/resmanissues/desalination.html.
[123] Department of Water Resources. 2003. "Water Desalination: Findings and Recommendations." Accessed at: http://www.water.ca.gov/desalination/pud_pdf/Findings-Recommendations.pdf.

The California Coastal Commission (2004)[124] lists other modifications to avoid or minimize entrainment and impingement impacts:

- Use alternative designs and mitigation measures to avoid intake of water.
- Where subsurface intakes are infeasible, open water intakes may be designed and located so that entrainment and impingement are reduced, but usually not entirely eliminated.

The California Coastal Commission (2004)[125] lists other modifications to avoid or minimize adverse effects caused by desalination discharges:

- Proper location
- Subsurface outfalls
- Structural measures – diffusers or multiport outfalls
- Minimizing chemical use or using alternative treatments
- Wastewater treatment systems or on-land disposal

Under CWA requirements, desalination plants require Federal permits from USACE, EPA, or both. Therefore, where critical habitat is designated for black abalone in areas where these plants operate, an ESA section 7 consultation may be required to determine impacts. Potential conservation efforts to mitigate desalination impacts are likely to include the treatment of hypersaline effluent to ensure that salinity levels are restored to normal values.

At the low end, this analysis assumes that the cost of reducing salinity levels will be minimal. For example, desalination plants may be co-located with power plants. If co-located, the effluent can be mixed with the power plants' wastewater to reduce salinity at minimal cost. Many desalination plants already choose to be co-located with power plants because co-location can result in construction and energy cost savings.[126] In the proposed rule, this analysis assumed that desalination plants would utilize alternate methods of brine disposal. These alternate methods can include using injection wells, evaporation ponds, or crystallizers. However, a public comment pointed out that one proposed plant already plans to mix the residual brine with wastewater to be discharged through an existing outfall.[127]

[124] California Coastal Commission. 2004. Seawater desalination and the California Coastal Act. March 2004. 99pp. Available online at: http://www.coastal.ca.gov/energy/14a-3-2004-desalination.pdf.
[125] Ibid.
[126] Poseidon Resources, "Desal 101." Accessed on June 1, 2009 at: http://www.poseidonresources.com/desal_101.html.
[127] Public comments from Catherine Kilduff, Staff Attorney, Oceans Program, Center for Biological Diversity, November 29, 2010; South Orange Coastal Desalination Project. 2008. Ocean desalination project update. Winter 2008/2009 Newsletter. Available online at: http://www.scwd.org/water/watersupply/desalplant.asp. Confirmed by personal communication with Karl Seckel, Assistant General Manager, Municipal Water District of Orange County, on February 7, 2011.

After further review of the identified desalination plants, a majority of the plants already plan to mix the residual brine with water from wells or wastewater prior to discharge. Based on this information, this analysis has been revised to reflect that the costs for alternate methods of brine disposal (e.g., injection wells, evaporation ponds, or crystallizers) are no longer applicable to the analysis.

In the absence of specific information about the extent of the regulatory baseline for black abalone, project modification costs for desalination projects are assumed to be attributable to the black abalone critical habitat designation. In addition, this analysis assumes that conservation measures undertaken for green sturgeon critical habitat may offer some additional baseline protections. However, the habitat needs of the species differ and require different conservation measures. Therefore this analysis assumes that approximately 50 percent of impacts in areas where green sturgeon critical habitat is present may be attributable to black abalone habitat. In cases where green sturgeon critical habitat is not present, approximately 100 percent of impacts are attributed to black abalone habitat. Appendix C of this report provides a sensitivity analysis for these assumptions, providing estimates assuming that black abalone critical habitat is responsible for the generation of all project modification costs for all projects.

2.10.4 Summary of Economic Impacts to Desalination Plants by Specific Area

As discussed above, potential impacts on desalination plants are subject to high levels of uncertainty for the following reasons:

- The number of future desalination plants is speculative
- Future management and required project modifications for desalination plants are uncertain and could vary depending on the location and size of the plant.

As stated above, since a majority of the plants already plan to mix the brine with water from wells or wastewater prior to discharge, the costs for alternate methods of brine disposal are no longer applicable to this analysis. Therefore, the analysis of economic impacts on desalination plants is discussed qualitatively. Table 2.10-3 presents a summary of our findings.

Table 2.10-3: Summary of Economic Impacts of Desalination Projects by Specific Area

Area	Number of Affected Plants		Incremental Score
	Existing	Proposed	
4	0	1	0.5
7	0	1	0.5
8	1	2	0.5
9	0	1	0.5
10	0	1	1.0
12	0	1	0.5
17	1	0	0.5
19	1	0	1.0
Total			

2.11 Economic Impacts of Critical Habitat Designation on Tidal and Wave Energy Projects

2.11.1 Description of Threat

NMFS has identified the construction and operation of alternative energy hydrokinetic projects (i.e., tidal and wave energy projects) as potentially affecting three specific areas considered for designation as black abalone critical habitat: specific areas 1, 10, and 19. This activity may affect the *rocky substrate* and *water quality* PCEs.

Tidal and wave energy projects are designed to harness the kinetic energy of waves, currents, or tides to generate electricity. These projects typically involve placement of structures, such as buoys, cables, and turbines, in the water column. Projects can vary greatly in terms of size and design, and most are not yet fully developed. The potential effects of coastal wave and tidal energy projects on black abalone habitat are uncertain, because these projects are relatively new and the impacts are very site-specific. Wave energy projects may result in reduced wave height by as much as 5 to 13%,[128] which may benefit abalone habitat. Effects on wave height would generally only be observed 1-2 km away from the wave energy device. Another concern is the potential for liquids used in the system to leak or be accidentally spilled, resulting in release of toxic fluids.[129] Toxins may also be released in the use of biocides to control the growth of marine organisms.[130] Impacts on habitat may also result from the installation of power lines to transport power to shore.

[128] Surfrider Foundation. Coastal A-Z, *Alternative Ocean Energy*. Accessed at: http://www.beachapedia.org/Renewable_Ocean_Energy.
[129] Ibid.
[130] Ibid.

2.11.2 Regulatory Environment & Extent of Activity

Under the Federal Power Act, the Federal Energy Regulatory Commission (FERC) is authorized to issue licenses for the construction, operation, and maintenance of hydropower projects, including alternative energy hydrokinetic projects. For projects on the Outer Continental Shelf (OCS), BOEMRE has jurisdiction to issue leases and FERC has jurisdiction to issue licenses to these projects.[131]

Tidal and wave energy projects are subject to FERC permitting and licensing requirements, and thus may be subject to review under section 7 of the ESA for impacts to listed species and critical habitat. Both NMFS and USFWS have commented on several of the preliminary permit applications for these projects. In its comments, NMFS noted affected areas that represent EFH for federally managed species under the Magnuson Stevens Fishery Management Act, but indicated that the breadth and magnitude of potential adverse impacts on this habitat are unknown and cannot be evaluated without further information on and analysis of the specific projects at issue.[132] Other environmental statutes applicable to proposed or pilot projects are the Marine Mammal Protection Act and section 401 of the CWA. A proposed project would also likely require a finding of consistency by the relevant state under section 307 (c) of the Coastal Zone Management Act to ensure the project complies with the state's coastal zone management plan.

To date, five projects within the specific areas have received preliminary permits from FERC. Three of these projects fall within specific area 1, one project is within specific area 10, and one project is within specific area 19. Preliminary permits are issued for up to three years and allow the permit-holder priority to develop that site for the duration of the permit. Preliminary permits, however, do not authorize any construction. In order to construct and operate a hydrokinetic facility, a license must be issued by FERC.

A list of hydrokinetic projects proposed within the specific areas is presented in Table 2.11-1 and is based on review of information posted on FERC's website (at www.ferc.gov) as of September 9, 2010:

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[131] Federal Energy Regulatory Commission (FERC) and U.S. Department of Interior. 2009. Memorandum of Understanding regarding renewable energy projects in offshore waters on the Outer Continental Shelf. April 9, 2009. 3pp. Available online at: http://www.ferc.gov/legal/maj-ord-reg/mou/mou-doi.pdf.

[132] See, for example, National Marine Fisheries Service. *Comments on San Francisco Bay Tidal Energy Project* (FERC No. 12585), August 12, 2005.

Table 2.11-1: Preliminary Permits Issued by FERC for Tidal and Wave Energy Projects

Area	Docket No.	Project Name	Permittee	Issue Date	Expiration Date	Capacity	Classification
1	P-13376	Del Mar Landing	Sonoma County Water Agency	07/09/09	06/30/12	5,000	Wave
1	P-13377	Fort Ross (South)	Sonoma County Water Agency	07/09/09	06/30/12	5,000	Wave
1	P-13378	Fort Ross (North)	Sonoma County Water Agency	07/09/09	06/30/12	5,000	Wave
10	P-13641	Central Coast WaveConnect	PG & E	04/28/10	03/31/13	100,000	Wave
19	P-13498	SWAVE Catalina Green Wave	Sara, Inc.	09/15/09	08/31/12	6,000	Wave
Source: Federal Energy Regulatory Commission**.** *Issued Hydrokinetic Projects Preliminary Permits*. Accessed at: http://www.ferc.gov/industries/hydropower/indus-act/hydrokinetics/permits-issued.xls on September 9, 2010							

2.11.3 Impacts of Critical Habitat Designation on Tidal and Wave Energy Projects

The technology for hydrokinetic projects is relatively new and is still being actively developed. It is not yet known what number of the proposed projects will be constructed and become operational. Thus the ultimate design, location, and impacts of these projects are difficult to predict. Project modifications that would be required to minimize impacts to black abalone critical habitat are similarly difficult to predict and quantify. Potential modifications to these projects to mitigate adverse impacts may include spatial or temporal restrictions on project installation, operation, and maintenance. In the absence of specific conservation efforts recommended for listed species, the potential impact of black abalone critical habitat on tidal and wave energy projects remains uncertain.

Black abalone critical habitat could impose modifications to tidal and wave energy projects, such as:

- Use of non-toxic fluids instead of toxic fluids in systems with working hydraulic fluids.
- When the project requires the use of power lines, use existing power lines instead of constructing new ones and avoid coastal rocky habitats.

Data on the costs of these measures were not widely available. To develop an estimate of potential costs, this analysis relied on the estimated costs of environmental measures for a single project, and assumed that these costs will be incurred by all tidal and wave energy projects (see Table 2.11-2). We recognize that this sample is small, and thus large uncertainties exist with respect to estimated potential impacts to these projects. In addition, FERC points out in the "Economic Analysis of the Impacts of Designating Critical Habitat for the Threatened Southern Distinct Population Segment of North American Green Sturgeon (NMFS 2008)" that license application costs and costs related to environmental review of the

projects may increase due to critical habitat designation. While costs of ESA section 7 consultations are discussed in Section 1 of this report, other environmental review costs are not explicitly captured in current estimates. To the extent that future projects require more or fewer project modifications than have been included in this example, these costs may over- or underestimate the economic effects.

Table 2.11-2: Environmental Measures for Example Wave Energy Project, with Annual Capital and O&M Costs, in 2010$

Project Modification	Annual Capital Cost	Annual O&M Cost
Use horizontal directional drilling to deploy transmission cable from shore station under beach and intertidal area, out to depth of 10 to 30 ft below mean lower low tide.	$44,260	$0
Design features to achieve a closed-loop system to prevent any marine life entering pressurized water flow.	$44,260	$22,000
Design features to minimize scale of anchor devices, project footprint on seafloor, and chain/cable sweep of seafloor.	$22,160	$0
Develop a schedule of regular system maintenance that minimizes site visits, disturbance to marine growth, and activity at the site.	$220	$550
Total	$110,900	$22,550
Annual Cost	$133,450	
Source: Cost estimates from the IEc (2009) and adjusted to 2010 dollars (2010$) using the Bureau of Labor Statistics Inflation Calculator.		

In the absence of specific information about the extent of the regulatory baseline for black abalone, project modification costs for tidal and wave projects are assumed to be attributable to the black abalone critical habitat designation. Although some level of protection would already be expected to exist under the listing of black abalone, this analysis is unable to separate those costs from critical habitat costs. In addition, this analysis assumes that conservation measures undertaken for green sturgeon critical habitat may offer some additional baseline protections. However, the habitat needs of the species differ and require different conservation measures. Therefore this analysis assumes that approximately 100 percent of impacts may be attributable to black abalone habitat.

2.11.4 Summary of Economic Impacts to Tidal and Wave Energy Projects by Specific Area

As discussed above, potential impacts on tidal and wave energy projects are subject to high levels of uncertainty for the following reasons:

- The number of future tidal and wave energy projects is speculative.
- Future management and required project modifications for black abalone critical habitat related to tidal and wave energy projects are uncertain and could vary in scope from project to project.

Table 2.11-3 presents a summary of our findings. Specific area 1 had the highest costs because there are three projects with preliminary permits. Specific areas 10 and 19 had the lowest costs because each specific area had only one project with a preliminary permit.

Table 2.11-3: Summary of Economic Impacts to Tidal and Wave Energy Projects by Specific Area

Area	Issued Preliminary Permits	Incremental Score	Total Annualized Costs
1	3	1.0	$400,000
10	1	1.0	$133,000
19	1	1.0	$133,000
Total			$667,000

2.12 Economic Impacts of Critical Habitat Designation on Liquefied Natural Gas Projects

2.12.1 Description of Threat

NMFS identified the construction and operation of LNG projects as a potential threat to black abalone critical habitat. While there are no identified LNG facilities within the confines of the specific areas, the development of future projects may still pose a threat. This activity may affect the *rocky substrate*, *food resources*, *settlement habitat*, and *water quality* PCEs.

LNG terminals may be located onshore or offshore, including: offshore floating terminals, offshore oil platform terminals, and gravity-based offshore ports.[133] One concern for offshore facilities is that construction of pipelines to transport LNG onshore may affect black abalone habitat. For onshore LNG terminals, construction of breakwaters, jetties, or other shoreline structures and the activities associated with construction (e.g., dredging) may affect black abalone habitat (see "in-water construction" and "coastal urban development" in Sections 2.1 and 2.4 of this report, respectively). Another concern is the increased potential for oil spills and potential effects on water quality from the presence of vessels transporting and offloading LNG at the terminals.

2.12.2 Regulatory Environment & Extent of Activity

Under the Energy Policy Act of 2005, FERC has exclusive authority to issue licenses for the siting, construction, operation, and modification of LNG import terminals onshore and in state waters. The Maritime Administration (MARAD) and the USCG have siting and permitting jurisdiction for "deepwater ports" in Federal waters, defined as "any fixed or floating man-made structures other than a

[133] Surfrider Foundation. Coastal A-Z, *LNG*. Accessed at: http://www.beachapedia.org/LNG_(Liquified_Natural_Gas).

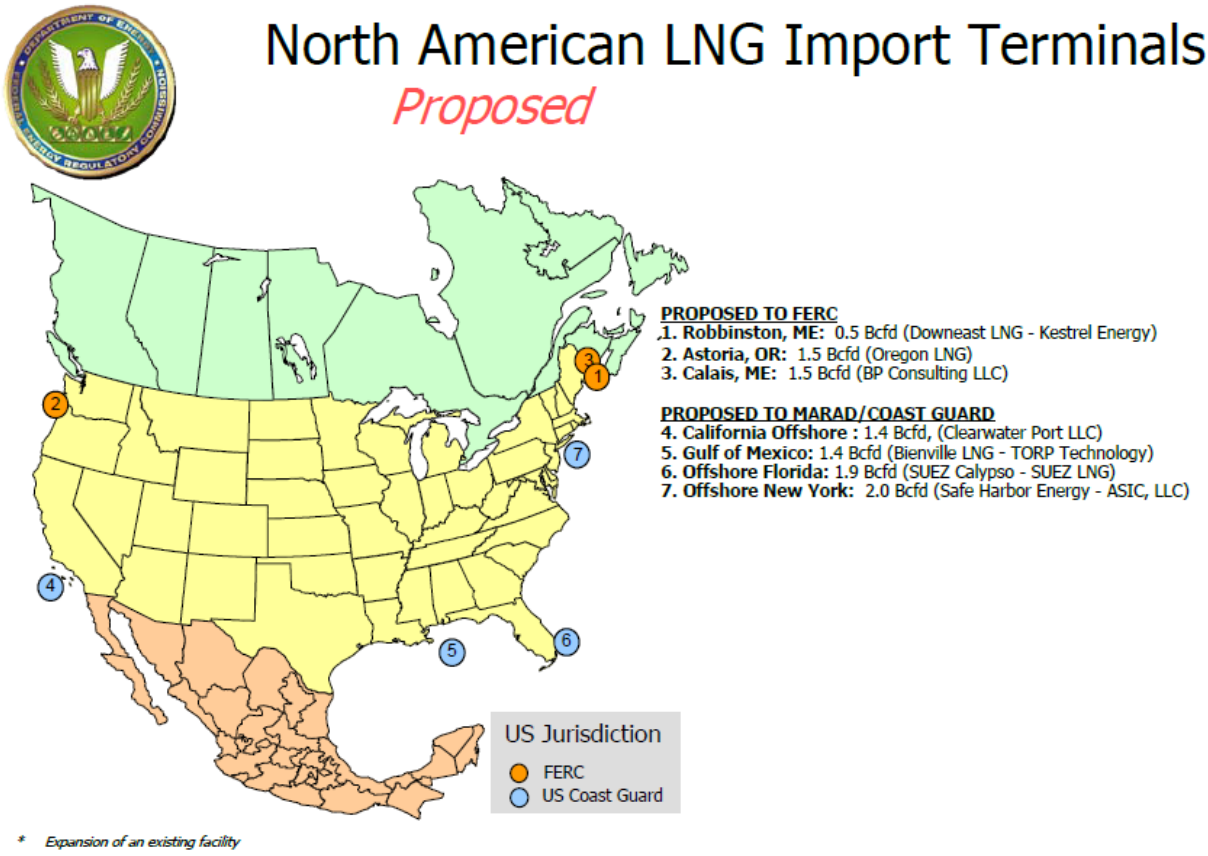
vessel…located beyond the territorial sea and off the coast of the United States …"[134] Approved LNG terminal projects must also obtain Coastal Zone Management Act, Section 404 (under the CWA) water quality certificate, and Section 404 (under the CWA) dredging permits.[135]

Based on review of FERC's database [136] updated as of April 12, 2010, there are no existing, approved, or proposed LNG facilities within the specific areas. There is one facility that has the potential of being built, however, the exact location of the facility is unknown at this time. It is important to note here that potential projects may never be elevated to a "proposed" status to FERC (see Figures 2.12-1, 2.12-2 and Table 2.12-1 below for more details).

