4.0 ALTERNATIVES

4.1 INTRODUCTION

An important element in analyzing the effects of a project, such as the Broad Beach Restoration Project (Project), on public trust resources is to identify and assess reasonable alternatives that may avoid or reduce adverse effects on such resources and feasibly attain the majority of Project objectives. In this Revised Draft Analysis of Public Trust Resources (APTR), the California State Lands Commission (CSLC) analyzes nine Project alternatives at a programmatic comparison level based on input from California Coastal Commission (CCC), city of Malibu, and other public agency staffs, the public, and the Broad Beach Geological Hazard Abatement District (BBGHAD or Applicant).[1] Alternatives were screened using the following criteria:

- The extent to which project objectives could be accomplished;
- The potential to avoid or reduce public trust impacts; and/or
- The potential feasibility of the alternative considering site suitability, availability of infrastructure, and consistency with local and State coastal plans and regulations.

The following alternatives were selected for full evaluation and are described and analyzed in this section.

Alternative 1	Relocation of Improved Revetment Landward of January 2010 Mean High Tide Line (MHTL) with Beach Nourishment and Dune Restoration
Alternative 2	Relocation of Improved Revetment Landward of Lateral Access Easements with Beach Nourishment and Dune Restoration
Alternative 3	Maximum Pull-back of Seawall with Beach Nourishment and Dune Restoration
Alternative 4	Reduced Beach Nourishment Volume and Dune Restoration with Revetment in Current Location
Alternative 5	Beach Nourishment and Dune Restoration with No Shore Protection Structure
Alternative 6	Relocation of Improved Revetment along Upgraded Leach Fields with Beach Nourishment and Dune Restoration
Alternative 7	Removal of Existing Emergency Revetment on the Eastern End of Broad Beach with Beach Nourishment and Restoration
Alternative 8	No Beach Nourishment at West Broad Beach with Revetment at Current Location
Alternative 9	Reduced and Phased Beach Nourishment at West Broad Beach with Existing Revetment

[1] The 2012 Draft APTR analyzed six project alternatives and three sand source alternatives, including the use of offshore sources of sand. Offshore sources have since been found to be infeasible; consequently, alternatives related to offshore sand sources are not analyzed in this Revised APTR.

Appendix L, *Alternatives Screening*, contains the methodology, rationale for selecting alternatives, and results of the alternatives screening process. Several of the alternatives listed above involve relocation or construction of a hard coastal protection structure landward of all public lands and easements. These approaches would leave areas of private property lying seaward of these coastal protection structures, raising potential beach and dune design, public and private access, and wastewater management issues, including potential tradeoffs regarding private land management, public access, and the effectiveness and extent of the Applicant's proposed habitat restoration and beach nourishment.

In response to agency direction, the Applicant's consultant, Moffatt & Nichol (2013), provided preliminary design proposals for a reinforced revetment, (using geofilter fabric and larger 3- to 5-ton boulders as armoring stone), a seawall, and a range of approaches to beach nourishment and dune creation. This Revised APTR analyzes these design suggestions and, as needed, has amended them to reflect the primary focus of the APTR on protection of public trust resources in balance with meeting Project objectives. Prior to construction of any of these alternatives presented in this analysis, the BBGHAD would be required to submit detailed design plans for review and approval by the CSLC and other applicable agencies.

4.2 EFFECTS OF ALTERNATIVES ON PUBLIC TRUST RESOURCES

This Revised APTR considers a range of reasonable alternatives to the Project, which would avoid or minimize adverse effects on public trust resources and feasibly attain most of the basic objectives of the Project. Each alternative is described below, analyzed for potential adverse effects on public trust resources, and then compared to the effects associated with the Project. This allows interested parties and decision-makers to compare the impacts of each to those of the proposed Project.

New impacts to a resource area, or impacts that have the potential for a noteworthy increase or decrease in severity as a result of a particular alternative, are discussed in detail. Impacts with minimal or no changes in severity are discussed only briefly by resource area in a table specific to each alternative. Table ES-2 in the Executive Summary of this Revised APTR provides a comparative summary of the environmental impacts of the Project and alternatives.

