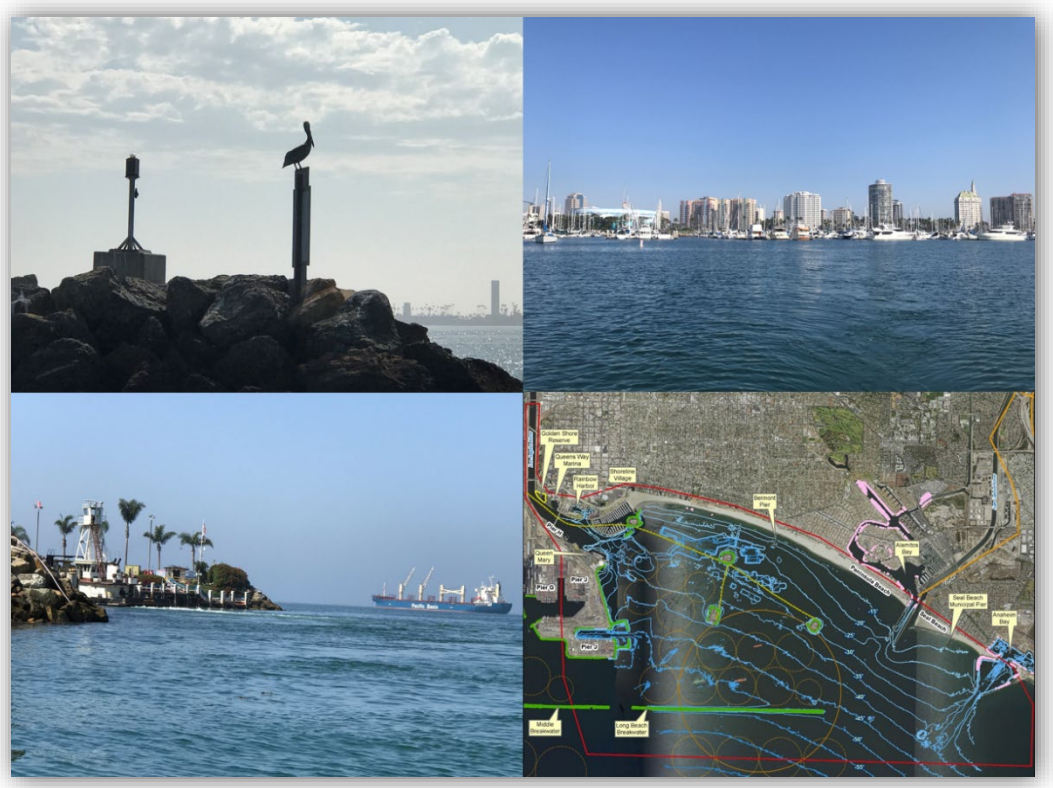
DRAFT INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL IMPACT STATEMENT / ENVIRONMENTAL IMPACT REPORT (EIS/EIR)

APPENDIX C: ECONOMICS AND SOCIAL CONSIDERATIONS

EAST SAN PEDRO BAY
ECOSYSTEM RESTORATION STUDY
Long Beach, California

November 2019



US Army Corps of Engineers ®

Blank page to facilitate duplex printing

TABLE OF CONTENTS

1 INTRODUCTION 1-1

1.1 PURPOSE 1-1
1.2 PLANNING PROCESS 1-1
1.3 GUIDANCE AND REFERENCES 1-1

2 PROJECT AREA 2-1

2.1 LOS ANGELES RIVER 2-1
2.2 LONG BEACH BREAKWATER 2-2
2.3 ENVIRONMENTAL RESOURCES 2-2

3 STUDY AREA DEMOGRAPHICS 3-1

3.1 POPULATION 3-1
3.2 EMPLOYMENT 3-1
3.3 INCOME 3-2
3.4 RACE & ETHNICITY 3-2

4 PROBLEMS, OPPORTUNITIES, OBJECTIVES, AND CONSTRAINTS 4-1

4.1 PROBLEMS AND OPPORTUNITIES 4-1
4.2 PLANNING OBJECTIVES 4-3
4.3 PLANNING CONSTRAINTS AND CONSIDERATIONS 4-3

5 WITHOUT-PROJECT CONDITIONS 5-1

6 ECOSYSTEM RESTORATION ALTERNATIVES 6-1

6.1 IDENTIFICATION OF MEASURES TO ADDRESS IDENTIFIED PLANNING OBJECTIVES 6-1
6.2 PRELIMINARY CONCEPTUAL ALTERNATIVES 6-3
6.3 BASE PLAN AND MANAGEMENT MEASURES FOR CEICA ANALYSIS 6-5
6.4 CEICA ANALYSIS 6-7
6.5 CEICA RESULTS 6-10
6.6 FINAL ARRAY OF ALTERNATIVES 6-14
6.7 ADDITIONAL PLANS (BW1 AND BW2) CONSIDERED 6-19
6.8 COMPARISON OF FINAL ARRAY ALTERNATIVES 6-23
6.9 IMPACTS TO RECREATION 6-24

7 TENTATIVELY SELECTED PLAN (TSP) 7-1

7.1 NATIONAL ECOSYSTEM RESTORATION (NER) PLAN SELECTION 7-1
7.2 TSP IMPACTS TO RECREATION 7-1
7.3 OTHER SOCIAL EFFECTS 7-1
7.4 REGIONAL ECONOMIC DEVELOPMENT IMPACTS 7-3
7.5 COST SHARING 7-4

8 SUMMARY OF RESULTS 8-1

9 ADDENDUM A: INCIDENTAL RECREATION IMPACTS 9-1

9.1 RECREATION SUPPLY AND DEMAND 9-1
9.2 INTRODUCTION TO INCIDENTAL RECREATION IMPACT ANALYSIS 9-9
9.3 INCIDENTAL RECREATION ANALYSIS PROCEDURE 9-9

9.4 INCIDENTAL RECREATION ANALYSIS RESULTS 9-10
9.5 WITHOUT-PROJECT UDV METHOD 9-14
9.6 UDV EVALUATION FOR THE TENTATIVELY SELECTED PLAN 9-16
9.7 RECREATION SUMMARY RESULTS 9-18

10 ADDENDUM B: EAST SAN PEDRO BAY ECOSYSTEM RESTORATIN OTHER SOCIAL EFFECTS 10-1

10.1 OVERVIEW 10-1
10.2 DIMENSIONS OF INTEREST AND ANALYSIS 10-1
10.3 SUMMARY OF NO ACTION PLAN AND TSP 10-6

11 ADDENDUM C: REGIONAL ECONOMIC DEVELOPMENT ANALYSIS 11-1

11.1 PURPOSE 11-1
11.2 PROCESS 11-1
11.3 ANALYSIS RESULTS 11-3

12 ADDENDUM D: REFERENCES 12-1

LIST OF TABLES

Table 3-1: Population of the City of Long Beach in Los Angeles County, CA 3-1
Table 3-2: City of Long Beach and the City of Los Angeles Labor Force Data 3-2
Table 3-3: City of Long Beach and the City of Los Angeles Annual Income Data 3-2
Table 3-4: Race and Hispanic Ethnicity 3-3
Table 6-1: Conceptual Alternatives 1 through 9 6-4
Table 6-2: Management Measures by Opportunity Zone 6-6
Table 6-3: Scales and Non-Combinability of Measures by IWR-Plan Identifier 6-7
Table 6-4: Cost and Output by Measure 6-8
Table 6-5: Best Buy Plan Measures 6-11
Table 6-6: Best Buy Plans – Measures Added per Plan 6-12
Table 6-7: Incremental Cost Analysis of Best Buy Plans 6-13
Table 6-8: Final Array Plan Summary 6-19
Table 6-9: Breakwater Plans Summary 6-20
Table 6-10: Alternatives Evaluation 6-23
Table 6-11: Final Array and Plans Summary 6-24
Table 7-1: Dimensions of Interest Summary 7-2
Table 7-2: RED Impacts from Best Buy Alt 4 (TSP) 7-3
Table 7-3: RED from Operations and Maintenance Expenditures (Annual) - TSP 7-3
Table 7-4 – TSP Costs 7-4
Table 9-1: Community Parks 9-2
Table 9-2: Garden Parks 9-3
Table 9-3: Golf Courses 9-3
Table 9-4: Mini Parks 9-4
Table 9-5: Neighborhood Parks 9-5
Table 9-6: State Parks 9-5
Table 9-7: Belmont Pier Visitation 9-6
Table 9-8: Sea Festival Visitation 9-7
Table 9-9: Commercial Slip Rates 9-7
Table 9-10: Recreational Slip Rates 9-7
Table 9-11: Sail Boat Visitation near East San Pedro Bay 9-8
Table 9-12: Summary of Visitation 9-9
Table 9-13: Impacts to Beach Visitation 9-10
Table 9-14: Impacts to Best Buy Plans 9-11
Table 9-15: Overall Color Ranking 9-13
Table 9-16: Recreation Models 9-14
Table 9-17: Points for Recreation 9-15
Table 9-18: Beach Unit Day Value Ratings - Without Project 9-16
Table 9-19: Harbor Unit Day Value Ratings – Without Project 9-16
Table 9-20: Beach Unit Day value Rating With-Project (TSP) 9-17
Table 9-21: Recreational Boating Unit Day value Ratings With-Project (TSP) 9-17
Table 10-1: Without Project Condition: Public Health 10-2
Table 10-2: Without Project: Environmental Justice 10-3
Table 10-3: Racial and Ethnicity Composition 10-3

Table 10-4: Median Household Income Data 10-3
Table 10-5: Without Project: Economic Vitality 10-4
Table 10-6: Without Project Condition: Community Cohesion 10-4
Table 10-7: Dimensions of Interest Summary 10-7
Table 11-1: Project First Costs -TSP 11-3
Table 11-2: RED Impacts from Best Buy Alt 4 (TSP) 11-3
Table 11-3: RED from Operations and Maintenance Expenditures (Annual) - TSP 11-4

LIST OF FIGURES

Figure 2-1: Study Area and Project Area 2-1
Figure 4-1 Coastal Wetland Conversion within San Pedro Bay 4-2
Figure 6-1: Opportunity Zones 6-2
Figure 6-2: Cost Effective Plans 6-10
Figure 6-3: Best Buy Plans 6-13
Figure 6-4 Alternative 2 Kelp Restoration Plan 6-16
Figure 6-5 Alternative 4A Reef Restoration Plan 6-17
Figure 6-6 Alternative 8 Scarce Habitat Restoration Plan 6-18
Figure 11-1: Illustration of How the Regional Economy can Experience Change in Demand Brought on by the Construction of the US Army Corps of Engineers Project 11-2

1 INTRODUCTION

1.1 PURPOSE

The purpose of this appendix is to identify and describe the socioeconomic resources and present the economic evaluation of the benefits and cost associated with ecosystem restoration plans within East San Pedro Bay in Long Beach, California.

1.2 PLANNING PROCESS

This feasibility study follows the U.S. Army Corps of Engineers (USACE) planning process. This process includes: 1) Specification of water and related land resources problems and opportunities associated with the federal objective and specific state and local concerns; 2) Inventory, forecast, and analysis of water and related land resource conditions within the planning area relevant to the identified problems and opportunities; 3) Formulation of alternative plans; 4) Evaluation of the effects of the alternative plans; 5) Comparison of alternative plans; and 6) Selection of a recommended plan based upon the comparison of alternative plans. This planning process is iterative in nature. USACE has also implemented a Risk Informed Decision Making (RIDM) approach to increase the efficiency of the planning process. Under RIDM, the emphasis throughout the planning process is to efficiently reduce uncertainty by gathering only the evidence needed to make the next planning decision, and to manage the risks that result from doing so without more complete information. This requires transparent discussion between the project delivery team and decision makers in order to successfully communicate and manage risks, and make decisions that accept risks when appropriate.

1.3 GUIDANCE AND REFERENCES

To complete the analysis, standard USACE methodology was followed throughout the study effort. The methodology employed for the economic analysis is in accordance with current principles and guidelines and standard economic practices, as outlined in the Planning Guidance Notebook: ER 1105-2-100. Evaluation of potential ecosystem restoration alternatives has been completed in accordance with Institute of Water Resources (IWR)-Report 95-R-1 –Evaluation of Environmental Investments: Procedures Manual (May 1995). Benefits and costs for plan formulation, comparison and evaluation were computed at FY 2018 price levels utilizing a federal discount rate of 2.75%. The period of analysis is 50 years, with an assumed Base Year of 2030. Benefits and costs for the Recommended Plan will be refined and updated to current price levels and the current discount rate for the Final Report.

2 PROJECT AREA

The project area (see Figure 2-1) is located within East San Pedro Bay (ESPB) between Long Beach Shoreline and the offshore Long Beach Breakwaters, east of the Port of Long Beach and Port of Los Angeles. To the west and northwest of San Pedro Bay are the communities of San Pedro and Wilmington, respectively and to the east the community of Seal Beach. The project area includes the waters in the immediate vicinity (and shoreward) of the breakwaters, the beaches of Long Beach spanning from the mouth of the Los Angeles River to Seal Beach. Features including the Los Angeles River, Long Beach Breakwater, and biological and water resource are primary factors to consider in environmental restoration. Other physical features relating to recreation in the area include beaches, piers, harbors and bays, a nature preserve, and tourist attractions such as the Queen Mary ship, the Aquarium of the Pacific and shopping areas are also considered part of the Project Area. Both the environmental resources and the other recreational features along the coastline are key to the implementation of a viable ecosystem restoration plan—one that suits the natural environment, recreation in the area, tourism and public interest.

Figure 2-1: Study Area and Project Area

2.1 LOS ANGELES RIVER

The Los Angeles River (LAR) is a major flood risk management waterway for the Los Angeles watershed basin. In the 1930s, USACE began channelizing the river for flood control and by 1954, the entire length of the river was channelized. The river is operated and maintained by the USACE and the LA County Department of Public Works. The LAR discharges into San Pedro Bay (see northwest corner of Figure 2-1). The evaluation of without project conditions and proposed measures and alternatives considered the potential impact of the LAR on the ecosystem within ESPB.

2.2 LONG BEACH BREAKWATER

San Pedro Bay is protected by breakwaters, totaling 8.6 miles, with two openings to allow ships to enter the Ports of Los Angeles and Long Beach. These openings divide the breakwater into three sections: the San Pedro Breakwater, the Middle Breakwater, and the Long Beach Breakwater. The San Pedro and Middle Breakwaters protect the Ports of Los Angeles and Long Beach, respectively. The construction of both breakwaters started in 1899 and 1932, and completed in 1912 and 1942. The 2.5 mile Long Beach Breakwater is the easternmost breakwater. The Long Beach Breakwater was constructed in 1941 but was halted in 1943 due to WWI. Construction resumed in 1946 and completed in 1949. After the construction of the breakwaters, the breakwaters provided a protected anchorage for the U.S. Navy's Pacific Fleet. The USACE maintains the federal breakwaters.

2.3 ENVIRONMENTAL RESOURCES

In addition to the Los Angeles River and the Breakwater, the project area contains several locations in which there is potential for ecosystem restoration.

2.3.1 BIOLOGICAL RESOURCES

Marine habitat in San Pedro Bay includes natural open water and sandy-bottom benthic habitats, as well as artificial habitats created by Bay structures. Organisms living in or on the sandy-bottom provide a food source for fish, invertebrates, and other organisms. However, species richness can be lower in sandy-bottom habitats compared to other vegetated habitats. But if conditions are appropriate eelgrass, a type of submerged aquatic vegetation can grow. Areas with eel grass have been found in San Pedro Bay. This habitat contributes to the productivity of the marine environment. It is important for fish and other organisms as a direct or indirect source of food. Despite the presence of eelgrass, the soft bottom subtidal zone along the Long Beach shoreline is degraded with significant amounts of trash lying on the bottom and embedded in the sand.

Artificial habitats created by Bay structures are of important ecological value. Bay structure habitats in San Pedro Bay are limited and include the breakwaters and jetties within the harbor complex as well as at pilings that support wharves and piers, and along the shoreline of the basins and channels. Additionally, the shore protection around the three oil islands within East San Pedro Bay provide hard substrate habitat. These Bay structures provide food, shelter, and spawning and nursery areas to a wide variety of fish and shellfish species, and many other organisms. Bay structures provide surfaces for the attachment of invertebrates and a variety of algae and kelp. Green algae (*Ulva sp. and Enteromorpha sp.*), and several species of red algae, and kelp (giant kelp (*Macrocystis pyrifera*) and feather boa kelp (*Egregia menziesii*) are characteristically populated at these types of structures.

Marine habitat also includes open water or pelagic habitats. Open water or pelagic habitats are areas in the water column of the open ocean. Organisms associated with this habitat occur within the water column, above the seafloor and below the surface. The open ocean habitat sustains a relatively large number of species of fish, marine mammals, turtles, and invertebrates that use this area for spawning, breeding, feeding, or growth to maturity. Open water or pelagic habitats exist throughout San Pedro Bay.

The open water or pelagic habitats attract migratory bird communities for potential food source. The shoreline and sheltered water provide a place to roost. Birds using sheltered waters within the harbor for feeding and resting include loons, grebes, surf scooters, and lesser scaup. The sheltered waters offer mollusks and fish that are preyed upon by these species. Rip- rap shoreline is preferred by spotted

sandpipers, surfbirds, willets, and pelagic cormorants. The small intertidal mudflat at Shoreline Aquatic Park (adjacent to the Los Angeles River estuary) is important foraging habitat for western sandpipers, semi-palmated plovers, and marbled godwits. This habitat is also used extensively by mew, ring-billed, and California gulls as a resting area. Buoys, barges, and pilings are primary roosting sites for double-crested cormorants, gulls, and brown pelicans. A number of special status species occur within the Project Area. They include the California least tern (*Sternula antillarum browni*), western snowy plover (*Charadrius alexandrinus nivosus*), Peregrine falcon (*Falco peregrinus anatum*), Belding's savannah sparrow (*Passerculus sandwichensis beldingi*), black skimmer (*Rynchops niger*), common loon (*Gavia immer*), loggerhead shrike (*Lanius ludovicianus*), and the burrowing owl (*Athene cunicularia*).

2.3.1 WATER RESOURCES

Water quality in the bay has improved over the past several decades. But, water quality in San Pedro Bay is still affected by factors such as climate, water circulation, biological activity, surface runoff, effluent discharges and accidental discharges of pollutants from shipping activities as well as water flushed from the harbor and vessel activity. These sources of contamination result in elevated levels of trace metals and organic chemicals in some areas, as well as elevated levels of bacteria (total coliforms, fecal coliforms, and *Enterococcus*). Additionally, trash and debris from the Los Angeles River continue to be a problem within the bay, and along the Long Beach shoreline. Beach closures and water advisories occur occasionally in Long Beach.

2.3.2 RECREATION

The Project Area has significant recreation resources. These resources can be categorized as follows: Onshore recreation activities, which include activities that occur on or near the beach and boardwalk; near-beach water recreation activities; and open water recreation activities.

2.3.2.1 ONSHORE RECREATION ACTIVITIES

Onshore recreation activities include those that occur on and adjacent to beaches in the Project Area.

Local beaches include Long Beach, Peninsula Beach and Seal Beach. These beaches provide various recreation opportunities such as running, walking, sightseeing, sunbathing, beach volleyball, beach combing and picnicking.

Other onshore recreation activities along the shoreline occur on the boardwalk, piers (Belmont Pier and Seal Beach Pier) and bays (Alamitos Bay, Anaheim Bay, and Queens Bay), such as walking, running, bicycling, sightseeing, and fishing.

One nature preserve is located in the Project Area. The Golden Shore Marine Biological Reserve Park is a bird watchers paradise, and is a sanctuary for birds and local aquatic life. The site is south of the original shoreline of Long Beach on an area accreted from sediment washed down the Los Angeles River and deposited at the mouth after the mouth of the river was channelized and the mouth repositioned. In 1997, construction began to convert a launch ramp and parking lot into 6.4 acres of intertidal and sub tidal wetland habitat as mitigation for the conversion of 20 acres of shoreline Park into the Aquarium of the Pacific and the Rainbow Harbor commercial and recreation attraction.

Other recreation features and attractions include sightseeing destinations, retail shopping, and places to stay and eat. The Queen Mary Ship, the Aquarium of the Pacific, Shoreline Village, and hotels and

restaurants near the Project Area assist in creating an diverse recreation environment—one that includes urban, onshore and near shore activities.

2.3.2.2 NEAR-BEACH WATER BASED RECREATION ACTIVITIES

Water-based recreation that occurs near the shoreline includes such activities as wading and swimming. Surfing is very limited, if it is feasible at all, due to the lack of wave action. . Some recreation users prefer the lack of surf within ESPB that results from the offshore breakwaters, e.g., families with small children that prefer calm waters for wading and swimming, paddle-boarders, boaters with small recreational boats, etc., while other uses are limited or excluded by the lack of waves, most notably surfing. There are also concerns about trash and debris and water quality which impact recreation demand in the Project Area.

2.3.2.3 OPEN WATER RECREATION ACTIVITIES

Open water recreation activities include uses such as boating (power and sail) and fishing. Harbor recreation at Rainbow Harbor include sports fishing, commercial cruises, tour boats, boating, and sailing. Within the Los Angeles and Long Beach Harbor complex several major charter boat companies provide service to Avalon and Isthmus Cove on Catalina Island. These recreation charters also serve specialized activities including sport fishing, scuba diving, whale watching, and harbor touring.

Commercial fishing within the bay is limited to a live-bait fishery, while a variety of commercial fisheries occur outside the harbors. Trap fisheries extend offshore from just outside the harbor breakwaters, while set and drift nets are restricted to beyond 3 miles from shore. Trawling occurs in deeper offshore waters. Primary target species from the various fishing operations include anchovies, squid, California halibut, rockfish, crab, and lobster.

3 STUDY AREA DEMOGRAPHICS

This section focuses on comparisons of demographic data for the Study Area. In addition data for the City of Long Beach, the evaluation also includes the adjacent communities of the City of Los Angeles to the west and Seal Beach to the east. The specific data used for the discussion include: population, employment, and income, and ethnicity. Details regarding socioeconomics are provided below.

3.1 POPULATION

According to US Census, the City of Long Beach is the seventh most populous incorporated community in Los Angeles County, California. As of 2018, the City of Long Beach population was 467,354, which represents an increase of 1.1% from the 2010 population of 462,257. This growth rate is significantly greater than that experienced between 2000 and 2010, during which population only increased by about 0.2%. City of Los Angeles neighborhoods adjacent to ESPB include San Pedro and Wilmington, which had 2018 populations of about 78,900 and 52,910, respectively, according to statistical atlas website. Neighboring city Seal Beach had a population of 24,119 as of 2018, per the U.S. Census.

Table 3-1: Population of the City of Long Beach in Los Angeles County, CA

Census	Population	Change
2018	467,354	1.1%
2010	462,257	0.2%
2000	461,522	7.5%
1990	429,433	18.8%
1980	361,498	0.7%
1970	358,879	7.4%
1960	334,168	33.3%

3.2 EMPLOYMENT

Four primary areas of employment in the City of Long Beach are 1) government, 2) trade and transportation, 3) professional and business services, and 4) educational and health services. The local economy and employment are significantly influenced by local tourism. Primary sources of employment in the governmental sector include the Veterans Administration Medical Center, the United States Postal Service and the City of Long Beach. Trade and transportation sector employers include the Port of Long Beach and Long Beach Transit. Professional and business services include Verizon Denso, Epson, Gulfstream Aerospace, Laserfiche, the Queen Mary, SCAN Health Plan, TABAC and Boeing. Educational and health services employees include: St Mary's Medical Center, Long Beach City College, Long Beach Memorial Medical Center, California State University, College Medical Center, Molina Healthcare, and Long Beach Unified School District.