It is difficult to predict the number and location of LNG facilities that will be built within the specific areas. In addition to a rigorous approval process, many of these projects face significant local opposition as has been witnessed in the Pacific Northwest, or are abandoned during the development stages for various reasons. FERC's website indicates that market forces will ultimately dictate the number of facilities constructed. Analysts project that about 30% (12) of the 40 LNG terminals currently being considered will ever be built.[137]

[134] 33 U.S.C.S. § 1502(10)
[135] FERC. *LNG Projects*. Accessed at: http://www.ferc.gov/industries/lng.asp. Updated as of April 12, 2010.
[136] Ibid.
[137] Federal Energy Regulatory Commission (FERC). Accessed at: www.ferc.gov.

Figure 2.12-1: Proposed North American LNG Import Terminals[138]



[138] Federal Energy Regulatory Commission (FERC). *North American LNG Import Terminals, Proposed.* Accessed at http://www.ferc.gov/industries/lng/indus-act/terminals/lng-proposed.pdf. Updated as of April 12, 2010.

Figure 2.12-2: Potential North American LNG Import Terminals[139]

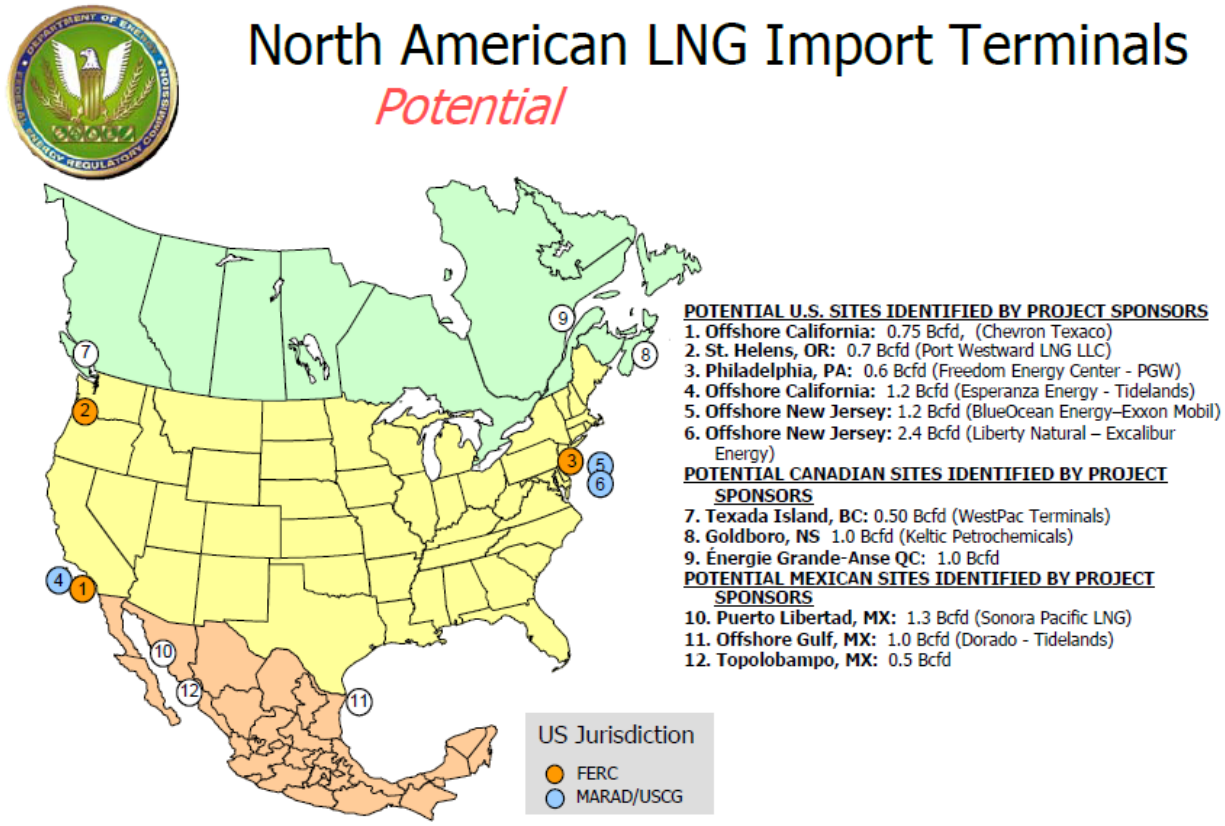


Table 2.12-1: Summary of Known LNG Import Terminals in California

Location	Applicant	Capacity	Comments
Existing			
None	N/A	N/A	N/A
Approved			
None	N/A	N/A	N/A
Proposed			
California Offshore, Clearwater Port, near Ventura County	Clearwater Port LLC (Northern Star Natural Gas)	1.4 Bcfd	The facility and its pipeline are not within the specific areas
Potential			
Offshore CA	Chevron Texaco	0.75 Bcfd	Exact location unknown
Offshore CA, Port Esperanza near Long Beach	Esperanza Energy, LLC	1.2 Bcfd	The facility and its pipeline are not within the specific areas

[139] FERC. *North American LNG Import Terminals, Potential.* Accessed at http://www.ferc.gov/industries/lng/indus-act/terminals/lng-potential.pdf. Updated as of April 12, 2010.

2.12.3 Impacts of Critical Habitat Designation on Liquefied Natural Gas Projects

Based on available data, this analysis cannot forecast how many projects may or may not ultimately be constructed. Because there are no LNG projects under consideration in this analysis, NMFS has yet to make specific recommendations about any project modifications that might be required to mitigate potential adverse impacts on critical habitat for black abalone. Until specific plans for the LNG projects are made available, their potential impact on black abalone habitat will remain uncertain, as will the nature of any project modifications that might be requested to mitigate adverse impacts. Potential modifications may include biological monitoring and specific measures to prevent or respond to catastrophes. While LNG projects on the West Coast are still in the preliminary stages, NMFS has consulted on several projects on the East Coast, and has not yet required project modifications to mitigate adverse impacts to an aquatic species. Because there is a high level of uncertainty associated with anticipating future management efforts for black abalone critical habitat as a result of LNG projects, this analysis presents only a qualitative discussion.

Black abalone critical habitat could impose modifications related to LNG projects such as:

- For offshore facilities: In the installation of pipelines, avoid rocky intertidal habitats or use existing pipelines.
- For onshore facilities: Avoid siting LNG projects within or adjacent to coastal rocky habitats.

Potential modification costs for future onshore LNG facilities might include costs similar to those for in-water construction (i.e., coastal armoring, breakwater, etc.) and dredging (see Section 2.1.3 of this report). Potential modification costs for future offshore LNG facilities might include the costs associated with installing pipelines to avoid rocky areas or with the use of existing pipelines onshore. Additional modifications that may incur a cost include a requirement that each LNG carrier maintain a shipboard oil pollution plan containing measures to be implemented in the event of a spill or release of oil, as well as a prohibition on liquid transfer and refueling of vehicles and equipment within 100 ft of waterbodies.[140] Table 2.12-1 summarizes possible cost estimates per LNG project, in 2010 dollars.

[140] FERC. 2008. Final EIS for the construction and operation of the Bradwood Landing Project. June 6, 2008. Accessed at: http://www.ferc.gov/industries/lng/enviro/eis/2008/06-06-08-eis.asp.

Table 2.12-1: Cost Estimates per LNG Project (2010$)

Sub-activity	Typical Project Modifications	Estimated Costs
Pipeline projects	• Erosion control (rock lining) • Bypass stream corridor • Riparian planning • Directional drilling ($900-$1,100)	$5,600-$222,000
Outfall structure projects	• Flagged boundaries • Complete site restoration and clean-up • Pollution and erosion control plan • Timing restrictions • Construction monitoring by an on-site biologist • Store and replace native soil upon project completion • Implement construction techniques to avoid sedimentation and conduct a sediment survey.	$111,500
Note: Adapted from NMFS, Final Economic Analysis of Critical Habitat Designation for Seven West Coast Salmon and Steelhead ESUs, Long Beach, CA, August 2005. Adjusted to 2010 dollars using the U.S. Bureau of Economic Analysis, National Economic Accounts, National Income and Product Accounts table, 2010.		

In the absence of specific information about the extent of the regulatory baseline for black abalone, project modification costs for LNG projects are assumed to be attributable to black abalone critical habitat designation. Some level of protection would already be expected to exist under the listing of black abalone. Therefore, this analysis assumes that approximately 50 percent of impacts may be attributable to black abalone critical habitat.

2.12.4 Summary of Economic Impacts to Liquefied Natural Gas Projects by Specific Area

As discussed above, potential impacts on LNG terminals are subject to high levels of uncertainty for the following reasons:

- The number of future LNG projects likely to reach the construction stage within the specific areas is speculative.
- Future management and required project modifications for LNG terminals are uncertain and could vary in scope from project to project.

NMFS was unable to present a quantitative assessment for possible LNG modifications for this analysis because there are currently no LNG projects or structures associated with LNG projects (i.e., pipelines to transport the LNG onshore) existing or proposed within the specific areas.

2.13 Economic Impacts of Critical Habitat Designation on Mineral and Petroleum Exploration and Extraction

2.13.1 Description of Threat

NMFS identified mineral and petroleum exploration and extraction as a potential threat to black abalone critical habitat in one specific area: specific area 10. Activities associated with mineral and petroleum exploration and extraction activities may affect the *rocky substrate, food resources, settlement habitat,* and *water quality* PCEs.

Mineral and petroleum exploration and extraction activities may result in increased sediment input into coastal rocky habitats and may increase the risk of an oil spill or leak. In a laboratory study, water-based drilling muds from an active platform were found to negatively affect the settlement of red abalone larvae on coralline algae, but fertilization and early development were not affected.[141] See Section 2.1 ("In-water construction") and Section 2.4 ("Coastal urban development") of this report for more information on the effects of sedimentation on black abalone habitat. Also, see Section 2.7 ("Oil and Chemical Spills: Prevention and Clean-up") of this report for more information on the effects of oil spills and leaks on black abalone habitat.

2.13.2 Regulatory Environment & Extent of Activity

The BOEMRE's mission is "to manage the mineral resources of the Outer Continental Shelf in an environmentally sound and safe manner."[142] The Outer Continental Shelf Lands Act authorizes the Federal Government, through the BOEMRE, to grant leases to the highest bidder for the exploration, development and production of oil and gas contained within the Outer Continental Shelf (OCS) beyond 3-miles from the State's seaward boundary. Each lease covers an area that is no more than 5,760 acres and is generally a square measuring 3 miles by 3 miles. Under a lease, a company has the right to apply for permits to explore and develop the mineral resources within that area. Before approving the permits, BOEMRE carefully reviews all applications to ensure that the activities will be conducted in a safe and environmentally sound manner and that the interests of key stakeholders are effectively addressed.[143]

There are two pipelines that come ashore in rocky habitat, both in specific area 10: (1) the Tranquillon Ridge Unit (Platform Irene); and (2) the Point Arguello Unit (Platforms Hermosa, Harvest, and Hidalgo) that comes ashore at Pt. Conception. These are drilled crossings, which means the pipeline goes under

[141] Raimondi et al. 1997, cited in Airoldi 2003
[142] BOEMRE. Pacific Region: Pacific OSC Region. Accessed at: http://www.boemre.gov/omm/pacific/index.htm, on November 2010.
[143] BOEMRE. Pacific Region: Lease Information. Accessed at: http://www.boemre.gov/omm/pacific/lease/lease.htm on November 2010.

rocky intertidal habitat and comes out on land. Consultation occurs during construction and during re-permitting (for replacing or removing a line, which is possible in the next 15-20 years).

There was one pipeline spill in September of 1997, known as the "Torch" oil spill. The spill involved a pipeline break about two miles from shore on the pipeline connecting Platform Irene in Federal waters to the onshore processing facility. The official amount of oil spilled was 167 barrels (bbls). The spill consisted of about 3,000 bbls of an oily water mixture, which was determined to be around 98% water and 2% oil.[144]

2.13.3 Impacts of Critical Habitat Designation on Mineral and Petroleum Exploration and Extraction

Project modifications for the protection of black abalone critical habitat may include[145]:

- Adoption of oil spill clean-up protocols and oil spill prevention plans;
- More Clean Seas boats as first responders to prevent oil spills from coming onshore; and
- Relocation of proposed oil platforms further away from black abalone habitats.

Possible modification costs include the costs associated with pipeline projects (to avoid rocky habitat or use existing onshore pipelines), erosion control measures, and oil spill response activities (see Sections 2.12.3, 2.1.3, and 2.7.3 of this report, respectively). Existing Federal, state, and local standards and regulations appear to offer the black abalone some level of baseline protection. Therefore this analysis assumes that approximately 50 percent of impacts may be attributable to black abalone critical habitat.

2.13.4 Summary of Economic Impacts to Mineral and Petroleum Exploration and Extraction by Specific Area

In addition to the direct costs to undertake consultations and project modifications outlined above, physical changes to habitat areas that may be associated with project modifications may have other indirect economic impacts on local industries and enterprises in the future. The potential regional impact is the restriction of pipeline construction. As such, any modifications to regulations or ensuing changes to oil spill prevention for oil and gas exploration are unknown at this time; therefore, this analysis does not attempt to quantify impacts. However, costs may include costs for oil spill response training and insurance associated with oil spill response. Table 2.13-1 presents a summary of our findings.

[144] Personal communication with Mary-Elaine Helix, Bureau of Ocean Energy Management, Regulation and Enforcement, on May 24, 2010.
[145] Note that Mineral/oil exploration is prohibited in the National Marine Sanctuaries and new California MPAs.

Table 2.13-1: Summary of Economic Impacts to Mineral and Petroleum Exploration and Extraction by Specific Area

Area	Number of Structures	Incremental Score
10	2	0.5

2.14 Economic Impacts of Critical Habitat Designation on Non-Native Species: Prevention and Management

2.14.1 Description of Threat

NMFS identified non-native species introduction prevention and non-native species management as potential threats to black abalone critical habitat in five specific areas: specific areas 2, 4, 8, 10, and 11. The most important mechanism for the introduction of aquatic species is transport in ship ballast tanks. Other mechanisms of introduction include: improper disposal of aquarium materials, bait and seafood packing materials, aquaculture operations, and research activities.[146] These activities may affect the *food resources* and *settlement habitat* PCEs.

The release of wastewater, sewage, and ballast water from commercial shipping presents a risk to kelp and other macro-algal species by the potential introduction of exotic species. Non-native species may displace native organisms by preying on them or out-competing them for resources such as food, space, or both. Non-native species may introduce disease-causing organisms and can cause substantial population, community, and habitat changes.

2.14.2 Regulatory Environment & Extent of Activity

Commercial Shipping

In response to national concern, the National Invasive Species Act of 1996 (NISA) was enacted which reauthorized and amended the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990. NISA required the USCG to establish national voluntary ballast water management guidelines. If the guidelines were deemed inadequate, NISA directed the USCG to convert them into a mandatory national program. Under the nationwide program which began in 1998, a self-policing program was established where ballast water management was voluntary for a period of 24 to 30 months for vessels over 300 gross tons. However, the USCG found the rate of compliance to be inadequate, and vessel operators often failed to submit the ballast water reports to the USCG. The voluntary program became mandatory in 2004, and the USCG may now impose a civil penalty of up to $27,500 per day or a Class C Felony charge for large

[146] MBNMS. *Resource Management Issues: Invasive Species. MBNMS Resource Management Issues.* Accessed at: http://montereybay.noaa.gov/resourcepro/resmanissues/invasive.html.

ships headed to the U.S. (entering the Exclusive Economic Zone, or 200 nautical miles from shore) that fail to submit a ballast water management reporting form.[147]

U.S. waterborne foreign trade by unit in metric tons (mt) is summarized in Table 2.14-1. Priority areas include specific area 11 (Los Angeles) and specific area 4 (San Francisco). The Los Angeles port receives the most incoming waterborne foreign trade, at just under 78 million metric tons in 2006. The San Francisco port receives the next highest incoming waterborne foreign trade, at about 5 million metric tons in 2006. Secondary areas include transit to the main west coast ports, which include specific areas 8 and 10.