During the implementation of an alternative, a different approach or a combination of approaches may result in corresponding changes to the impacts discussed below. For example, while relocation of the revetment landward of the January 2010 Mean High Tide Line (MHTL) and reduced beach nourishment at west Broad Beach are analyzed separately, these alternatives could be combined resulting in corresponding increases or decreases in the severity of impacts described for each separate alternative and tradeoffs regarding public access and protection of public trust resources.

4.2.1 Alternative 1: Relocation of Improved Revetment Landward of January 2010 MHTL with Beach Nourishment and Dune Restoration

Description

This alternative would be similar to the Project as it would include beach and dune restoration identical to the Project along with the retention of a landward relocated revetment. Under this alternative, the existing emergency revetment would be moved landward of the January 2010 MHTL surveyed by CSLC staff and off of all public trust lands.[2] Much of the revetment would only require minor landward movement of 3 to 5 feet to avoid public trust lands, but several sections on the eastern end of Broad Beach would require more extensive relocation of 15 to 20 feet landward. This alternative would also include placing relocated rock over geotextile filter fabric to reduce the chance of settling and strengthening the relocated revetment with an outer lining of 3- to 5-ton boulders over existing smaller rock (see Figure 4-1). These measures would reduce chance of revetment damage or failure and mobilization of boulders if the revetment were to become exposed due to long-term wave action and persistent wave attack. The reinforced revetment would be no wider than the existing 38-foot width at its base with a crest elevation of approximately 15 feet above Mean Low Low Water (MLLW). This design would be required to demonstrate that the armoring of the existing revetment would not increase the width of the revetment to minimize beach coverage, which may require removal of existing smaller stones, or incorporation of these smaller stones into a steeper reinforced revetment.

Beach nourishment, dune creation, and habitat restoration components under this alternative would remain similar to those described for the Project, with approximately 43,000 haul heavy trips being required to haul 600,000 cubic yards (cy) of sand from inland quarry sources. Similar to the Project, post construction beach width would range from 85 feet on the west end in Lechuza Cove to as wide as 230 feet near the east end of the beach. Dune habitats would be established and restored by creating a sand berm that would run along the length of the beach, with a minimum of 2 feet of sand over the rock revetment. The berm would extend approximately 30 to 50 feet inland and 0 to 10 feet seaward of the revetment, depending on location. The dune system, consisting of hummocks varying in height from 17 to 22 feet above MLLW would be constructed on top of this berm. The width of the dune system would vary from 40 to 60 feet. Landward relocation of the revetment would result in the exposure of additional existing sand volume seaward of the revetment, potentially incrementally increasing the life of the initial nourishment event and reducing the probability of revetment exposure.

[2] This APTR acknowledges that there is a disagreement among experts between CSLC and Applicant surveyors as to which surveyed MHTL represents the best evidence of the last MHTL prior to artificial fill and accretion (and the boundary between state-owned land and private upland). Since the January 2010 MHTL was surveyed just prior to the emergency revetment construction, this alternative reflects revetment relocation assuming the January 2010 MHTL.