For Seal Beach, the top employers are primarily in the category of professional and business services. These businesses include Boeing, Mag Tek, Siemens Medical Solutions, Target, First Team Real Estate, Farmers & Merchants Bank of Long Beach, Bixby Ranch Company, Kohl's, Spaghetti Grill and Lounge, Albertsons, Custom Building Products, Autism Partnership, P2F Holdings, Health Net, Original Parts Group and Baker Corp. There is also the Seal Beach National Naval Weapons Station a U.S. military facility.

3.3 INCOME

Due to the continued strong economy subsequent to the Great Recession, local area unemployment rates are very low, as shown on Table 3-2. The City of Seal Beach, the City of Long Beach and the City of Los Angeles had unemployment rates ranging from 3.5 to 4.7% as of June 2019. The value for the City of Long Beach is the same as the City of Los Angeles's unemployment rate (4.7%). The unemployment rate for Sea Beach was even lower, at 3.5%. Data for Table 3-2 was obtained from the CA.gov website and is a different source than the one used to obtain income data located in the main report.

Table 3-2: City of Long Beach and the City of Los Angeles Labor Force Data

Area Name	Labor Force	Employment	Unemployment	
			Number	Rate
Seal Beach City	10,000	9,600	300	3.5%
Long Beach City	237,300	226,100	11,200	4.7%
Los Angeles City	2,055,600	1,960,000	95,700	4.7%

The City of Seal Beach has a higher median household income than the City of Long Beach and the City of Los Angeles, as shown in Table 3-3. The poverty rate for the City of Long Beach is 19.1%, which is slightly lower than Los Angeles City at 20.4%. The City of Seal Beach poverty rate is substantially lower at 7.3%. Data for Table 3-3 was obtained from community profile data found on the Census Bureau website for 2017 and is a different source than the one used to obtain income data located in the main report.

Table 3-3: City of Long Beach and the City of Los Angeles Annual Income Data

Area Name	Median Household Income	Per Capita Income	Poverty Rate
Seal Beach City	$65,401	$52,119	7.3%
Long Beach City	$58,314	$29,586	19.1%
Los Angeles City	$54,501	$31,563	20.4%

3.4 RACE & ETHNICITY

Table 3-4 provides a summary of race and Hispanic ethnicity for the Study Area. White alone represents the majority of the racial composition for the Study Area, although the cities of Long Beach and Los Angeles have a much lower white population than the City of Seal Beach. Los Angeles and Long Beach have diverse populations, e.g., Black and Asian populations represent about 13% each for the City of Long Beach, with those identifying as having two or more races at 5.5%. Hispanic populations for Long Beach and Los Angeles are approximately 42% and 49%, respectively.

Table 3-4: Race and Hispanic Ethnicity

Area Name	Race (%)					Hispanic Ethnicity (%)
	White Alone	Black Alone	Asian Alone	Other	Two or More	
City of Long Beach	53.1	13.0	13.0	2.1	5.5	42.4
City of Los Angeles	52.4	9.0	11.6	0.9	3.6	48.6
City of Seal Beach	81.9	1.2	8.7	0.3	4.4	13.0
Los Angeles County	71.0	9.1	15.1	1.9	3.0	48.5
Source: U.S. Census (2017)						

4 PROBLEMS, OPPORTUNITIES, OBJECTIVES, AND CONSTRAINTS

The first step in the planning process is to identify problems and opportunities in the Project Area relating to ecosystem resources. Once problems and opportunities are identified, the next step is to identify the planning objectives and constraints which will guide the formulation of management measures and plans to address these objectives.

4.1 PROBLEMS AND OPPORTUNITIES

4.1.1 ECOSYSTEM RESTORATION PROBLEMS

The following aquatic ecosystem problems have been identified for the ESPB Project Area:

1. Loss of historic coastal wetlands and sensitive marine habitat areas with associated nursery, reproductive, and other ecological functions; and
2. Reduced abundance and biodiversity of marine populations as a result of habitat loss.

San Pedro Bay and coastal wetland ecosystems have been altered significantly with the development of the Port of Los Angeles and the San Pedro Breakwater starting in 1899. The Port of Long Beach was developed on what was the Los Angeles River estuary mudflats around the same time. These two ports together filled in nearly half of San Pedro Bay. Development within the Los Angeles River watershed and the historic flooding of 1938 prompted the City of Los Angeles to call upon the Corps to channelize what was once a broad, meandering river, greatly reducing flows of nutrients and sediments into the bay. Construction of the Middle and Long Beach Breakwaters by the federal government along with the Alamitos Bay Jetties contributed to altered circulation and sediment movement patterns over time.

Due to the large number of people living along the Southern California Bight, there has been a great demand placed upon this ecological resource, and the intersection of biodiversity and economics means that this is a coastal ecosystem at risk from various anthropogenic influences. Subtidal rocky outcrops, subtidal shoals, and tidal wetlands support valued ecosystem services and are under threat from various human activities and climate change throughout the Southern California Bight, thus a restoration focus on these habitats is warranted for East San Pedro Bay.

In particular, the following habitat types have been reduced, degraded, or altered in San Pedro Bay:

- Historically, a large kelp bed existed in the San Pedro Bay area, but disappeared by the 1930's. The Horseshoe Kelp Bed off the Palos Verdes Peninsula was reported to be two miles long and one-quarter to one-half mile wide (equates to 320 to 640 acres). One study showed that when kelp was removed from a reef, fish biomass declined by 63%.
- Rocky reef and other hard bottom habitat provide valuable habitat for economically important fish and macro invertebrates. Current hard bottom habitat is limited to linear features of the breakwater and riprap protecting the THUMS oil islands and port facilities. Historically, rocky reef areas existed in San Pedro Bay prior to development of the ports/harbors, but were disturbed or removed by dredging and/or infrastructure fill projects.
- Wetlands associated with the San Pedro Bay historically accounted for more than 80% of all historical wetland habitats in the southern California region (see

- Figure 4-1). Today, this habitat has been reduced by 93% of its historical extent. The only remaining wetlands under state or Federal jurisdiction within the general study are the restored coastal salt marshes at the Golden Shore Marine Reserve and the Los Cerritos Wetlands along the San Gabriel River.

- Limited Eelgrass Beds - Eelgrass beds, high in productivity and important to fish and other organisms, are limited in coverage and density along the Long Beach shoreline. Seagrass beds constitute a critical habitat in near shore ecosystems, serving as a nursery ground for a diversity of organisms including economically important fishes and invertebrates. They provide numerous ecosystem services, including sediment stabilization, filtration of pollutants, and carbon storage.

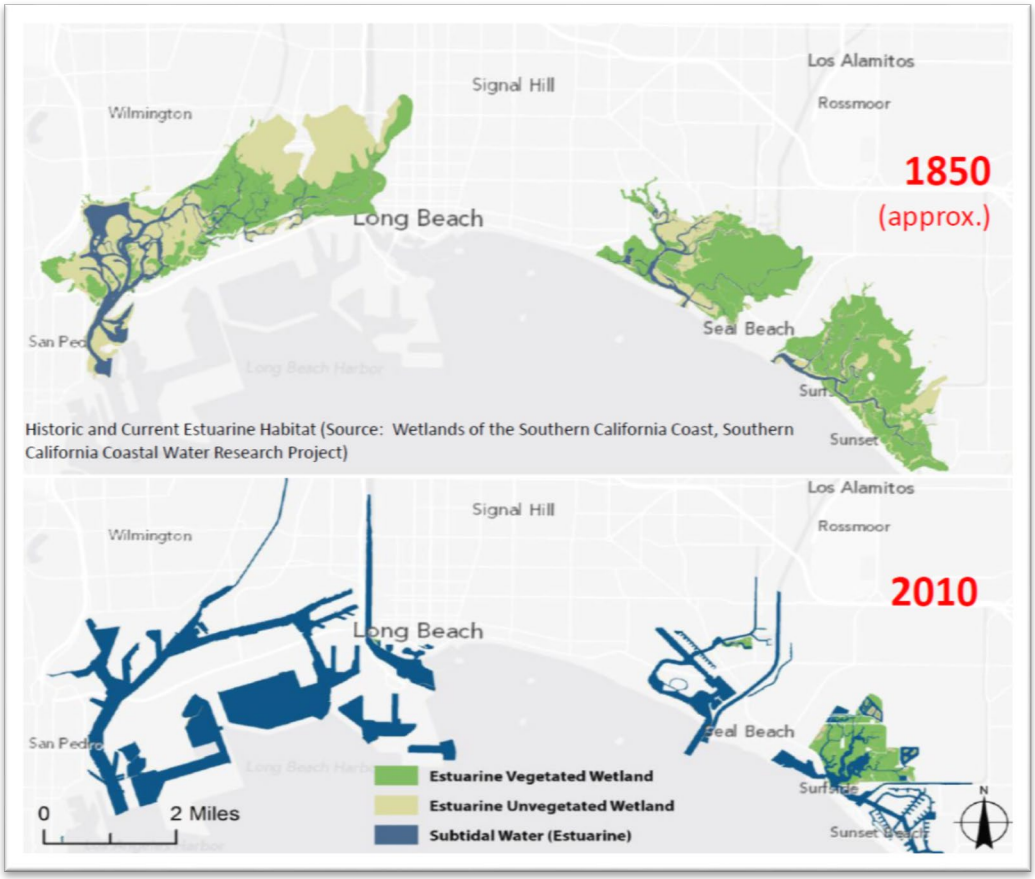


Figure 4-1 Coastal Wetland Conversion within San Pedro Bay

4.1.2 OPPORTUNITIES

Opportunities to restore habitat types lost or degraded in the Project Area including:

- Existing open and undeveloped areas with minimal or degraded habitats in the project area are available for restoration to provide restored ecosystem functions and increased biodiversity in ESPB within the regional setting of the southern California Bight.

- The project area contains an abundance of soft-bottom habitat that can be converted to more scare high-value habitats to restore lost ecological functioning within ESPB and the SCB, including benefits to support migratory species with ranges that extend far beyond the SCB.

- Restoration features can be located within the project area to be compatible with existing environmental conditions and processes and to contribute to regional connectivity to estuarine and open water environments within the region.
- Restoration features can be configured within the project area to intentionally deliver highest habitat value, augmenting value of existing habitat that grew as an "unintended consequence" of construction of ports, the breakwaters and oil islands
- Augment existing habitat on "living breakwater" with strategically placed rock to maximize optimal environmental conditions for rocky reef and/or kelp beds.
- Beneficial uses of dredged sediments and construction materials can be used to construct features that mimic degraded or lost habitats such as rocky reefs, emergent sandy islands, kelp beds or coastal wetlands to restore regional patterns of ecosystem functions and outputs.
- Kelp beds and rocky reef lost or degraded due to navigational functions in San Pedro Bay can be restored within project area where optimal open ocean conditions exist that do not interfere with navigational operations.
- Shallow nearshore areas provide suitable restoration opportunities for intertidal zone habitats that have been lost such as sandy islands and rocky reef.
- Restoring coastal wetlands would boost nursery production and provide other ecosystem services that could bolster aquatic wildlife and coastal bird population as well as indirectly provide filtration services.

4.2 PLANNING OBJECTIVES

The specific planning objective is to: ***Restore and support the sustained functioning of imperiled aquatic habitats such as kelp, rocky reef, coastal wetlands, and other types historically present in San Pedro Bay of sufficient quality and quantity to support diverse resident and migratory species within ESPB during the period of analysis (50 years)***

The goals of the ESPB restoration project are intended to focus on habitats rather than individual species (except for those habitats that are created by a single species, e.g., eelgrass or oyster beds). This approach avoids prioritizing some species over others.

4.3 PLANNING CONSTRAINTS AND CONSIDERATIONS

- Constraint 1a: Do not negatively impact the U.S. Navy's maritime operations which support national security.
- Constraint 1b: Do not significantly reduce operational capacity for the ports, THUMS oil extraction islands or other existing maritime operations.
- Constraint 2: Do not allow for infilling any of the energy island borrow pits located within the ESPB boundary.
- Consideration 1: Minimize impacts to known major utilities or navigation channels and anchorages.

- Consideration 2: Avoid increases in shoreline erosion, wave related damages, and coastal flooding to existing residences, public infrastructure, marinas, existing jetties, other structures, and recreational beaches.
- Consideration 3: Minimize impact to flood risk management operations on the LA River.
- Consideration 4: Minimize vulnerability of coastal areas to accelerating sea level rise.

5 WITHOUT-PROJECT CONDITIONS

The without project conditions are those conditions expected to exist into the future without the implementation of a cost-shared project to address the water resources problems and opportunities discussed in this report. These conditions serve as a baseline against which alternatives are compared to assess plan benefits and costs. As the focus of this feasibility study is on aquatic ecosystem restoration within ESPB, the baseline conditions will focus on the existing and projected habitat conditions expected for within ESPB over the period of analysis. Since recreation resources are a significant consideration within the Project Area, the evaluation of alternatives will also consider any anticipated impacts to recreation resources and values.

To evaluate habitat conditions within ESPB, a model was developed that quantifies habitat value based upon the suitability of conditions to support specific habitat types. For each habitat type, a Habitat Suitability Index (HSI) model was developed, which based upon the site specific conditions, can range from 0 to 1.0, with a 1.0 representing ideal conditions to support the habitat type. These HSI values are multiplied times the area (in acres) of each habitat to derive estimates of Habitat Units (HUs). Habitat Units are projected over the 50-year period of analysis, with the average value over the period representing Average Annual Habitat Units (AAHUs).

The only existing habitat within ESPB is a small amount of eelgrass located within the Nearshore Zone. The value of this habitat is estimated at about 2.0 AAHUs.

6 ECOSYSTEM RESTORATION ALTERNATIVES

The plan formulation process is described in detail in Chapter 4 of the Main IFR. This appendix mentions briefly some of the plan formulation processes, evaluation criteria and arrays of plans that were considered. It does not describe these processes or information in detail. For a more detailed description the reader should refer to the Main IFR.

Ecosystem restoration is one of the primary missions of the Corps of Engineers Civil Works program. The Corps objective in ecosystem restoration planning is to contribute to national ecosystem restoration (NER). Contributions to NER are increases in the net quantity and/or quality of desired ecosystem resources. Measurement of NER is based on changes in ecological resource quality and a function of improvement in habitat quality and/or quantity and expressed quantitatively in physical units or indexes (but not monetary units). These net changes are measured in the planning area and in the rest of the nation. Thus, single purpose ecosystem restoration plans shall be formulated and evaluated in terms of their net contributions to increases in ecosystem value (NER outputs) expressed in non-monetary units (habitat units).

For ecosystem restoration projects, a plan that reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective, is generally selected. The selected plan must be shown to be a cost effective plan for achieving the desired level of output and economically justified (determined to be worth its investment cost). This plan is identified as the National Ecosystem Restoration (NER) Plan. This formulation, evaluation, and selection process is described below.

6.1 IDENTIFICATION OF MEASURES TO ADDRESS IDENTIFIED PLANNING OBJECTIVES

A management measure is a feature or activity at a site, which addresses one or more of the planning objectives. Over 200 distinct measures were collected and compiled from various public, stakeholder, and Project Delivery Team (PDT) efforts that began in 2009. From the list, The PDT screened measures on three different occasions. In screening 1, the PDT took the over 200 distinct measures and grouped them into 29 categories generalized measures. Then, the PDT screened them, in the process narrowing the categories of generalized measures to 17. Twelve of these categories were screened out. Screening 2 evaluated the 17 generalized categories of measures using the formulation criteria as given and defined in ER 1105-2-100. The criteria in the screening included the extent to which the measures addressed the planning objectives, efficiency, implementability, and acceptability. During screening 3, 5 additional generalized measures were screened out. The remaining measures were fine-tuned later to include 11 vegetation and structural measures, including: 1) rocky fish reef (no giant kelp), 2) rocky reef tidal zone, 3) giant kelp beds, 4) eelgrass beds, 5) sandy islands, 6) oyster beds, and 7) coastal wetlands, 8) breakwater modifications (notching, lowering, and removing a portion of the breakwater) 9) Underwater contouring Cut/Fill, 10) Los Angeles River Training Wall, and 11) Remove entire Breakwater. Even later in the study process, measures nine through eleven were also removed, leaving only 8 vegetation and structural measures. These measures are located spatially into five opportunity zones. They are: nearshore, open water, LA river mouth, port, open water, and breakwater (See Figure 6-1).

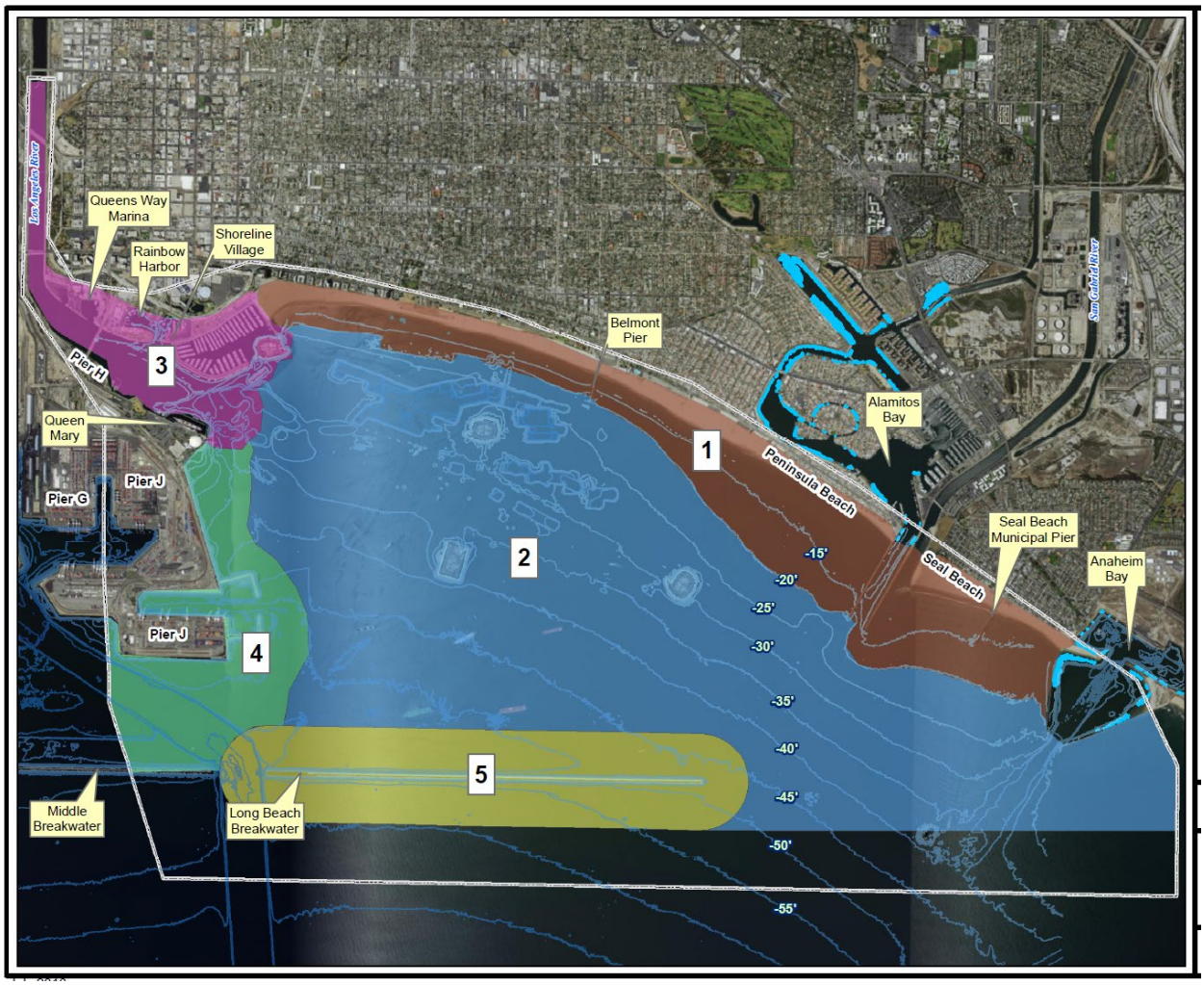


Figure 6-1: Opportunity Zones

6.1.1 ZONE DESCRIPTION

1. Nearshore Zone: The nearshore zone is a seaward area located along the recreational beaches in Long Beach and Seal Beach, The area starts at the seaward edge near the LA River Mouth and ends at the Anaheim Bay jetties farther eastward. The area includes the Belmont Pier, Peninsula Beach, the Alamitos Bay Jetties, and Seal Beach, up to but not including the Anaheim Bay jetties.

2. Open Water Zone: The open water zone is east of the LA river zone and port zone, northward of the breakwater zone and south of the nearshore zone. The open water zone includes 3 oil islands.

3. LA River Mouth Zone: The LA river mouth zone extends from West Anaheim Street Bridge crossing down 1 mile to the river mouth and includes the Queen Mary, Rainbow Harbor, Long Beach Shoreline Marina and Grissom Oil Island.

4. Port Zone: Includes the Carnival Cruise Pier, the "Cove" (a rectangular inset along Pier G/J), Pier J, and is out approximately 3,000 feet from the port shoreline to Queens Gate.

5. Breakwater Zone: The breakwater zone is buffered by approximately 1,500 feet on either side. The buffer zone includes the Queens Gate navigation opening between the Long Beach and Middle Breakwaters.

6.2 PRELIMINARY CONCEPTUAL ALTERNATIVES

Eighteen conceptual alternatives were formulated by grouping one or more of these management measures by zone. They were compared with the "No Action Plan." USACE is required to consider the option of ''No Action" as one of the alternatives in order to comply with the requirements of the National Environmental Policy Act (NEPA). No Action assumes that no project would be implemented by the Federal Government or by local interests to achieve the planning objectives. No Action, synonymous with the Without Project Condition, forms the basis from which all other alternative plans are measured. Results for the Without Project conditions were presented in Section 5.

The 18 conceptual alternatives that were initially considered in the study are summarized below. These alternatives were created to aid in the modelling process for coastal engineers at the US Army Corps of Engineers, Los Angeles District and aid the Engineering Research and Development Center (ERDC) in modeling environmental output. A full description of these conceptual alternatives and how they were developed can be found in the Main Report of this feasibility study. Also, found in the Main Report are maps depicting the alternatives and a detailed view of the scale and placement of each measure within each alternative.

Table 6-1: Conceptual Alternatives 1 through 9

Measure or Mini Alternative	Alternatives																	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Base Plan	x	x	x	x	x	x	x	x	x	X	x	x	x	x	x	x	x	x
(1) Small Emergent Island				x				x		X	x	x	x					
(1) Small and (1) Medium Emergent Island					x										x	x	x	
(1) Large Emergent Island						x				X	x	x	x	x	x	x	x	
Small Oyster Reef (WJ)				x							x	x						
(2) Medium Oyster Reef (WJ + EJ)						x	x	x	x				x					
(1) Rocky Reef Complex (Scale 1)		x																x
(2) Rocky Reef Complex (Scale 2)			x	x	x					X	x	x	x	x	X	x	x	
(3) Rocky Reef Complex (Scale 3) + (2) Rocky Reef Complex Island B						x	x	x	x	X	x	x	x		X	x	x	
Add Scattered Rock (Scale 1)			x	x	x									x				
Add Scattered Rock (Scale 2)						x	x	x	x	X	x	x	x		X	x	x	
Small Tidal Wetland							x	x	x	X	x	x	x		X	X	x	
Training Wall & Bottom Contouring							x	x	x	X	x	x	x					
Small Tidal Wetland								x								X	x	
Medium Tidal Wetland									x	X	x	x	x			x		
Add Rock (Scale 1)		x												x	X		x	
Add Rock (Scale 2)			x	x	x												x	
Add Rock (Scale 3)						x	x	x	x						X			
(1) Small Emergent Island									x		x							

6.3 BASE PLAN AND MANAGEMENT MEASURES FOR CEICA ANALYSIS

As noted above, the preliminary alternatives served as a basis for identifying potential restoration measures, including the most suitable locations for such measures as well as scales. However, after an evaluation of the initial costs and output for these plans, it was apparent that they were not cost effective or efficient, and more efficient plans could be generated by considering different combinations of the measures. Therefore, the output and costs of the measures comprising the preliminary conceptual alternatives were broken out to aid in conducting a Cost Effectiveness and Incremental Cost Analysis (CEICA) to determine the most cost effective and efficient plan combinations.