Table 2.14-1: U.S. Waterborne Foreign Trade by U.S. Custom Ports (metric tons)

Area	U.S. Custom Ports	2003	2004	2005	2006
4	San Francisco, CA	1,715,797	4,879,903	4,589,269	5,123,602
8	Monterey, CA	212	877	189	104
10	Port San Luis Harbor, CA	8,396	3,550	2,679	1,678
11	Los Angeles, CA	54,190,481	61,143,996	64,663,218	77,808,057
Total		55,914,886	66,028,325	69,255,355	82,933,441
Source: U.S. Source: U.S. Department of Transportation, Maritime Administration, Port Import Export Reporting Service (PIERS), collected from Vessel Manifests and Bills of Lading. Accessed at: http://www.marad.dot.gov/marad_statistics/index.html, April 2009.					

Aquaculture

Offshore aquaculture operations may be subject to a variety of Federal and State water quality standards, affording black abalone and their habitat a level of baseline protection. However, NMFS has yet to make specific conservation recommendations related to aquaculture for these areas.

Structures in navigable waters, such as cages or net pens, may require approval from the USCG to ensure they don't adversely affect navigation. The USCG may also require buoys or markers to be maintained over the structures. The applicant may be required to submit information about the structures to include on nautical charts. An aquaculture facility may require a Section 404 permit (under the CWA) from the USACE if it involves placing fill in navigable waters, and a Section 10 permit under the RHA if the project involves placing a structure in a navigable waterway. Facilities may require review from under section 7 of the ESA for their potential effects on endangered, threatened, or other sensitive species. They may also require review for effects on EFH, marine mammals, and migratory birds. Other permits may also be required from the EPA (e.g., NPDES permit), BOEMRE, and others agencies.

[147] USCG. *Aquatic Nuisance Species*. Accessed in May 2010 at: http://www.uscg.mil/hq/cg5/cg522/cg5224/ans.asp.

Seventeen aquaculture facilities were identified in specific area 2, primarily in Drakes Bay and Tomales Bay.

2.14.3 Impacts of Critical Habitat Designation on Non-Native Species

Modifications to prevent impacts on black abalone critical habitat from commercial shipping include:

- Safe (non-contaminated) ballast disposal.
- Rinse anchors and anchor chains when retrieving the anchor to remove organisms and sediments at their place of origin.
- Remove hull fouling organisms from hull, piping, propellers, sea chests, and other submerged portions of a vessel, on a regular basis, and dispose of removed substances in accordance with local, state, and federal law.

Modifications to prevent impacts on black abalone critical habitat from aquaculture include:

- Inspect aquaculture facilities to prevent non-native species transport in packing materials.
- Enforcement to prevent bilge water influx/introduction.
- Develop and implement Best Management Practices.
- Develop educational materials about non-native species and measures to minimize introductions.

Existing Federal, state, and local standards and regulations appear to offer the black abalone critical habitat a high level of baseline protection. Therefore this analysis assumes that approximately 10 percent of impacts may be attributable to black abalone critical habitat.

2.14.4 Summary of Economic Impacts to Non-Native Species by Specific Area

Any modifications to USCG regulations or ensuing changes to ballast water discharge requirements for commercial shipping activities are unknown at this time; therefore, this analysis does not attempt to quantify impacts. However, costs may include costs of treating ballast disposal and other disposal outside of state waters. The majority of ships will face costs associated with the use of ballast pumps, although these costs are usually quite small. A very small number of ships may have additional costs associated with an extension of their voyage. Options for treating ballast water that may add additional costs are: filtration systems, oxidizing and non-oxidizing biocides, thermal techniques, electric pulse and pulse plasma techniques, ultraviolet treatment, acoustic systems, magnetic fields, deoxygenation, biological techniques, and anti-fouling coatings.

Possible modifications to aquaculture facilities may include: education, Best Management Practices, enforcement to prevent bilge water influx/introduction, and inspection (additional inspections by CDFG

and NOAA for aquaculture to prevent importing hitchhikers in packing materials with shipped organisms/live fish or epibionts). However, potential impacts related to non-native species introduction prevention and management are unclear. Due to this uncertainty, this analysis does not quantify impacts associated with non-native species.

Table 2.14-2 presents a summary of activities associated with non-native species prevention and management by specific area.

Table 2.14-2: Summary of Economic Impacts to Non-Native Species by Specific Area

Area	Commercial Shipping (2006 metric tons)	# of Aquaculture Facilities	Incremental Score
2		17	0.1
4	5,123,602		0.1
8	104		0.1
10	1,678		0.1
11	77,808,057		0.1

2.15 Economic Impacts of Critical Habitat Designation on Kelp Harvesting

2.15.1 Description of Threat

NMFS identified kelp harvesting as a threat to black abalone critical habitat in 14 specific areas: specific areas 7-20. This activity may affect the *food resources* PCE, since kelp is the primary source of food for black abalone. Kelp is harvested for algin, which is used as a binder, emulsifier, and molding material in a broad range of products, and as a food source in abalone aquaculture operations.[148] The harvest is small, but the kelp grows quickly, and harvest could generate drift (which can potentially be beneficial to black abalone).

2.15.2 Regulatory Environment & Extent of Activity

The volume and area of kelp harvesting activities are currently regulated by the California Fish and Game Commission. Kelp harvesting is regulated by the state and does not require a Federal permit.

GIS data were collected from the California Administrative Kelp Bed Boundaries. Table 2.15-1 displays the acreage of kelp under each status type (closed, leased, leasable, and open). A "closed" kelp bed means that harvesting is not permitted. A "leased" kelp bed means that mechanical harvesting can occur. A "leasable" kelp bed may be harvested by anyone with a kelp harvesting license, until the bed is leased.

[148] Weinstein, Anna. "Socioeconomic Uses: IV Mariculture and Kelp Harvesting." Watershed Institute, CSU Monterey Bay. Accessed at: http://montereybay.noaa.gov/sitechar/soci4.html.

There is an opportunity to become the sole harvester. An “open” kelp bed may be harvested by anyone with a kelp harvesting license; however, there is no opportunity to become the sole harvester.

Table 2.15-1: Total Acres of Kelp Harvest Beds, by Status and Specific Area

Areas	Closed	Leased	Leasable	Open
1	79,741			
2	125,289			
3				
4	37,568			
5	35,619			
6	119			
7	27,623	27,755		24,897
8			39,544	87,152
9		16,342	66,598	8,241
10	40,772	7,826	76,238	39,692
11				24,218
12	8,221			12,906
13				56,505
14				97,269
15			42,835	86,464
16				37,245
17			60,900	
18			28,214	
19				113,057
20			49,978	60,731
Total	354,952	51,922	364,308	648,377

2.15.3 Summary of Economic Impacts to Kelp Harvesting by Specific Area

Potential impacts related to kelp harvesting are unclear. This analysis was unable to determine specifically how this threat would be alleviated for any specific area (i.e., what type of special management might be required). There is currently no federal nexus for kelp harvesting, thus there are no costs that can be attributed to this activity. Therefore, this analysis does not quantify impacts associated with kelp harvesting. However, if a federal nexus were to be in place with regard to kelp harvesting, this analysis assumes that approximately 100 percent of impacts may be attributable to black abalone critical habitat. Table 2.15-2 presents a summary of our findings.

Table 2.15-2: Summary of Economic Impacts to Kelp Harvesting by Specific Area

Area	Total Acres of Kelp Harvest Beds	Incremental Score
7	52,652	1.0
8	126,696	1.0
9	91,181	1.0
10	123,755	1.0
11	24,218	1.0
12	12,906	1.0
13	56,505	1.0
14	97,269	1.0
15	129,300	1.0
16	37,245	1.0
17	60,900	1.0
18	28,214	1.0
19	113,057	1.0
20	110,710	1.0
Total	1,064,607	

2.16 Economic Impacts of Critical Habitat Designation on Activities that Lead to Global Climate Change

NMFS identified activities that lead to global climate change (e.g., fossil fuel combustion) as a threat to black abalone critical habitat in all of the specific areas identified. Activities that lead to global climate change can include some of the activities discussed previously and may affect all of the PCEs. There is little information on these effects, however. Global climate change that results in increased global temperatures is predicted to accelerate sea level rise and result in the inundation of many existing intertidal areas. Sea level rise would alter habitat availability and distribution for black abalone, and result in increased in-water construction (coastal armoring) to protect coastal structures from inundation. Sea surface water temperatures that exceed 25ºC may increase risks to black abalone. Ocean warming can cause increased virulence of withering syndrome and affect water quality as changes in temperature, pH, and salinity occur. Ocean pH values that are outside of the normal range for seawater (i.e., pH less than 7.5 or greater than 8.5) may cause reduced growth and survivorship in abalone as has been observed in other marine gastropods.[149] Increasing partial pressure of carbon dioxide may reduce abundance of coralline algae and thereby affect the survival of newly settled black abalone.[150]

Potential actions to address this threat may include the organization of a task force and development of a plan that offers recommendations for ways to minimize the impacts of global climate change on black

[149] Shirayama and Thornton 2005.

abalone and other ESA-listed species. However, this analysis was unable to determine specifically how activities that lead to global climate change (e.g., fossil fuel combustion) may be affected by the black abalone critical habitat designation (i.e., what type of special management might be required), or if a Federal nexus exists. Therefore, this analysis does not quantify impacts associated with activities that lead to global climate change. Existing Federal, state, and local standards and regulations (e.g., the California Global Warming Solutions Act of 2006, EPA, and National Highway Traffic Safety Administration initiatives to improve fuel efficiency and reduce greenhouse gas emissions and fuel use for cars and trucks) may offer baseline protections to black abalone critical habitat. However, due to uncertainties in the effectiveness of measures currently in place to regulate activities that lead to global climate change, as well as uncertainty regarding how the designation may affect these activities, this analysis is unable to determine the incremental impact of this critical habitat designation on those activities at this time.

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[150] Feely et al. 2004; Hall-Spencer et al. 2008

SECTION 3: SUMMARY OF RESULTS

3.1 Summary of Results

This section presents seven tables that summarize the results of this analysis.

Tables 3-1a and 3-1b present the level of economic activity, by specific area and by threat, and the metric used to estimate the level of activity, which varies by threat. For example, the estimated number of power plants is based on the approximate number of facilities currently in place, whereas the estimated number of tidal and wave energy projects is based on the potential number of projects (estimated using the current number of projects with preliminary permits).

Table 3-2 presents the estimated annualized cost and present discounted values, in 2010 dollars, by activity. The “Annualized Costs” column summarizes the costs presented throughout Section 2 of this report for each category of activity. The "Cost Range" column presents a per project cost estimate that has not been discounted and is assumed to be spread evenly over the number of years listed in the "Timeframe" column. The “Present Value” column is then calculated based on the annualized costs, across the indicated timeframe, and discounted at a 3 percent and 7 percent discount rate.

Table 3-3 presents the incremental scores by activity and specific area. The incremental score is used to develop an estimate of the proportion of the impacts that may be attributed to black abalone critical habitat. The scores vary both by activity and by specific area depending on the level of baseline protection provided by Federal, state and local standards and regulations as well as the presence of other listed species and other designated critical habitat. The incremental scores range from 0.1 for activities that occur in specific areas with a high level of baseline protections (e.g., specific areas that overlap with NMS and with critical habitat designations for other species), to 1.0 for activities that occur in specific areas with little to no existing protections for black abalone critical habitat.

Tables 3-4a and 3-4b present total estimated impacts (costs) by specific area and by activity for both the low and high cost scenarios for the sevenactivity categories where a quantitative assessment was possible.

Table 3-5 presents total impacts summarized by specific area under the low, mid, and high cost scenarios. In the low cost scenario, specific area 11 had the highest annual impacts at about $42,000, while specific areas 10 and 19 had the next highest annualized impacts at $30,000 and $23,000, respectively. In the high

cost scenario, again, specific area 7 had the highest annual impacts at $1,004,000, while specific areas 10 and 8 had the next highest annualized impacts at $882,000 and $629,000, respectively. Specific areas 6, 13, 14, 15, and 18 had the lowest impacts ($0) because the only activities identified in these specific areas could only be discussed qualitatively. However, this does not mean that in the future, there will be zero costs.

Table 3-1a: Summary of the Estimated Level of Activities for Specific Areas 1-10

Activities	Metric \ Areas	1	2	3	4	5	6	7	8	9	10
In-water construction	# of JDs										0.6
Sand replenishment	# of projects		0.2		0.1			0.3			
NPDES: Minor	# of facilities (high buffer estimates)	4	23	22	22	1		6	4	2	2
NPDES: Major	# of facilities (high buffer estimates)		19	19	22	1		4	4	1	7
Coastal development	# of JDs		5		1			3	1		0.8
Sediment disposal ("side-casting")	# of cubic yards							30,000	N/A		
Agricultural Activities	acres of farmland (high buffer estimates)	4,988	7,568	1,848	6,596			20,751	19,386	5,608	22,576
Oil & chemical spills and response	# gallons (actual + potential)				350	70		200	140	70	
Vessel grounding	# of vessel incidents	9							1		
Power plants	# of facilities										1
Desalination plants	# of facilities				1			1	3	1	1
Tidal and wave energy projects	# of projects	3									1
Mineral and petroleum exploration and extraction	# of pipeline structures										2
Non-native species: Commercial shipping	metric tons				5,123,602				104		1,678
Non-native species: Aquaculture	# of farms		17								
Kelp harvesting	# of acres							52,652	126,696	91,181	123,755

Table 3-1b: Summary of the Estimated Level of Activities for Specific Areas 11-20

Activities	Metric \ Areas	11	12	13	14	15	16	17	18	19	20
In-water construction	# of JDs							0.2		0.4	0.2
Sand replenishment	# of projects	0.1									
NPDES: Minor	# of facilities (high buffer estimates)	50	2				1	1			
NPDES: Major	# of facilities (high buffer estimates)	11	5				2			2	
Coastal development	# of JDs							0.2		0.6	0.2
Sediment disposal ("side-casting")	# of cubic yards										
Agricultural Activities	acres of farmland (high buffer estimates)		5,054								
Oil & chemical spills and response	# gallons (actual + potential)		1			40				180	
Vessel grounding	# of vessel incidents										
Power plants	# of facilities										
Desalination plants	# of facilities		1					1		1	
Tidal and wave energy projects	# of projects									1	
Mineral and petroleum exploration and extraction	# of pipeline structures										
Non-native species: Commercial shipping	metric tons	77,808,057									
Non-native species: Aquaculture	# of farms										
Kelp harvesting	# of acres	24,218	12,906	56,505	97,269	129,300	37,245	60,900	28,214	113,057	110,710

Table 3-2: Summary of Estimated Annualized Costs, Cost Range, and Present Value, by Activity (in 2010 dollars)

Activity	Cost Category	Metric	Annualized Costs	Timeframe (years)	Cost Range	Present Value (Discounted at 3%)	Present Value (Discounted at 7%)
In-water construction	Low	per project	$5,000	8	$38,000	$33,000	$28,000
	Mid		$8,000		$66,000	$58,000	$49,000
	High		$12,000		$94,000	$83,00	$70,000
Sand replenishment	Low	per project	$0	6	$0	$0	$0
	Mid		$72,000		$429,000	$387,000	$341,000
	High		$143,000		$858,000	$775,000	$682,000
NPDES: Minor	Low	per facility	$0	20	$0	$0	$0
	Mid		$8,000		$151,000	$112,000	$80,000
	High		$15,000		$302,000	$225,000	$160,000
NPDES: Major	Low	per facility	$53,000	20	$1,059,000	$788,000	$561,000
	Mid		$69,000		$1,378,000	$1,025,000	$730,000
	High		$85,000		$1,697,000	$1,262,000	$899,000
Coastal development	Low	per project	$2,000	20	$40,000	$30,000	$21,000
	Mid		$8,000		$163,000	$121,000	$86,000
	High		$14,000		$286,000	$213,000	$152,000
Sediment disposal ("Side-casting")	Low: Area 7	per project	$0	1	$0	$0	$0
	Mid: Area 7		$137,000		$137,000	$133,000	$128,000
	High: Area 7		$274,000		$274,000	$266,000	$256,000
Agriculture: Irrigation	Low	acres per specific area	$0-$17,000	Varies by specific area depending on acreage			
	High		$22,000-$677,000				
Tidal and wave energy projects	Low	per project	$0	30	$0	$0	$0
	Mid		$67,000		$2,002,000	$1,308,000	$828,000
	High		$133,000		$4,004,000	$2,616,000	$1,656,000

Table 3-3: Summary of Incremental Scores by Specific Area (1 – 20)

Activities	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
In-water construction										0.5							0.5		0.5	0.5
Sand replenishment		1.0		1.0			1.0				1.0									
NPDES-permitted activities	0.1	0.1	0.2	0.1	0.1		0.1	0.1	0.1	0.1	0.1	0.1				0.2	0.2		0.2	
Coastal development		0.5		0.5			0.5	0.5		0.5							0.5		0.5	0.5
Sediment disposal ("Side-casting")							0.5	0.5												
Agriculture: Pesticide application	0.1	0.1	0.1	0.1			0.1	0.1	0.1	0.1		0.1				0.1				
Agriculture: Irrigation	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0		1.0				1.0				
Vessel grounding								0.2												
Desalination plants				0.5			0.5	0.5	0.5	1.0		0.5					0.5		1.0	
Tidal and wave energy projects	1.0									1.0									1.0	
Mineral and petroleum exploration and extraction										0.5										
Non-native species introduction and management		0.1		0.1				0.1		0.1	0.1									
Kelp harvesting							1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Table 3-4a: Total Estimated Economic Impacts for Specific Areas 1-9