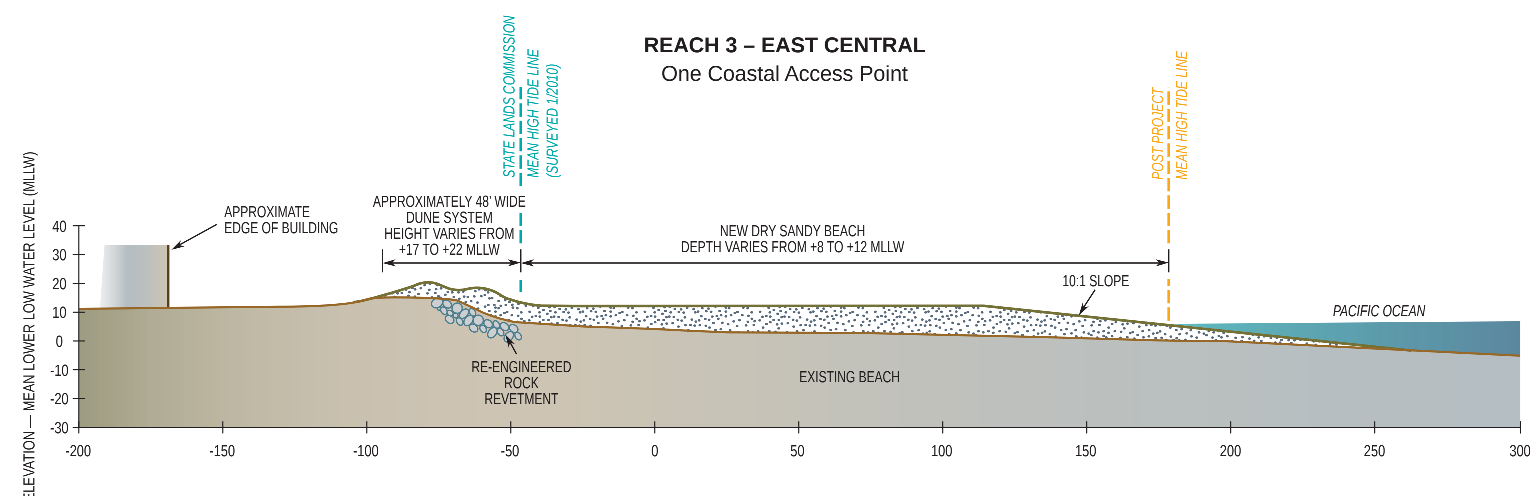
Similar to the Project, public use and access under this alternative would be permitted along the beach to the toe of the restored dunes where a line of rope or cable and signs would prohibit access to potential environmentally sensitive habitat areas (ESHA) within the dunes. This rope or cable system, combined with the approximately 40- to 60-foot-wide dune system, would also ensure residential privacy. In addition, rather than provide for 112 coastal access walkways across the restored dunes as included in the Project, this alternative would include installation of shared private coastal access walkways, with one walkway approximately every 300 feet to be shared between six homes. These walkways would be connected by a shared path along the back dune, lined with a sand fence along the seaward side to minimize sand migration into private yards and minimize resident and pet access into the dune ESHA. Each of these walkways would be roped off to minimize private access into the dunes. This distance was selected as an intermediate value that would improve dune habitat quality while minimizing disruption to private homeowner beach access.

The existing two public vertical coastal access points along Broad Beach Road would remain open and the two public trails across the dunes would be roped off to limit access into the dunes. Since the revetment would be located on private property and not public trust lands, public trust lands would be available for public access, recreation, and habitat restoration. This alternative may still interfere with public rights to pass along existing Lateral Access Easements (LAEs), many of which would remain beneath or landward of the revetment. This alternative would also recognize the public's rights to pass along public land below the January 2010 MHTL and across existing LAEs. This would ensure that over the long-term after nourishment ceases, the revetment is removed, and the beach and dunes erode, the public would continue to have access across the beach. Public access to and along these LAEs would be available when the sensitive dune habitats that overlie these LAEs eventually erode over the long-term and public access to these LAEs becomes necessary and available.

This alternative would involve additional new major construction activities compared to the Project. Installing a properly engineered revetment would involve the use of heavy equipment to remove some of the boulders, move some of the existing boulders inland, and install larger boulders. Revetment reconfiguration would require an estimated 4,500 new haul truck trips (approximately two or three boulders per truck) to deliver additional boulders to the beach in order to armor approximately 3,650 feet of the revetment.[3] Armoring would consist of placing a layer of boulders, one or two boulders deep; from below the revetment toe to its crest. A larger staging area within Zuma Beach Parking Lot 12 may be needed to accommodate additional equipment and material storage.

[3] The westernmost 470 feet of the emergency revetment was built to a different standard and incorporated larger boulders; thus it would not receive further armoring.