To assure that a minimum level of ecosystem restoration output is achieved, in terms of addressing the planning objectives, a Base Plan was developed. This plan was identified to serve as the building block for potential plan combinations, i.e., all plans considered include the Base Plan. The Base Plan includes five rocky reef shoals along the east side of the Nearshore Zone, eelgrass along the Nearshore Zone, and scattered rock for a kelp reef located in the Open Water Zone. It is the minimally acceptable plan to be evaluated and is therefore included in all combinations of larger alternatives considered. The Base Plan includes measures in the Nearshore and Open Water Zones, but does not include measures in the LA River Zone, Port zone and the Breakwater Zone.

The following is a list of management measures by zone. (A more detailed table can be found in Chapter 4, entitled Plan Formulation of Measures and Alternatives, under the heading 4.3.4 Measure Outputs (Cost Estimates and Habitat Evaluation Results). These include multiple scales of some measures. These measures can be combined according to rules related to measure dependencies, scales, and non-combinability into full plans and then evaluated to identify plan combinations that are the most cost effective and efficient. After the list of management measures by zone is another table with a description of the dependencies, scales, and non-combinability for these measures by zone.

Table 6-2: Management Measures by Opportunity Zone

Zone	IWR Plan ID	Description
	N-Baseplan	(5) Rocky Reef Shoals East
	O-Baseplan	Place scattered rock for Kelp Forest
	T	Base Plan Total
Nearshore Zone	NA1	(2) Small Emergent Islands
	NA2	(1) Small and (1) Medium Emergent Island
	NA3	(1) Large Emergent Island
	NB	Small Oyster Reef (WJ)
	NC	(2) Medium Oyster Reef (WJ + EJ)
	ND1	Add (1) Rocky Reef Shoal
	ND2	Add (3) Rocky Reef Shoals East
	NE	(1) Small Emergent Island
Open Water Zone	OA1	(1) Rocky Reef Complex Island A
	OA2	(2) Rocky Reef Complex Island A
	OA3	(3) Rocky Reef Complex Island A + (2) Rocky Reef Complex Island B
	OA4	(5) Rocky Reef Complex Island A + (2) Rocky Reef Complex Island B
	OB1	Add Scattered Rock (Scale 1)
	OB2	Add Scattered Rock (Scale 2)
	OB3	Add Scattered Rock (Scale 3)
	OB4	Add Scattered Rock (Scale 4)
LA River Zone	LA	Small Tidal Wetland
	LB	Training Wall & Bottom Contouring (Dropped)
	LC	(1) Large Size Oyster Reef
Port Zone	PA1	Small Tidal Wetland
	PA2	Medium Tidal Wetland
	PA3	Large Tidal Wetland
Breakwater Zone	BA	Reduce Rock (Dropped)
	BB1	Add Rock (Scale 1)
	BB2	Add Rock (Scale 2)
	BB3	Add Rock (Scale 3)
	BB4	Add Rock (Scale 4)
	BC1	(1) Small Emergent Island
	BC2	(1) Small and (1) Medium Emergent Island
	BC3	(1) Large Emergent Island
	BD	Notch Breakwater
	BE	Remove 1/3 Breakwater
	BF	Lower Breakwater

Note: The training wall and bottom contouring were eventually eliminated due to excessive costs and limited Habitat Units. Measure BA was also eliminated from CEICA runs.

Table 6-3: Scales and Non-Combinability of Measures by IWR-Plan Identifier

Zone	Scales and Non-combinability (All Measures Dependent on the Base Plan)
Nearshore	NA has 3 scales; ND has 2 scales.
	Scales of same measures are not combinable.
	NB and NC are not combinable.
	NA and ND are combinable.
	NE and NA are not combinable.
Open Water	OA has 4 scales.
	Scales of same measure are not combinable.
LA River Mouth	All measures have one scale, no non-combinability.
Port	PA has 3 scales.
	Scales of same measure are not combinable
Breakwater	BB has 4 scales. BC has 3 scales.
	Scales of the same measure are not combinable.

6.4 CEICA ANALYSIS

USACE guidance requires that the ecosystem related benefits of proposed alternatives be subjected to detailed economic analysis, allowing an explicit comparison of the costs and benefits associated with the alternatives. Consequently, it is necessary that the environmental benefits of the alternatives be based on some quantifiable unit of value. Since ecosystem restoration value is difficult to monetize, instead of calculating benefits in monetary terms, USACE ecosystem restoration projects calculate the value of benefits of restored habitat using established habitat assessment methodologies. The output is in the form of Habitat Units.

CEICA is an evaluation technique used to help facilitate good decision making and communication. It evaluates pre-formulated plans or management measures in terms of variations in output levels and in costs. There are two distinct analysis that must be conducted: cost effectiveness analysis and incremental cost analysis. Cost effective means that for a given level of non-monetary output, no other plan costs less, and no other plan yields more output for less money. Incremental cost analysis is the subset of cost effective plans. They are examined sequentially (by increasing scale and increment of output) to ascertain which plans are most efficient in the production of environmental benefits. Those most efficient plans are called best buy plans. They have the lowest incremental costs per unit of output. CEICA results will not identify a unique solution but rather will identify a set of best buy plans. The results must be synthesized with other decision-making criteria (e.g., uncertainty and reasonableness of costs) to help the planning team select and recommend a particular plan.

6.4.1 INPUTS INTO CEICA

IWR-Planning Suite II (version 2.0.9.1), developed by the Institute of Water Resources, was used to complete the CEICA analysis. The required inputs for the model are average annual habitat units and annualized costs by measure.

6.4.1.1 HABITAT UNITS

As noted, there is minimal existing habitat within ESPB. An evaluation was also conducted of the change in habitat values (AAHUs) associated with each of the management measures listed on Table 6-2.

6.4.1.2 COSTS

Feasibility level cost estimates were developed for each management measure. All cost are presented in 2018 price levels. Supporting cost information can be found in the Cost Appendix of the Feasibility Report. Costs include monitoring and adaptive management costs. Interest during construction was also calculated based upon estimated construction periods to derive tot total investment cost. Annualized investment costs were then computed using a Federal discount rate of 2.75 percent over a 50 year period of analysis. Finally, annual operation and maintenance costs were added to derive total average annual costs for each measure.

6.4.1.3 SUMMARY OF INPUTS

The table below shows the AAHU and average annual costs applied for the CEICA analysis. All measures were applied except for two. The training wall and bottom contouring (LB) are not carried forward because the measure proved ineffective and inefficient. The measure cost $63 million and did not produce any AAHUs. And, the reduced rock measure (BA) was no longer applicable to the current formulation of measures and therefore was not included.

Table 6-4: Cost and Output by Measure

Cost ID	Description	First Cost	O&M Cost	AA Cost	AAHU
NB	(5) Rocky Reef Shoals East	$51,906,079	$207,390	$2,166,700	29.3
OB	Place scattered rock for Kelp Forest	$3,927,253	$0	$145,800	4.3
TB	Base Plan Total	$55,833,332	$207,390	$2,312,500	33.5
NA1	(2) Small Emergent Islands	$60,974,761	$1,628,850	$3,923,500	13.8
NA2	(1) Small and (1) Medium Emergent Island	$83,180,205	$2,062,310	$5,205,900	22.7
NA3	(1) Large Emergent Island	$104,044,069	$2,498,250	$6,400,100	30.0
NB	Small Oyster Reef (WJ)	$816,903	$0	$30,300	0.07
NC	(2) Medium Oyster Reef (WJ + EJ)	$1,134,303	$0	$42,100	0.23
ND1	Add (1) Rocky Reef Shoal	$11,429,493	$43,720	$468,000	8.1
ND2	Add (3) Rocky Reef Shoals East	$41,899,298	$163,035	$1,734,100	12.1
NE	(1) Small Emergent Island	$33,429,766	$1,120,920	$2,368,300	7.0
OA1	(1) Rocky Reef Complex Island A	$23,110,916	$0	$858,000	13.7
OA2	(2) Rocky Reef Complex Island A	$45,065,003	$0	$1,674,700	27.4

Cost ID	Description	First Cost	O&M Cost	AA Cost	AAHU
OA3	(3) Rocky Reef Complex Island A + (2) Rocky Reef Complex Island B	$105,363,253	$0	$3,938,200	68.4
OA4	(5) Rocky Reef Complex Island A + (2) Rocky Reef Complex Island B	$145,078,753	$0	$5,428,800	95.9
OB1	Add Scattered Rock (Scale 1)	$1,150,003	$0	$42,700	8.3
OB2	Add Scattered Rock (Scale 2)	$2,035,503	$0	$75,600	16.0
OB3	Add Scattered Rock (Scale 3)	$2,921,003	$0	$108,400	24.4
OB4	Add Scattered Rock (Scale 4)	$5,134,753	$0	$190,700	42.3
LA	Small Tidal Wetland	$24,973,211	$623,770	$1,560,400	7.1
LB	Training Wall & Bottom Contouring (Dropped)	$63,406,000	$2,473,967	$4,852,000	0.0
LC	(1) Large Size Oyster Reef	$759,403	$11,010	$39,400	0.08
PA1	Small Tidal Wetland	$76,775,476	$1,120,150	$4,025,800	7.8
PA2	Medium Tidal Wetland	$106,244,476	$1,444,100	$5,472,800	17.6
PA3	Large Tidal Wetland	$187,522,676	$2,479,495	$9,615,700	40.6
BA	Reduce Rock (Dropped)				
BB1	Add Rock (Scale 1)	$4,548,250	$0	$168,900	4.2
BB2	Add Rock (Scale 2)	$5,852,350	$0	$217,500	8.5
BB3	Add Rock (Scale 3)	$8,484,700	$0	$316,100	16.9
BB4	Add Rock (Scale 4)	$19,014,100	$0	$708,300	49.6
BC1	(1) Small Emergent Island	$92,451,570	$3,923,310	$7,435,600	5.9
BC2	(1) Small and (1) Medium Emergent Island	$142,085,070	$6,156,820	$11,566,300	18.0
BC3	(1) Large Emergent Island	$124,166,070	$5,350,460	$10,042,800	19.2
BD	Notch Breakwater	$899,961,300	$1,440,670	$35,500,600	0.0
BD-RQ	Notch Breakwater Westside-With Higher RR Shoals Zone N	$982,220,985	$1,648,060	$38,821,100	0.0
BE	Remove 1/3 Breakwater	$600,640,000	$733,650	$24,025,400	0.0
BE-RQ	Remove 1/3 Breakwater Eastside-With Higher RR Shoals Zone N	$658,810,985	$941,040	$26,488,600	0.0
BF	Lower Breakwater	$1,419,918,300	$962,860	$56,409,300	0.0

6.5 CEICA RESULTS

The IWR-Planning Suite software conducts CEICA analysis by first combining each of the measures into all of the possible plan combinations. Once IWR Plan combines measures to formulate possible plans, these plans are then evaluated for cost effectiveness. It must be shown through cost effectiveness analysis that an alternative restoration plan's output cannot be produced more cost effectively by another alternative. "Cost effective" means that, for a given level of non-monetary output, no other plan costs less, and no other plan yields more output for less money. The end result is only cost effective alternatives are retained for the next step of analysis.

6.5.1 COST EFFECTIVE PLANS

The cost effectiveness analysis of the plan combinations yielded 249 cost effective plans. All plans combinations include the Base Plan, which is the smallest scale plan shown on the figure below. The Base Plan has a First Cost of about $55 million, and average annual cost of about $2.3 million, and generates about 33.5 AAHUs. The largest cost effective plan is shown in the upper right corner of the graph. This plan has a Total First Cost of about $710 million, an average annual cost of about $39.7 million, and generates nearly 331 AAHUs.

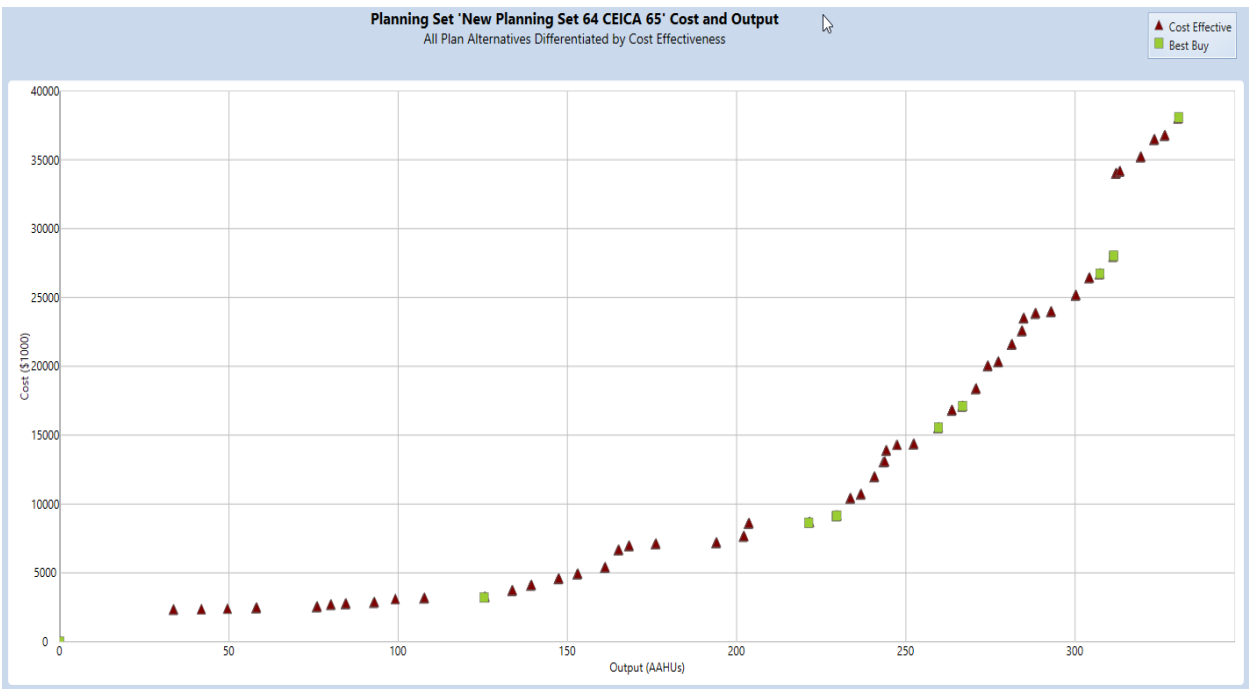


Figure 6-2: Cost Effective Plans

6.5.2 BEST BUY PLANS

The subset of cost effective plans are examined sequentially (by increasing scale and increment of output) to ascertain which plans are most efficient in the production of environmental benefits. Those most efficient plans are called "Best Buys". They provide the greatest increase in output for the least increases in cost. Of the 249 cost effective plans, 11 plans were Best Buy Plans (including the No Action Plan). Table 6-5 below summarizes the management measures included in each of the Best Buy Action Plans (Best Buy Plan 1 is the No Action Plan

Table 6-5: Best Buy Plan Measures

IWR Plan ID	BB 2	BB 3	BB 4	BB 5	BB 6	BB 7	BB 8	BB 9	BB 10	BB 11	Measures
N- Base Plan	x	x	x	x	x	x	x	x	x	X	(5) Rocky Reef Shoals East
O-Base Plan	x	x	x	x	x	x	x	x	x	X	Place scattered rock for Kelp Forest
T	x	x	x	x	x	x	x	x	x	X	Base Plan
NA1											(2) Small Emergent Islands
NA2											(1) Small and (1) Medium Emergent Island
NA3					x	x	x	x	x	X	(1) Large Emergent Island
NB											Small Oyster Reef (WJ)
NC				x	x	x	x	x	x	X	(2) Medium Oyster Reef (WJ + EJ)
ND1			x	x	x	x	x				Add (1) Rocky Reef Shoal (Scale 1)
ND2								x	x	X	Add (3) Rocky Reef Shoals East (Scale 2)
NE											(1) Small Emergent Island
OA1											(1) Rocky Reef Complex Island A
OA2											(2) Rocky Reef Complex Island A
OA3											(3) Rocky Reef Complex Island A + (2) Rocky Reef Complex Island B
OA4		x	x	x	x	x	x	x	x	X	(5) Rocky Reef Complex Island A + (2) Rocky Reef Complex Island B
OB1											Add Scattered Rock (Scale 1)
OB2											Add Scattered Rock (Scale 2)
OB3											Add Scattered Rock (Scale 3)
OB4	x	x	x	x	x	x	x	x	x	X	Add Scattered Rock (Scale 4)
LA						x	x	x	x	X	Small Tidal Wetland
LB											Training Wall & Bottom Contouring
LC									x	X	(1) Large Size Oyster Reef
PA1											Small Tidal Wetland

IWR Plan ID	BB 2	BB 3	BB 4	BB 5	BB 6	BB 7	BB 8	BB 9	BB 10	BB 11	Measures
PA2											Medium Tidal Wetland
PA3							x	x	x	X	Large Tidal Wetland
BB1											Add Rock (Scale 1)
BB2											Add Rock (Scale 2)
BB3											Add Rock (Scale 3)
BB4	x	x	x	x	x	x	x	x	x	X	Add Rock (Scale 4)
BC1											(1) Small Emergent Island
BC2											(1) Small and (1) Medium Emergent Island
BC3										X	(1) Large Emergent Island
BD											Notch Breakwater
BE											Remove 1/3 Breakwater
BF											Lower Breakwater

Table 6-6: Best Buy Plans – Measures Added per Plan

Plan	Measures Added
1	No Action Plan
2	Base Plan, Scattered Rock Scale 4 (Zone Open Water), Add Rock Scale 4 (Zone Breakwater)
3	(5) Rocky Reef Complex Island A + (2) Rocky Reef Complex Island B (Zone Open Water)
4	(1) RR Shoals East (Scale 1) (Zone Nearshore)
5	(2) Medium Oyster Reefs (WJ and EJ) (Zone Nearshore)
6	(1) Large Emergent Island (Zone Nearshore)
7	Small Tidal Wetland (Zone LA River Mouth)
8	Large Tidal Wetland (Zone Port)
9	Add (3) Rocky Reef Shoals East (Scale 2) (Zone Nearshore)
10	Large Sized Oyster Reef (Zone LA River Mouth)
11	Large Emergent Island (Zone Breakwater)

The next table lists the costs, output, incremental cost and output, and incremental cost per unit of output for the Best Buy Plans.

Table 6-7: Incremental Cost Analysis of Best Buy Plans

Plan	First Cost	O&M Cost	AA Cost	Inc. AAC	AAHU	Inc. AAHU	Inc. AAC/AAHU
Best Buy 2	$79,982,185	$207,390	$3,211,500	$3,211,500	125.40	125.4	$25,610
Best Buy 3	$225,060,938	$207,390	$8,640,300	$5,428,800	221.30	95.9	$56,611
Best Buy 4	$236,490,432	$251,110	$9,108,300	$468,000	229.40	8.1	$57,724
Best Buy 5	$237,624,735	$251,110	$9,150,400	$42,100	229.63	0.23	$186,283
Best Buy 6	$341,668,804	$2,749,360	$15,550,500	$6,400,100	259.63	30.0	$213,337
Best Buy 7	$366,642,015	$3,373,130	$17,110,900	$1,560,400	266.73	7.1	$219,775
Best Buy 8	$554,164,691	$5,852,625	$26,726,600	$9,615,700	307.33	40.6	$236,840
Best Buy 9	$584,634,496	$5,971,940	$27,992,700	$1,266,100	311.33	4.0	$316,525
Best Buy 10	$585,393,899	$5,982,950	$28,032,100	$39,400	311.41	0.1	$492,500
Best Buy 11	$709,559,970	$11,333,410	$38,074,900	$10,042,800	330.61	19.2	$523,063

The table above shows that the first cost of the Best Buy Plans range from about $80 million to about $710 million, with average annual costs (AAC) ranging from about $3.2 million to about $38 million. AAHUs range from about 125 AAHUs to about 331 AAHUs. Incremental AAC per AAHU range from about $26,000 for the smallest Best Buy Plan to about $523,000 for the largest Best Buy Plan.

Figure 6-3 is a box plot graph that depicts the incremental cost per output for the Best Buy Plans.

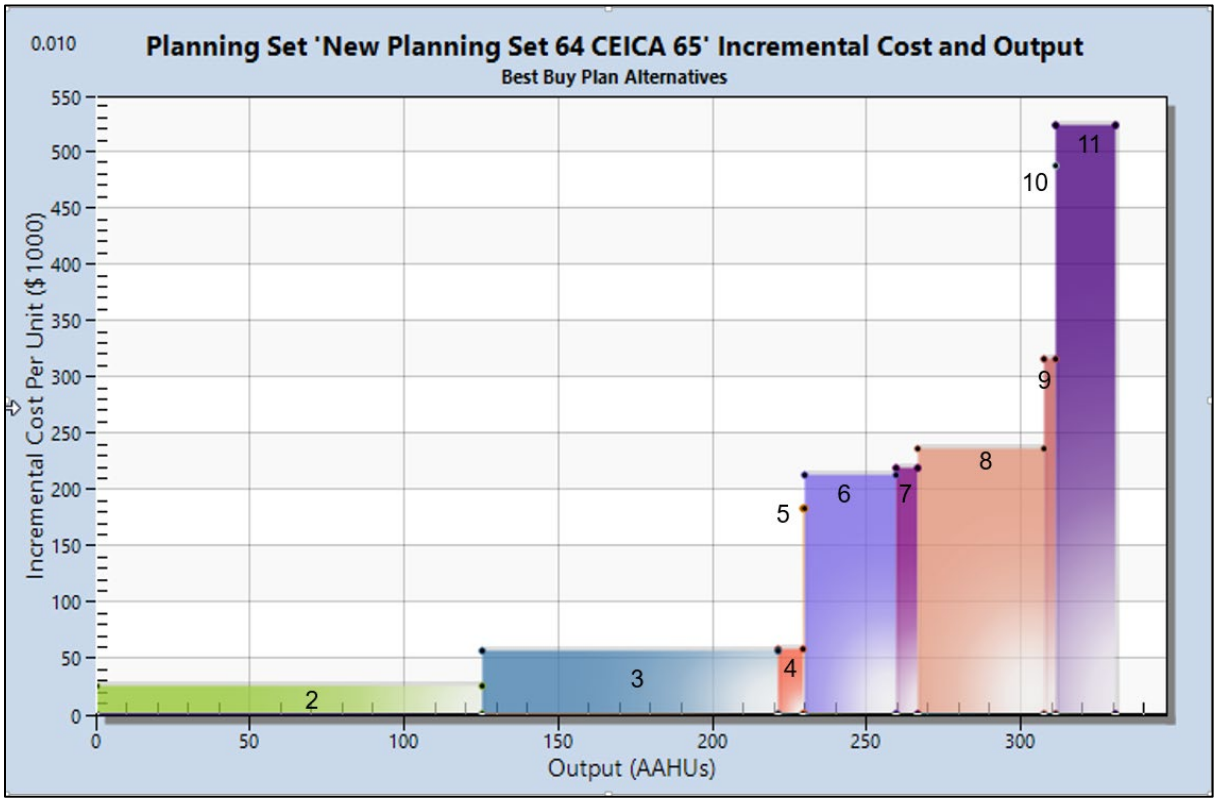


Figure 6-3: Best Buy Plans

Figure 6-3 shows that there are substantial increases in the incremental AAC/AAHU going from Best Buy Plan 4 to Best Buy Plan 5, from Best Buy Plan 8 to Best Buy Plan 9, and from Best Buy Plan 9 to Best Buy Plan 10. These "jumps" in the incremental cost curve depict substantial changes in the relative efficiency of the Best Buy Plans in terms of the additional cost required to gain additional output.