Activity		1	2	3	4	5	6	7	8	9
In-water construction	Low									
	High									
Sand replenishment	Low		$0		$0			$0		
	High		$29,000		$14,000			$43,000		
NPDES: Minor	Low	$0	$0	$0	$0	$0		$0	$0	$0
	High	$6,000	$35,000	$66,000	$33,000	$2,000		$9,000	$6,000	$3,000
NPDES: Major	Low		$0	$0	$16,000	$0		$5,000	$5,000	$0
	High		$161,000	$322,000	$187,000	$9,000		$34,000	$34,000	$9,000
Coastal development	Low		$5,000		$1,000			$3,000	$1,000	
	High		$36,000		$7,000			$21,000	$7,000	
Sediment disposal ("Side-casting")	Low							$0	N/A	
	High							$274,000	N/A	
Agricultural Irrigation	Low	$3,000	$10,000	$0	$1,000			$5,000	$2,000	$5,000
	High	$150,000	$227,000	$55,000	$198,000			$623,000	$582,000	$168,000
Tidal and wave energy projects	Low	$0								
	High	$400,000								

Table 3-4b: Total Estimated Economic Impacts for Specific Areas 10-20

Activity		10	11	12	13	14	15	16	17	18	19	20
In-water construction	Low	$1,000							$1,000		$1,000	$1,000
	High	$4,000							$1,000		$2,000	$1,000
Sand replenishment	Low		$0									
	High		$14,000									
NPDES: Minor	Low	$0	$0	$0				$0	$0			
	High	$3,000	$76,000	$3,000				$3,000	$3,000			
NPDES: Major	Low	$11,000	$42,000	$11,000				$0			$21,000	
	High	$59,000	$93,000	$42,000				$34,000			$34,000	
Coastal development	Low	$1,000							$1,000		$1,000	$1,000
	High	$6,000							$1,000		$4,000	$1,000
Sediment disposal ("Side-casting")	Low											
	High											
Agricultural Irrigation	Low	$17,000		$1,000								
	High	$677,000		$152,000								
Tidal and wave energy projects	Low	$0									$0	
	High	$133,000									$133,000	

Table 3-5: Specific Areas Ranked by High Total Annualized Impacts

Area	Annualized Impacts			Activities with only a qualitative analysis (NOT included in the estimated costs)[a/]
	Low	Mid	High	
7	$14,000	$509,000	$1,004,000	Agricultural pesticide application, Desalination plants, Kelp harvesting, and Oil/chemical spill response
10	$30,000	$456,000	$882,000	Agricultural pesticide application, Desalination plants, Mineral and petroleum exploration and extraction, Non-native species introduction and management and Kelp harvesting
8	$9,000	$319,000	$629,000	Agricultural pesticide application, Vessel grounding, Desalination plants, Non-native species introduction and management, Kelp harvesting, and Oil/chemical spill response
1	$3,000	$280,000	$556,000	Agricultural pesticide application
2	$15,000	$251,000	$487,000	Agricultural pesticide application and Non-native species introduction and management
3	$0	$222,000	$444,000	Agricultural pesticide application
4	$17,000	$228,000	$439,000	Agricultural pesticide application, Desalination plants, Non-native species introduction and management, and Oil/chemical spill response
12	$12,000	$104,000	$197,000	Agricultural pesticide application, Desalination plants, Kelp harvesting, and Oil/chemical spill response
11	$42,000	$113,000	$183,000	Non-native species introduction and management and Kelp harvesting
9	$5,000	$92,000	$180,000	Agricultural pesticide application, Desalination plants, Kelp harvesting, and Oil/chemical spill response
19	$23,000	$98,000	$174,000	Desalination plants, Kelp harvesting, and Oil/chemical spill response
16	$0	$18,000	$37,000	Agricultural pesticide application and Kelp harvesting
5	$0	$5,000	$10,000	Oil/chemical spill response
17	$1,000	$3,000	$6,000	Desalination plants and Kelp harvesting
20	$1,000	$2,000	$3,000	Kelp harvesting
6	$0	$0	$0	
13	$0	$0	$0	Kelp harvesting
14	$0	$0	$0	Kelp harvesting
15	$0	$0	$0	Kelp harvesting and Oil/chemical spill response
18	$0	$0	$0	Kelp harvesting
Totals[b/,c/]	$170,000	$2,131,000	$4,091,000	Agricultural pesticide application, Vessel grounding, Desalination plants, Mineral and petroleum exploration and extraction, Non-native species introduction and management, Kelp harvesting, and Oil/chemical spill response

Notes:

a/ Activities that lead to global climate change are also discussed qualitatively in this analysis and are recognized as potential threats to black abalone in all areas (see Section 2.16 of this report).

b/ While the costs attributed to the power plant in Specific Area 10 is the best known estimate, this activity is the least certain and thus has a lower level of confidence than the other costs found in this analysis.

c/ Totals are adjusted for double-counting of NPDES outfalls and acres of agricultural land that overlap multiple specific areas. See Sections 2.3 and 2.6 of this report for more details.

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APPENDIX A: NON-COST SUMMARY INFORMATION

Appendix A provides a table showing non-cost summary information for the 17 categories of activities identified in this report. Table A-1 shows the economic activities, by specific area, that may require special management to protect black abalone critical habitat. The "Y" stands for yes, that the activity is present in the respective specific area.

Table A-1: Summary of Potential Threats within Specific Areas Considered for Black Abalone Critical Habitat Designation

Activities	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Dredging																				
In-water construction										Y							Y		Y	Y
Sand replenishment		Y		Y			Y				Y									
NPDES-permitted activities	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y				Y	Y		Y	
Coastal development		Y		Y			Y	Y		Y							Y		Y	Y
Sediment disposal ("Side-casting")							Y	Y												
Agricultural Activities	Y	Y	Y	Y			Y	Y	Y	Y		Y				Y				
Oil & chemical spills and response				Y	Y		Y	Y	Y			Y			Y				Y	
Vessel grounding								Y												
Power plants										Y										
Desalination plants				Y			Y	Y	Y	Y		Y					Y		Y	
Tidal and wave energy projects	Y									Y									Y	
Liquefied natural gas (LNG)																				
Mineral and petroleum exploration and extraction										Y										
Non-native species introduction and management		Y		Y				Y		Y	Y									
Kelp harvesting							Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Activities that lead to global climate change	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Table A-2 provides the specific area(s) in which the activity is located, the PCE(s) the activity could affect and the nature of that threat, the ESA Section 7 nexus for that activity, and the possible modifications to the activity due to the black abalone critical habitat designation.

Table A-2: Summary of Activities: Nature of Threat, ESA Section 7 Nexus, and Possible Modifications

Activity	Areas	PCE and nature of the threat	Section 7 nexus	Possible modification(s) to the activity
Dredging and disposal of dredged material	Uncertain	*Rocky substrate* PCE—Dredging that does occur near rocky intertidal areas may increase sedimentation into the rocky habitat. A variety of harmful substances, including heavy metals, oil, TBT, PCBs and pesticides, can be absorbed into the seabed sediments and contaminate them. *Water quality* PCE—Dredging and disposal processes can release contaminants into the water column, affecting water quality, and making them available to be taken up by animals and plants, which could cause morphological or reproductive disorders.	The USACE issues permits pursuant to Section 404 of the Clean Water Act (CWA), among several others. The USACE must then consult with NMFS under section 7 of the ESA.	Restrictions on the spatial and temporal extent of dredging activities and the deposition of dredge spoil. Requirements to monitor the effects of dredge spoil deposition on black abalone habitat.
In-water construction	10, 17, 19, and 20	*Rocky substrate* PCE— Increased sedimentation, a side effect of some in-water construction projects, can reduce the quality and/or quantity of rocky substrate. *Food resources* PCE— The presence of in-water structures may affect black abalone habitat by affecting the distribution and abundance of algal species that provide food for abalone or the distribution and abundance of other intertidal invertebrate species. *Settlement habitat* PCE—Changes in algal communities could affect settlement of larval abalone (believed to be influenced by the presence of coralline algae). *Nearshore circulation pattern* PCE—Nearshore circulation patterns may affect intertidal communities by providing stepping-stones between populations, resulting in range extensions for species with limited dispersal distances. Artificial structures, like	The USACE issues permits pursuant to Section 10 of the Rivers and Harbors Act of 1899 (RHA) among several others. Although in-water construction projects are commonly undertaken by private or non-Federal parties, in most cases they must obtain a USACE permit. The USACE must then consult with NMFS under section 7 of the ESA.	Bank stabilization measures and more natural erosion control.

		breakwaters, may also alter the physical environment by reducing wave action and modifying nearshore circulation and sediment transport.		
Sand replenishment	2, 4, 7, and 11	*Rocky substrate* PCE —Sand movements could cover up rocky substrate, thereby reducing its quality and/or quantity.	The USACE is responsible for administering Section 404 permits under the CWA, which are required for sand replenishment activities.	Monitor the water quality (turbidity) during and after the project. Place a buffer around pertinent areas within critical habitat that sand replenishment projects have to work around. Ensure any dredge discharge pipelines are sited to avoid rocky intertidal habitat. Construct training dikes to help retain the sand at the receiving location, which should minimize movement of sand into rocky intertidal areas.
NPDES-permitted activities	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 16, 17, and 19	*Food resources* PCE—Sewage outfalls may affect food resources by causing light levels to be reduced to levels too low to support *Macrocystis* germination and growth. Eutrophication occurs around southern California sewage outfalls where phytoplankton crops and primary production exceed typical levels and approach values characteristic of upwelling periods. Discharge that results in reduced ocean pH could reduce the abundance of coralline algae. W*ater quality* PCE—Exposure to heavy metals can affect growth of marine organisms, either promoting or inhibiting growth depending on the combination and concentrations of metals. There is little information on these effects on black abalone, however. Discharge that results in ocean pH values outside the normal range for seawater (e.g., typically ranging from 7.5 to 8.5) may cause reduced growth and survival of abalone, as has been observed in other marine gastropods (Shirayama and Thornton 2005).	Issuance of CWA permits. State water quality standards are subject to an ESA section 7 consultation between NMFS and the EPA, and NMFS can review individual NPDES permit applications for impacts on ESA-listed species.	Where federal permits are necessary, ensure discharge meets standards relevant for black abalone. Require measures to prevent or respond to a catastrophic event (i.e., using best technology to avoid unnecessary discharges).
Coastal development	2, 4, 7, 8, 10, 17, 19, and	*Rocky substrate* PCE— Increased sediment load that may result from urbanization of the coast and of watersheds (increased transport of fine sediments into	The USACE permits construction or expansion of stormwater outfalls, discharge or fill of wetlands, flood control	Stormwater pollution prevention plan; permanent stormwater site plan; and

	20	the coastal zone by rivers or runoff) can reduce the quality and/or quantity of rocky substrate. For example, in a study on San Nicolas Island, black abalone "dominated areas where rock contours provided a refuge from sand deposition" (Littler *et al.* 1983, cited in Airoldi 2003). Overall, there has been little study of the effects of increased sedimentation on rocky shoreline communities (Airoldi 2003). In addition, construction of coastal armoring is often associated with coastal urban development to protect structures from wave action or prevent erosion (see "in-water construction" in Section 2.1 of this report). *Food resources* PCE— Increased sedimentation may also affect feeding by covering up food resources, altering algal communities (including algal communities on the rocky reef and the growth of kelp forests that supply drift algae), and altering invertebrate communities (affecting biological interactions). Ephemeral and turf-forming algae were found to be favored in rocky intertidal areas that experience intermittent inundation (Airoldi 1998, cited in Thompson *et al.* 2002). *Settlement habitat* PCE—Increased sedimentation may affect settlement of larvae and propagules by covering up settlement habitat as well as affecting the growth of encrusting coralline algae (see Steneck *et al.* 1997, cited in Airoldi 2003), thought to be important for settlement.	projects, bank stabilization, and in-stream work	stormwater best management practice operations and maintenance.
Sediment disposal associated with road maintenance, repair, and construction ("Side-casting")	7 and 8	*Rocky substrate* and *settlement habitat* PCEs—Increased likelihood of sediment input into rocky intertidal habitats may reduce its quality and quantity. *Food resources* PCE—Sediment input into rocky intertidal habitat may result in reductions or changes to food resources. See sedimentation effects as described under "Coastal development", above.	NMS regulations prohibit discharge of materials within its boundaries, as well as outside its boundaries if the material may enter the sanctuary and harm sanctuary resources. However, under certain circumstances, a permit may be obtained from the MBNMS to allow for a prohibited activity.	Haul away (or store locally) excess material from road maintenance activities; place excess material at a stable site at a safe distance from rocky intertidal habitats; and use mulch or vegetation to stabilize the material.
Agricultural activities	1, 2, 3, 4, 7, 8, 9,	*Rocky substrate* PCE—Soil erosion from intensive irrigated agriculture or livestock farming in areas	*Irrigation*—water suppliers may provide water via contract with USBR or using	For irrigated agriculture: conservation crop rotation,

(including pesticide application, irrigation, and livestock farming)	10, 12, and 16	adjacent to the coast can cause increased sedimentation thereby reducing the quality and quantity of rocky substrate. *Food resources* PCE—Herbicides are designed to kill plants, thus herbicide contamination of water could have devastating effects on aquatic plants. *Settlement habitat* PCE—Laboratory experiments showed that the presence of pesticides (those examined in the study were DDT, methoxychlor, dieldrin, and "2,4-D") interfered with larval settlement. Presence of pesticides had a much lesser effect on survival of larvae. W*ater quality* PCE—Pesticides alter the chemical properties of sea water such that they can interfere with settlement cues emitted by coralline algae and associated diatom films and/or they may inhibit growth of marine algae upon which black abalone depend for food. There is little information on these effects on black abalone or related species, however, especially for pesticides that are currently in use.	infrastructure owned or maintained by the USBR. Privately owned diversions may require a Federal permit from USACE under sections 401 or 404 of the CWA. *Pesticide Application*—EPA consultation on FIFRA, pesticide registration program, and NPDES permits for aquatic pesticides. *Livestock farming*— Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) lands.	underground outlets, land smoothing, structures for water control, subsurface drains, field ditches, mains or laterals, and toxic salt reduction. For pesticides application: restrictions on application of some pesticides within certain distances from streams would provide protection for black abalone habitat. For livestock farming: fencing riparian areas; placing salt or mineral supplements to draw cattle away from rivers; total rest of allotments when possible; and frequent monitoring.
Oil & chemical spills and response	2, 4, 5, 7, 8, 9, 12, 15, and 19	*Rocky substrate* and *settlement habitat* PCEs—Oil spill clean-up activities may be as destructive, or more destructive, than the oil spill itself. Oil spill clean-up may involve application of toxic dispersants and the use of physical cleaning methods such as the use of high pressure and/or high temperature water to flush out oil which may decrease the quality of rocky substrate and settlement habitat in an area. Oil, oil/dispersant mixtures, and dispersants used in oil spill clean-up may adversely affect grazing mollusks like abalone in rocky intertidal areas, although less-toxic dispersants have been developed in recent years. *Food resources* PCE—The use of dispersants and physical cleaning methods may affect black abalone food resources (algal community). Chemical spills could also affect food resources, if the chemicals kill algae or affect algal growth.	Review of oil spill response plan from USCG. Regulations under the Water Pollution Control Act.	Modifications are uncertain. They could include measures to prevent or minimize the spill from coming onshore (e.g., deploy boom, apply dispersants, mechanical recovery of spilled substance) and monitoring of the shoreline and water quality during and after the spill. These measures may already be considered due to the presence of other sensitive resources.