Detail



LEGEND

- Existing Public Access
- Approximate Limits of Beach Nourishment/ New Beach
- Existing Emergency Revetment Relocated and Armored
- Proposed New Dry Sandy Beach
- Proposed New Intertidal Beach Area
- Proposed Restored Dune
- Area of Dune or Beach Face (3:1 and 10:1 slopes)
- State Lands Commission Mean High Tide Line (surveyed 1/2010)
- Applicant Mean High Tide Line (surveyed 10/15/2009)
- Post Project Mean High Tide Line
- Existing Septic Tank
- Existing Leach Field/Drain Field
- Impacted Leach Field
- Existing Lateral Access Easements (LAEs)
- Easement on file, but no dry beach to dedicate
- Surf Grass
- ##### Property Address

Note: Beach dimensions and post project average high water line reflect beach status immediately after completion of beach nourishment and construction/shaping activities; the equilibrium beach that would result from dynamics such as waves, tidal and wind action would likely be of somewhat different dimensions.

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Landward Location of Improved Revetment Inland of Mean High Tide Line Off Public Land with Beach Nourishment and Dune Restoration

FIGURE 4-1

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Additional construction equipment, such as one or two heavy cranes and bulldozers, and additional construction personnel would also be required to relocate the existing rock revetment, and move and position new rock. This would result in increased fueling activity and additional traffic along the beach. This additional truck traffic would increase that associated with sand importation by approximately 10 percent. Traffic control measures for sand haul trucks entering and leaving the parking lot, as well as transiting along the beach would be implemented.

Under this alternative, as many as five onsite wastewater treatment systems (OWTS) would need to be relocated, as the relocated revetment would displace all or portions of the OWTS. Alternately, these short segments of the relocated revetment could be narrowed through steepening slopes of armor stone or narrowing the base of the revetment. This may also require removal of some private improvements, such as patios.

Similar to the Project, approximately 7 acres of the west end of Zuma Beach, including Parking Lot 12 and the beach fronting this area, would be used for construction staging. Equipment storage and staging would occur within the parking lot, sand storage, handling and transfer would occur on the beach. Heavy equipment and truck haul routes would be established on the beach. Most of Broad Beach and western Zuma Beach would remain closed to public access during weekday construction periods.

Major components of this alternative would include:

- Relocating the existing revetment 5 to 20 feet inland using heavy cranes and bulldozers;
- Importing large 3- to 5-ton boulders via an estimated 4,500 heavy haul truck trips and potentially exporting a portion of the smaller rock;
- Placing new larger boulders over and at the toe of the existing revetment using heavy cranes and bulldozers;
- Transporting sand from inland quarries to Broad Beach via 43,000 heavy haul truck trips;
- Transporting the sand from storage areas at Zuma Beach and hauling it up coast to Broad Beach with heavy trucks or scrapers;
- Redistributing sand on Broad Beach as needed with earthmoving equipment, such as bulldozers, and grading the beach fills to required dimensions;
- Creating a system of shared walkways to provide private lateral and vertical private coastal access for homeowners across the new dune system;
- Providing two vertical public access trails across the dunes to connect existing public access points to the widened beach and ensuring public lateral access along the widened beach seaward of the January 2010 MHTL;

- Performing backpassing of the sand, ranging of approximately 25,000 to 35,000 cy, from the east to west end of the beach based on triggers and using heavy equipment such as scrapers and bulldozers; and
- Initiating one future major renourishment event of approximately 450,000 cy in roughly 10 years.

Potential Impacts to Public Trust Resources

This alternative to the Project would result in additional construction activities associated with the landward relocation of the revetment above the January 2010 MHTL. This alternative would result in major changes to impacts associated with terrestrial biological resources, recreation, and public access. Adverse impacts resulting from this alternative may include effects on coastal dune ESHAs on the eastern end of Broad Beach, described in the Malibu Local Coastal Program (LCP), as well as an incremental increase in potential for hazardous spills in the terrestrial and marine environment. Further, public access during construction activities would be incrementally reduced relative to the Project due to increased heavy equipment use. However, beneficial impacts associated with this alternative would include improved protection of created dune habitat through a reduction in private coastal access walkways and associated disruption of sensitive dune habitats, as well as improvement of the Project's consistency with coastal public access and recreation polices, as the revetment would be moved landward of the January 2010 MHTL and off of public trust lands. Resource areas with major changes to impacts relative to the Project are discussed in detail below, while the resource areas with negligible changes to impacts are summarized in Table 4-1.