6.6 FINAL ARRAY OF ALTERNATIVES

To arrive at the Final Array of Alternatives, the study team undertook multiple iterations of alternatives evaluation and screening following the identification of the Best Buy Plans. This process included a substitution of a Best Buy Plan with a Cost Effective Plan, and the introduction and eventual elimination of Plans of Local Interest, Breakwater Plans, from consideration.

6.6.1 BEST BUY PLAN EVALUATION

The PDT carefully considered the 11 Best Buy Plans for potential inclusion in the Final Array of Alternatives. Best Buy Plan 2 is the least cost Best Buy Plan that minimally meets project objectives with the inclusion of open water giant kelp beds in two zones and nearshore rocky reef/eelgrass complexes in one zone. This plan was therefore carried forward to the Final Array as the smallest scale plan for consideration.

The PDT then evaluated the incremental AAC/AAHU for Best Buy Plans larger than Best Buy Plan 2, and determined that Best Buy Plans 3 and 4 were very similar in terms of efficiency, while Best Buy Plan 5 had a much higher incremental AAC/AAHU. Accordingly, Best Buy Plan 4 represented a logical candidate for consideration as a Final Array plan. Relative to Best Buy Plan 2, Best Buy Plan 4 adds a new habitat type -- seven (7) open water rocky reef patches, which functions as habitat "stepping stones" which promotes improved connectivity. Best Buy Plan 4 also extends the nearshore reef/eelgrass complexes with an additional node to the west, strengthening the connection to existing eelgrass beds. CEICA shows Best Buy Plan 4 as having essentially the same incremental AAC/AAHU as Best Buy Plan 3, while producing an additional 8.1 AAHUs through the addition of another rocky reef shoal in the nearshore zone. Best Buy Plan 5, the next most efficient plan, adds a small amount of additional output, and is not nearly efficient, with an incremental AAC/AAHU three times greater than that of Best Buy Plan 4. Best Buy Plans 5 through 8 are all similar in terms of efficiency, with similar incremental costs per output.

For the Final Array, the team also looked for a more comprehensive plan with features located in all of the opportunity zones and that restores more of the scarce habitat types valued by resource agencies (sandy islands, coastal wetlands, oyster beds). The PDT determined that Best Buy Plan 8 best met this objective while also considering cost effectiveness and efficiency. Sandy islands came in with Best Buy Plan 6, and the smallest coastal wetland in the Los Angeles River Mouth Zone came in with Best Buy Plan 7. Best Buy Plan 8 provides a jump in output to over 300 AAHU with the inclusion of a second large-scale coastal wetland in the Port Zone. It shows similar efficiencies as Best Buy Plans 6 and 7, albeit at a greater total cost and incremental AAC/AAHU. The incremental cost per output for Best Buy Plan 9 increases significantly, and is therefore a much less efficient plan. Plans 10 and 11 add more rocky reef/eelgrass complexes and oyster beds, which does not add much habitat value overall.

After initially identifying Best Buy Plans 2, 4 and 8 as Final Array Plans, the PDT further reviewed the costs and output of the components of these plans. Concerns over the high cost of open water rocky reef included in Best Buy Plan 4 prompted the team to propose a smaller scale of that same measure. By reducing the number of reef patches from seven (7) down to two (2), the project first cost was reduced by about $100 million. This plan modification corresponds with one of the Cost Effective Plans identified

by CEICA, which the team named Alternative 4A. This plan still includes open water rocky reefs, providing the important connectivity related benefits. Further the smaller scale of this measure is nearly as efficient as the larger scale included in Best Buy Plan 4. Alternative 4A was determined to be a superior plan to carry forward into the Final Array over Best Buy Plan 4 because it still provides significant outputs while reducing costs by around $100 million relative to Best Buy Plan 4.

Based upon the criteria of efficiency, reasonableness of cost, and the extent to which plans met planning objectives, three Plans: Best Buy Plan 2, Cost Effective Plan 4A, and Best Buy Plan 8, stood out for inclusion in the Final Array of Alternatives. They represented a wide range of habitat restoration approaches, from a minimum restoration scenario (Best Buy Plan 2), to a plan that includes a highly productive habitat type while substituting a smaller scale of one of the measures based upon reasonableness of cost considerations (Cost Effective Plan 4A), and a maximum restoration scenario that included scarce habitat types (Best Buy Plan 8). These plans range in cost from $80 million to $554 million. Average annual costs range from $3.2 million to $26.7 million, with AAHUs ranging from 125.4 to 307.3. The No Action Plan (Alternative 1) is also included as one of the four Final Array of Alternatives.

Final Array of Alternatives:

Alternative 1 (No Action Plan)
Alternative 2 (Best Buy Plan 2)
Alternative 4A (Cost Effective Variation of Best Buy Plan 4)
Alternative 8 (Best Buy Plan 8)

Plans of Local Interest (screened out):

Alternative BW1 *(Breakwater Western Notching Plan)*
Alternative BW2 *(Breakwater Eastern Removal Plan)*

The Non-Federal Sponsor also requested the addition of two breakwater modification plans to be considered for inclusion in the Final Array. These two Plans of Local Interest (POLI) were included in the evaluation of alternatives, although they were not included in the Final Array due to the coastal modeling results which indicated these plans would have significant impacts to national security and other maritime operations and habitat modeling results showing that the plans would not provide habitat restoration benefits. The two POLIs included a Breakwater Western Notching Plan (Alternative BW1) and a Breakwater Eastern Removal Plan (Alternative BW2), both coupled with a modification of Best Buy Plan 2. The Feasibility Report documents the analysis conducted for these plans.

6.6.2 DESCRIPTION OF FINAL ARRAY OF ALTERNATIVES

6.6.2.1 ALTERNATIVE 1 (NO ACTION PLAN)

Under the No Action Alternative, existing kelp and hard bottom habitat within ESPB would likely continue to be limited to features associated with the breakwater and other artificial hard substrates. Eelgrass beds located along a narrow band of shallow water offshore of Cherry beach would not likely increase significantly under the No Action Alternative. Other existing habitats, such as native and non-native oysters, coastal saltmarsh, and soft bottom habitat would not substantially change. However, in light of the persistent threat from the effects of climate change, climate change-induced alteration to rainfall patterns, and sea level rise over time, is expected that the existing habitats within the project area will become increasingly vulnerable and less resilient to the effects of these stressors (e.g., exacerbated loss of existing habitat, decreased viability of existing increased chances of wetland/habitat type conversion, submergence of transitional habitats).

6.6.2.2 ALTERNATIVE 2 (BEST BUY PLAN 2) - KELP RESTORATION PLAN

Alternative 2 is the least-cost best buy action plan and minimally meets the planning objectives. Open water kelp, shown as blue and yellow circles, provides high habitat output at a relatively low cost. This plan introduces three habitat types including eelgrass, (nearshore) rocky reef, and kelp reef, creating a horseshoe shaped benefit area. The most prevalent habitat type in this plan are 60+ acres of kelp beds in open water and off of the breakwater. The kelp bed placement takes advantage of beneficial open ocean currents. The yellow patches placed at differing intervals along the breakwater not only expands existing rocky reef habitat, but greatly increases the complexity and value through the undulating edges layout. Nearshore rocky reef in shallow ~15' depth provides habitat for intertidal zone kelp/algae and provides the conditions needed (calm, shallow waters) for eelgrass establishment. This serves to extend existing eelgrass beds west of Belmont Pier.

Figure 6-4 Alternative 2 Kelp Restoration Plan

6.6.2.3 ALTERNATIVE 4A (COST EFFECTIVE PLAN 4A) - REEF RESTORATION PLAN

Alternative 4A introduces a productive new habitat type with two 15 acre rocky reef patches placed along oil island (Island Chaffee) in the center of the open water zone. This placement augments existing rocky reef habitat at the oil island. Rocky reef provides high habitat value due to the ability to support of a wide variety of aquatic species, and have vertical as well as horizontal habitat benefits. Placing two rocky reef patches adjacent to each other promotes synergies between the patches, augmenting habitat value. Alternative 4A has increased habitat connectivity among and between zones, creating a benefit area that is more triangular and larger than Alternative 2. Alternative 4A also includes an additional nearshore rocky reef and eelgrass complex west of Belmont Pier. This additional complex strengthens the connections between new and established eelgrass beds to the west.

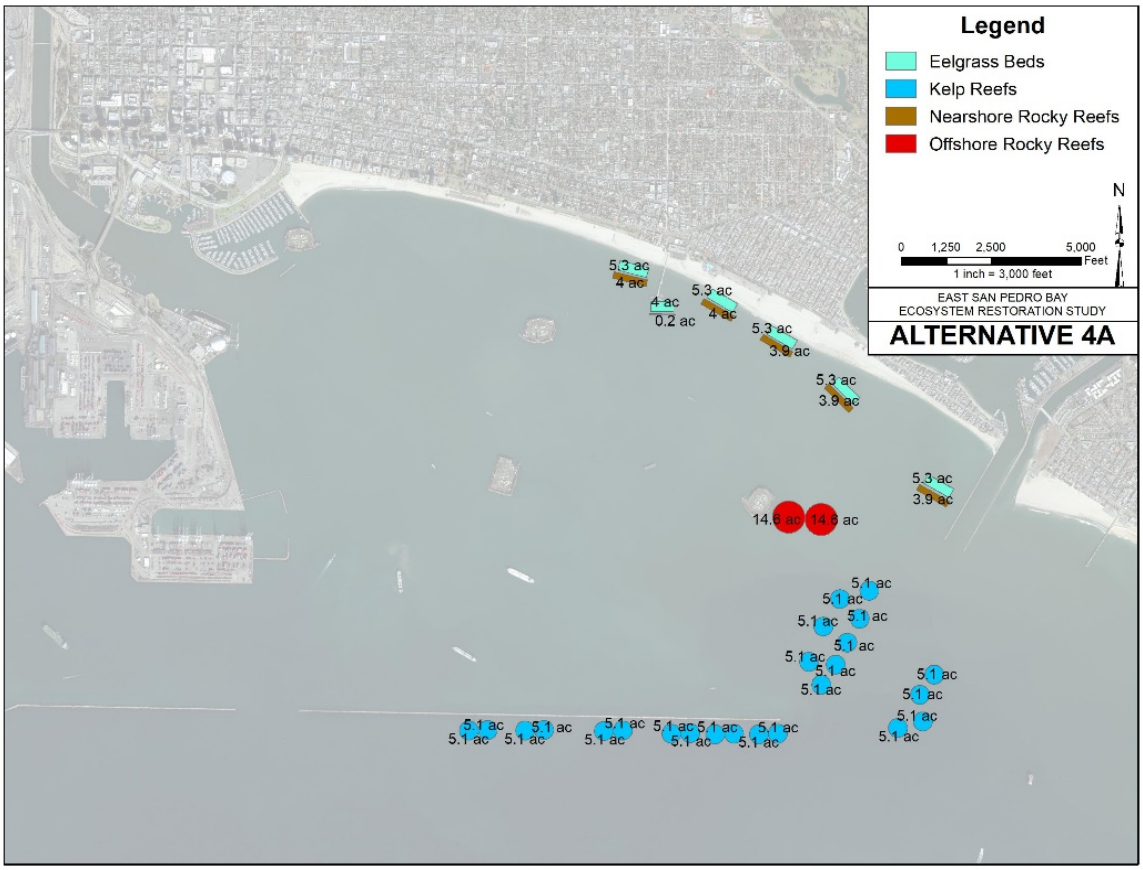


Figure 6-5 Alternative 4A Reef Restoration Plan

6.6.2.4 ALTERNATIVE 8 (BEST BUY PLAN 8) - SCARCE HABITAT RESTORATION PLAN

Alternative 8 restores, in addition to the features in Alternative 4A, aquatic habitat types which have been largely lost and degraded within the southern California bight including sandy islands, coastal wetlands, and oyster beds. This alternative places restoration features in all five zones within the bay, expanding the benefit area to include the entire project area. Much of California's coastal wetlands have been lost. The proposed 24-acre sandy island provided much needed habitat for threatened and endangered shorebirds which are subject to disturbance from people and predators. Two tidal salt marsh wetlands are proposed, totaling ~50 acres, providing transitional habitat to support aquatic species, amphibians (land and water), shorebirds, and terrestrial species. Proximity of the proposed wetlands to the existing Golden Shores wetland would facilitate exchange of species and support nursery function. Oyster beds provide important filtration as well as habitat value.

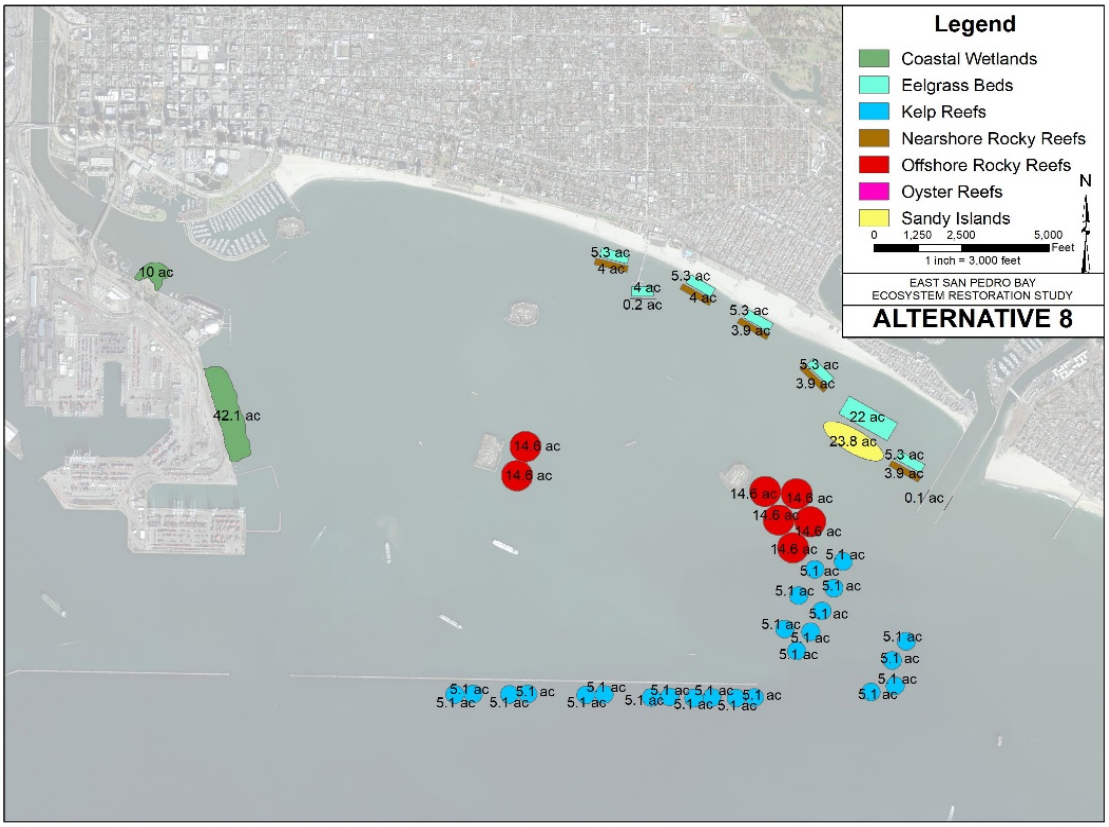

Legend
Coastal Wetlands
Eelgrass Beds
Kelp Reefs
Nearshore Rocky Reefs
Offshore Rocky Reefs
Oyster Reefs
Sandy Islands
N
0 1,250 2,500 5,000 Feet
1 inch = 3,000 feet
EAST SAN PEDRO BAY
ECOSYSTEM RESTORATION STUDY
ALTERNATIVE 8
10 ac
42.1 ac
14.6 ac
14.6 ac
5.3 ac
4 ac
4 ac
0.2 ac
5.3 ac
4 ac
5.3 ac
3.9 ac
5.3 ac
3.9 ac
22 ac
23.8 ac
5.3 ac
3.9 ac
0.1 ac
14.6 ac
14.6 ac
14.6 ac
14.6 ac
14.6 ac
14.6 ac
5.1 ac
5.1 ac
5.1

Table 6-8: Final Array Plan Summary

FINAL ARRAY PLAN SUMMARY			
	Alternative 2	**Alternative 4A**	**Alternative 8**
First Cost	$83,587,000	$140,908,000	$560,681,000
OMRR&R	$207,000	$251,000	$5,853,000
Average Annual Cost	$3,407,000	$5,689,000	$27,892,000
AAHUs	125.4	160.9	307.3
AAC/AAHU	$27,200	$35,400	$90,800
Zones with Restoration	3	3	5
Restored Acres	162	201	372
First Cost/Restored Acre	$516,000	$701,000	$1,507,000

As shown on Table 6-8, there is a substantial range of both cost and output for the Final Array plans. While Alternative 8 provides significantly greater output, as measured by AAHUs, restored acres, and zones with restoration, this plan also has a much higher cost than the other Final Array plans.

6.7 ADDITIONAL PLANS (BW1 AND BW2) CONSIDERED

Two other plans were considered and evaluated which featured modifications to the breakwater. These plans were not Best Buy Plans, but were plans of interest to the non-Federal Sponsor and other stakeholders. For more detail with regard to why the breakwater plans were added to the preliminary array of plans, see Section 4.4.4: Addition of Local (Breakwater) Plans of Chapter 4. Section 4.5.5 and 4.5.6 discuss in detail the cross-section layout of both alternatives, discusses cost and quantities of material needed to construct, along with illustrations of two alternatives with each breakwater measure added. A brief description of these plans follows.

6.7.1 BW1 BREAKWATER WESTERN NOTCHING PLAN + BEST BUY PLAN 2 (MODIFIED)

The Breakwater Western Notching Plan (Alternative BW1) includes all of the ecosystem restoration measures specified for Alternative 2 along with the following additional measures:

6.7.1.1 BREAKWATER MODIFICATION

Under this plan, two 1,000 foot notches on the western portion of the existing Long Beach Breakwater would be created. Stones removed from the breakwater would be reused to build protective structures around the Oil Islands, Pier J structures, and the parking lot near Junipero Beach. Stones would be removed by crane, cleaned, and transported by barge to serve as protective measures for the oil islands. The remaining sand and clay core material would remain in place to be naturally transported or dredged and utilized as fill material.

6.7.1.2 PROTECTIVE MEASURES

Under this alternative, protective measures would be needed to protect existing infrastructure from increased wave energy. These would require increasing the amount of protection (armoring) of the existing oil islands. This would be accomplished by placing a second layer of larger stone along the existing slopes of the oil islands. A cast-in place concrete parapet wall would also be added on top of the revetment. A small emergent breakwater would be created to protect Belmont Pier from increased wave

energy. Protective measures would be built at Pier J and the parking lot near Junipero Beach as described above.

Slight modifications from Alternative 2 would be necessary for this and the other breakwater plan. These include a shifted rocky reef shoal/eelgrass bed to provide coverage for Peninsula Beach, and kelp beds being split apart to allow for boat passage out of Alamitos Bay.

6.7.2 BW2 BREAKWATER EASTERN REMOVAL PLAN + BEST BUY PLAN 2 (MODIFIED)

The Breakwater Eastern Removal Plan (Alternative BW2) includes all of the ecosystem restoration measures specified for Alternative 2 along with the following additional measures:

6.7.2.1 BREAKWATER MODIFICATION

Under this Breakwater Plan, approximately 1/3 (approximately 24-acres) of the existing Long Beach Breakwater would be removed. Stones removed from the breakwater would be reused to build protective structures around the Oil Islands and Belmont Pier only. Armoring methods for these features would be as described for the Alternative BW1.

6.7.2.2 PROTECTIVE MEASURES

Under this alternative, protective measures would be needed to reduce impacts to existing infrastructure and shoreline development from increased wave energy and coastal flooding. These would require increasing the amount of protection (armoring) of the existing oil islands and the creation of a small emergent breakwater to protect Belmont Pier. Additionally, the nearshore reefs would need to be constructed to a higher elevation to achieve a similar level of protection as the existing Long Beach Breakwater to the shorefront structures and limit excessive shoreline erosion along East Beach.

The same modifications described above for the Western Notching Plan are applied to the Eastern Removal Plan.

The following table summarizes the cost and output for the two breakwater modification plans.

Table 6-9: Breakwater Plans Summary

	Breakwater Plan (1/3rd)	**Breakwater Plan (Notch)**
First Cost	$670,240,000	$993,650,000
OMRR&R	$1,148,430	$1,691,780
Average Annual Cost	$26,956,600	$39,289,100
AAAHUs	133.5	133.5
AAC/AAHU	$201,922	$294,300
Zones with Restoration	3	3

6.7.2.3 REASONS FOR EXCLUDING THE BREAKWATER PLANS FROM THE FINAL ARRAY

Both breakwater modification plans were considered and evaluated along with the Best Buy Plans. However, they were not selected for inclusion in the final array due to three primary reasons: 1) the negative operational impacts to navigation and national security, 2) the very high costs of implementing any of the breakwater alternatives, and 3) the lack of ecosystem restoration benefits.

Navigation Impacts

Impacts to the Port of Long Beach, the Navy and other navigational interests resulting from the Breakwater Western Notching Plan and Breakwater Eastern Removal Plan were analyzed through evaluation of coastal modeling results of increased waves within ESPB resulting from the plans and feedback received on the plans which indicates significant negative impacts attributable to the increase in wave heights and frequencies within ESPB.

Response to City Questionnaire

The City requested feedback on the plans via a questionnaire. The respondents were a mix of individuals related to the port, including an international transportation service company, many Port ship pilots, and the general public. Of the responses, a majority responded negatively to any modification of the breakwater. The feedback for the breakwater plans included the following concerns:

- Increased Transportation Costs – Need to change itineraries, need to wait for safe transit conditions, including during potential shut down of operations for portions of the Port. Demurrage charges to shippers for delays.
- Potential need to relocate Carnival Cruise Lines operations.
- Potential damage to vessels, e.g., vessels breaking from moorings.
- Potential damages to berths, cranes, marinas, oil islands, coastal flooding.
- Inability to bunker and service vessels, including crew changes, supply deliveries, etc. Potential releases of petroleum during bunkering due to unsafe wave conditions.
- Safety – potential line breaks, wave action impacts to crane operators and dock workers resulting in potential injury or death.
- Regional Economic Development impacts – Loss in revenues, jobs, negatively impacting the Port and Long Beach city economy.

In addition to the survey responses above, more specific feedback was received on potential impacts on Navy and the THUMS Energy Island operations.