		Water quality PCE—Effects of oil spills vary from no discernable differences to widespread mortality of marine invertebrates over a large area and reduced densities persisting a year after the spill.		
Vessel grounding incidents and response	8	*Rocky substrate* and *settlement habitat* PCEs—Vessel grounding can affect the rocky substrate and have substantial effects on the environment, ranging from minor displacement of sediment to catastrophic damage to reefs. Wave activity may also cause the vessel to roll excessively and do more damage to the ocean floor. *Food resources* and *water quality* PCEs—The risk of invasion by foreign species attached to the ship's hull into a local environment. The wreck of an ocean-going vessel can result in large masses of steel distributed over substantial areas of seabed, particularly in high energy, shallow water environments. The wreckage may be a chronic source of dissolved iron. Elevated levels of iron may affect water quality and result in an increase of opportunistic algae blooms	The United States Coast Guard (USCG) has the authority to respond to all oil and hazardous substance spills in the offshore/coastal zone, while the EPA has the authority to respond in the inland zone.	Best management practices (BMP) for oil spill and debris clean-up to reduce trampling. Education of USCG, NMS biologists, and others involved in clean-up to raise awareness of black abalone.
Power plant construction and operation	10	*Water quality* PCE—The power plants' use of coastal waters for cooling and subsequently discharging of heated water back into the marine environment may raise water temperatures and introduce contaminants into the water. Elevated water temperatures have been linked to increased virulence of the withering syndrome disease.	The Diablo Canyon Nuclear Power Plant, located in specific area 10, is licensed through the Nuclear Regulatory Commission.	Modifications are uncertain at this time. The feasibility of closed-system wet cooling towers is questionable. Because the CWA provides a high level of baseline protections, black abalone critical habitat is not likely to result in additional modifications.
Desalination plant construction and operation	4, 7, 8, 9, 10, 12, 17, and 19	*Water quality* PCE—Discharge of hyper-saline water results in increased salinity and fluctuating salinity conditions that may affect sensitive organisms near the outfall. The impacts of brine effluent are generally more severe in rocky substrate than on sandy seafloor habitats. However, more research is needed on the tolerance level of black abalone for different salinities. Other effects of the discharge on water quality include increased turbidity, concentration of organic substances and metals contained in the feed waters, concentration	A desalination facility may require a Section 404 permit under the CWA from the USACE if it involves placing fill in navigable waters, and a Section 10 permit under the RHA if the proposal involves placing a structure in a navigable waterway.	Potential conservation efforts to mitigate desalination impacts may include the treatment of hyper-saline effluent to ensure that salinity levels are restored to normal values. The costs of treating hyper-saline effluent or finding an alternate manner of brine disposal can vary

		of metals picked up through contact with the plant components, thermal pollution, and decreased oxygen levels. Entrainment and impingement of black abalone larvae may also occur from water intake at desalination plants, but this is primarily a take issue.		widely across plants depending on plant capacity and design.
Tidal and wave energy project construction and operation	1, 10, and 19	*Rocky substrate* PCE—Impacts on rocky substrate may result from the installation of power lines to transport power to shore. These projects typically involve placement of structures, such as buoys, cables, and turbines, in the water column. *Water quality* PCE—Alternative energy projects may result in reduced wave height by as much as 5 to 13%, which may benefit abalone habitat. Effects on wave height would generally only be observed 1-2 km away from the wave energy device. Another concern is the potential for liquids used in the system to leak or be accidentally spilled, resulting in release of toxic fluids. Toxins may also be released in the use of biocides to control the growth of marine organisms. The potential effects of coastal wave and tidal energy projects on black abalone habitat are uncertain, because these projects are relatively new and the impacts are very site-specific.	Subject to FERC permitting and licensing requirements, as well as requirements under Section 401 of the CWA.	Use of non-toxic fluids instead of toxic fluids. When the project requires the use of power lines, use existing power lines, instead of constructing new ones, and avoid rocky intertidal areas.
Liquefied natural gas (LNG) project construction and operation	Uncertain	*Rocky substrate* PCE—Onshore LNG terminals involve construction of breakwaters, jetties, or other shoreline structures and activities associated with construction (e.g., dredging) that may affect black abalone habitat. Offshore LNG terminals involve construction of pipelines to transport LNG onshore and may affect rocky habitat. See sedimentation effects described under "dredging", "in-water construction", and "coastal development". *Food resource* and *water quality* PCEs—There is an increased potential for oil spills and potential effects on water quality from the presence of vessels transporting and offloading LNG at the terminals.	FERC has license authority for terminals built onshore and in state waters. MARAD and USCG have siting and permitting authority for deepwater ports in Federal waters. CWA permits under section 401 (water quality certificate) and/or section 404 (a dredge and fill permit) and Clean Air Act permits under section 502 may be required.	Onshore siting considerations: Avoid siting LNG projects within or adjacent to rocky intertidal habitats. Offshore facilities: In the installation of pipelines, avoid rocky intertidal habitats or use existing pipelines.
Mineral and petroleum exploration	10	*Rocky substrate* PCE—This activity may result in increased sedimentation into rocky intertidal habitats. See sedimentation effects described under "dredging",	The BOEMRE manages the Nation's offshore energy and mineral resources, including oil, gas, and alternative energy	Adoption of erosion control measures. Adoption of oil spill clean-up protocols and

and extraction		"in-water construction", and "coastal development". *Food resources* and s*ettlement habitat* PCE—In a laboratory study, water-based drilling muds from an active platform were found to negatively affect the settlement of red abalone larvae on coralline algae, but fertilization and early development were not affected. *Water quality* PCE—The activity may cause an increased risk of oil spills or leaks and increased sedimentation, thereby affecting water quality.	sources, as well as sand, gravel and other hard minerals on the outer continental shelf.	oil spill prevention plans; more Clean Seas boats as first responders to prevent oil spills from coming onshore; and relocation of proposed oil platforms further away from black abalone habitats.
Non-native species introduction and management	2, 4, 8, 10, and 11	*Food resources* PCE—The release of wastewater, sewage, and ballast water from commercial shipping presents a risk to kelp and other macroalgal species because of the potential introduction of exotic species. *Settlement habitat* PCE—Non-native species may displace native organisms by preying on them or out-competing them for resources such as food, space or both. Non-native species may introduce disease-causing organisms and can cause substantial population, community, and habitat changes.	The National Invasive Species Act of 1996 (NISA) and the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 under the USCG.	For commercial shipping: Safe (non-contaminated) ballast disposal; Rinse anchors and anchor chains when retrieving the anchor to remove organisms and sediments at their place of origin; Remove hull fouling organisms from hull, piping, propellers, sea chests, and other submerged portions of a vessel, on a regular basis, and dispose of removed substances in accordance with local, state, and federal law. For aquaculture: Inspect aquaculture facilities to prevent non-native species transport in packing materials.
Kelp harvesting	7-20	*Food resources* PCE—Kelp is the primary source of food for black abalone. Kelp is harvested for algin, which is used as a binder, emulsifier, and molding material in a broad range of products, and as a food source in abalone aquaculture operations. The harvest is small, but the kelp grows quickly, and harvest could generate drift (which can potentially be beneficial to black abalone). Potential impacts related to kelp harvesting are unclear.	None	None

Activities that lead to global climate change	1-20	Affects all PCEs. There is little information on these effects, however. *Water quality* PCE- Sea surface water temperatures that exceed 25ºC may increase risks to black abalone. Ocean pH values that are outside of the normal range for seawater (i.e., pH less than 7.5 or greater than 8.5) may cause reduced growth and survivorship in abalone as has been observed in other marine gastropods (Shirayama and Thornton, 2005). *Food resources and settlement habitat* PCE-Increasing partial pressure of carbon dioxide may reduce abundance of coralline algae and thereby affect the survival of newly settled black abalone (Feely *et al.*, 2004; Hall-Spencer *et al.*, 2008).	Uncertain	Potential actions to address this threat may include the organization of a task force and development of a plan that offers recommendations for ways to minimize the impacts of global climate change on black abalone and other ESA-listed species. However, this analysis was unable to determine specifically how activities that lead to global climate change (e.g., fossil fuel combustion) may be affected by the black abalone critical habitat designation (i.e., what type of special management might be required), or if a Federal nexus exists.

APPENDIX B: LAWS AND REGULATIONS THAT MAY PROVIDE BASELINE PROTECTION FOR BLACK ABALONE

The Endangered Species Act (16 U.S.C. 1531 et seq.)
Section 7 of the Act and implementing regulations (50 CFR Part 402) require Federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species, or destroy or adversely affect its critical habitat.

Clean Water Act (33 U.S.C. 1251 ET SEQ. 1987)
The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States. It gives the Environmental Protection Agency (EPA) the authority to implement pollution control programs such as setting wastewater standards for industry. The CWA also continued requirements to set water quality standards for all contaminants in surface waters.

Pursuant to Section 404 of the CWA, it is unlawful for any person to dredge, dispose of dredged material, or discharge a pollutant from a point source into navigable waters, unless a permit is obtained from the U.S. Army Corps of Engineers (USACE). As part of pollution prevention activities, the USACE may limit activities in waterways through the Section 404 permitting process, independent of black abalone concerns. These reductions in pollution may benefit black abalone critical habitat.

Pursuant to Section 402 of the CWA and under the National Pollutant Discharge Elimination System (NPDES) program, EPA sets pollutant-specific limits on point source discharges for major industries and provides permits to individual point sources that apply to these limits. Under the water quality standards program, EPA, in collaboration with States, establishes water quality criteria to regulate ambient concentrations of pollutants in surface waters.

Under section 401 of the CWA, all applicants for a Federal license or permit to conduct activities that may result in discharge to navigable waters are required to submit a State certification to the licensing or permitting agency. For example, the 1995 Bay-Delta Water Quality Control Plan and Water Right Decision 1641 incorporates objectives such as providing water for fish and wildlife, including anadromous fish. Costs associated with this and other existing water control plans are considered baseline protection in this analysis.

Marine Protection, Research, and Sanctuaries Act of 1972
This Act authorizes the Secretary of Commerce to designate and manage areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or aesthetic qualities as national marine sanctuaries. The Act also directs the Secretary to facilitate all public and private uses of those resources that are compatible with the primary objective of resource protection. Four sanctuaries have been designated within the areas considered for designation as black abalone critical habitat: Channel Islands, Gulf of Farallones, and Monterey Bay.

Federal Power Act (16 U.S.C. § 800 1920, as amended)
The Federal Power Act (FPA) was promulgated to establish the Federal Energy Regulatory Commission (FERC) to oversee non-Federal hydropower generation, including alternative energy hydrokinetic projects. The FERC is an independent Federal agency governing approximately 2,500 licenses for non-Federal hydropower facilities and has responsibility for national energy regulatory issues. This Act may provide protection by requiring consideration of the potential effects to black abalone habitat from

hydropower activities. Section 10(j) of the Federal Power Act (FPA) was promulgated to ensure that FERC considers both power and non-power resources during the licensing process.

Rivers and Harbors Act (33 USC §§ 401 ET SEQ. 1938)
The Rivers and Harbors Act (RHA) places Federal improvements of rivers, harbors and other waterways under the jurisdiction of the Department of the Army, USACE, and requires that all improvements include due regard for wildlife conservation. This Act may provide protection to the areas being considered for designation as black abalone critical habitat. Under sections 9 and 10 of the RHA, the USACE is authorized to regulate the construction of any structure or work within navigable waterways. This includes, for example, bridges and docks.

National Environmental Policy Act (42 USC §§ 4321-4345 1969)
The National Environmental Policy Act (NEPA) requires that all Federal agencies conduct a detailed environmental impact statement (EIS) in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment. The NEPA process may provide protection to the areas considered for designation as black abalone critical habitat for activities that have Federal involvement, if alternatives are considered and selected that are less harmful to black abalone habitat than other alternatives.

The National Historic Preservation Act of 1966 (16 U.S.C. 470 et seq.)
Section 106 of the Act and implementing regulations (36 CFR Part 800) require the Regional Administrator, before issuing a license, to adopt measures when feasible to mitigate potential adverse effects of the licensed activity and properties listed or eligible for listing in the National Register of Historic Places. The Act's requirements are to be implemented in cooperation with State Historic Preservation Officers and upon notice to, and when appropriate, in consultation with the Advisory Council on Historic Preservation.

The Oil Pollution Act of 1990 (33 U.S.C. 2701-2761)
The Oil Pollution Act of 1990 amended the Clean Water Act and addressed the wide range of problems associated with preventing, responding to, and paying for oil pollution incidents in navigable waters of the United States. It created a comprehensive prevention, response, liability, and compensation regime to deal with vessel- and facility-caused oil pollution to U.S. navigable waters. OPA greatly increased federal oversight of maritime oil transportation, while providing greater environmental safeguards by:

- Setting new requirements for vessel construction and crew licensing and manning,
- Mandating contingency planning,
- Enhancing federal response capability,
- Broadening enforcement authority,
- Increasing penalties,
- Creating new research and development programs,
- Increasing potential liabilities, and
- Significantly broadening financial responsibility requirements.

The Sikes Improvements Act (16 USC §670 1997)
The Sikes Improvement Act (SIA) requires military installations to prepare and implement an Integrated Natural Resources Management Plan (INRMP). The purpose of the INRMP is to provide for:

- The conservation and rehabilitation of natural resources on military installations;
- The sustainable multipurpose use of the resources, which shall include hunting, fishing, trapping, and nonconsumptive uses; and
- Subject to safety requirements and military security, public access to military installations to facilitate the use of the resources.

INRMPs developed in accordance with the SIA may provide protection to areas considered for designation as black abalone critical habitat that are located within military training ranges.

California Environmental Quality Act (CEQA) (California Natural Resources Code §15065(A))
CEQA is a California State statute that requires State and local agencies (known as "lead agencies") to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. Projects carried out by Federal agencies are not subject to CEQA provisions. CEQA instructs the lead agency (typically a county or city community development or planning department in the case of land development projects) to examine impacts from a broad perspective, taking into account the value of species' habitats that may be impacted by the project in an Environmental Impact Report (EIR). The lead agency must determine which, if any, project impacts are potentially significant and, for any such impacts identified, whether feasible mitigation measures or feasible alternatives will reduce the impacts to a level less than significant. It is within the power of a lead agency to decide that negative impacts are acceptable in light of economic, social, or other benefits generated by the project.

California Marine Life Protection Act (MLPA)
California's Marine Life Protection Act (MLPA) of 1999 requires the state to re-evaluate all existing marine protected areas (MPAs) and potentially design new MPAs to develop a statewide MPA network. To implement the MLPA, the state has been divided into five study regions: North Coast (California/Oregon border to Alder Creek near Point Arena), North Central Coast (Alder Creek near Point Arena to Pigeon Point, including the Farallon Islands), Central Coast (Pigeon Point to Point Conception), San Francisco Bay (waters within San Francisco Bay, from the Golden Gate Bridge northeast to Carquinez Bridge), and South Coast (Point Conception to the California/Mexico border). Regulations have been adopted in the Central Coast (effective September 2007), North Central Coast (effective May 2010), and South Coast (effective October 2011) regions, whereas the planning processes are currently underway in the North Coast and San Francisco Bay regions. The designation of MPAs and the implementation of protective regulations (e.g., prohibitions on the recreational or commercial collection of invertebrates within some MPAs) may benefit black abalone and its habitat within the areas considered for designation as critical habitat.

Cal Trans Environmental Enhancement and Mitigation Program
This program was established by the enactment of the Transportation Blueprint Legislation of 1989. This legislation provided for the annual allocation of $10 million that was distributed through the California Resources Agency to fiscal year 2000-2001. The program provides grants to local, state, and Federal agencies and nonprofit entities to mitigate the environmental impact of modified or new public transportation facilities. Eligible projects for funding include the acquisition, restoration, or enhancement of resource lands to mitigate the loss of, or the detriment to, resource lands lying within or near the right-of-way acquired for proposed transportation improvements. Resource lands include natural areas, wetlands, forests, woodlands, meadows, streams, or other areas containing fish or wildlife habitat.

Ocean Dumping Act
The Ocean Dumping Act prohibits any person from dumping, or transporting for the purpose of dumping, sewage sludge or industrial waste into ocean waters without a permit (16 USC §1411b). No permits can be issued to dump radiological, chemical, and biological warfare agents, high-level radioactive waste, and medical waste (16 USC §1412). The EPA has responsibility for regulating the dumping of all material except dredged material.

National Park System Act
The National Park System Act authorizes the Secretary of the Department of the Interior to recommend areas to Congress for inclusion in the National Park system, and authorizes the Secretary to administer designated parks, including through promulgation of regulations. Black abalone are found in the Channel

Islands National Park (CINP), Golden Gate National Recreation Area (GGNRA), and Point Reyes National Seashore (PRNS), which are managed by the National Park Service. The CINP encompasses five of the California Channel Islands: Anacapa, Santa Cruz, Santa Rosa, San Miguel, and Santa Barbara. The GGNRA encompasses several areas in the region surrounding the mouth of San Francisco Bay where the bay meets the Pacific Ocean. The PRNS encompasses Point Reyes Peninsula, just north of San Francisco Bay. Certain regulations apply in all three areas that may provide protections to specific areas being considered for designation as black abalone critical habitat, including: prohibitions on the introduction of wildlife, fish, or plants into a park ecosystem (36 CFR 2.1); prohibitions on polluting or contaminating park waters or water courses (36 CFR 2.14); restrictions on landing in and public access to specific areas within the parks (36 CFR 1.5); and regulations on mining and mineral exploration (36 CFR Part 9). In the CINP, regulations specifically prohibit the taking of any invertebrates in waters less than 5 m depth, the taking of abalone for commercial purposes on Anacapa and Santa Barbara Islands, and the transport or delivery of certain types of materials that may carry invasive species to any of the islands (36 CFR 1.5 and 7.84)

National Wildlife Refuge Administration Act
The National Wildlife Refuge Administration Act directs the U.S. Fish and Wildlife Service to manage the Refuge System as a national system of lands and waters devoted to conserving and, where appropriate, restoring fish, wildlife, and plant resources and their habitats (15 USC § 668dd). The law also declared that compatible wildlife-dependent recreational uses are acceptable activities on refuges. Black abalone are found at the Farallon National Wildlife Refuge, encompassing the Farallon Islands. This refuge is closed to the public.

Water Resources Development Act
The Water Resources Development Act (33 USC §§ 2201 et seq.) authorizes the construction or study of USACE projects and applies to all features of water resources development and planning, including environmental assessment and mitigation requirements.

Act to Prevent Pollution from Ships
The Act to Prevent Pollution from Ships (APPS), as amended by the Marine Plastic Pollution Research and Control Act (MPPRCA), protects coral reefs by requiring all U.S. ships and all ships in U.S. navigable waters or the exclusive economic zone (EEZ) to comply with the International Convention for the Prevention of Pollution from Ships (33 USC §§ 1901 et seq.). Under the regulations implementing APPS as amended by MPPRCA, the discharge of plastics, including synthetic ropes, fishing nets, plastic bags, and biodegradable plastic, into the water is prohibited. Discharge of floating dunnage, lining, and packing materials is prohibited in the navigable waters and in areas offshore less than 25 nautical miles from the nearest land. Food waste or paper, rags, glass, metal, bottles, crockery, and similar refuse cannot be discharged in navigable waters or in waters offshore inside 12 nautical miles from the nearest land. Finally, food waste, paper, rags, glass, and similar refuse cannot be discharged in navigable waters or in waters offshore inside three nautical miles from the nearest land. USCG has the primary responsibility of enforcing regulations under the APPS, and the APPS applies to all vessels, including cruise ships, regardless of flag, operating in U.S. navigable waters and the EEZ.