Table 4-1. Alternative 1 – Potential for Landward Relocation of OWTS

Address	Number of Affected OWTS	Potential for Landward Relocation Behind Revetment[1]	Potential for Relocation Landward of Home [2]
31324	1	Potentially Feasible	Insufficient Area
31336	1	Potentially Feasible	Insufficient Area
31280	1	Potentially Feasible	Insufficient Area
31250	1	Feasible	Feasible
31228	1	Feasible	Insufficient Area
Total Affected Properties	**Total Affected System Components**	**Number of OWTS Feasible to Relocate Landward of Revetment**	**Number of OWTS Feasible to Relocate Landward of Home**
5	5	2	1

Source: Topanga Underground 2012.
[1]Feasibility determined via aerial imagery and CAD files provided by the city of Malibu.
[2]Feasibility determined via the recommendations of Topanga Underground (2012).

Air Quality and Greenhouse Gases: Under Alternative 1, criteria pollutant emissions would incrementally increase relative to the Project associated with the 4,500 additional heavy haul truck trips used to transport armoring boulders, as well as operation of additional heavy equipment needed to relocate and improve the revetment. These emissions would increase the severity of Impact AQ-1 and exceed South Coast Air Quality Management District (SCAQMD) and Ventura County Air Pollution Control District (VCAPCD) thresholds and SCAQMD Localized Significance Criteria (LSTs) for construction activities, particularly for project-level emissions of volatile organic compounds (VOCs), and onsite and project-level emissions of nitrogen oxides (NO_x). Relative to the Project, emissions of both of these criteria pollutants would incrementally increase under this alternative as there would be additional construction activities as well as a 10 percent increase in heavy haul truck trips (Appendix G). Additionally, there would be an incremental increase in other criteria pollutants including carbon monoxide (CO), sulfur oxides (SO_x), and particulate matter (PM). This increase in emissions relative to the Project, particularly the increase in VOC and NO_x emissions, would require additional avoidance and minimization measures (AMMs) such as use of newer haul trucks with clean-burning diesel engines. Greenhouse gas (GHG) emissions described in Impact AQ-2 would be incrementally increased but would remain below SCAQMD and VCAPCD thresholds. Finally, increased truck traffic and heavy equipment operation associated with reinforcement and relocation of the rock revetment would incrementally increase toxic air contaminant emissions; however Impact AQ-3 would remain minor as thresholds would not be exceeded.

While implementation of Alternative 1 would increase short-term construction-related air quality impacts, this alternative may incrementally reduce the severity of construction emissions from backpassing (see Impact AQ-1). As previously described, additional sand would be made available with the seaward relocation of the revetment behind the January 2010 MHTL. This would incrementally delay the exposure of the revetment after the initial nourishment event based on a continued average sand loss rate of about 35,000 to 45,000 cy per year (Moffatt & Nichol 2013).[4] However, while the need for backpassing may be incrementally reduced, backpassing would still be required to maintain the wide sandy beach, and backpassing construction emissions would be a major adverse effect.

Coastal Processes, Sea Level Rise, and Geologic Hazards: Reinforcement of the revetment with 3- to 5-ton armoring stones would reduce potential impacts of coastal processes on existing private improvements including septic systems across the length of the 4,100-foot revetment. Erosion of beach and dunes after cessation of nourishment would continue as described under the Project, with the benefits of nourishment enduring for an estimated 10 to 20 or more years and the revetment then becoming exposed as a result of persistent wave action. Anticipated sea level rise (SLR) of approximately 8.5 inches by 2030 would further exacerbate erosion effects, including increased frequency and intensity of storm surges and wave attack. However, under