Impacts to Navy Operations

The Navy operates explosives anchorage used for transfer of ammunition inside the breakwater – these operations are required for Navy contingency operations in support of the National Defense Strategy. Because of its purpose as a strategic contingency asset, the anchorage must be available for use on short notice at any given time. The breakwater provides a protected bay environment consistent with the operating criteria to facilitate safe and efficient ordnance and fuel transfer operations. Feedback from the Navy indicates:

- Any modifications to the breakwater resulting in an increase to wave energy will impact the Navy's ability to safely perform ordnance and fuel transfer operations.
- Any modifications to the breakwater would result in an increase in dynamic vessel motion, a decrease in safety for Navy personnel conducting the operations, and would hinder the ability to perform ordnance and fuel transfer operations year-round.
- Proposed modifications to the breakwater exhibit a high probability of impacting the National Defense Strategy.
- Relocation of Navy operations to alternative sites would be cost prohibitive and unlikely to be supported due to public opposition.

Impacts to THUMS Energy Island Operations

Feedback on the THUMS Energy Island operations indicates that their operation costs could increase between $12 million to $48 million per year with implementation of the breakwater modification alternatives. In addition, all crew boats, barges, and tugs would have an increased safety risk due to larger swells resulting from any removal of the breakwater. This increased risk to personnel, equipment, and the environment may require the acquisition of new vessels to mitigate this impact. New vessel costs are not included in the cost estimate.

<u>Reasonableness of Cost for Breakwater Modification Plans</u>

In addition to the negative navigation and national security impacts associated with the breakwater modification plans, these plans are also very costly relative to the Best Buy Plans. The cost of the breakwater western notching plan is nearly $1 billion or 1.77 greater than Best Buy Plan 9 (the largest Best Buy plan included in the Final Array) and over 12 times greater than Best Buy Plan 2 (the smallest scale Best Buy Plan after the no action plan). The cost of the Breakwater Eastern Removal Plan is nearly $659 million, which is nearly $105 million greater than Best Buy Plan 9, despite providing significantly lower ecosystem restoration output.

<u>Lack of Ecosystem Restoration Outputs</u>

Despite the significant costs associated with the breakwater modification measures, the habitat modeling results did not indicate that these measures provide any ecosystem restoration benefits. Hence, these plans add considerable costs, while not providing any restoration benefits. Because of this, these plans are extremely inefficient.

While plans that include breakwater modifications may provide some recreation benefits for some types of recreation, e.g., surfing, they provide some offsetting negative impacts to recreation for other recreation users that do not prefer increased waves, such as recreational boating and paddle boarding.

<u>SUMMARY</u>

Because the two plans featuring modification to the breakwater have a very high cost, do not generate ecosystem restoration benefits, have significant impacts to navigation, and result in impacts to national security, these plans were not carried forward into the Final Array.

6.8 COMPARISON OF FINAL ARRAY ALTERNATIVES

The three Final Array of Alternatives were compared against each other using the four screening criteria as well as national significance criteria (as outlined in detail in the Main Report). Each of the alternatives were color coded from low to high. The deeper shade indicated strongest overall performance of that plan and lighter shades indicated weakest performance of that plan, with respect to the restoration objectives. With the inclusion of two coastal wetlands and a sandy island, Alternative 8 had more cells of deeper shaded green than the other plans. However, Alternative 4A also had a number of deeply shaded cells, just below and at a much lower cost than Alternative 8.

Table 6-10: Alternatives Evaluation

	ALT 2	ALT 4A	ALT 8
COMPLETENESS			
EFFECTIVENESS			
Sub-Obj. 1 – increase habitat total area			
Sub-Obj. 2 – increase habitat diversity & spatial distribution			
Sub-Obj. 3 – increase habitat connectivity with project area			
Least Adverse Impacts to Natural Resources			
Technical Recognition: Biodiversity			
Technical Recognition: Status & Trends			
Technical Recognition: Scarcity/ Rarity			
Technical Recognition: Connectivity			
Technical Recognition: Hydrologic/Geomorphic			
Technical Recognition: Special Status Species			
Institutional and Public Recognition			
EFFICIENCY			
Is the plan a Best Buy Plan?			
Incremental AAC/AAHU			
To what extent are the benefits worth the cost, given the output?			
ACCEPTABILITY			
To what extent is the PLAN acceptable to the Sponsor?			
To what extent is the PLAN acceptable to resource agencies?			
To what extent is the PLAN acceptable to maritime interests?			

6.8.1 EFFECTIVENESS

The plans were evaluated with their effectiveness to meet the overall study objective to restore ecosystem structure and function for increased biodiversity and ecosystem value in the bay, as well as against the sub-objectives noted in Table 8 above. Additionally, the plans were evaluated against the national significance criteria to determine total effectiveness scores. Plan 2 and Plan 4A received similar scores but with Plan 4A receiving higher scores due to the jump in acres restored, increased connectivity

and inclusion of high value habitats. Plan 8 saw a significant increased score over Plan 4A due to the inclusion of two additional scarce habitat types of coastal wetlands and a sandy island, as well as the largest restoration acreage.

6.8.2 EFFICIENCY

Efficiency refers to the extent to which a Plan is the most cost effective means of achieving the objectives. The following table summarizes benefits and costs for the Final Array of Alternatives. Alternatives 2 and 4A have relatively lower construction and O&M costs than Alternative 8. Alternative 8 has about twice the output as Alternative 4A, but at nearly four times the construction cost. Alternative 2 is the most efficient of the Final Array alternatives, as shown by its low AAC/AAHU. However, Alternative 4A has only a slightly higher incremental AAC/AAHU while providing substantially greater output. Alternative 8, while providing a significant increase in output, is much less efficient than Alternatives 2 and 4A.

Table 6-11: Final Array and Plans Summary

FINAL ARRAY PLAN SUMMARY			
	Alternative 2	**Alternative 4A**	**Alternative 8**
First Cost	$83,587,000	$140,908,000	$560,681,000
OMRR&R	$207,000	$251,000	$5,853,000
Average Annual Cost	$3,407,000	$5,689,000	$27,892,000
AAHUs	125.4	160.9	307.3
AAC/AAHU	$27,200	$35,400	$90,800
Zones with Restoration	3	3	5
Restored Acres	162	201	372
First Cost/Restored Acre	$516,000	$701,000	$1,507,000

6.8.3 ACCEPTABILITY

All three plans address applicable laws, regulations and public policies and provide stakeholder satisfaction in terms of restoration results. Some stakeholders may not be as supportive of the three restoration plans so they did not score 3's. Resource agencies, ocean protection stakeholders and the science community may prefer the Scarce Habitat Restoration Plan over the others for the additional habitat types it proposes to restore.

6.9 IMPACTS TO RECREATION

The study efforts also included an analysis of incidental recreation impacts of alternatives. It was conducted to assure all impacts are considered when making a plan selection. The goal is to select an ecosystem restoration plan maximizes ecosystem restoration benefits relative to costs and also considers impacts to other resources, such as recreation. Note that some measures may provide positive impacts to some types of recreation and negative impacts on others depending on the activity desires at the bay.

Alternative 2 is expected to have mixed impacts to recreation. With the construction of the nearshore rocky reef shoals, impacts are expected to be mixed for near beach water activities such as swimming and wading because some individuals prefer calm waters while other prefer more waves. Surfing is limited to nonexistent in the project area and therefore it is not anticipated that there would be adverse impacts to surfing from proposed rocky reef shoals that would reduce waves in the project area. Since windsurfing

activities are focused outside of the nearshore area between the shoreline and the proposed shoals, it is not expected that there would be any noticeable impacts from the shoals to this recreation activity. The scattered rock measures in the open water zone and breakwater zone, as well as kelp forest, are anticipated to result in some noticeable impacts to boaters, depending on the size and type of vessel. The presence of the kelp forest and rocky reef would be anticipated to require boaters to avoid such features. Speed reduction may also be employed to avoid conflicts with the restoration features, and aids to navigation may be established. Motor and sail boats with a deeper keel would be anticipated to have to avoid the features more than those boats with greater under keel clearance. Sail boats may also have to exercise greater care navigating around the kelp beds especially if they are not equipped with a motor. Boaters may also have to reduce speeds in the vicinity of these project features. The kelp beds and rocky reefs will limit the paths for vessels in and out of ESPB and in and out of Alamitos Bay, and aids to navigation may be established. While the features can be anticipated to result in some changes to specific navigation routes by individual craft, the general availability or quality of boating within ESPB is not anticipated to be reduced. Note that the kelp beds features are anticipated to be refined to allow for easier passage of boats in and out of Alamitos Bay.

Alternative 4A is expected to result in a minor increase in negative recreation impacts. The plan adds one rocky reef shoal on the east side in the nearshore zone plus 2 rocky reef complexes near Island A in the open water zone. The added rocky reef complexes are expected to result in some minor negative impacts to boating over Alternative 2.

Alternative 8 includes features in all of the opportunity zones. Relative to Alternative 4A, this alternative adds five additional rocky reef shoals in the open water zone, oyster reefs and a large emergent island in the nearshore zone, and tidal wetlands in the LA River and port zones. The large emergent island is expected to have positive impacts for beach activities and paddleboarding. The tidal wetlands may also potentially negatively impact boating.

Overall the impacts to recreation are mixed depending on the activity desired at the bay. Alternatives 2 and 4A have generally minor negative impacts to recreation—some negative impacts are reflected in the nearshore water activities and more so for and boating activities. For Alternative 8, the plans have mixed positive impacts for beach and boardwalk activities and paddle boarding and negative impacts to near beach water activities and more negative impacts for boating. As noted, the lack of surfing activity in the project area under without project conditions limits the potential impacts to this activity from proposed project features.

7 TENTATIVELY SELECTED PLAN (TSP)

After evaluation of the three (3) Final Array of Alternatives, the National Ecosystem Restoration (NER) Plan was chosen using criteria of completeness, effectiveness, efficiency and acceptability. This section describes the rationale for selecting the NER Plan as the Tentatively Selected Plan (TSP). Based on the comparison of plans in light of this context, Alternative 4A, also known as the "Reef Restoration Plan," was selected as the NER plan.

7.1 NATIONAL ECOSYSTEM RESTORATION (NER) PLAN SELECTION

Alternative 4A meets ecosystem restoration objectives as well as planning objectives and reasonably maximizes environmental benefits while passing tests of cost effectiveness and incremental cost analyses. Alternative 4A provides connectivity for productive habitats including open water rocky reef, intertidal zone rocky reef, eelgrass and open water kelp. These habitats have been reduced, fragmented, or eliminated by urbanization of coastal watersheds, development of ports and Federal infrastructure projects such as the three breakwaters. Alternative 4A provides limiting habitat or habitat for key life stages for (which species or for robust and diverse populations of fish, aquatic species) by providing foraging and especially critical nursery functions, supporting population health and growth. Provides sustainable resilience and redundancy to withstand stressors and occasional habitat loss events.

Alternative 2 has habitat types in three (3) zones of the project area whereas Alternative 4A adds approximately 30 acres of hard substrate for establishment of another habitat type (deep open water rocky reef) compared to Alternative 2. The increase in cost for Alternative 4A ($141 million vs. $84 million) relative to Alternative 2, is reasonable, especially with the modification to Best Buy Plan 4 to introduce a smaller scale of the open water rocky reef measure. Further, Alternative 4A is similar in terms of efficiency to Alternative 2 while providing substantially greater output (28% increase in AAHUs). Given these factors, the incremental cost of Alternative 4A is considered "worth it", in terms of maximizing net ecosystem restoration benefits.

Alternative 8 clearly provided the greatest habitat restoration output of the three Final Array Plans, but it did so at a very high incremental cost when compared to Alternatives 2 and 4A (with a total first cost in excess of $561 million). The costs associated with additional rocky reef patches are high due to time-consuming construction methodology required. While the benefits are substantial, the PDT determined that Alternative 8 would not reasonably maximize beneficial effects compared to costs.

7.2 TSP IMPACTS TO RECREATION

See Section 6.9 for an overview of potential impacts to recreation from proposed measures and alternatives. These are described in detail in Addendum A.

Overall, recreation values are projected to decrease slightly when compared to the without project condition. This is primarily because the losses to recreation experience are counterbalanced by expected improvements to environmental quality associated with the TSP ecosystem restoration features.

7.3 OTHER SOCIAL EFFECTS

Other impacts resulting from the TSP can be categorized by Other Social Effects (OSE) dimensions of interest. They are summarized as follows.

- Public health is a concern within the Project Area. Approximately 25% or more in the Project Area are considered obese and this percentage is on the rise. However, there is also a significant population that is healthy and active. The TSP may result in an increase in recreation visitation for some users (e.g., those who prefer more calm waters), which could encourage individuals who are less active to become more active in these recreational areas. However, the TSP will likely result in a decline in recreation visitation for other users (e.g., others who prefer more waves).

- Economic justice is at a moderate level of concern. Many social groups are represented in the city and surrounding areas. Many of these groups appear to be fairly represented. But, it is possible that there could be impacts to social justice associated with the TSP. The TSP would restore key areas along the coast line. This may benefit homeowners with real estate price appreciation but could negatively impact home renters who could face higher rents. These impacts may disproportionately impact minorities or other disadvantaged groups. However, these impacts, if realized, are anticipated to be small.

- Economic vitality is strong within the Los Angeles County area. Many economic sectors are represented. The construction of the TSP would result in expenditures of money in the region and support jobs within the County. These direct expenditures within the area have a multiplicative effect associated with indirect and induced expenditures, further enhancing economic activity in the region.

- Community Cohesion and Identity/wellbeing are also a moderate level concern. The sense of community is moderately facilitated by the many existing recreational facilities within the Project Area. The many existing recreational activities available at the bay encourage youths, adults, and seniors to recreate there. These recreational facilities to support these activities may even help to reduce crime. The TSP could impact community cohesion and identity by a small amount. There are likely mixed impacts in terms of beach and near-beach based recreation, so the overall impact associated with beach recreation on these OSE factors is not anticipated to be significant. As noted, the enhanced environmental setting could impact property values, but the affect is likely small. For more detail on the Other Social Effects please refer to Addendum B of this report entitled East San Pedro Bay Ecosystem Restoration - Other Social Effects.

Table 7-1: Dimensions of Interest Summary

Category	Current Level within Project Area Without Project Condition	The Beneficial or Negative Effects from the TSP
Public Health	Moderate	Small Positive or No change
Environmental Justice	Moderate	Very Small Negative or No change
Economic Vitality	Moderate	Small to Moderate Positive
Community Cohesion	Moderate	Small Positive
Identity/Wellbeing	Moderate	Small Positive

7.4 REGIONAL ECONOMIC DEVELOPMENT IMPACTS

The implementation of the TSP is also expected to positively impact the regional economy. In terms of regional economic development (RED), based on the estimated direct impacts we can expect about 1,168 jobs to be created within the Los Angeles County, California region from construction of the TSP. These impacts are anticipated to occur over a span of about 6 years. Overall there would be an additional 2,017 jobs supported (direct, indirect, and induced) by the construction of the TSP, primarily in information, professional scientific and technical services, manufacturing, and finance insurance, real estate, rental, and leasing . Overall, the construction of the TSP is expected to lead to about $156 million in value added in goods and services to the region and increased labor income of over $112 million. For more detail on Regional Economic Development refer to Addendum C of this report entitled East San Pedro Bay Ecosystem Restoration - Regional Economic Development.

Table 7-2: RED Impacts from Best Buy Alt 4 (TSP)

		Regional	State	National
Total Spending		$136,478,700	136,476,700	136,476,700
Direct Impact	**Output**	126,768,565	135,434,336	135,930,551
	Jobs	1,168	1,380	1,394
	Labor Income	61,595,514	68,445,896	68,838,159
	Value Added	71,868,972	78,582,174	78,966,582
Total Impact	**Output**	267,707,914	299,402,470	392,104,302
	Jobs	2,017	2,367	2,939
	Labor Income	111,729,831	124,704,679	151,366,485
	Value Added	156,124,389	174,378,310	218,407,953

In addition to construction impacts, post-construction operation and maintenance (O&M) expenses will also increase output, jobs, labor income, and added value of the local economy annually (as shown below in Table 7-3). These increases are in addition to the increases displayed in Table 7-2.

Table 7-3: RED from Operations and Maintenance Expenditures (Annual) - TSP

		Regional	State	National
Total Spending		251,110	251,110	251,110
Direct Impact	**Output**	213,203	238,347	250,801
	Jobs	2	2	2
	Labor Income	150202	172,429	180,858
	Value Added	160462	184601	192,975
Total Impact	**Output**	458,895	530457	687,346
	Jobs	4	4	5
	Labor Income	238,359	273,527	325,379
	Value Added	312,702	362,064	443,976

7.5 COST SHARING

Alternative 4A Reef Restoration Plan has been identified as the NER plan. The non-Federal sponsor has indicated that they support the NER Plan as the Tentatively Selected Plan.

Table 7-4 summarizes the cost estimates broken down by federal and non-federal sponsor cost-shares. The total project first cost is approximately $141 million (which accounts for Lands & Damages costs of about $1.356 million). This cost includes cost contingency estimates based on an abbreviated cost risk analysis.

Table 7-4 – TSP Costs

Item	Federal Cost (65%)	Non-Federal Cost (35%)	Total Cost
Ecosystem Restoration			
LERRD - Lands & Damages	$35,000	$1,321,000	$1,356,000
Construction	$85,303,000		$85,303,000
Monitoring and Adaptive Management	$1,908,000		$1,908,000
Planning Engineering & Design (PED)	$7,419,000		$7,419,000
Construction Management (S&A)	$3,210,000		$3,210,000
Contingency	$41,712,000		$41,712,000
Non-Federal Cash Contribution	-$47,996,800	$47,996,800	$0
Subtotal	$91,590,200	$49,317,800	$140,908,000

8 SUMMARY OF RESULTS

1. Measures and alternatives were formulated to provide ecosystem restoration benefits within East San Pedro Bay. A cost effectiveness and incremental cost analysis was conducted to determine the most efficient plan combinations to support the identification of Final Array Plans and NER Plan.

2. The CEICA analysis of measures yielded 249 cost effective combinations and 11 Best Buy Plans including the No Action plan.

3. The total first cost of the Best Buy action plans range from $80 million to $710 million. Average Annual Costs range from $3.2 million to $39.7 million.

4. Average Annual Habitat Units range from 125.4 to 330.6.

5. Based upon the criteria of efficiency, reasonableness of cost, and the extent to which plans met planning objectives, three plans were carried forward to the Final Array. The three plans are Alternative 2 (Best Buy Plan 2), Alternative 4A (Cost Effective Plan 4A), and Alternative 8 (Best Buy Plan 8).

6. Alternative 2 has been identified as the Minimum Restoration Plan, Alternative 4A has been identified as the Reef Plan, and Alternative 8 is has been identified as the Scarce Habitat Plan. These plans range in cost from $83.6 million to $560.7 million. Average annual costs range from $3.4 million to $27.9 million, with AAHUs ranging from 125.4 to 307.3.

7. Breakwater modification measures and the Training Wall were not included in the CEICA, since the habitat model did not indicate these measures generate habit benefits. Adding a breakwater modification alternative will add significant costs without generating AAHU benefits. In addition these plans are expected to cause significant impacts to navigation and national security. Therefore, these plans were not carried forward into the Final Array.

8. Alternative 4A was identified as the NER Plan and TSP. This plan has a first cost of $141 million and generates 161 AAHUs. This plan is anticipated to have some impacts to recreation, including some minor impacts to beach and near beach water based activities and negative impacts to recreational boating. The TSP is anticipated to have substantial positive RED impacts associated with project construction and ongoing O&M expenditures. OSE impacts are generally expected to be minor.

9 ADDENDUM A: INCIDENTAL RECREATION IMPACTS

A detailed analysis of incidental recreation impacts was conducted for this study. It was completed in four parts. The first part discusses an inventory of recreation in the Project Area and estimated visitation. Part two ranks each of the study measures and their impact on recreation activities. The third part ranks each best buy plan and ranks their impact on recreation activities. Finally, the fourth part is an evaluation utilizing the Unit Day Value (UDV) Method. This method uses administratively determined dollar values for recreational categories. Recreation values will be compared without vs. with project to determine the net benefits (or costs) resulting from the recommended ecosystem restoration plan.

9.1 RECREATION SUPPLY AND DEMAND

Many recreation opportunities exist inland of the City of Long Beach. These are primarily parks and linear trail systems. But, when visitors travel beach-ward recreation activity is centered on the beach and in the open water. Within a couple of miles of the East San Pedro Bay there are also numerous parks and trail systems where individuals can walk, run, or bike either at a localized park or they can move linearly along a trail or boardwalk. Several trails exist along the Pacific Coast Highway and vicinity allowing for pedestrians to walk, run, or bike their way along the scenic beach. In addition, there are opportunities for individual water recreation activities such as sun bathing, swimming, gondolas tours, harbor tours, hydro bike activities, jet skis experiences, kayak rentals, and kite surfing adventures. Boat activities include sailing, charter fishing, and boating (owners with boats). Educational opportunities are also available. Individuals can learn a variety of boating skills and experience environmental and marine biology activities. Once a year City of Long Beach holds a summer sea festival with many activities held throughout the festival day.

The following paragraphs describe the supply of recreation facilities in the East San Pedro Bay vicinity. Also, provided, where possible, are background table depicting usage numbers. Some of the usage numbers are approximations, while others are more exact and were derived by counters, slips, registration fees, etc. Some of the visitation numbers are also for one or more years. This depends highly on the parks due to resources devoted to maintaining park visitation estimates.

9.1.1 PARKS

Within the City of Long Beach, there are 211 parks scattered throughout the city. Over half of them, 130 to be exact, are located south of the Pacific Coast Highway between the mouth of the Los Angeles River and the jetties allowing access to Alamitos Bay. The proximity of these parks to the Pacific Ocean and amenities complement the recreation needs of the City. Individuals living in the City can walk or bike from their homes along the numerous pathways to the beach, shopping, restaurants and more. These parks fall into 5 park types. They are: community parks (15), gardens (24), golf courses (3), multi-use (36), neighborhood parks (12), and state-owned parks (40).

Community Parks: Community parks average 35 acres in size and serve neighborhoods within range of one mile. Community parks serve a broader purpose than neighborhood parks, focusing on community recreation including sport fields and preserving unique landscapes and open spaces. Community parks permit all of the uses allowed in neighborhood parks plus swimming pools. Building coverage in community parks is limited to ten percent of the total park area.

Greenway Belts (includes gardens): Green belts are a largely undeveloped green space, often a remnant or odd shaped piece of land left over from development which can be used for casual recreation uses. They can be right of ways. Greenways can serve to connect or link recreation opportunities throughout a community. Building coverage in greenway parks is limited to one percent of the total park area.

Golf Courses: Golf courses range in size and have different facilities tailoring to the golfers. These parks serve the community within ½ hour drive time. Golf courses attract community park users plus user with specialized interest in golf. Building coverage can me up to 10 percent of the total park area.

Mini Park (includes Multi-use parks): Mini Parks are small parks serving neighbors within 1/8 mile, generally less than two acres in size, it may include: landscaping, irrigation, walking paths, seating areas and picnic tables, sandboxes/tot-lots, playground equipment, plan court, sculpture/art, drinking fountains and trash receptacles. Building coverage in mini parks is limited to one percent of the total park area.

Neighborhood Parks: Neighborhood parks average eight acres in size and serve neighbors within ¼ mile (high density areas) and ½ mile (low density areas), a neighborhood park permits all of the uses allowed in mini parks plus: restroom buildings, recreation fields, courts and rinks, water features, libraries, day care centers, community centers, and parking and drive aisles. Building coverage is neighborhood parks is limited to seven percent of the total park area.