The Lacey Act
The Lacey Act, as amended in 1981 (16 USC §§ 3372 et seq.), prohibits the trade of fish, wildlife, or plants taken in violation of any foreign, state, tribal or other U.S. law. For example, it is a violation of the Lacey Act for an individual to illegally possess or attempt to sell black abalone shells or meat.

Marine Debris Research, Prevention, and Reduction Act
The Marine Debris Research, Prevention and Reduction Act (MDRPRA) was passed to establish programs within the National Oceanic and Atmospheric Administration (NOAA) and the United States

Coast Guard (USCG) to help identify, determine sources of, assess, reduce, and prevent marine debris and its adverse impacts on the marine environment and navigation safety. MDRPRA also reactivates the Interagency Marine Debris Coordinating Committee, which EPA co-chairs with NOAA.

The General Mining Law of May 10, 1872, as amended (30 U.S.C. §§ 22-54 and §§ 611-615)
The General Mining Law is the major Federal law governing locatable minerals. This law allows citizens of the United States the opportunity to explore for, discover, and purchase certain valuable mineral deposits on those Federal lands that are open for mining claim location and patent (open to mineral entry). These mineral deposits include most metallic mineral deposits and certain nonmetallic and industrial minerals. The law sets general standards and guidelines for claiming the possessory right to a valuable mineral deposit discovered during exploration. The General Mining Law allows for the enactment of State laws governing location and recording of mining claims and sites that are consistent with Federal law. The Federal regulations implementing the General Mining Law are found at Title 43 of the Code of Federal Regulations (CFR) in Groups 3700 and 3800.

Natural Gas Act of 1938
Under the Natural Gas Act of 1938, approval by FERC, is required for the siting, construction, and operation of onshore LNG import and export facilities.

Federal Deepwater Port Act of 1974
The Federal Deepwater Port Act of 1974 gives the U.S. Coast Guard and U.S. Maritime Administration authority to issue licenses for the ownership, construction, and operation of deepwater ports, including deepwater LNG facilities.

Atomic Energy Act of 1954
Under the Atomic Energy Act of 1954, the Nuclear Regulatory Commission (NRC) regulates the licensing, safety, and operations of nuclear power plants (i.e., Diablo Canyon Nuclear Power Plant).

Other Statutes and Regulations
While the following statutes and regulations may apply to lands and waters that fall within the specific areas being considered for designation as black abalone critical habitat, they are unlikely to provide significant baseline protections and are not considered in the analysis.

• *Coastal Zone Management Act (16 USC §§ 1451 et seq. 1972)* – CZMA establishes an extensive Federal grant program to encourage coastal States to develop and implement coastal zone management programs to provide for protection of natural resources, including wetlands, flood plains, estuaries, beaches, dunes, barrier islands, coral reefs, and fish and wildlife and their habitat.

• *California Endangered Species Act (California Fish and Game Code §§ 2050, et seq.)* - The CESA parallels the main provisions of the Federal Endangered Species Act and is administered by the California Department of Fish and Game (DFG). CESA prohibits the "taking" (the California Fish and Game Code defines "take" as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill") of listed species except as otherwise provided in State law. The CESA also applies the take prohibitions to species petitioned for listing ("candidate species"). Black abalone are not currently listed under the CESA, but white abalone (*Haliotis sorenseni*) are.

APPENDIX C: INCREMENTAL SCORE SENSITIVITY ANALYSIS

Section 2 of this analysis presents estimated annualized impacts by specific area and activity. These estimated impacts assume that a certain baseline level of protection is afforded black abalone from existing Federal, state, and local regulations, as well as the presence of other listed marine species and other designated critical habitat. However, a degree of uncertainty exists regarding this level of baseline protection and future actions likely to be undertaken specifically for the benefit of the black abalone critical habitat.

Due to this level of uncertainty, this appendix presents impacts without applying the "incremental scores," in order to inform decision-makers about the range of potential impacts. Table C-1 presents total un-scaled impacts by specific area, as well as the difference between these impacts and those estimated and presented in Section 2 of this report, which applied incremental scores. Using the midpoint of the low and high cost scenarios, the ranking of total impacts by specific area changes slightly, when comparing costs that incorporate incremental scores to costs without incremental scores. Under this sensitivity analysis, the increase in the estimated economic impacts to specific areas 2, 3, 4, 5, and 11 raised the relative ranking (in terms of the total impacts) of these specific areas compared to the other specific areas. For specific areas 2, 3, 4, and 11, this increase was primarily due to increased costs associated with NPDES-permitted facilities. For specific area 5, this increase was primarily due to the increased costs associated with oil and chemical spill prevention and cleanup activities, as well as those associated with major NPDES-permitted facilities.

Tables C-2 through C-11 present the estimated total economic impacts, by specific area, without applying the incremental scores (i.e., assuming that all potential economic impacts can be attributed to the black abalone critical habitat designation).

Table C-1: Summary of Estimated Annualized Impacts by Specific Area

Area	No Incremental Scores			With Incremental Scores			Difference		
	Low	Mid	High	Low	Mid	High	Low	Mid	High
1	$3,000	$307,000	$610,000	$3,000	$280,000	$556,000	$0	$27,000	$54,000
2	$20,000	$1,153,000	$2,286,000	$15,000	$251,000	$487,000	$5,000	$902,000	$1,799,000
3	$0	$1,000,000	$2,000,000	$0	$222,000	$444,000	$0	$778,000	$1,555,000
4	$161,000	$1,293,000	$2,425,000	$17,000	$228,000	$439,000	$144,000	$1,065,000	$1,986,000
5	$0	$50,000	$100,000	$0	$5,000	$10,000	$0	$45,000	$90,000
6	$0	$0	$0	$0	$0	$0	$0	$0	$0
7	$64,000	$875,000	$1,687,000	$14,000	$509,000	$1,004,000	$51,000	$367,000	$683,000
8	$57,000	$526,000	$996,000	$9,000	$319,000	$629,000	$49,000	$208,000	$367,000
9	$5,000	$144,000	$283,000	$5,000	$92,000	$180,000	$0	$52,000	$104,000
10	$127,000	$790,000	$1,453,000	$30,000	$456,000	$882,000	$98,000	$334,000	$571,000
11	$424,000	$1,063,000	$1,703,000	$42,000	$113,000	$183,000	$381,000	$950,000	$1,519,000
12	$107,000	$356,000	$606,000	$12,000	$104,000	$197,000	$95,000	$252,000	$409,000
13	$0	$0	$0	$0	$0	$0	$0	$0	$0
14	$0	$0	$0	$0	$0	$0	$0	$0	$0
15	$0	$0	$0	$0	$0	$0	$0	$0	$0
16	$0	$103,000	$207,000	$0	$18,000	$37,000	$0	$85,000	$170,000
17	$1,000	$11,000	$20,000	$1,000	$3,000	$6,000	$1,000	$8,000	$15,000
18	$0	$0	$0	$0	$0	$0	$0	$0	$0
19	$56,000	$144,000	$232,000	$23,000	$98,000	$174,000	$33,000	$45,000	$58,000
20	$1,000	$3,000	$5,000	$1,000	$2,000	$3,000	$1,000	$2,000	$3,000
Total*	$1,027,000	$5,430,000	$9,833,000	$170,000	$2,131,000	$4,091,000	$857,000	$13,299,000	$5,741,000

*Totals are adjusted for double-counting of NPDES outfalls and acres of agricultural land that overlap multiple specific areas. See Sections 2.3 and 2.6 of this report for more details.

Table C-2: Summary of Economic Impacts to In-Water Construction Activities by Specific Area

	Total Annualized Costs		
Area	**Low**	**Mid**	**High**
10	$3,000	$5,000	$7,000
17	$1,000	$2,000	$2,000
19	$2,000	$3,000	$5,000
20	$1,000	$2,000	$2,000
Total	$7,000	$12,000	$17,000

Table C-3: Summary of Economic Impacts to Sand Replenishment Activities by Specific Area

Area	Total Annualized Impacts
2	$29,000
4	$14,000
7	$43,000
11	$14,000
Total	$100,000

Table C-4: Summary of Economic Impacts to Minor NPDES-permitted Facilities by Specific Area

	Total Annualized Impacts		
Area	**Low**	**Mid**	**High**
1	$0	$30,000	$60,000
2	$0	$174,000	$347,000
3	$0	$166,000	$332,000
4	$0	$166,000	$332,000
5	$0	$8,000	$15,000
7	$0	$45,000	$91,000
8	$0	$30,000	$60,000
9	$0	$15,000	$30,000
10	$0	$15,000	$30,000
11	$0	$378,000	$755,000
12	$0	$15,000	$30,000
16	$0	$8,000	$15,000
17	$0	$8,000	$15,000
Total*	$0	$702,000	$1,404,000

*Totals are adjusted for double-counting of NPDES outfalls that overlap multiple specific areas. See Section 2.3 of this report for more details.

Table C-5: Summary of Economic Impacts to Major NPDES-permitted Facilities by Specific Area

Area	Total Annualized Impacts		
	Low	Mid	High
2	$0	$806,000	$1,612,000
3	$0	$806,000	$1,612,000
4	$159,000	$1,013,000	$1,867,000
5	$0	$42,000	$85,000
7	$53,000	$196,000	$339,000
8	$53,000	$196,000	$339,000
9	$0	$42,000	$85,000
10	$106,000	$350,000	$594,000
11	$424,000	$678,000	$933,000
12	$106,000	$265,000	$424,000
16	$0	$85,000	$170,000
19	$53,000	$69,000	$85,000
Total*	$953,000	$2,809,000	$4,665,000

*Totals are adjusted for double-counting of NPDES outfalls that overlap multiple specific areas. See Section 2.3 of this report for more details.

Table C-6: Summary of Economic Impacts to Coastal Urban Development Activities by Specific Area

Area	Total Annualized Costs		
	Low	Mid	High
2	$10,000	$41,000	$72,000
4	$2,000	$8,000	$14,000
7	$6,000	$24,000	$43,000
8	$2,000	$8,000	$14,000
10	$2,000	$7,000	$11,000
17	$400	$2,000	$3,000
19	$1,000	$5,000	$9,000
20	$1,000	$2,000	$3,000
Total	$24,000	$96,000	$169,000

Table C-7: Summary of Economic Impacts to Sediment Disposal Activities Associated with Road Maintenance, Repair, and Construction ("Side-Casting") by Specific Area

Area	Total Annualized Costs
7	$548,000
8	N/A
Total	$548,000

Table C-8: Summary of Economic Impacts to Agricultural Irrigation Activities by Specific Area

Area	Total Annualized Impacts		
	Low	Mid	High
1	$3,000	$76,000	$150,000
2	$10,000	$119,000	$227,000
3	$0	$28,000	$55,000
4	$1,000	$99,000	$198,000
7	$5,000	$314,000	$623,000
8	$2,000	$292,000	$582,000
9	$5,000	$87,000	$168,000
10	$17,000	$347,000	$677,000
12	$1,000	$76,000	$152,000
Total*	$44,000	$1,142,000	$2,240,000

*Totals are adjusted for double-counting of acres of agricultural land that overlap multiple specific areas. See Section 2.6 of this report for more details.

Table C-9: Summary of Economic Impacts to Tidal and Wave Energy Projects by Specific Area

Area	Total Annualized Costs
	High
1	$400,000
10	$133,000
19	$133,000
Total	$667,000

APPENDIX D: DISCOUNT RATE SENSITIVITY ANALYSIS

Appendix D provides a discount rate sensitivity analysis for the estimated economic impacts discussed in Section 2 of this report. As mentioned in Section 1.4.7 of this report, the OMB Circular A-94 and A-4 state that discount rates of 3 percent and 7 percent should be used as base-cases for regulatory analyses. In Table D-1, the "Annualized Costs" column summarizes the estimated costs presented in Section 2 of this report. The "Cost Range" column presents a per project cost estimate that has not been discounted and is assumed to be spread evenly over the number of years listed in the "Time frame" column. The costs in the "Present Value" column were then calculated based on the annualized costs, across the indicated time frame, and discounted using a 3, 7, and 2.1 percent discount rate. A 2.1 percent discount rate was used here to test the sensitivity of the 3 and 7 percent discount rates used in Section 2 and 3 of this report. The 2.1 percent discount rate was selected based on guidance in Appendix C of the OMB Circular A-94 (as revised in December 2010),[151] which recommended a discount rate of 2.1 percent for a 20 year analysis when conducting cost-effectiveness analyses.[152] Further guidance from OMB stated that the discount rates in Appendix C do not apply to regulatory analysis4 and therefore cannot be used as the base-case. However, OMB stated that the 2.1 percent discount rate could be used in the sensitivity analysis for the discount rates.[153] Table D-1 shows the present discounted value cost estimates, in 2010 dollars, by activity, comparing all three discount rates.

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[151] U.S. Office of Management and Budget. 2010. Discount Rates for Cost-Effectiveness, Lease Purchase, and Related Analyses: Appendix C, Revised December 2010. Available online at: http://www.whitehouse.gov/omb/circulars_a094_a94_appx-c/

[152] U.S. Office of Management and Budget. 2011. Memorandum 11-12 from Jacob J. Lew, Director, for the heads of departments and agencies regarding 2011 Discount Rates for OMB Circular No. A-94. February 2, 2011. 2pp. Available online at: http://www.whitehouse.gov/sites/default/files/omb/memoranda/2011/m11-12.pdf

[153] Personal communication with Nathan Frey and Amanda Lee, OMB, on September 27, 2011.

Table D-1: Summary of Estimated Annualized Costs, Cost Range, and Present Value, by Activity and Area (in 2010 dollars)

Activity	Cost Category	Metric	Annualized Costs	Timeframe (years)	Cost Range	Present Discounted Value		
						2.1%	3.0%	7.0%
In-water construction	Low	per project	$5,000	8	$38,000	$35,000	$33,000	$28,000
	Mid		$8,000		$66,000	$60,000	$58,000	$49,000
	High		$12,000		$94,000	$86,000	$83,000	$70,000
Sand replenishment	Low	per project	$0	6	$0	$0	$0	$0
	Mid		$72,000		$429,000	$399,000	$387,000	$341,000
	High		$143,000		$858,000	$798,000	$775,000	$682,000
NPDES: Minor	Low	per plant	$0	20	$0	$0	$0	$0
	Mid		$8,000		$151,000	$122,000	$112,000	$80,000
	High		$15,000		$302,000	$245,000	$225,000	$160,000
NPDES: Major	Low	per plant	$53,000	20	$1,059,000	$857,000	$788,000	$561,000
	Mid		$69,000		$1,378,000	$1,116,000	$1,025,000	$730,000
	High		$85,000		$1,697,000	$1,374,000	$1,262,000	$899,000
Coastal development	Low	per project	$2,000	20	$40,000	$32,000	$30,000	$21,000
	Mid		$8,000		$163,000	$132,000	$121,000	$86,000
	High		$14,000		$286,000	$232,000	$213,000	$152,000
Sediment disposal ("Side-casting")	Low: Area 7	per project	$0	1	$0	$0	$0	$0
	Mid: Area 7		$137,000		$137,000	$134,000	$133,000	$128,000
	High: Area 7		$274,000		$274,000	$269,000	$266,000	$256,000
Agriculture: Irrigation	Low	acres per area	$0-$17,000	Varies by area depending on acreage				
	High		$22,000-$677,000					
Power plants	Low	per plant	$50,000	20	$999,000	$809,000	$743,000	$529,000
	Mid		$149,949,000		$2,998,976,000	$2,428,379,000	$2,230,859,000	$1,588,560,000
	High		$299,848,700		$5,996,952,000	$4,855,951,000	$4,460,975,000	$3,176,590,000
Tidal and wave energy projects	Low	per project	$0	30	$0	$0	$0	$0
	Mid		$67,000		$2,002,000	$1,474,000	$1,308,000	$828,000
	High		$133,000		$4,004,000	$2,948,000	$2,616,000	$1,656,000

APPENDIX E: FINAL REGULATORY FLEXIBILITY ANALYSIS

This analysis considers the extent to which the potential economic impacts associated with the black abalone critical habitat designation could be borne by small businesses. The analysis presented is conducted pursuant to the Regulatory Flexibility Act (RFA) as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996. Information for this analysis was gathered from the Small Business Administration (SBA) and U.S. Census Bureau.

Introduction

First enacted in 1980, the RFA was designed to ensure that the government considers the potential for its regulations to unduly inhibit the ability of small entities to compete. The goals of the RFA include increasing the government's awareness of the impact of regulations on small entities and to encourage agencies to exercise flexibility to provide regulatory relief to small entities.