[4] Estimates of sand loss rates vary from 25,000 cy/year based on past observations to 100,000 cy/year based on the GENESIS model; a loss rate of 45,000 cy/year has been determined to be a reasonable worst case estimate (see Section 3.1, *Coastal Processes, Sea Level Rise, and Geologic Hazards*).

this alternative, after the revetment is exposed, potential impacts of coastal processes on the revetment identified in Impact CP/GEO-2 would be reduced as the revetment would be substantially strengthened by addition of heavier armor stones. Consequently, impacts to public trust resources identified in Impact CP/GEO-3 (e.g., water quality) due to damage to homes, OWTS, and accessory structures from coastal erosion would be reduced. The reengineered revetment would also provide long-term protection for this existing development from coastal erosion.

Similar to the impact of the existing revetment, the reengineered revetment would also impact coastal processes by incrementally increasing wave refraction when exposed and negligibly depriving down coast beaches (e.g., Zuma Beach) of a minor source of sand from dune erosion. However, Impact CP/GEO-7 would remain beneficial as effects of the longshore currents on nourishment and renourishment of sand in the short- to mid-term include both erosion of sand from Broad Beach and accretion of sand at down coast beaches, and additional sand would be exposed seaward of the relocated revetment. Over the long-term, longshore currents would transport this additional sand farther down coast and possibly offshore.

The reinforced revetment with larger boulders as armoring would increase the structural stability of the revetment, reducing potential adverse impacts associated persistent wave attack. This alternative would substantially reduce the adverse effects associated with Impact CP/GEO-1. However, as the revetment could likely not be keyed into the bedrock located at 16 feet below ground level (SubSurface Designs, Inc. 2006), the risk of liquefaction, seismic settlement, and lateral spreading in the event of an earthquake would still exist as described for the Project. Impacts related to sand compatibility (CP/GEO-4), wave height and direction, tides, and currents (CP/GEO-5), wave run-up (CP/GEO-6), and sea level rise (CP/GEO-8) would be similar to those described for the proposed Project, as beach nourishment activities would remain the same.

***Illustration 4-1**: Relocation of the revetment beyond the CSLC-surveyed MHTL would adversely affect ESHA located behind the revetment's current location. However, winter storms in 2013-2014 and the major storm event of March 2, 2014, substantially eroded remaining dune habitat leaving a large escarpment, destroying Sakrete and sand bag revetments leaving exposed debris.*

Terrestrial Biological Resources: Relocation of the existing 4,100-foot revetment would require use of heavy cranes and bulldozers that would have major adverse effects on the existing, but often degraded southern foredune habitat. With landward relocation, the revetment would overly remaining southern foredune habitat, particularly on the eastern reach of Broad Beach. However, the most recent reconnaissance survey at Broad Beach found that the eastern reaches of Broad Beach were eroded extensively during storm events in March 2014 exposing and damaging sand bag and Sakrete revetments and further eroding degraded southern foredune habitat (Illustration 4-1). While heavy equipment would generally operate on the seaward side of the revetment, relocation of the structure would result in large boulders being laid into this southern foredune habitat, potentially adversely impacting native vegetation and/or sensitive wildlife species and increasing the severity of the adverse effects associated with Impact TBIO-2. Adverse effects to ESHAs resulting from this alternative would be similar in type to those described in Impact TBIO-2, but the area of impact would be increased under as additional ESHA would be disturbed due to revetment relocation prior to beach nourishment activities. Impact TBIO-4 may also become more severe due to operation of additional heavy equipment within ESHAs necessary to relocate the revetment. This alternative would also slightly increase the short-term impacts of TBIO-5 as additional sand would be exposed seaward of the relocated revetment. However, the potential beneficial effects of dune restoration associated with Impact TBIO-6 and TBIO-7 would still occur under this alternative. Requiring shared private coastal access walkways would also substantially reduce disturbance of the proposed dune system, protecting this established and restored dune habitat. Impacts related to installation of the existing revetments (TBIO-1), backpassing operations (TBIO-3), and long term erosion of the newly created dune habitat (TBIO-8) would remain largely similar to those described for the Project.