State Parks: State parks are managed by the State of California and could be of minimum acreage. These parks serve the community within ½ hour drive time, a State park permits all of the uses allowed in community parks plus other desired features. Building coverage in a state park can be a majority of the total park area.

In total, the parks within this small region south of Pacific Coast Highway cover 583 acres of land that is set aside for recreation. Visitation numbers for these parks were not available.

Table 9-1: Community Parks

Community Parks	Park Location	Acres
Alamitos Heights	Vermont, Colorado, Orlena, Colorado Lagoon	1.1
Bixby	130 Cherry Ave (Ocean Blvd to 1st St)	3.84
Bixby	130 Cherry Ave (1st St To 2nd St)	4.03
Bixby	130 Cherry Ave (2nd St To Broadway)	2.02
Bixby	130 Cherry Ave (South of Ocean Blvd)	6.8
Cesar E. Chavez	401 Golden Ave (W 3rd St to W 6th St)	8.42
Cesar E. Chavez	401 Golden Ave (Ocean Blvd to Broadway)	3.01
Cesar E. Chavez	401 Golden Ave (Broadway to W 5th St)	6.18
Cesar E. Chavez	401 Golden Ave (Broadway to W 3rd St)	2.86
Cesar E. Chavez	401 Golden Ave (W 5th St to W 6th St)	1.95
Cesar E. Chavez	401 Golden Ave (Ocean Blvd to Broadway)	4.42
Recreation	4900 E 7th St	0.69
Recreation	4900 E 7th St	6.94
Recreation	4900 E 7th St	58.81
Robert Gumbiner	E 7th and Martin Luther King Jr. Ave	0.73
Total Acres		111.8

Table 9-2: Garden Parks

Garden Parks	Park Location	Acres
Bluff	E Ocean Blvd from 20th Pl to 36th Pl	13.2
Channel View	Palo Verde Ave (from Loynes Dr to E 7th St)	5.1
Daisy Ave	Daisy Ave(Pacific Coast Hwy to W 19th St)	0.54
Jack Nichol	E Pacific Coast Hwy and Los Cerritos Channel	3.5
Pacific Electric Right-of-Way	E 4th St and Park Ave to E 11th St and Loma Ave	2.3
Pacific Electric Right-of-Way	E 4th St and Park Ave to E 11th St and Loma Ave	0.95
Pacific Electric Right-of-Way	E 4th St and Park Ave to E 11th St and Loma Ave	3.64
Pacific Electric Right-of-Way	E 4th St and Park Ave to E 11th St and Loma Ave	1.4
Pacific Electric Right-of-Way	E 4th St and Park Ave to E 11th St and Loma Ave	2.64
Santa Cruz (Victory)	W Ocean Blvd (Golden Shore to World Trade Center)	0.34
Santa Cruz (Victory)	W Ocean Blvd (Magnolia Ave to Chestnut Pl)	0.2
Santa Cruz (Victory)	W Ocean Blvd (Golden Shore to World Trade Center)	0.35
Santa Cruz (Victory)	W Ocean Blvd (Chestnut Pl to Cedar Wk)	0.21
Santa Cruz (Victory)	W Ocean Blvd (West End to Cedar Wk)	0.3
Santa Cruz (Victory)	W Ocean Blvd (Magnolia Ave to Chestnut Pl)	0.21
Santa Cruz (Victory)	W Ocean Blvd (World Trade Center to Magnolia Ave)	0.29
Victory	W Ocean Blvd (Pacific Ave to Pine Ave)	0.5
Victory	E Ocean Blvd (Linden Ave to Shoreline Dr)	1.28
Victory	E Ocean Blvd (Hart Pl to Linden Ave)	0.66
Victory	W Ocean Blvd (Cedar Wk to Pacific Ave)	0.33
Victory	W Ocean Blvd (Cedar Wk to East End)	0.05
Victory	E Ocean Blvd (Hart Pl to Linden Ave)	0.29
Victory	E Ocean Blvd (Locust Ave to Collins Way)	0.38
Victory	E Ocean Blvd (Pine Ave to Locust Ave S)	0.65
Total Acres		39.31

Table 9-3: Golf Courses

Golf Courses	Park Location	Acres
Recreation 9 Hole Golf Course	5000 E 7th St (North of 6th St)	25.22
Recreation 9 Hole Golf Course	5000 E 7th St (South of 6th St)	14.68
Recreation Park Golf Course	5000 E Anaheim St	120.35
Total Acres		160.25

Table 9-4: Mini Parks

Mini Parks	Park Location	Acres
Alamito at 72nd	72nd Pl and E Ocean Blvd	0.3
Bayshore Playground	5415 E Ocean Blvd	1.2
Bouton Creek	Atherton St From Litchfield Ave to Tulane Ave	0.38
Bouton Creek	Atherton St and Litchfield Ave	0.05
Bouton Creek	Atherton St From Elmfield Ave to Litchfield Ave	0.36
Carroll	Carroll Park Street Island N/E	0.12
Carroll	Carroll Park Street Island S/E	0.03
Carroll	Carroll Park Street Island S/W	0.32
Carroll	Carroll Park Street Island N/W	0.21
Craftsman Village Park	851 Orange Ave	0.34
East Village Arts	150 Elm Ave	0.1
Fourteenth Street	W 14TH St (Chestnut Ave to Cedar Ave)	0.43
Fourteenth Street	E 14TH ST (Pine Ave to Locust Ave)	0.39
Fourteenth Street	E 14TH ST (Locust Ave to Palmer Ct)	0.39
Fourteenth Street	W 14TH ST (Cedar Ave to Pacific Ave)	0.34
Harvey Milk Promenade	The Promenade North of 3rd St	0.2
Livingston Drive	Livingston Dr and Park Ave (Argonne to the Toledo)	0.33
Livingston Drive	Livingston Dr and Park Ave (Park to St Joseph)	0.54
Livingston Drive	Livingston Dr and Park Ave (Roycroft to Park)	0.39
Livingston Drive	Livingston Dr and Park Ave (St Joseph to Argonne)	0.52
Lookout	End of Appian Way on Naples Island	0.16
Los Altos Plaza	Anaheim Rd and Los Altos Plz	0.71
Maurice 'Mossy' Kent	Alamitos Bay Marina at Fuel Dock Rd	0.1
Miracle on 4th Street	1518 E 4th St	0.14
Overlook	Naples Plaza at Corso Di Napoli	0.36
Peace	E 14th St and Atlantic Ave (1411 Atlantic Ave)	0.4
Plaza Zaferia	E Pacific Coast Hwy and Redondo Ave	0.8
Rosa Parks	E 15th St and Alamitos Ave (E 16th to Barcelona)	0.08
Rosa Parks	E 15th St and Alamitos Ave (E 15th to 16th)	0.01
Rosa Parks	E 15th St and Alamitos Ave (North of Barcelona Pl)	0.27
Rose	Orizaba Ave and E 8th St	0.7
Rotary Centennial	E Pacific Coast Hwy and Junipero Ave	1.2
The Colonnade	The Colonnade and Naples Canal	0.22
Treasure Island	Florence Wk and Treasure Island Ln	0.1
Will Rogers	Appian Way and Nieto Ave	0.5
Will Rogers	Appian Way and Nieto Ave	1.2
Total Acres		13.89

Table 9-5: Neighborhood Parks

Neighborhood Parks	Park Location	Acres
College Estates	808 Stevely Ave	2.3
Drake	951 Maine Ave	6.6
Ernest S McBride, Sr, Community Center	1550 Martin Luther King Jr Ave	2.5
Macarthur	1325 E Anaheim St	3.9
Marina Vista	5355 Eliot St	17.72
Orizaba	E 14th and Orizaba Ave	0.01
Orizaba	Orizaba Ave and Spaulding St (1435 Orizaba Ave)	3.72
Orizaba	Orizaba Ave and Spaulding St (1435 Orizaba Ave)	1.19
Seaside	Chestnut Ave and W 14th St	2.5
Trolley	Redondo Ave and 2nd St	0.13
Whaley	5620 Atherton St	8.92
Whaley	5620 Atherton St	4.55
Park Acres		54.04

Table 9-6: State Parks

State Parks	Park Location	Acres
Belmont Pier and Plaza	35 39th Pl	1.82
Belmont Pool Complex	4000 Olympic Plaza	4.6
Chavez Wetlands	Long Beach Fwy and Los Angeles River	1.58
Chavez Wetlands	Long Beach Fwy and Los Angeles River	8.26
Colorado Lagoon	5119 E Colorado St	29
Davies Launch Ramp	6201 2nd St	6.07
Downtown Dog Park	Pacific Ave and Broadway (Part of Lincoln Park)	0.55
Downtown Marina Mole	450 E Shoreline Dr to 600 E Shoreline Dr	9.3
Golden Shore Marine Reserve	Golden Shore Ave and Los Angeles River	9.19
Golden Shore Rv	101 Golden Shore Ave	5.17
Harry Bridges Memorial Park at the Queen Mary	1126 Queens Hwy	4.1
Jack Dunster Marine Reserve	Boathouse Ln (By Archer Rowing Center)	2.7
K-9 Corner Dog Park	Pacific Ave and W 9th St (906 Pacific Ave)	0.08
La Bella Fontana di Napoli	Ravenna Dr and Corinthian Wk	0.4
Leeway Sailing Center	5437 E Ocean Blvd	0.7
Lincoln	Pacific Ave and Broadway	5.6
Loma Vista	Loma Vista Dr and Daisy Ave	0.14
Long Beach Aquarium of the Pacific	Aquarium Way at Rainbow Harbor	0.14
Long Beach Aquarium of the Pacific	Aquarium Way at Rainbow Harbor	4.88
Long Beach Aquarium of the Pacific	Aquarium Way at Rainbow Harbor	3.16
Long Beach Museum of Art	2300 E Ocean Blvd	1.87
Long Beach Senior Center	1150 E 4th St	1.25
Marina Green	386 E Shoreline Dr (Shoreline Village Dr to Linden	9.5
Marine Park (Mother's Beach)	5839 Appian Way	9.31
Marine Stadium	2ND St and Appian Way	1.3
Marine Stadium	2ND St and Appian Way	0.8
Marine Stadium	2ND St and Appian Way	0.48

State Parks	Park Location	Acres
Marine Stadium	2ND St and Appian Way	21.34
Michael K. Green Skate Park	W 14th St (Pacific Ave to Pine Ave)	0.43
Poly High Gateway	998 E Pacific Coast Hwy	0.24
Promenade Square	E 1st St and the Promenade North	0.57
Rainbow Harbor Esplanade	Pine Ave South of Shoreline Dr	7.2
Rainbow Lagoon	Pine Ave and E Shoreline Dr	12
Rancho Los Alamitos	6400 Bixby Hill Rd	7.5
Recreation Dog Park	5201 E 7th St (Part of Recreation Park)	2
Rosie's Dog Beach	E OCEAN BLVD (Roycroft Ave to Argonne Ave)	2.9
Shoreline Aquatic	Aquarium Way	12.3
Sims Pond	Loynes Dr and E Pacific Coast Hwy	5.98
South Shore Launch Ramp	590 Queensway Dr	6.48
Terrace Theater	300 E Ocean Blvd	2.6
Total Acres		203.49

9.1.2 ON SHORE AND NEAR BEACH WATER ACTIVITIES

In addition to the availability of parks in the area, there are also beaches within the East San Pedro Bay study limits. Individuals who recreate along the East San Pedro Bay beach area sun bathe, swim, paddle board, play volleyball, and walk, run and bike on the boardwalk behind the beach front. Unfortunately, the number of individuals recreating at these activities is difficult to count so daily, monthly or even yearly totals were unavailable. Lifeguard estimates vary considerably and there are not adequate estimates to serve as a basis for determining annual visitation. Therefore, visitation numbers for sun bathing, swimming, paddle board, walking, running and biking and pier visitors were estimated using a laser counter located at Belmont Pier just east of the beach area. The estimate assumes the Pier is a good proxy for activities in the vicinity of the Pier. This estimate becomes less accurate when approximating the entire beach area within Long Beach but no other estimates are available so the visitation is probably an underestimate. To eliminate double counting the estimates provided by the City of Long Beach Recreation Department were halved under the assumption that an individual who crosses the laser counter will come back the other way on their way home. Visitation estimates for the beach area on the other side of the Long Beach Jetties near Seal Beach was not estimated. Visitation there can be quite high.

Table 9-7: Belmont Pier Visitation

Pedestrian	2016
October	31,970
November	27,743
December	20,417
Total Pedestrian	80,130

Other onshore and near beach activities include the Long Beach Sea Festival during the California summer months from June to September on the Coast of Long Beach. Three key events that take place at the festival are the Annual Sand Castle Competition at Granada Beach, the Spring National Powerboat Racing Event at Marine Stadium and the Kids Fishing Rodeo on the Belmont Pier. There are also moonlight movies on the beach at Granada Beach.

Table 9-8: Sea Festival Visitation

Months	2012	2013	2014	2015	2016
June	0	0	0	11,000	7,200
July	42,300	19,500	45,932	26,900	20,700
August	25,050	39,150	30,700	68,700	44,600
September	8,800	22,800	0	0	0
Total	76,150	81,450	76,632	106,600	72,500

9.1.3 OPEN WATER ACTIVITIES

In addition to recreating at local parks and beaches, another primary recreation activity is boating. Boats included in this analysis are commercial and recreation boats, sail boats, and personal watercraft.

9.1.3.1 COMMERCIAL AND RECREATION BOATS AT RAINBOW HARBOR

The entirety of the Long Beach Marinas include Rainbow Harbor, Rainbow Marina, Shoreline Marina and Alamitos Bay Marina. They have 90 slips for commercial and 2,831 slips for recreation vessels. One Harbor has a 150 foot long dock inside the marina for day guests and 250 feet day moorings outside the entrance to the harbor. The Harbors attract individuals who would like to participate in sports fishing, whale watching, harbor cruises, dinner cruises, private charter boats, rental boats and personal water crafts. The harbors are also close to shopping, dining, and restaurants located at Shoreline Village and the Pike Outlet stores. The following two tables are the slip rates of boats at the Harbors from September 2016 to January 2017. On average the slip rates indicate 76 slips taken for commercial boats and 2,629 slips taken for recreational boats. Included in the commercial boat slip rate are about 15 commercial boat companies classified as bus, charter, and harbor cruise. To obtain visitation numbers for commercial boats, 76 boats were multiplied by 2 people per boat and then multiplied by 6 trips a year (1 trip every 2 months). Total yearly commercial boat visitation was estimated at 912. Recreation boat visitation was done in a similar way. An estimated number of 2,629 boats was multiplied by 2 people per boat and then multiplied by 6 trips per year (1 every 2 months). Total yearly recreational boat visitation was estimated at 31,548.

Table 9-9: Commercial Slip Rates

Category	Month	Year	Slips Taken	Total Slips	Occupancy
Commercial Boat Slips	September	2016	75	90	83%
Commercial Boat Slips	October	2016	75	90	83%
Commercial Boat Slips	November	2016	65	90	72%
Commercial Boat Slips	December	2016	83	90	92%
Commercial Boat Slips	January	2017	81	90	90%

Table 9-10: Recreational Slip Rates

Category	Month	Year	Slips Taken	Total Slips	Occupancy
Recreational Boat Slips	September	2016	2,520	2,732	92%
Recreational Boat Slips	October	2016	2,650	2,831	94%
Recreational Boat slips	November	2016	2,657	2,831	94%
Recreational Boat Slips	December	2016	2,661	2,831	94%
Recreational Boat Slops	January	2017	2,655	2,831	94%

9.1.3.2 SAIL BOATS

Boat ramps used primarily for sail boats are located at some of the harbors. The number of paid cars that entered the sail boat ramp parking lot is used as an estimate of the number of sail boats launched during the year. The following table lists the number of cars accessing boat ramps from 2007 to 2016. The yearly totals reflect a stable usage of around 38 thousand visitors by car each year. If there is on average 2 people per car, visitors recreating by sail boat doubles to 76 thousand visitors. Table 9-11 shows the adjusted number to reflect visitation and not the autos counted at launch ramp parking lots.

Table 9-11: Sail Boat Visitation near East San Pedro Bay

Months	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
January	5,440	1,702	3,890	2,808	3,472	3,116	2,276	3,858	4,294	3,218
February	1,744	2,354	2,600	2,654	2,256	2,826	1,826	2,788	5,750	1,774
March	4,470	4,404	3,986	4,080	2,222	2,852	4,786	4,802	5,958	7,582
April	5,030	5,016	4,836	4,808	3,900	3,520	4,312	3,896	4,648	5,192
May	6,660	5,366	5,326	4,516	4,856	5,000	4,628	3,794	10,690	2,788
June	9,162	8,522	7,530	10,466	6,928	8,800	6,822	8,342	9,940	13,810
July	13,652	13,554	13,894	13,298	13,384	9,508	11,898	9,720	13,332	5,220
August	10,568	8,824	11,422	12,496	13,132	15,118	12,606	16,400	5,770	22,028
September	8,598	9,390	10,466	11,212	9,188	13,702	8,272	9,882	18,882	9,492
October	3,828	5,912	6,842	3,920	3,926	4,946	5,772	7,946	7,330	7,698
November	5,630	2,900	3,822	3,826	3,252	2,208	3,720	2,664	2,352	1,520
December	2,734	3,046	3,308	1,708	2,782	3,698	4,082	1,848	5,882	6,438
Total	77,516	70,990	77,922	75,792	69,298	75,294	71,000	75,940	94,828	86,760

9.1.3.3 PERSONAL WATERCRAFT RENTALS

There are several personal watercraft rental facilities located in the East San Pedro Bay area. Some personal watercraft rentals specialize in gondola tours, hydro bike tours, jet skis, kayaks, and kite surfing. Any usage number for these facilities is very limited. Usage numbers are expected to be relatively low when compared to other categories of use.

9.1.4 SUMMARY OF VISITATION ESTIMATES

The visitation numbers provided previously were entered into the following table. If two or more years' worth of data by month were known, the average was taken and was used as a proxy for missing months during missing years. Table 9-12 shows the results of the estimated visitation for individuals recreating at the harbor and the beach within the East San Pedro Project Area. In total, there are nearly 300 thousand visitors to this area per year. This approximation does not include other recreation uses such as sailing lessons and other ecological classes offered at Leeway Center in close proximity to East San Pedro Bay. So, the estimate of 300 thousand visitors is a conservative one.

Table 9-12: Summary of Visitation

Category	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Pedestrian										
October	31,970	31,970	31,970	31,970	31,970	31,970	31,970	31,970	31,970	31,970
November	27,743	27,743	27,743	27,743	27,743	27,743	27,743	27,743	27,743	27,743
December	20,417	20,417	20,417	20,417	20,417	20,417	20,417	20,417	20,417	20,417
Pedestrian Total	80,130	80,130	80,130	80,130	80,130	80,130	80,130	80,130	80,130	80,130
Sailing										
January	5,440	1,702	3,890	2,808	3,472	3,116	2,276	3,858	4,294	3,218
February	1,744	2,354	2,600	2,654	2,256	2,826	1,826	2,788	5,750	1,774
March	4,470	4,404	3,986	4,080	2,222	2,852	4,786	4,802	5,958	7,582
April	5,030	5,016	4,836	4,808	3,900	3,520	4,312	3,896	4,648	5,192
May	6,660	5,366	5,326	4,516	4,856	5,000	4,628	3,794	10,690	2,788
June	9,162	8,522	7,530	10,466	6,928	8,800	6,822	8,342	9,940	13,810
July	13,652	13,554	13,894	13,298	13,384	9,508	11,898	9,720	13,332	5,220
August	10,568	8,824	11,422	12,496	13,132	15,118	12,606	16,400	5,770	22,028
September	8,598	9,390	10,466	11,212	9,188	13,702	8,272	9,882	18,882	9,492
October	3,828	5,912	6,842	3,920	3,926	4,946	5,772	7,946	7,330	7,698
November	5,630	2,900	3,822	3,826	3,252	2,208	3,720	2,664	2,352	1,520
December	2,734	3,046	3,308	1,708	2,782	3,698	4,082	1,848	5,882	6,438
Sailing Total	77,516	70,990	77,922	75,792	69,298	75,294	71,000	75,940	94,828	86,760
Summer Sea Festival										
June	9,100	9,100	9,100	9,100	9,100	9,100	9,100	9,100	11,000	7,200
July	31,066	31,066	31,066	31,066	31,066	42,300	19,500	45,932	26,900	20,700
August	41,640	41,640	41,640	41,640	41,640	25,050	39,150	30,700	68,700	44,600
September	15,800	15,800	15,800	15,800	15,800	8,800	22,800	15,800	15,800	15,800
Summer Sea Festival Total	No Data	No Data	No Data	No Data	No Data	85,250	90,550	101,532	122,400	88,300
Commercial Boats Total	912	912	912	912	912	912	912	912	912	912
Recreational Boats Total	31,548	31,548	31,548	31,548	31,548	31,548	31,548	31,548	31,548	31,548
Grand Total Harbor & Beaches	287,712	281,186	288,118	285,988	279,494	273,134	274,140	290,062	329,818	287,650
Grand Total Beaches	80,130	80,130	80,130	80,130	80,130	80,130	80,130	80,130	80,130	80,130
Grand Total Harbor	207,582	201,056	207,988	205,858	199,364	193,004	194,010	209,932	249,688	207,520

9.2 INTRODUCTION TO INCIDENTAL RECREATION IMPACT ANALYSIS

This incidental analysis is conducted to assure all impacts are considered when making a plan selection. The goal is to select an ecosystem restoration plan maximizes ecosystem restoration benefits relative to costs and also considers impacts to other resources, such as recreation. Note that some measures may provide positive impacts to some types of recreation and negative impacts on others.

9.3 INCIDENTAL RECREATION ANALYSIS PROCEDURE

Coastal Engineering staff developed wave height maps and tables that show the amount and location of changes in wave heights as a result of breakwater modifications. Some other measures also may have impacts to wave height. Potential changes in wave heights from management measures, as well as descriptions of proposed measures and the potential locations were provided participants of a survey. These participants were project delivery team members and a member of the Long Beach Recreation Department. They were asked to look at the tables with individual measures listed in the first column and beach activities in the successive columns. They were asked to rank each activity from -3 to 3 for various

activities, with a negative values indicating negative impacts to the recreation activity and positive values impacting positive impacts.

9.4 INCIDENTAL RECREATION ANALYSIS RESULTS

These results were entered into a spreadsheet and analyzed. First, a table was created ranking each of the activities by zone and by measure. In the far right column, averages across all activities were calculated. Then, the ranks were color-coded to designate which activity was impacted by what measure. Low positive impacts were colored light green. Higher positive impacts were colored green. Orange impacts designated low negative impacts and finally red denoted higher negative impacts. The greatest impacts were from breakwater modifications. Surfing and near beach water activities were positively impacted by breakwater modifications while paddle boarding and boating were negatively impacted by breakwater modifications. Even though there is very minimal if any surfing in the project area, surfing was evaluated as a criterion so that if measures that could result in increased wave action, such as breakwater modifications, were to be implemented, the team would also capture the potential impact of other measures if implemented in conjunction with such wave-action-increasing measures. Therefore ratings for rocky shoals and other measures reflect that potential combination. These impacts across activities tended to average from 0.0 to -1.3 primarily because many of the activities were not impacted at all and received a zero rating.