When a Federal agency proposes regulations, the RFA requires the agency to prepare and make available for public comment an analysis that describes the effects of the rule on small entities (i.e., small businesses, small organizations, and small government jurisdictions). For the proposed rule, an initial regulatory flexibility analysis (IRFA) was prepared and made available for public comment as part of the draft Economic Analysis Report (NMFS 2010). For the final rule, this analysis takes the form of a final regulatory flexibility analysis (FRFA). Under 5 U.S.C., Section 603(b) of the RFA, an FRFA is required to contain:

i. A description of the reasons why action by the agency is being considered;
ii. A succinct statement of the objectives of, and legal basis for, the final rule;
iii. A description of and, where feasible, an estimate of the number of small entities to which the final rule will apply;
iv. A description of the projected reporting, recordkeeping, and other compliance requirements of the final rule, including an estimate of the classes of small entities which will be subject to the requirement and the type of professional skills necessary for preparation of the report or record;
v. An identification, to the extent practicable, of all relevant Federal rules which may duplicate, overlap or conflict with the final rule;
vi. Each final regulatory flexibility analysis shall also contain a description of any significant alternatives to the final rule which accomplish the stated objectives of applicable statutes and which minimize any significant economic impact of the final rule on small entities.

Needs and Objective of the Rule

The black abalone was listed as endangered throughout its range under the Endangered Species Act (ESA) on January 14, 2009 (74 FR 1937). Section 4(b)(2) of the ESA requires the Secretary of Commerce, through NMFS, to designate critical habitat for threatened and endangered species "on the basis of the best scientific data available and after taking into consideration the economic impact, impact on national security, and any other relevant impact, of specifying any particular area as critical habitat." The ESA defines critical habitat under Section 3(5)(A) as:

> "(i) the specific areas within the geographical area occupied by the species, at the time it is listed…, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed…upon a determination by the Secretary that such areas are essential for the conservation of the species."

DESCRIPTION AND ESTIMATE OF THE NUMBER OF SMALL ENTITIES TO WHICH THE RULE APPLIES

Definition of a Small Entity

Three types of small entities are defined in the RFA:

i. **Small Business.** Section 601(3) of the RFA defines a small business as having the same meaning as a small business concern under section 3 of the Small Business Act. This includes any firm that is independently owned and operated and is not dominant in its field of operation. The U.S. Small Business Administration (SBA) has developed size standards to carry out the purposes of the Small Business Act, and those size standards can be found in 13 CFR 121.201. The size standards are matched to North American Industry Classification System (NAICS) industries. The SBA definition of a small business applies to a firm's parent company and all affiliates as a single entity.

ii. **Small Governmental Jurisdiction.** Section 601(5) defines small governmental jurisdictions as governments of cities, counties, towns, townships, villages, school districts, or special districts with a population of less than 50,000. Special districts may include those servicing irrigation, ports, parks and recreation, sanitation, drainage, soil and water conservation, road assessment, etc. Most tribal governments will also meet this standard. When counties have populations greater than 50,000, those municipalities of fewer than 50,000 can be identified using population reports.

Other types of small government entities are not as easily identified under this standard, as they are not typically classified by population.

iii. **Small Organization.** Section 601(4) defines a small organization as any not-for-profit enterprise that is independently owned and operated and not dominant in its field. Small organizations may include private hospitals, educational institutions, irrigation districts, public utilities, agricultural co-ops, etc. Depending upon state laws, it may be difficult to distinguish whether a small entity is a government or non-profit entity. For example, a water supply entity may be a cooperative owned by its members in one case and in another a publicly chartered small government with the assets owned publicly and officers elected at the same elections as other public officials.

Description of Activities for which Impacts are Most Likely

Any activity conducted by a small entity that affects the habitat or habitat features essential to the black abalone has the potential to be affected by the critical habitat designation. As described in the main text of this analysis, NMFS identified 17 categories of activities as potentially requiring modification to avoid destruction or adverse modification of the black abalone critical habitat. These "activities" include the operation of some facilities, such as coastal power plants, where special management of operations may be required to address potential effects on black abalone critical habitat. The following are the categories of activities assessed in this FRFA:

i. Dredging and disposal of dredged material
ii. In-water construction
iii. Sand replenishment
iv. NPDES-permitted activities (point source discharge)
v. Coastal urban development
vi. Sediment disposal associated with road maintenance, repair, and construction (previously called "side-casting")
vii. Agriculture (including pesticide use, irrigation, and livestock farming)
viii. Oil & chemical spills: prevention & clean-up
ix. Vessel grounding incidents and response
x. Power plant operations and construction
xi. Desalination plant operations and construction
xii. Tidal and wave energy project construction and operations
xiii. Liquefied natural gas (LNG) project operations and construction
xiv. Mineral and petroleum exploration and extraction
xv. Non-native species: prevention and management

xvi. Kelp harvesting

xvii. Activities that lead to global climate change

As discussed earlier in this report, a great deal of uncertainty exists with regard to how potentially regulated entities will attempt to avoid the destruction or adverse modification of critical habitat. This is because, for many of the activities, relatively little data exist on the effects of the activities on black abalone habitat. In addition, this economic analysis attempts to estimate the incremental impacts resulting specifically from the critical habitat designation, recognizing that current listing-related conservation measures and existing regulations are expected to provide some level of baseline protection for black abalone habitat. As discussed earlier in this report, in cases where it was difficult to separate the costs associated with protections under the listing of black abalone from the costs associated with the designation of critical habitat, we used our best professional judgment to identify and estimate the incremental economic impacts of the critical habitat designation.

This FRFA estimates the potential number of small businesses that may be affected by the final critical habitat designation for black abalone, and the average annualized impact per entity for a given specific area and activity type. Specifically, based on an examination of the North American Industry Classification System (NAICS), this analysis classifies the potentially affected activities into industry sectors and provides an estimate of the number of small businesses affected in each sector based on the applicable NAICS codes. Table E-1 presents a list of the major relevant activities and descriptions of the industry sectors involved in those activities, including NAICS codes, and the SBA thresholds for determining whether a business is a small business.

This FRFA does not consider all types of small businesses that could be affected by the critical habitat designation due to the lack of information (i.e., the NAICS codes) needed to identify small entities for all of the activity types. We used U.S. Census Bureau county data and NAICS codes to identify the number of small businesses that may be affected by the critical habitat designation for black abalone. We were able to identify the NAICS code for only 8 of the 17 categories of activities and thus were only able to estimate the number of and economic impacts to small businesses that may be affected for those 8 categories of activities. Impacts to small businesses involved in the 8 categories of activities are discussed below.

Table E-1: Major Relevant Activities and a Description of the Industry Sectors Engaged in those Activities

Activity	Description of included industry sectors	NAICS code	SBA size standard
In-water Construction & Dredging	**Construction Sand and Gravel Mining** This industry comprises establishments primarily engaged in one or more of the following: (1) operating commercial grade (i.e., construction) sand and gravel pits; (2) dredging for commercial grade sand and gravel; and (3) washing, screening, or otherwise preparing commercial grade sand and gravel.	212321	500 employees
	Water and Sewer Line and Related Structures Construction This industry comprises establishments primarily engaged in the construction of water and sewer lines, mains, pumping stations, treatment plants and storage tanks.	237110	$33.5 million average annual receipts
	Oil and Gas Pipeline and Related Structures Construction This industry comprises establishments primarily engaged in the construction of oil and gas lines, mains, refineries, and storage tanks.	237120	
	Power and Communication Line and Related Structures Construction This industry comprises establishments primarily engaged in the construction of power lines and towers, power plants, and radio, television, and telecommunications transmitting/receiving towers.	237130	
	Other Heavy and Civil Engineering Construction This industry comprises establishments primarily engaged in heavy and engineering construction projects (excluding highway, street, bridge, and distribution line construction).	237990	
NPDES	**Sewage Treatment Facilities** This industry comprises establishments primarily engaged in operating sewer systems or sewage treatment facilities that collect, treat, and dispose of waste.	221320	$7.0 million average annual receipts
	Food Manufacturing Industries in this sector transform livestock and agricultural products into products for intermediate or final consumption. The industry groups are distinguished by the raw materials (generally of animal or vegetable origin) processed into food products.	311	500 employees
	Wood Product Manufacturing Industries in this sector manufacture wood products, such as lumber, plywood, veneers, wood containers, wood flooring, wood trusses, manufactured homes (i.e., mobile home), and prefabricated wood buildings.	321	500 employees
	Paper and Pulp Mills This industry comprises establishments primarily engaged in manufacturing paper and/or pulp.	322	750 employees
Coastal urban development	**Highway, Street and Bridge Construction** This industry comprises establishments primarily engaged in the construction of highways (including elevated), streets, roads, airport runways, public sidewalks, or bridges. The work performed may include new work, reconstruction, rehabilitation, and repairs.	237310	$33.5 million average annual receipts
	Water Supply and Irrigation Systems This industry comprises establishments primarily engaged in operating water treatment plants and/or operating water supply systems. The water supply system may include pumping stations, aqueducts, and/or distribution mains. The water may be used for drinking, irrigation, or other uses.	221310	$7.0 million average annual receipts

Activity	Description of included industry sectors	NAICS code	SBA size standard
Agriculture: Pesticides	**Farm Supplies Merchant Wholesalers** This industry comprises establishments primarily engaged in the merchant wholesale distribution of farm supplies, such as animal feeds, fertilizers, agricultural chemicals, pesticides, plant seeds, and plant bulbs.	424910	100 employees
Tidal & Wave Energy	**Hydroelectric Power Generation** This U.S. industry comprises establishments primarily engaged in operating hydroelectric power generation facilities. These facilities use water power to drive a turbine and produce electric energy. The electric energy produced in these establishments is provided to electric power transmission systems or to electric power distribution systems.	221111	4 million megawatts for the preceding year[1]
	Other Electric Power Generation This U.S. industry comprises establishments primarily engaged in operating electric power generation facilities (except hydroelectric, fossil fuel, nuclear). These facilities convert other forms of energy, such as solar, wind, or tidal power, into electrical energy. The electric energy produced in these establishments is provided to electric power transmission systems or to electric power distribution systems.	221119	
LNG	**Natural Gas Liquid Extraction** This U.S. industry comprises establishments primarily engaged in the recovery of liquid hydrocarbons from oil and gas field gases. Establishments primarily engaged in sulfur recovery from natural gas are included in this industry.	211112	500 employees
Mineral & Petroleum Exploration	**Crude Petroleum and Natural Gas Extraction** This U.S. industry comprises establishments primarily engaged in (1) the exploration, development and/or the production of petroleum or natural gas from wells in which the hydrocarbons will initially flow or can be produced using normal pumping techniques or (2) the production of crude petroleum from surface shales or tar sands or from reservoirs in which the hydrocarbons are semisolids. Establishments in this industry operate oil and gas wells on their own account or for others on a contract or fee basis.	211111	500 employees
	Drilling Oil and Gas Wells This U.S. industry comprises establishments primarily engaged in drilling oil and gas wells for others on a contract or fee basis. This industry includes contractors that specialize in spudding in, drilling in, redrilling, and directional drilling.	213111	500 employees
	Support Activities for Nonmetallic Minerals (except Fuels) Mining This U.S. industry comprises establishments primarily engaged in providing support activities, on a fee or contract basis, for the mining and quarrying of nonmetallic minerals (except fuel) and for the extraction of nonmetallic minerals (except site preparation and related construction activities). Exploration for minerals is included in this industry. Exploration (except geophysical surveying and mapping services) includes traditional prospecting methods, such as taking core samples and making geological observations at prospective sites.	213115	$7.0 million average annual receipts

Note:
(1) All entities in the Electric Services Sectors are assumed to be small entities. Consequently, the number for small entities in these sectors represents an upper bound estimate. The number of small entities in the hydroelectric power generation and electrical services industries is unknown because of the unavailability of data related to small business thresholds. For both of these industry sectors the SBA defines a firm as "small" if, including its affiliates, it is primarily

Activity	Description of included industry sectors	NAICS code	SBA size standard
engaged in the generation, transmission, and/or distribution of electric energy for sale, and its total electric output for the preceding fiscal year did not exceed 4 million megawatt hours. It was not possible to locate a source that provides this information for all regulated entities within these sectors. Sources: Definitions compiled from U.S. Census Bureau. North American Industry Classification System (NAICS). Accessed at: http://www.census.gov/cgi-bin/sssd/naics/naicsrch?chart=2007; SBA size standards complied from U.S. Small Business Administration. Table of Small Business Size Standards Matched to North American Industry Classification System Codes. November 2010. Accessed at: www.sba.gov/sites/default/files/Size_Standards_Table.pdf.			

ESTIMATE OF THE NUMBER OF SMALL ENTITIES TO WHICH THE RULE WILL APPLY

Approach for Estimating the Number of Small Entities

The specific areas considered for designation as critical habitat, and hence the action area for this rule, spans from the Del Mar Landing Ecological Reserve to Dana Point in California, including several offshore islands. We defined the specific areas in Section 1 and identified the activities, both water and land-based, that could be affected by the designation in Section 2 of this report. Although the specific areas being considered for designation include coastal rocky habitats and nearshore marine waters, the small business analysis is focused on land-based areas (consistent with Section 2 of this report), where most of the potentially affected activities occur.

Ideally, this analysis would directly identify the number of small entities that are located within the coastal areas adjacent to the specific areas. However, it is not possible to directly determine the number of businesses in each industry sector within these specific areas because business activity data are maintained at the county level. Therefore, this analysis provides a maximum number of small businesses that could be affected. This number is most likely inflated because it is unlikely that all of the identified small businesses are located in close proximity to the specific areas.

After determining the number of small entities that may be affected, this analysis estimates the impact per entity for each specific area and industry sector. The following steps were used to provide these estimates:

- Total impact for every specific area and activity type was determined based on the results presented earlier in this report (see Executive Summary);
- The proportion of businesses that are small was calculated for every specific area and for every activity type;
- The impact to small businesses for every specific area and activity type was estimated by multiplying the total impacts estimated for all businesses with the proportion of businesses that were determined to be small;
- The average impact per small business was estimated by taking the ratio of the total estimated impacts to the total number of small businesses.

Discussion of Results

The eleven counties adjacent to or overlapping with the specific areas along the California coast and that may be affected by the black abalone critical habitat designation represent a range of urban and rural environments. The list of counties, industry sectors (identified by NAICS codes), and the SBA-specified

small business size thresholds was used to search the U.S. Census Bureau County Business Patterns database[154] for the year 2007. An estimate of the total number of small entities that could be potentially affected by the designation is summarized in Tables E-2, E-3a, E-3b, E-3c, and E-4.

Demographic Data

Table E-2 shows the socioeconomic profile of the applicable counties along the California coast. Note that some counties are adjacent to more than one specific area and some of the counties are adjacent to the coastline where there are no specific areas identified.

Los Angeles County was the most populous county of the eleven counties, with a population of nearly 10 million in 2008, representing about 26.8 percent of the population of California. Orange County had the second largest population, with a little over 3 million people in 2008. Orange County contained 8.2 percent of California's population. Marin and Santa Cruz Counties had the smallest populations of the eleven counties with 249,000 and 253,000 people, respectively, in 2008.

The populations of all but one of the 11 counties analyzed grew between 2000 and 2008. The largest growth was in San Luis Obispo County where the population increased by 7.5 percent. Santa Cruz County was the only county that experienced negative growth, at a rate of 1.0 percent between 2000 and 2008.

Median per capita income in three of the eleven counties was lower than median per capita income for the state. The poverty rate in two of the eleven counties exceeded the poverty rate of the state. In Los Angeles County, the poverty rate was the highest among the eleven counties with 15.3 percent of residents below the poverty threshold.

Eight of the eleven counties had a greater population density than the state. Notice that San Francisco County had a large population density of nearly 10,000 people per square mile, but only held 2 percent of the population of California.

[154] NAICS codes can be accessed from the US Census Bureau website: http://www.census.gov/epcd/www/naics.html; and the U.S. Census Bureau. *Number of Firms, Number of Establishments, Employment, Annual Payroll, and Receipts by Receipt Size of the Enterprise for the United States, All Industries -2002.* Accessed at: http://www2.census.gov/csd/susb/2002/usalli_r02.xls.

In short, the counties adjacent to the specific areas range from rural, lightly populated counties with as few as 75 persons per square mile to urban, heavily populated counties with as many as 10,000 people per square mile. The spectrum of economic welfare across the eleven counties is equally diverse encompassing counties with a median per capita income of about $20,000 in Monterey County to about $45,000 in Marin County.

Table E-2: Socioeconomic profile of counties bordering the specific areas

Area(s)	County	Population (2008)	% of Statewide Population	% Change (2000-2008)	Per Capita Income (1999)	Poverty Rate (2008)	Population Density (persons/sq mi)
1	Sonoma	466,741	1.3%	1.8%	$25,724	10.4%	291
2	Marin	248,794	0.7%	0.6%	$44,962	7.1%	475.6
3 & 4	San Francisco	808,976	2.2%	4.2%	$34,556	11.2%	9,999.90
4, 5, 6, & 7	San Mateo	712,690	1.9%	0.8%	$36,045	6.5%	1,575.00
7	Santa Cruz	253,137	0.7%	-1.0%	$26,396	13.3%	574.4
8 & 9	Monterey	408,238	1.1%	1.6%	$20,165	12.7%	120.9
9 & 10	San Luis Obispo	265,297	0.7%	7.5%	$21,864	12.1%	74.7
10, 13, 14, 15, & 18	Santa Barbara	405,396	1.1%	1.5%	$23,059	12.7%	145.9
16 & 17	Ventura	797,740	2.2%	5.9%	$24,600	8.7%	408.2
11, 19, & 20	Los Angeles	9,862,049	26.8%	3.6%	$20,683	15.3%	2,344.10
12	Orange	3,010,759	8.2%	5.8%	$25,826	9.9%	3,607.50

Source: U.S. Census Bureau. *State and County QuickFacts, Census 2006.* Accessed at: http://quickfacts.census.gov/qfd on July 2008.