Recreation and Public Access: This alternative would result in the operation of additional heavy equipment, which would increase short-term adverse effects to public access associated with Impact REC-1. However, backpassing operations and associated impacts identified in Impact REC-2 would remain similar to those described for the Project. Landward relocation of the revetment off of public trust land would improve Project consistency with coastal public use and recreation policies. However, the revetment would still cover or cut off access to approximately one acre of LAEs. Although the revetment would be moved landward of the January 2010 MHTL and the beach and dune system is expected to sustain itself marginally longer than the Project, the wide sandy beach would still erode after the cessation of nourishment, leaving the revetment exposed after cessation of beach nourishment and erosion of the newly widened beach in 10 to 20 or more years and ultimately impacting long-term public lateral access as detailed in Impact REC-4. Medium- and short-term benefits to public recreation opportunities due to a wide sandy beach berm and increased lateral access would remain similar to those identified for the Project in Impact REC-3.

Marine Water Quality: Installation of a properly engineered revetment would substantially reduce potential impacts to Marine Water Quality. Potential damage to homes, OWTS, and accessory structures from coastal erosion, and beneficial impacts to public trust resources identified in Impact MWQ-3 would be increased, as the reengineered revetment would provide long-term protection of existing development from coastal erosion. However, leach fields west of 31022 Broad Beach Road would be located within 15 feet of the wave uprush limit calculated by Moffatt & Nichol (2013). Consequently, after cessation of beach nourishment and erosion of the newly widened beach in 10 to 20 or more years these leach fields may experience splashing or minor seawater intrusion from waves overtopping the improved revetment during large 100-year storm events which may incrementally impact near shore water quality. However, this would also require waves to erode the overlying seaward end of the dune system. Further, after cessation of nourishment and erosion of the beach in 10 to 20 or more years, the CSLC would consider disposition of all improvements that overlie state sovereign lands or LAEs and would address any outstanding wastewater treatment issues at that time. Construction-related impacts to impairment of area waters from operation of heavy equipment and potential for oil leaks or spills described in Impact MWQ-1 would be slightly increased due to the additional construction activities associated with relocation and reinforcement of the revetment. However, as the total quantity of sand added would remain the same as for the Project, Impacts MWQ-2 and MWQ-4 would remain similar.

Utilities and Service Systems: Relocation of the revetment inland of the January 2010 MHTL would require potential landward relocation of as many as five OWTS or the steepening of the landward slope and narrowing of the reinforced revetment in these locations to retain room for septic leach fields. If landward movement of these systems were not possible the revetment would have to be redesigned fronting these residences or potentially relocated landward, but still partially on or in front of the January 2010 MHTL in these areas. This decision would result in potential tradeoff between impacts to recreation and utilities and public systems. Based on aerial imagery it appears feasible for at least two of the systems to be relocated landward and potentially feasible for the remaining two. However, this aerial analysis does not take into consideration underlying utilities that may further complicate landward relocation of the OWTS.

Potential for relocation of OWTS may be limited due to space restraints and code issues. Additionally, relocation of the revetment landward of the January 2010 MHTL west of 31022 Broad Beach Road may cause future permitting issues with the city of Malibu and potentially other agencies as all properties must comply with city code if repairs or upgrades are made to an existing treatment system. Such repairs are required for major remodels or home expansion and also for resale and as such Ensitu (2013) have cited such relocation as infeasible. However, as discussed Section 3.7.6 *Utilities and Service Systems*, the city of Malibu Municipal Code does not appear to directly conflict with this alternative. Further, the feasibility of revetment relocation off public lands does not consider the ability to expand existing homes, but rather the ability of the OWTS to serve the existing home. Finally, Applicant-prepared studies have identified a requirement for septic system leach fields to be setback a minimum of 15 feet from a wave uprush zone, effectively requiring a 15 foot setback from the landward toe of the relocated revetment. As noted above, such uprush is projected to occur only during a 100 year event and after erosion of the beach and overlying dune system in 10 to 20 or more years. The reinforced revetment would limit, but not fully eliminate the size and intensity of such wave uprush; however, limited amounts of water overtopping the revetment would likely have only moderate effects on water quality as contact with any released septic effluent with marine waters would be limited by the revetment.