Table 9-13: Impacts to Beach Visitation

Measure	Zone	Beach/Boardwalk	Near Beach Water Activities (Swimming/ Wading, etc.)	Paddle Boarding (prefer calm)	Surfing	Boating	Average
Oyster Bed	**N**	0.0	0.0	0.0	0.0	0.0	0.0
Eelgrass	**N**	0.0	0.0	0.0	0.0	0.0	0.0
Sandy Rocky Shoals	**N**	0.0	-1.0	0.0	-1.0	-1.5	-1.3
Emergent Bird Islands	**N**	0.3	-1.0	1.0	-1.0	0.3	.36
Submerged Fish Reef	**O**	0.0	0.0	1.0	-1.0	0.5	-1.1
Oil Island Kelp Reef	**O**	0.0	0.0	0.0	0.0	-2.3	-0.5
Harbor Kelp Reef	**O**	0.0	0.0	0.0	0.0	-2.3	-0.5
Training Wall	**O**	0.0	0.0	0.0	0.0	-2.5	-0.5
Breakwater Kelp Reef	**B**	0.0	0.0	0.0	0.0	-1.3	-0.3
Notch Western Portion of BW	**B**	0.0	2.0	-2.0	2.0	-1.5	0.1
Remove 1/3 of BW	**B**	0.0	2.0	-2.0	2.0	-1.8	0.1
Lower BW	**B**	0.0	2.0	-3.0	3.0	-1.8	0.1

Measure	Zone	Beach/Boardwalk	Near Beach Water Activities (Swimming/ Wading, etc.)	Paddle Boarding (prefer calm)	Surfing	Boating	Average
Salt Water Marsh LA River	LA River Mouth	0.0	0.0	0.0	0.0	-1.0	-0.2
Salt Water Marsh Pier J	Port	0.0	0.0	0.0	0.0	0.0	0.0

The color-coded Table 9-14: Impacts to Best Buy Plans depicts the overall effects of each Best Buy Plan and breakwater alternatives on onshore, beach, and open water activities. A more detailed description follows:

Table 9-14: Impacts to Best Buy Plans

BB Plan	Beach/Boardwalk	Near Beach Water Activities (Swimming/ Wading, etc.)	Paddle Boarding (prefer calm)	Surfing	Boating
BB2					
BB3					
BB4					
BB5					
BB6					
BB7					
BB8					
BB9					
BB10					
BB11					
BW1: Western Notch BW					
BW2: Eastern Remove 1/3rd					

[1]Red indicates minor to substantial negative impacts to recreation, orange indicates mixed positive and negative impacts to recreation, and green indicates positive impacts to recreation.

Best Buy Plan 2 includes the Base Plan which has 5 rocky reef shoals on the east side of East San Pedro Bay along the Nearshore Zone and a kelp forest in the open water zone. The plan also includes scattered rock scale 4 in the Open Water zone and breakwater zones. With the construction of the nearshore rocky reef shoals, impacts are expected to be mixed for near beach water activities such as swimming and wading because some individuals prefer calm waters while other prefer more turbulent waters. Surfing is limited to nonexistent in the project area currently. Waves shoreward of the rocky reef shoals may be smaller or otherwise altered. Impacts would be minimal relative to without project conditions. The scattered rock measure in the open water zone and breakwater zone are expected to alter the patterns

of boating (speed, geographic distribution) in a minor way, moderately, or substantially depending on the size and type of vessel. The presence of the kelp forest and rocky reef would be anticipated to require boaters to avoid such features. Speed reduction may also be employed to avoid conflicts with the restoration features, and aids to navigation may be established. Motor and sail boats with a deeper keel would be anticipated to have to avoid the features more than those boats with greater under keel clearance. Sail boats may also have to exercise greater care navigating around the kelp beds especially if they are not equipped with a motor. Boaters may also have to reduce speeds in the vicinity of these project features. The kelp beds and rocky reefs will limit the paths for vessels in and out of ESPB and in and out of Alamitos Bay, and aids to navigation may be established. While the features can be anticipated to result in some changes to specific navigation routes by individual craft, the general availability or quality of boating within ESPB is not anticipated to be reduced. Note that the kelp beds features are anticipated to be refined to allow for easier passage of boats in and out of Alamitos Bay.

Best Buy Plan 3 includes all of the features in Best Buy Plan 2 and also the addition of rocky reef complexes in the open water zone. This addition of rocky reef complexes near two islands adds minor negative impacts for boating activities. Therefore, the color rating remains the same as for Best Buy Plan 2.

Best Buy Plan 4 includes all of the features in Best Buy Plan 3 and also the addition of 1 rocky reef shoal located on the east side of the Bay in the nearshore zone. This measure will minimally increase the negative impacts to nearshore beach activities, surfing and boating. Again, the increase of negative impacts is not expected to change the overall impacts significantly relative to the previous Best Buy Plan (orange for nearshore water activities and surfing and red for boating and a zero color rating for beach/boardwalk and paddle boarding).

Alternative 4A also is expected to have similar overall impacts as Best Buy Plan 4. The only difference is that Alternative 4A has fewer rocky reef complexes in the open water zone, and therefore has reduced impacts to boating relative to Best Buy Plan 4.

Best Buy Plan 5 includes all the features in Best Buy Plan 4 but also includes 2 medium oyster reefs on the west and east jetty in the Nearshore Zone. This plan is not expected to have a significant impact over Best Buy Plan 4; therefore, the color scheme remains the same.

Best Buy Plan 6 includes all the features in Best Buy Plan 5 but includes 1 large emergent island in the Nearshore Zone. The added measure is expected to have a positive impact for beach activities and paddle boarding but mixed impacts to nearshore water activities. Overall, the color scheme changes with the addition of green colors for the positive effect of this measure on beach/boardwalk and paddle boarding activities. Near beach activities and surfing still stay orange and boating still stays red.

Best Buy Plan 7 includes all the features in Best Buy Plan 6 but includes a small tidal wetland at the Los Angeles River mouth. This addition is expected to have a minor negative impact on boating. The color scheme is the same as Best Buy Plan 6.

Best Buy Plan 8 includes all the features in Best Buy Plan 7 but has an additional measure a large tidal wetland in the Port Zone. This measure is not expected to have a significant increase in negative impacts to boating over Best Buy Plan 7. Again the color scheme stays the same as for Best Buy Plan 7.

Best Buy Plan 9 includes all the features in Best Buy Plan 8. The added feature for this plan is 3 rocky reef shoals on the east side in the Nearshore Zone rather than 1 added in Best Buy Plans 4-8. The additional nearshore shoals will negatively impact surfing, boating, and near beach water activities.

Best Buy Plan 10 includes all the features in Best Buy Plan 9 but also includes a large-sized oyster reef at the Los Angeles River mouth. No significant impact over Best Buy plan 9 is expected.

Finally, Best Buy Plan 11 is the largest best buy plan and includes all the features in Best Buy Plan 10 but also includes a large emergent island in the Breakwater Zone. The measure is not expected to have a significant impact over Best Buy Plan 10.

Two more alternatives are included in this analysis: 1) Notch the Breakwater on the western side and 2) Remove 1/3 of the Breakwater. These breakwater alternatives that were formulated with local sponsor input.

Both breakwater alternatives are not expected to have a significant effect on the beach and boardwalk activities. However, near-beach water activities and surfing will have a positive effect while paddle boarding and boating will have negative effects.

Finally, the overall incidental impacts to recreation are measured for each Best Buy Plans again in color code. All of the proposed plans are assigned an orange rating, since they have mixed positive and negative impacts to various recreation activities. Best Buy Plans 2 through 5 have generally negative impacts to recreation—some negative impacts are reflected in the nearshore water based activities and more so in the boating activities. For Best Buy Plans 6 through 11, the plans have mixed positive impacts for beach and boardwalk activities and paddle boarding and negative impacts to near beach water activities and more significantly to boating. Both breakwater plans are also expected to have some positive effect on some recreational activities (near beach water activities and surfing), with negative impacts to some other activities, such as boating and paddle boarding.

Table 9-15: Overall Color Ranking

BB Plan	Overall Assessment
BB2	
BB3	
BB4	
Alt 4A	
BB5	
BB6	
BB7	
BB8	
BB9	
BB10	
BB11	
BW1 Western Notch BW	
BW2 Eastern Remove 1/3rd	

9.5 WITHOUT-PROJECT UDV METHOD

Several methods for assessing recreation values are outlined in the National Economic Development Procedures Manual for Recreation produced by IWR in March of 1986. They are the Unit Day Value Method, the Travel Cost Method, and the Contingent Valuation Method. The unit day value method uses administratively set values for how much a person is willing to pay for a day of recreating. The value is determined by providing cardinal values to a set of criteria. The sum of all the criteria produces a value that can be looked up in a table of set values to determine the unit day value. This value is then multiplied by visitation to determine the monetary recreation value. The second method, the travel cost method, uses the variable costs of travel as a proxy for price in determining the willingness to pay or the area under the demand curve while the third method, the contingent value method, estimates NED benefits based on designing and using hypothetical markets to identify the value of recreational amenities, just as actual markets would, if they existed. These three methods can be divided into categories. The Use Estimation Models which include the Travel Cost Method and the Contingent Valuation Method and Administratively Set Models such as the Unit Day Value Method. The methods within these two model categories have several advantages and disadvantages.

Table 9-16: Recreation Models

Consideration	Use Estimation Model	Administratively Set Model
Advantages	Statistically Sophisticated	Speed of Application
Disadvantages	Data Availability Time Requirements	Does not involve estimation of specific demand
Use	Visitation Numbers Must be High	Small Projects

Of these methods, the administratively set unit day value method is the most appropriate for the small-scale recreation projects and projects focused on non-recreation purposes such as flood risk management and ecosystem restoration and is a method most commonly applied. This methodology has been utilized to further assess and quantify the potential incidental impacts to recreation from the Tentatively Selected Plan (Alternative 4A).

To evaluate recreation using the UDV, a table of criteria and judgment factors are used. The criteria provided by the Unit Day Values of Recreation Guidance for FY 2018 is shown below.

Table 9-17: Points for Recreation

Criteria	Judgment Factors				
Recreation Experience	Two general activities 0-4	Several general activities 5-10	Several general activities on high-quality value activity 11-16	Several general activities more than on high quality high activity 17-23	Numerous high quality value activities some general activities 24-30
Availability of Opportunity	Several within 1 hr. travel time: a few within 30 min. travel time 0-3	Several within 1 hr. travel time: none within 30 min travel time 4-6	One or two within 1 hr. travel time none within 45 min. travel time 7-10	None within 1 hr. travel time 11-14	None within 2 hr. travel time 15-18
Carrying Capacity	Minimum Facility for development for public health and safety 0-2	Basic facility to conduct activity(ies) 3-5	Adequate facilities to conduct without deterioration of the resource of activity experience 6-8	Optimum facilities to conduct activity at site potential 9-11	Ultimate facilities to achieve intent of selected alternative 12-14
Accessibility	Limited access by any means to site or within site 0-3	Fair access, poor quality roads to sits; limited access within site 4-6	Fair access, fair road to site; fair access, good roads within site 7-10	Good access, good roads to site, fair access, good roads, within site 11-14	Good access, high standard road to site; good access within site 15-18
Environmental Quality	Low aesthetic factors that significantly lower quality 0-2	Average aesthetic quality; factors exist that lower quality to minor degree 3-6	Above average aesthetic quality; any limiting factors can be reasonably rectified 7-10	High aesthetic quality; no factors exist that lower quality 11-15	Outstanding aesthetic quality; no factors exist that lower quality 16-20

The East San Pedro Bay beach area rating results are listed below in Table 9-18. A rating of 32 points is equal to a UDV of $6.38 per visit. Applying this UDV to the estimated annual visitation results in a total recreation value of $511,000 dollars under the without project condition. This number was derived by multiplying the average visitation from year 2007 to 2016 in Table 9-12 for beach recreation (80,130) by the UDV of $6.38. For boating, the rating is 50 points and is equal to a UDV of $8.61 per visit. Therefore, the recreation value is approximately $1,787,000. This number was derived by multiplying the average boating visitation from year 2007 to 2016 in Table 9-18 (207,600) by the UDV of $8.61. For both areas, the combined without recreation value is about $2,298,000.

Table 9-18: Beach Unit Day Value Ratings - Without Project

Criteria	Description	Points
Recreational Experience	Several general beach activities are available at the beach. They are paddle boarding, swimming, walking, sunbathing, beach combing, etc.	7
Availability of Opportunity	Along the Long beach coastline there are several beaches within 1 hour travel time and a few within 30 minutes of travel time.	1
Carrying Capacity	There are adequate facilities to conduct recreation without any deterioration the resource or activity.	6
Accessibility	There is good access and good roads to the site. There is an entry point at almost every residential block.	11
Environmental Quality	There is an above average aesthetic.	7
Total		32

Table 9-19: Harbor Unit Day Value Ratings – Without Project

Criteria	Description	Points
Recreational Experience	There are numerous high valued boating activities that range for all boat types. Some general activities also exist.	16
Availability of Opportunity	Several opportunities exist within 1 hour travel time; there are none within 30 minutes travel time.	6
Carrying Capacity	There are adequate facilities to conduct recreation without deterioration of the resource or activity.	8
Accessibility	Good access and good roads exist to the site.	13
Environmental Quality	Average aesthetic quality factors exist that lower the quality to a minor degree.	7
Total		50

9.6 UDV EVALUATION FOR THE TENTATIVELY SELECTED PLAN

Based upon an evaluation of recreation resources for ESPB beaches, a with-project rating for the TSP for beach based recreation of 32 points was estimated, which corresponds with UDV dollar value of $6.38 per visit. Applying this UDV results in a recreation value of $511,000 when applied to the ESPB beach based recreation visitation of 80,130. Even though the point values changed per category from the without project evaluation the overall recreation value is estimated to be about same as the without project condition. Table 9-15 indicates a generally negative impact for near-beach water based activities, such as swimming, due to the nearshore rocky reef shoals. Surfing would also be affected if the area was currently had more waves and was more suitable for surfing, but since this activity is limited to nonexistent in this area the impact on the UDV is limited. The reduction of unobstructed water for swimmers is reflected in the UDV point value reduction for recreational experience. However, the reduction in recreation experience was counterbalanced by improvements in environmental quality resulting from the restoration features.

Recreation ratings at and in the vicinity of Rainbow Harbor for recreational boating are listed below in the second table. The rating is 47 points and is equal to a UDV of $8.30 per visit. This value is lower than the without project condition. Recreational experience and accessibility within the recreation area were reduced. In terms of recreation experience, the scattered rock measure in the open water zone and breakwater zone are expected to alter the patterns of boating (speed, geographic distribution) in a minor way, moderately, or substantially depending on the size and type of vessel. The presence of the kelp

forest and rocky reef would be anticipated to require boaters to avoid such features. Speed reduction may also be employed to avoid conflicts with the restoration features, and aids to navigation may be established. Motor and sail boats with a deeper keel would be anticipated to have to avoid the features more than those boats with greater under keel clearance. Sail boats may also have to exercise greater care navigating around the kelp beds especially if they are not equipped with a motor. Boaters may also have to reduce speeds in the vicinity of these project features. The kelp beds and rocky reefs will limit the paths for vessels in and out of ESPB and in and out of Alamitos Bay, and aids to navigation may be established. While the features can be anticipated to result in some changes to specific navigation routes by individual craft that can be considered negative impacts, the general availability or quality of boating within ESPB is not anticipated to be reduced. Note that the kelp beds features are anticipated to be refined to allow for easier passage of boats in and out of Alamitos Bay.

These reductions in value were not counterbalanced by gains made from the improved environmental quality due to the implementation of the restoration project. The recreation value is approximately $1,723,000. For both areas, the value is $2,234,000. This is a reduction in value from the without project conditions by $64,000.

Table 9-20: Beach Unit Day value Rating With-Project (TSP)

Criteria	Description	Points
Recreational Experience	The addition of the measures such as the rocky reef shoals in the nearshore for the TSP will negatively impact near beach water based activities, most notably swimming.	5
Availability of Opportunity	Along the Long Beach coastline there are several beaches within 1 hour travel time and a few within 30 minutes of travel time.	1
Carrying Capacity	There are adequate facilities to conduct recreation without any deterioration the resource or activity.	6
Accessibility	There is good access and good roads to the site. There is an entry point at almost every residential block.	11
Environmental Quality	Aesthetic quality will improve from the without project condition with the implementation of the TSP	9
Total		32

Table 9-21: Recreational Boating Unit Day value Ratings With-Project (TSP)

Criteria	Description	Points
Recreational Experience	Several general boating activities of all types operate at the Harbor. The placement of rocky reef shoals in the nearshore and rocky reef complexes and kelp beds in the open water zones are expected to negatively impact boating within the bay.	14
Availability of Opportunity	Several opportunities exist within 1 hour travel time; there are none within 30 minutes travel time.	6
Carrying Capacity	There are adequate facilities to conduct recreation without deterioration of the resource or activity.	8
Accessibility	Accessibility within the site will be a diminished due kelp beds and rocky reef complexes. Both the kelp beds and the rocky reef in the open water zone will limit the boats path in and out of ESPB and Alamitos Bay. Currently, the kelp beds have been reformulated to allow for passage of boats in and out of Alamitos Bay.	10
Environmental Quality	Aesthetic quality will improve from the without project condition with both the implementation of the TSP	9
Total		47

9.7 RECREATION SUMMARY RESULTS

This recreation analysis indicated minor overall impacts to near beach water activities and more significant negative impact for commercial, recreational, sail boats from restoration measures within the bay. Personal water craft is also affected. The overall recreation value only decreased slightly when compared to the without project condition. This is primarily because the losses to recreation experience to water based recreation are counterbalanced by improvements to environmental quality associated with the ecosystem restoration project. The more substantial recreation impacts would be to boating.

10 ADDENDUM B: EAST SAN PEDRO BAY ECOSYSTEM RESTORATIN OTHER SOCIAL EFFECTS

10.1 OVERVIEW

A water resources development project's potential beneficial or adverse effects on social well-being are reported under the Other Social Effects (OSE) account and reflects a highly complex set of relationships and interactions between inputs and outputs of a plan and the social cultural setting in which these are received and acted upon. The OSE account also integrates information into the planning process that is not reflected in the other three accounts used by the US Army Corps of Engineers (Corps) to evaluate projects and alternative plans. These other accounts include the (1) National Economic Development (NED) account which measures benefits and costs of a project or alternative, from a national perspective; (2) the Environmental Quality (EQ) of the impacted area; and (3) Regional Economic Development (RED) account which measures benefits and costs realized by the region by not the nation, as a whole.

The Corps has placed more emphasis over on the role and importance of OSE factors in water resources planning. EC 1105-2-409, "Planning in a Collaborative Environment" places much greater emphasis on the importance of including a broad range of considerations in planning that are to be used to develop appropriate water resources solutions. These include social factors addressed in the OSE account, and addressed herein. ER 1105-2-409 states, "[a]ny alternative plan may be selected and recommended for implementation if it has, on balance, net beneficial effects after considering all plan effects, beneficial and adverse, in the four Principles and Guidelines evaluation accounts," of which the OSE is one. The Principles and Guidelines state that the OSE, when included in U.S. Army Corps of Engineers documents, should "display plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation and others."

This OSE analysis focuses on the social impact induced by plans (with a focus on the Tentatively Selected Plan, or "TSP" relative to the No-Action Plan (NAP) in the East San Pedro Bay Study Area.

10.2 DIMENSIONS OF INTEREST AND ANALYSIS

This OSE analysis addresses the impact of the TSP (Alternative 4A) on various dimensions of interest in the OSE account. These dimensions of interest were taken from a report entitled: *Applying Other Social Effects in Alternative Analysis*, published by the Institute of Water Resources of the US Army Corps of Engineers. They are public health, environmental justice, economic vitality, community cohesion, and identity/well-being. They are listed in tables below. Following each table is a discussion of how the dimensions highlighted in the tables apply to the NAP and the TSP. The primary purpose of proposed project alternatives is to restore the ecosystem within the Project Area, with incidental impacts to recreation for existing recreation resources. Accordingly, it is generally through the enhancement of the environment that the TSP impacts each of the dimension of interest.

The TSP, identified as Alternative 4A, or the Reef Plan, includes the Base Plan measures which includes: 5 rocky reef shoals along the Nearshore Zone, placing scattered rock in the Open Water Zone and a kelp forest also in the Open Water Zone. Other features include: placing scattered rock in the Open Water Zone, adding rock in the Breakwater Zone and two rocky reef complexes around one of the oil island located in the Project Area. Overall, Alternative 4A has a First Cost of about $136 million, an average annual cost of about $5.4 million, and generates nearly 161 AAHUs. Relative to Alternative 2, this plan adds an additional rocky reef shoal in the Nearshore Zone, in addition to the rocky reef complexes in the

Open Water Zone. This plan is expected to support different aquatic species, provide connectivity and increase complexity of marine species.

10.2.1 DIMENSION OF INTEREST: PUBLIC HEALTH

The first dimension of interest is public health. The two elements that comprise the public health element within this report are health cost and physical health. Ecosystem restoration measures within the Project Area are anticipated to have mixed results in recreation value for beach goers, with some negative impacts to the recreation experience offset by improvements in environmental quality. The ability to enjoy the restored environment may result in some increased recreation visitation, in particular for such activities as walking/jogging/bike along the beach. To the extent that such increased boardwalk usage represents increased physical activity to those not currently recreating at the site and those who recreate along the site regularly, this could provide public health benefits and reduce health related costs. However, these impacts are not expected to be significant.

Table 10-1: Without Project Condition: Public Health

Social Factor	Metric	Description
Public Health	Health Cost	Issues affecting the overall health of a person, such as obesity
	Physical Health	Issues affecting a person's physical health. A relationship exists between reduced obesity and activity level.

10.2.1.1 ANALYSIS OF TSP: PUBLIC HEALTH AND SAFETY

The TSP would restore the bay and should improve the environmental setting. Implementation of restoration features as proposed by project alternatives and the TSP in particular would provide the proximity to an enhanced and more aesthetically pleasing environment, which could contribute to increased recreation use and corresponding physical activity, helping contribute to public health benefits. Although some project features could reduce the recreation experience for some water based activities, such impacts are likely offset by an enhanced environmental setting and potential improvements to water quality. The TSP could provide obese and at-risk community members with some increased opportunities for physical activity and exercise, and also provide opportunities for healthy and active members of the community who regularly exercise to sustain their health. This could improve the health of the community as a whole by reducing health care costs, increasing productivity, and promoting well-being, although these impacts are not anticipated to be significant.

10.2.2 DIMENSION OF INTEREST: ENVIRONMENTAL JUSTICE

The second dimension of interest is environmental justice. Environmental justice is the fair distribution of environmental benefits and burdens. In 1994, the President of the United States issued EO 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations*. The objective of this EO include developing Federal agency implementation strategies, identifying minority and low-income populations where proposed Federal actions could have disproportionately high and adverse human health and environmental effects, and encouraging the participation of minority and low-income populations.

The Council on Environmental Quality (CEQ) identifies minority groups as American Indian or Alaskan Native, Asian or Pacific Islander, Black not of Hispanic origin, and Hispanic (CEQ 1997). It defines a minority

population as any group of minorities that exceed 50 percent of the existing population where a minority group comprises a meaningfully greater percentage of the local population than in the general population.

Table 10-2: Without Project: Environmental Justice

Social Factors	Metric	Description
Environmental Justice	Residents in Study Area	Issues Affecting the overall social justice to the population within the Study Area

The City of Long Beach has a significant minority population. Hispanics represent about 25.3% of the population, while the Black and Asian populations both represent about 13% of the population.