Small Business Analysis

Tables E-3a, E-3b, and E-3c present the distribution of small businesses by specific area and by county for businesses identified as small businesses based on the number of employees, revenue, and capacity, respectively. An estimated maximum of 3,560 small businesses may be involved in activities most likely to be affected by the final black abalone critical habitat designation.[155] The majority of the small

[155] This is based on the assumption that all small businesses counted across specific areas and activity types are separate entities. However, it is likely that a particular small business may appear multiple times as being affected by conservation measures for multiple specific areas and activity types. Hence, total small business estimates across specific areas and activity types are likely to be overestimated.

businesses that may be affected were located in Los Angeles County (n = 1,978 small businesses). Orange and Ventura Counties contained about 200 to 450 small businesses that may be affected by the final critical habitat designation.

Table E-3a: Estimated Number of Potentially Affected Entities that are Small, Based on Number of Employees (by specific area, county, and activity type)

Max. # of employees to be considered small:		500 employees	500 employees	500 employees	500 employees	500 employees	500 employees	750 employees	100 employees
Area	**NAICS Code – Category (Activity)** / **County**	211111—Crude Petroleum and Natural Gas Extraction (Mineral & Petroleum)	211112—Natural Gas Liquid Extraction (LNG)	212321—Construction Sand and Gravel Mining (Dredging and In-Water Construction)	213111—Drilling Oil and Gas Wells (Mineral & Petroleum)	311—Food Manufacturing (NPDES)	321—Wood Product Manufacturing (NPDES)	322—Paper and Pulp Mills (NPDES)	424910—Farm Supplies Merchant Wholesalers (Agriculture: Pesticides)
1	Sonoma	N/A	N/A	N/A	N/A	79	39	2	11
2	Marin	N/A	N/A	N/A	N/A	24	10	0	3
3 & 4	San Francisco	N/A	N/A	N/A	N/A	118	14	6	8
4, 5, 6, & 7	San Mateo	N/A	N/A	N/A	N/A	91	9	8	3
7	Santa Cruz	N/A	N/A	N/A	N/A	43	13	0	5
8 & 9	Monterey	N/A	N/A	N/A	N/A	76	8	4	27
9 & 10	San Luis Obispo	3	N/A	1	1	23	4	3	8
10, 13, 14, 15, & 18	Santa Barbara	13	N/A	2	4	33	13	2	22
16 & 17	Ventura	N/A	N/A	3	N/A	53	13	11	17
11, 19, & 20	Los Angeles	N/A	N/A	16	N/A	1100	257	191	N/A
12	Orange	N/A	N/A	N/A	N/A	259	98	71	21

Table E-3b: Estimated Number of Potentially Affected Entities that are Small, Based on Revenue (by specific area, county, and activity type)

Max. revenue to be considered small:		$7.0 million average annual receipts	$7.0 million average annual receipts	$7.0 million average annual receipts	$33.5 million average annual receipts	$33.5 million average annual receipts	$33.5 million average annual receipts	$33.5 million average annual receipts	$33.5 million average annual receipts
Area	**NAICS Code –Category (Activity)** / **County**	213115—Support Activities for Nonmetallic Minerals (Mineral & Petroleum)	221310—Water Supply and Irrigation Systems (Coastal Development)	221320—Sewage Treatment Facilities (NPDES)	237110—Water and Sewer Line and Related Structures Construction (Dredging and In-Water Construction)	237120—Oil and Gas Pipeline and Related Structures Construction (Dredging and In-Water Construction)	237130—Power and Communication Line and Related Structures Construction (Dredging and In-Water Construction)	237310—Highway, Street and Bridge Construction (Coastal Development)	237990—Other Heavy and Civil Engineering Construction (Dredging and In-Water Construction)
1	Sonoma	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A
2	Marin	N/A	4	0	N/A	N/A	N/A	6	N/A
3 & 4	San Francisco	N/A	1	0	N/A	N/A	N/A	7	N/A
4, 5, 6, & 7	San Mateo	N/A	9	1	N/A	N/A	N/A	19	N/A
7	Santa Cruz	N/A	3	0	N/A	N/A	N/A	14	N/A
8 & 9	Monterey	N/A	16	1	N/A	N/A	N/A	6	N/A
9 & 10	San Luis Obispo	0	13	1	23	3	7	17	4
10, 13, 14, 15, & 18	Santa Barbara	0	5	0	21	0	5	7	6
16 & 17	Ventura	N/A	29	0	29	5	7	26	10
11, 19, & 20	Los Angeles	N/A	72	3	104	19	48	94	64
12	Orange	N/A	N/A	1	N/A	N/A	N/A	N/A	N/A

Table E-3c: Estimated Number of Potentially Affected Entities that are Small, Based on Capacity (by specific area, county, and activity type)

Max. capacity to be considered small:		4 million megawatts for the preceding year[1]	4 million megawatts for the preceding year[1]
	NAICS Code – Category (Activity)	221111— Hydroelectric Power Generation (Tidal & Wave Energy)	221119— Other Electric Power Generation (Tidal & Wave Energy)
Area	**County**		
1	Sonoma	0	0
2	Marin	N/A	N/A
3 & 4	San Francisco	N/A	N/A
4, 5, 6, & 7	San Mateo	N/A	N/A
7	Santa Cruz	N/A	N/A
8 & 9	Monterey	N/A	N/A
9 & 10	San Luis Obispo	0	0
10, 13, 14, 15, & 18	Santa Barbara	0	0
16 & 17	Ventura	N/A	N/A
11, 19, & 20	Los Angeles	3	8
12	Orange	N/A	N/A

Table E-4 sums the information displayed in Tables E-3a, E-3b, and E-3c, and presents the total number of small businesses by specific area. Specific area 19 contained the highest number of potentially affected small entities (n = 995), followed by specific area 11 (n = 776 small entities) and specific area 12 (n = 450 small entities). No potentially affected small entities were identified for specific areas 6, 13, 14, 15, and 18.

Small businesses receiving NPDES permits represent the largest number (n = 2,673) of potentially affected small entities. This group includes the manufacturing sector (e.g., food processing facilities, paper and pulp mills or sewage treatment plants). An estimated 125 small businesses involved in agricultural pesticide use are also expected to be affected by this rule. Thus, about 80 percent of the small entities that may be affected by the critical habitat designation were identified because of their involvement in activities that may affect water quality. As discussed previously in this report, the States and the Environmental Protection Agency (EPA) have already established acceptable levels of contaminants in waterways. Entities are already required to obtain NPDES permits to discharge contaminants. In cases where NPDES permits are not required, monitoring and compliance with the clean

water standards set by the EPA and the States may be required to avoid the destruction or adverse modification of critical habitat for black abalone.

Table E-5 estimates for every activity type the proportion of small businesses within a specific area. The proportion of small businesses in most specific areas and for most activity types was greater than 98 percent. Thus, for the activity types considered in this analysis, most businesses in the study area can be considered to be small.

Table E-6 combines the annualized cost estimates from previous sections of this report and the information from Table E-5 to estimate the total annualized impacts that may be borne by small entities within each specific area, by activity type. Based on information from Table E-4, small businesses adjacent to or in specific area 19 would be the most heavily impacted, if the criterion was the total number of small businesses. However, as Table E-6 indicates, if the total annualized impacts to small entities were considered, small businesses in specific areas 2, 3, 4, 11, and 19 would be the most heavily impacted, with potential impacts greater than $100,000.

Table E-7 combines information from Tables E-4 and E-6 to generate for each specific area and activity type the potential annualized impact to a typical small business. As explained above, this estimate was generated for each specific area and activity type by taking the ratio of the total annualized impacts and the total number of small businesses, multiplied by the proportion of businesses that are small, as presented in Table E-4.

Evaluation of Alternatives

In accordance with the requirements of the RFA (as amended by SBREFA, 1996) this analysis considered various alternatives to the critical habitat designation for the black abalone. The alternative of not designating critical habitat for the black abalone was considered and rejected because such an approach would not meet the legal requirements of the ESA and would not provide for the conservation of the black abalone. The alternative to designate all of the 20 specific areas as critical habitat (i.e., no areas excluded) was also considered. Finally, an alternative to designating critical habitat within all 20 specific areas was the designation of critical habitat within a subset of these areas. This approach would help to reduce the number of small businesses potentially affected. The extent to which the economic impact to small entities would be reduced depends on how many and which areas would be excluded.

Table E-4: Estimated Number of Regulated Entities Classified as Small (by specific area and activity)

Area	Dredging & In-water Construction	NPDES[1]	Coastal Urban Development	Agriculture: Pesticides	Tidal & Wave Energy	LNG	Mineral & Petroleum	Total
1		120		11	0			131
2		34	10	3				47
3		69		4				73
4		105	22	6				133
5		27						27
6								0
7		92	30	7				129
8		44	22	14				79
9		60		18				77
10	33	63	41	26	0		17	181
11		776						776
12		429		21				450
13								0
14								0
15								0
16		39		17				56
17	54	39	56					148
18								0
19	125	776	83		11			995
20	125		83					208
Total	338	2,673	346	125	11	0	17	3,509

Table E-5: Percentage of Businesses that are Classified as Small (by specific area and activity type)

Area	Dredging & In-water Construction	NPDES	Coastal Urban Development	Agriculture: Pesticides	Tidal & Wave Energy	LNG	Mineral & Petroleum	Total
1		99%		100%	0%			99%
2		100%	98%	100%				100%
3		100%		100%				100%
4		100%	98%	100%				100%
5		99%						99%
6								
7		100%	98%	100%				99%
8		100%	98%	100%				99%
9		99%		100%				100%
10	98%	100%	98%	100%	0%		100%	99%
11		100%						100%
12		100%		100%				100%
13								
14								
15								
16		100%		94%				98%
17	98%	100%	98%					99%
18								
19	98%	100%	98%		100%			99%
20	98%		98%					98%
Total	98%	100%	98%	99%	100%		100%	99%

Table E-6: Estimated Annualized Impacts Borne by Small Entities by specific area and activity type

Area	Dredging & In-water Construction	NPDES: Minor	NPDES: Major	Coastal Urban Development	Tidal & Wave Energy	Total
1		$3,000	$0		$0	$3,000
2		$17,000	$81,000	$20,000		$118,000
3		$33,000	$161,000			$194,000
4		$17,000	$101,000	$4,000		$122,000
5		$1,000	$4,000			$5,000
6						$0
7		$5,000	$20,000	$12,000		$36,000
8		$3,000	$20,000	$4,000		$27,000
9		$2,000	$4,000			$6,000
10	$2,000	$2,000	$35,000	$6,000	$0	$45,000
11		$38,000	$68,000			$105,000
12		$2,000	$27,000			$28,000
13						$0
14						$0
15						$0
16		$2,000	$17,000			$18,000
17	$2,000	$2,000	$0	$2,000		$5,000
18						$0
19	$3,000	$0	$27,000	$5,000	$35,000	$102,000
20	$2,000			$2,000		$3,000
Total	$9,000	$124,000	$564,000	$54,000	$35,000	$817,000

Table E-7: Estimated Annualized Impacts per Small Entity by specific area and activity type

Area	Dredging & In-water Construction	NPDES: Minor	NPDES: Major	Coastal Urban Development	Tidal & Wave Energy
1		*	$0		$0
2		$1,000	$2,000	$2,000	
3		$1,000	$2,000		
4		$1,000	$1,000	$1,000	
5		*	$1,000		
6					
7		*	$1,000	$1,000	
8		*	$1,000	$1,000	
9		*	*		
10	*	*	$1,000	$1,000	$0
11		*	*		
12		*	*		
13					
14					
15					
16		*	$1,000		
17	*	*	$0	*	
18					
19	*	$0	*	*	$3,000
20	*			*	

*Estimated annualized impacts per small entity were less than $100.

APPENDIX F: ENERGY IMPACTS ANALYSIS

Introduction

Pursuant to Executive Order No. 13211, "Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use," issued May 18, 2001, Federal agencies must prepare and submit a "Statement of Energy Effect" for all "significant energy actions." The purpose of this requirement is to ensure that all Federal agencies "appropriately weight and consider the effects of the Federal Government's regulations on the supply, distribution, and use of energy."[156]

The Office of Management and Budget (OMB) provides guidance for implementing this Executive Order, outlining nine outcomes that may constitute "a significant adverse effect" when compared with the regulatory action under consideration:

- Reductions in crude oil supply in excess of 10,000 barrels per day (bbls);
- Reductions in fuel production in excess of 4,000 barrels per day;
- Reductions in coal production in excess of 5 million tons per year;
- Reductions in natural gas production in excess of 25 million Mcf per year;
- Reductions in electricity production in excess of 1 billion kilowatts-hours per year or in excess of 500 megawatts of installed capacity;
- Increases in energy use required by the regulatory action that exceed the thresholds above;
- Increases in the cost of energy production in excess of one percent;
- Increases in the cost of energy distribution in excess of one percent; or
- Other similarly adverse outcomes.[157]

Of these, the most relevant criteria to this analysis are potential changes in natural gas and electricity production, as well as changes in the cost of energy production. Possible energy impacts may occur as the result of requested project modifications to power plants, tidal and wave energy projects and LNG facilities. The following sections describe the potential for these impacts in greater detail.

[156] U.S. Office of Management and Budget. 2001. Memorandum For Heads of Executive Department Agencies, and Independent Regulatory Agencies, Guidance for Implementing E.O. 13211, M-01-27. July 13, 2001. Available online at: http://www.whitehouse.gov/omb/memoranda/m01-27.html.
[157] Ibid.

Power Plants

As discussed in Section 2.9 of this report, there is currently only one power plant, the Diablo Canyon Nuclear Power Plant (DCNPP), that is located within the specific areas and that could be affected by the black abalone critical habitat designation. The DCNPP is a nuclear power plant and is described in more detail in Section 2.9.2 of this report. As discussed in Section 2.9 of this report, the high level of baseline protections provided under the CWA make it highly unlikely that additional modifications beyond those required under existing regulations would result due to this critical habitat designation. Therefore, we concluded that the black abalone critical habitat designation is not likely to result in incremental impacts to the cost of operating the DCNPP and, consequently, is not likely to result in impacts to energy production and associated costs.

Tidal and Wave Energy Projects

As discussed in Section 2.11, the number of future tidal and wave energy projects that will be constructed within the specific areas is unknown. Currently there are no actively-generating wave or tidal energy projects located within the study area. However, as described in Section 2.11 of this report, five projects have received preliminary permits from the Federal Energy Regulatory Commission (FERC).[158]

Future management measures and required project modifications for black abalone critical habitat related to tidal and wave energy projects are uncertain and could vary widely in scope from project to project. Moreover, because the proposed projects are still in the preliminary stages, the potential impact of possible black abalone conservation efforts on the projects' energy production and the associated cost of that energy are unclear.

As shown in Table F-2, proposed tidal and wave energy projects within the study area have a combined production capacity of 121 megawatts. It is more likely that any additional cost of black abalone conservation efforts would be passed on to the consumer in the form of slightly higher energy prices. That said, any increase in energy prices as a result of black abalone conservation would have to be balanced against changes in energy price resulting from the development of these projects. That is, the construction of tidal and wave energy projects may result in a general reduction in energy prices in affected areas. Without information about the effect of the tidal and wave energy projects on future energy prices and more specific information about recommended conservation measures for black abalone, this analysis is unable to forecast potential energy impacts resulting from changes to tidal and wave energy projects.

[158] FERC. 2010. *Issued and Valid Hydrokinetic Projects Preliminary Permit*. Accessed at: http://www.ferc.gov/industries/hydropower/indus-act/hydrokinetics/permits-issued.xls on April 5, 2010.

Table F-2: Summary of Capacity at Proposed Tidal and Wave Energy Projects

Area	Docket No.	Project Name	Classification	Capacity (MW)
1	P-13376	Del Mar Landing	Wave	5
1	P-13377	Fort Ross (South)	Wave	5
1	P-13378	Fort Ross (North)	Wave	5
10	P-13641	Central Coast WaveConnect	Wave	100
19	P-13498	SWAVE Catalina Green Wave	Wave	6
Total Known Capacity				121

Source: Federal Energy Regulatory Commission**.** *Issued and Valid Hydrokinetic Projects Preliminary Permits*. Accessed at: http://www.ferc.gov/industries/hydropower/indus-act/hydrokinetics/permits-issued.xls, on April 5, 2010

LNG Projects

Similar to tidal and wave energy projects, the number of future LNG projects that will be built within the specific areas is unknown. As described in Section 2.12 of this report, many LNG projects are likely to be abandoned during the development stages for reasons unrelated to the black abalone critical habitat designation. In addition, the potential impact of LNG facilities on black abalone habitat remains uncertain, as is the nature of any project modifications that might be requested to mitigate adverse impacts. Because there are no LNG projects in the development stage within the study area, the potential impact of possible black abalone conservation efforts on the project's energy production and the associated cost of that energy are unclear.

As discussed in Section 2.12 of this report, project modifications may include biological monitoring, spatial restrictions on project installation, and specific measures to prevent or respond to catastrophes. Out of these project modifications, spatial restrictions on project installation could have effects on energy production. This modification could increase LNG construction costs, which may result in higher natural gas costs. However, the construction of LNG facilities and associated increased energy supplies to consumers aim to generally result in lower energy prices than would have otherwise been expected. Therefore, this analysis is unable to forecast potential energy impacts resulting from changes to LNG projects without specific information about recommended black abalone conservation measures or future forecasts of energy prices that reflect future markets with increased energy supplies from LNG projects.