Table 10-3: Racial and Ethnicity Composition

Area Name	Race (%)					Hispanic Ethnicity (%)
	White Alone	Black Alone	Asian Alone	Other	Two or More	
City of Long Beach	53.1	13.0	13.0	2.1	5.5	42.4
City of Los Angeles	52.4	9.0	11.6	0.9	3.6	48.6
City of Seal Beach	81.9	1.2	8.7	0.3	4.4	13.0
Los Angeles County	71.0	9.1	15.1	1.9	3.0	48.5
Source: U.S. Census (2017)						

The CEQ guidelines do not specifically define low income populations, but some agencies have developed thresholds for environmental justice impacts analysis. Disadvantaged communities are defined in California Guidelines as those communities with an annual median household income less than 80 percent of the statewide annual median household income (California Water Code § 79505.5(a)). Using 2017 Census data, the statewide annual median household income for disadvantaged communities is $37,994. In comparison, in 2017 the annual median household income for Long Beach City is $58,314. For Los Angeles County the annual median household income is $61,015, and for the state it is 67,169.

Table 10-4: Median Household Income Data

AREA	MEDIAN HOUSEHOLD INCOME (MHHI)	MHHI Higher than Disadvantaged MHHI
City of Long Beach	58,314	53%
Los Angeles County	61,015	60%
California	67,169	76%

10.2.2.1 ANALYSIS OF TSP: ENVIRONMENTAL JUSTICE

The TSP will provide a benefit to a community with a significant minority population, in terms of providing a restored aquatic ecosystem within their community. It is possible that the project could result in increased local property values, which could benefit minority homeowners but may result in a burden to minority home renters in underserved areas should rents increase.

10.2.3 DIMENSION OF INTEREST: ECONOMIC VITALITY

The third dimension of interest is economic vitality or how a person or group's standard living is affected. Los Angeles County is a thriving community with most sectors of the economy represented. The services sector, construction and management sector are all represented to some extent within Los Angeles County economy. Construction projects spur additional regional economic activity. Within the study area, there are generally few leakages of construction related expenditures outside the local economy since the local economy can provide all or most of the needed labor, materials and services needed to construct most projects. Individuals living in the Los Angeles metropolitan area benefit from construction projects as the injection of project funds makes its way through the economy and into future savings.

Table 10-5: Without Project: Economic Vitality

Social Factor	Metric	Description
Economic Vitality	Financial Impacts	Issues affecting a person or group's standard of living

10.2.3.1 ANALYSIS OF TSP: ECONOMIC VITALITY

The construction of the TSP is expected to contribute economically to the study area during the construction phase in a direct and indirect manner in the short run. During construction, project expenditures enter into the local economy. Funds entering into the regional economy directly affect the construction sector as individuals buy and sell construction goods, services and agriculture products. These funds have an indirect effect on the regional economy through linkages to the construction sectors such as construction suppliers and manufacturers. Meanwhile, direct and indirect construction and manufacturing activity impacts the regional economy by inducing spending on local good and services such as restaurants, grocery stores, hotels and gas stations. These are induced effects. Both indirect and induced effects affect the external economy through positive and negative changes to external demand and leakages to and from the economy. Finally, both indirect and induced effects are estimated through multipliers which can be thought of figuratively as money multiplying throughout the regional economy. The larger the project, the greater the positive impact to the regional economy and economic vitality. These impacts are further described in the Regional Economic Development analysis (Section 11).

10.2.4 DIMENSION OF INTEREST: COMMUNITY COHESION

The fourth dimension of interest is community cohesion. Community cohesion is generally defined as the degree to which residents feel a sense of belonging to their neighborhood or municipality. Other important measurements include the level of commitment residents feel to the community and the level of attachment residents have to certain neighbors, groups, or institutions. Generally, these levels are higher as a result of continued association over time.

Table 10-6: Without Project Condition: Community Cohesion

Social Factor	Metric	Description
Community Cohesion	Social Connectedness	Issues affecting local social networks, including personal networks

The established parks near and beaches along the East San Pedro Bay Project Area (south of Pacific Coast Highway between Rainbow Harbor and the Long Beach Jetties) help satisfy the need for community interaction by enticing residents into public spaces with trees, greenery, natural settings, and recreational

facilities. The parks in the Project Area bring neighbors together, encourage safer, cleaner neighborhoods and create a livelier community atmosphere. These areas also help improve a community's image, socioeconomic status and enhance the area's desirability. Perhaps most importantly, these recreation areas become a source of community pride and inspiration for further community improvements and revitalization.

10.2.4.1 ANALYSIS OF TSP: COMMUNITY COHESION

The TSP may promote community cohesion to local neighborhoods and by extension to the neighboring cities a short drive from East San Pedro Bay. This community cohesion or "social capital,"[8] may be strengthened by providing a restored aquatic ecosystem within the Project Area. Any improvements to water quality of the bay and restored environment may encourage some recreation activities, although there are also expected to be some negative impacts to other recreation activities such as boating. The TSP will not displace important community businesses and centers of community interaction such as churches, community centers, and recreation areas or residences.

10.2.5 DIMENSION OF INTEREST: WELL BEING

The fifth dimension of interest is wellbeing. Wellbeing includes the immediate mental health benefits which help with stress recovery and the longer-term psychological benefits which help with ongoing health restoration. Rhode and Kendle (1994) apply both parts of this definition by incorporating aspects of stress reduction and health restoration. They also add another aspect to the definition of wellbeing: behavioral changes to those who experience nature. Specifically, Rhode and Kendle (1994) suggest that urban nature brings emotional benefits (by lowering stress and increasing happiness), cognitive benefits (by reducing mental fatigue) and behavioral benefits (by encouraging adventurous behavior).[9]

In terms of immediate mental health benefits, individuals recreating at East San Pedro Bay may turn to the natural world for relief. Research supports this by saying that contact with nature in general can have a calming effect, helping to reduce stress.[10] In terms of longer term mental health, East San Pedro Bay may act as a restorative environment, providing restoration from mental fatigue.

10.2.5.1 SUPPORT OF YOUTHS AND SENIORS

Play is the foundation for children's healthy development. [16] Children's Participation at the surrounding ball fields, soccer fields, lacrosse fields, and playgrounds is evidence of the child's need to play. The benefits of outdoor play are maximized when developmentally appropriate equipment and materials provided.[13] Preschool students exposed to a structured intervention program of a physical education demonstrated significantly higher improvement in fundamental locomotion and object control skills than preschool students who were only allowed to have unstructured physical play with limited equipment.[14] Also, participation in sports and physical activities is positively associated with psychological maturity and identity development for young women.[15] Finally, environments such as those that align East San Pedro Bay are nurturing to the point where many youth can have a sense of achievement and recognition as well as opportunities for creative expression, physical activity, and social interaction provides the best settings for them to achieve the five development competencies needed to be successful as adults.

In Long Beach, the percentage of seniors is low at 9.3% when compared with the Los Angele County (10.9%) and California State (11.4%) statistics. For seniors, recreation can enhance active living, helping limit the onset of disease and impairment normally associated with the aging process. Physical activity help the aging population lead independent and satisfied lives helping them remain mobile, flexible and

maintaining their cognitive abilities.[17] Recreation activities provide socialization opportunities and help keep seniors active in the community.

10.2.5.2 PARKS AND HOUSING VALUES

The real estate market consistently demonstrates that many people are willing to pay a larger amount for property located close to parks and open space areas than for a home that does not offer this amenity. Many people including those located near the beach at East San Pedro Bay may be willing to pay more for a home close to a nice beach area. Economists call this phenomenon "hedonic value." Hedonic value is affected primarily by two factors: distance from the recreation area and the quality of the recreation area itself. While proximate value can be measured up to 2,000 feet from a large recreation area, most of the value is within the first 500 feet. Moreover, people's desire to live near a recreation area depends on characteristics of the area. Beautiful natural resource areas with great views, beach, and boardwalk are markedly valuable. Other recreation areas with excellent recreational facilities are also desirable. Less attractive or poorly maintained recreation areas are only marginally valuable. Recreation areas with frightening or dangerous aspects can reduce nearby property values.[18] The preponderance of studies has revealed that excellent recreation areas may add 15 percent to the value of a proximate dwelling; on the other hand, problematic recreation areas may subtract 5 percent of home value.[19]

10.2.5.3 ANALYSIS OF TSP: IDENTITY/WELLBEING

The TSP is anticipated to have minor beneficial impacts to community well-being. Potential benefits from the provision of a restored aquatic ecosystem in the Project Area include: reductions in in short term stress and promotion of long term well-being and restorative psychological effects; improvement of community social interactions and community health; and increased community involvement and strength; support of youth development and senior citizen health; and potentially increases in housing values.

10.3 SUMMARY OF NO ACTION PLAN AND TSP

The OSE analysis describes the beneficial social effects from the TSP. Impacts are categorized by OSE dimensions of interest.

- Public health is a concern within the Study Area. Approximately 25% or more in the Study Area are considered obese. This percentage is on the rise. However, there is also a significant population that is healthy and active. The TSP may result in an increase in recreation visitation for some users, which could encourage individuals who are less active to become more active in these recreational areas. However, the TSP will likely result in a decline in recreation visitation for other users (e.g., surfers and others who prefer more waves).

- Economic justice is at a moderate level of concern. Many social groups are represented in the city and surrounding areas. Many of these groups appear to be fairly represented. But, it is possible that there could be impacts to social justice associated with the TSP. The TSP would restore key areas along the coast line. This may benefit homeowners with real estate appreciation but could negatively impact home renters who could face higher rents. These impacts may disproportionately impact minorities or other disadvantaged groups. However, these impacts, if realized, are anticipated to be small.

- Economic vitality is strong within the Los Angeles County area. Many economic sectors are represented. The construction of the TSP would encourage the contractors to spend money and

support jobs within the County. These expenditures within the area would generate multiplicative effect of indirect and induced spending, helping the local economy.

- Community Cohesion and Identity/wellbeing are also a moderate level concern. The sense of community is moderately facilitated by the many existing recreational facilities within the Project Area.

- Identity/wellbeing are also at a moderate level. The many existing recreational activities available at the bay encourage youths, adults, and seniors to recreate there. These recreational facilities to support these activities may even help to reduce crime. The TSP could impact community cohesion and identity by a small amount. There are likely mixed impacts in terms of beach and near-beach based recreation, so the overall impact associated with beach recreation on these OSE factors is not anticipated to be significant. As noted, the enhanced environmental setting could impact property values, but the affect is likely small.

Table 10-7: Dimensions of Interest Summary

Category	Current Level within Project Area Without Project Condition	The Beneficial Effect from the TSP
Public Health	Moderate	Small Positive or No change
Environmental Justice	Moderate	Very Small Negative or No change
Economic Vitality	Moderate	Small to Moderate Positive
Community Cohesion	Moderate	Small Positive
Identity/Wellbeing	Moderate	Small Positive

11 ADDENDUM C: REGIONAL ECONOMIC DEVELOPMENT ANALYSIS

11.1 PURPOSE

The Federal objective in water resource planning is contributing to national economic development and the Federal perspective is the nation as a whole. Local communities and regions directly impacted by water resource planning may consider impacts at the state, regional, or local level a more relevant measure. From the Federal perspective, transferring employment opportunities and resources from one region of the nation to another to construct a water resource project does not in itself constitute national economic development. However, from a regional or local perspective, the transfer of employment opportunities and resources to construct a project in that region, as opposed to some other region of the United States, can be a significant benefit to the local economy in terms of more local employment, more local spending, and more local production.

11.2 PROCESS

To perform an economic analysis from the regional perspective (RED account), several different impacts from constructing the water resource project have to be analyzed. These impacts are termed direct, indirect, and induced effects.

i) *Direct effects* are immediate effects associated with the change in total sales for a particular industry. In other words the proportion of the expenditure in each industry that flows to material and service providers in that region. Stated simply, these are the direct impacts to employment and income due to the demand for goods and services to complete construction (e.g. construction equipment and labor). The region is typically defined by political rather than economic or geographic boundaries. Political boundaries are broken down to state and county or metropolitan area for analysis.

ii) *Indirect Effects* are changes in inter-industry purchases in response to new demand from the directly affected industries. In other words the supply of materials and services to meet the needs of the companies or individuals directly engaged in constructing the project (e.g. concrete suppliers).

iii) *Induced effects* are changes in spending patterns from increases in income to directly and indirectly affected industries. Stated simply, this is the increased spending on local goods and services such as restaurants, grocery stores, hotels, and gas stations due to the direct and indirect effects of the project.

Figure 11-1 illustrates conceptually how the regional economic can experience changes in demand from the construction of a US Army Corps of Engineers project. During construction, Federal project funds enter into the local economy. Funds entering into the regional economy directly affect the construction sector as individuals buy and sell construction goods, services and agriculture products. These funds have an indirect effect on the regional economy through linkages to the construction sectors such as construction suppliers and manufacturers. Meanwhile, direct and indirect construction and manufacturing activity impacts the regional economy by inducing spending on local good and services such as restaurants, grocery stores, hotels and gas stations. These are induced effects. Both indirect and induced effects affect the external economy through positive and negative changes to external demand and leakages to and from the economy. Finally, both indirect and induced effects are estimated through multipliers which can be thought of figuratively as money multiplying throughout the regional economy.

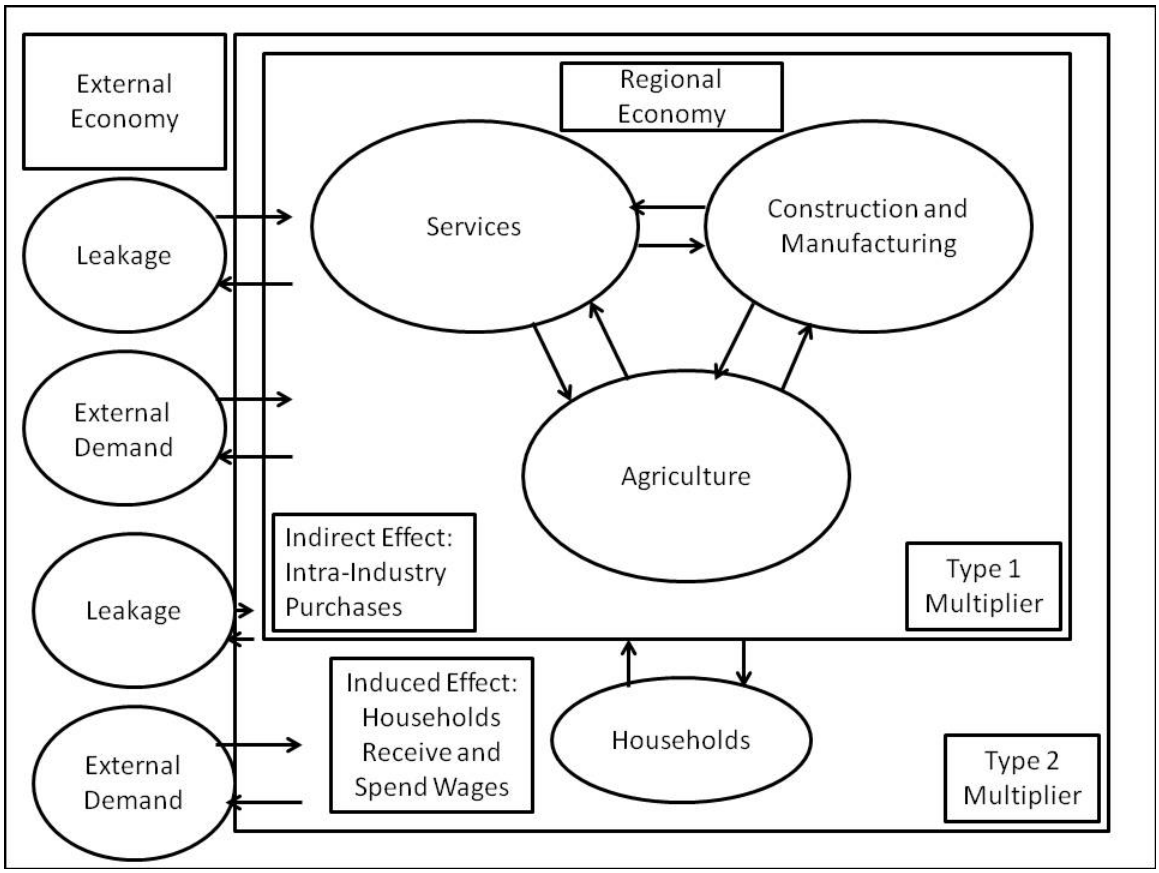


Figure 11-1: Illustration of How the Regional Economy can Experience Change in Demand Brought on by the Construction of the US Army Corps of Engineers Project

To estimate these regional effects the RECONS model was utilized. The RECONS model was developed by the Institute of Water Resources along with the Minnesota Planning Group and it is used to evaluate RED impacts of US Army Corps of Engineers projects. The RECONS model was used to estimate the direct, indirect, and induced effects of the TSP. The TSP has been identified as Alternative 4A.

The RECONS model generates regional construction multipliers based on the USACE business lines (navigation, flood mitigation, water storage & supply, etc.). Each business line is subdivided into numerous work activities, which improves the accuracy of the estimates for regional and national job creation, and retention and other economic measures such as income, value added, and sales. For this analysis the business line is Environmental Stewardship and the work activity is Environment Construction Activities for Ecosystem and Habitat Restoration or Improvements. Table11-1 below shows the first costs for the TSP. These costs include contingency and costs associated with planning engineering and design and construction management. These costs do not include operations and maintenance (projected ongoing costs that will be incurred subsequent to project construction) or interest during construction (an economic rather than financial cost). It is assumed that the project construction costs shown below will be incurred over approximately six years.

Table 11-1: Project First Costs -TSP

Plan	Costs
TSP (Alt 4A)	$136,476,700

Note – Does not include Real Estate costs

11.3 ANALYSIS RESULTS

Results are presented for the region, state, and nation. The region consists of the Los Angeles/Long Beach-Santa Ana CA MSA. This means regional impacts that have been measured are similar to those within the urbanized area of Los Angeles County, Long Beach and Santa Ana California MSA. The state-level impacts are for California and the national impacts are for the contiguous United States.

Direct impacts (effects) to employment and income due to the demand for goods and services to construct ecosystem habitat restoration improvements include information, professional scientific technical services, manufacturing, inputted rents, and finance, insurance, real estate, rental and leasing. These contribute to additional output, additional demand for jobs, and increased value-added to goods and services within the urban area of Los Angeles County/Long Beach-Santa Ana CA MSA, the State of California, and the nation.

The TSP results show that based on the estimated direct impacts we can expect about 1,168 jobs to be supported within the region from the implementation of the TSP. These impacts are anticipated to occur over a span of about 6 years. Overall there would be an additional 2,017 jobs supported (direct, indirect, and induced) by the TSP, primarily in labor, finance, insurance real estate rental and leasing, information, manufacturing, and professional scientific and technical services sectors. In addition to these jobs, ongoing post-construction O&M expenses are projected to support about 4 additional jobs within the local economy throughout the study period. Overall, the TSP construction is expected to lead to about $156 million in value added in goods and services to the region and increased labor income of nearly $112 million.

Table 11-2: RED Impacts from Best Buy Alt 4 (TSP)

		Regional	State	National
Total Spending		$136,476,700	136,476,700	136,476,700
Direct Impact	**Output**	126,768,565	135,434,336	135,930,551
	Jobs	1,168	1,380	1,394
	Labor Income	61,595,514	68,445,896	68,838,159
	Value Added	71,868,972	78,582,174	78,966,582
Total Impact	**Output**	267,707,914	299,402,470	392,104,302
	Jobs	2,017	2,367	2,939
	Labor Income	111,729,831	124,704,679	151,366,485
	Value Added	156,124,389	174,378,310	218,407,953

After construction ongoing operation and maintenance (O&M) expenses will also increase jobs, labor income, and added value of the local economy annually (as shown below in table 11-3). These increases are in addition to the increases displayed in Table 11-2 for construction of the TSP.

Table 11-3: RED from Operations and Maintenance Expenditures (Annual) - TSP

		Regional	State	National
Total Spending		251,110	251,110	251,110
Direct Impact	**Output**	213,203	238,347	250,801
	Jobs	2	2	2
	Labor Income	150202	172,429	180,858
	Value Added	160462	184601	192,975
Total Impact	**Output**	458,895	530457	687,346
	Jobs	4	4	5
	Labor Income	238,359	273,527	325,379
	Value Added	312,702	362,064	443,976

12 ADDENDUM D: REFERENCES

[1] Finkelstein, E., Trogdon, J., Cohen, J. & Dietz, W. 2009. "Annual medical spending attributable to obesity: payer- and service-specific estimates." *Health Affairs* 28(5).

[2] Moriarty, J., Branda M., Olsen, K., Shah, N., Borah, B., Wagie, A., Egginton, J. & Naessens, J. 2012. "The effects of incremental costs of smoking and obesity on health care costs among adults: A 7-year longitudinal study." *Journal of Occupational and Environmental Medicine* Mar; 54(3).

[3] Witters, D. & Agrawal, S. 2011. "Unhealthy U.S. workers' absenteeism costs $153 billion." Internet website: http://www.gallup.com/poll/150026/Unhealthy-Workers-Absenteeism-Costs-153-Billion.aspx.

[4] U.S. Department of Health and Human Services. 2008. "Physical activity guidelines for Americans." Hyattsville, MD. U.S. Department of Health and Human Services.

[5] American Planning Association, 2003. "How cities use parks to improve public health, help children learn, create safer neighborhoods." *City Parks Forum Briefing Papers.*

[6] Resources for State and Community Programs. 2010. "CDC's guide to strategies for increasing physical activity in the community." (CD-ROM). Centers for Disease Control and Prevention.

[7] Kahn, E., Ramsey, L., Brownson, R., et al. 2002. "The effectiveness of interventions to increase physical activity: A systematic review." *Am J Prev Med*. 22, (4 suppl).

[8] Jacobs, J. 1961. *The Death and Life of Great American Cities.* New York: Random House. February 1993 [1961].

[9] Rohde, C. & Kendle, A. 1994. "Report to English nature-human wellbeing, natural landscapes and wildlife in urban areas: A Review." Department of Horticulture and Landscape and the Research Institute for the Care of the Elderly, Bath: University of Reading, UK.

[10] Palace Road Nature Garden. 2011. "The relationship between nature and human health and well-being in urban areas." Notes on the Royal Commission on Environmental Pollution Study on Urban Environments, Well-being and Health, as found in https://www.facebook.com/notes/palace-road-nature-garden/the-relationship-between-nature- and-human-health-and-well-being-in-urban-areas/158334140891119, March 16, 2011.

[11] Gies, E. 2006. "The health benefits of parks - how parks help keep Americans and their Communities fit and healthy." The Trust for Public Land.

[12] Sherer, Paul. 2004. "Park power land & people." The Trust for Public Land. http://www.tpl.org.

[13] Sawyers, Janet K. 1994. "The Preschool Playground." *The Journal of Physical Education, Recreation & Dance. 65*(6). p.32-33. August, 1994.

[14] Ishee, Jimmy H. 2003. "The Influence of Motor Skill Interventions on Disadvantaged Children." *The Journal of Physical Education, Recreation & Dance. 74*(8), p.14. October, 2003.

[15] Shaw, Susan; Klieber, Douglas A.; Caldwell, Linda L. 2001. "Leisure and Identity Formation in Male and Female Adolescents: A Preliminary Examination." *Journal of Leisure Research, 27*(3), 245- 263,

[16] Hudson, Susan D. 1997 "Helping Youth Grow." *The Journal of Physical Education, Recreation & Dance*, *68*(9). pp.16-17. Nov/Dec, 1997.

[17] State of California Resources Agency. 2005. "The Health and Social Benefits of Recreation-An Element of the California Outdoor Recreation Planning Program." California State Parks Planning Division.

[18] Harnik, P. & Welle, B. 2009. "Measuring the economic value of a city park system." The Trust for Public Land.

[19] Ibid.