Under this alternative, beach nourishment and to a greater degree reinforcement of the existing revetment would reduce potential impacts to Utilities and Service Systems. This alternative would substantially increase the beneficial impacts associated with UTL-1. Potential damage to OWTS from coastal erosion, and associated indirect impacts to public trust resources identified in Impact UTL-2, including adverse effects to water quality as well as public use and enjoyment of the beach and ocean would be greatly reduced, as the reinforced revetment would provide long-term protection of existing OWTS from coastal erosion. However, leach fields west of 31022 Broad Beach Road would be located within 15 feet of the wave uprush limit calculated by Moffatt & Nichol (2013) after cessation of nourishment activities and erosion of the newly widened beach and dune system in 10 to 20 or more years. Consequently, these leach fields may experience splashing or minor seawater intrusion from waves overtopping the improved revetment during large 100-year storm events.

Relocation of the revetment closer inland would also result in similar public drainage-related impacts of the Project as discussed in Impact UTL-3 as construction of the restored dunes and beach nourishment will bury or obstruct public drains. Similar to the Project, Impact UTL-3, such impacts would be a minor adverse effect with implementation of AMM UTL-3 (Master Drainage Plan).

Other Resource Areas: This alternative would have similar impacts to the Project in terms of its effects on scenic resources, marine biological resources, and environmental justice. Effects on transportation, traffic, parking, and noise would be somewhat more severe due to increase levels of vehicular activity and congestion related to construction phases (Table 4-2). Effects on public health and safety hazards and historic resources may be incrementally increased due to increased construction activity associated with the relocation and reinforcement of the revetment.

Table 4-2. Alternative 1 – Changes in Impact Severity

Resource Area	Relative Change in Impact Severity	Discussion
Scenic Resources	No Major Change in Adverse Impacts	Additional construction equipment associated with landward relocation of the revetment may intensify the adverse impacts associated with temporary construction activities, with a slight increase in the severity of adverse effects associated with Impact SR-2 and SR-4. Similar to the Project, permanent authorization of the revetment through a long-term lease and approval of Coastal Development Permits (CDPs) would create the potential for long-term degradation of the visual environment of Broad Beach after nourishment activities end and natural coastal erosion causes the revetment to become exposed as described in Impact SR-1.
Marine Biological Resources	Incremental Decrease in Indirect Adverse Impacts	Placement of sand and potential burial of rocky intertidal and subtidal marine biological resources would have a major adverse effect to intertidal habitats and offshore habitats of Broad Beach similar to the Project as described in Impacts MB-1, MB-2, MB-3, MB-4, MB-5, and MB-8. Additionally, similar to the Project, impacts to down coast habitats would be negligible as discussed in Impact MB-7. However, potential indirect impacts associated with water pollution from damage to OWTS from coastal erosion would be reduced along the length of the existing revetment. The potential for fuel or oil release described in Impact MB-6 would be slightly increased due to increased construction activities.
Cultural and Paleontological Resources	Incremental Increase in Adverse Impacts	Disturbance of the near shore environment associated with the landward relocation of the revetment would result in a slightly increased potential to disturb cultural resources, resulting in an additional adverse impact similar in type to Impact CR-1. However, implementation of standard Best Management Practices (BMPs) (e.g., work stoppage and notification of the State archeologist) would substantially reduce this impact.
Noise	Incremental Increase in Adverse Impacts	A temporary increase in noise due to additional construction activities associated with the landward relocation of the revetment would result in adverse impacts to beach users and residents on PCH. Consequently, this alternative would result in slight increases in adverse effects associated with Impact N-1 and N-2. However, these impacts would be reduced through implementation of AMM N-1a, similar to the Project.
Public Health and Safety Hazards	No Major Change in Adverse or Beneficial Impacts	This alternative would result in a slight increase in the adverse effects associated with Impact HAZ-2, as the presence of additional heavy construction equipment (i.e., bulldozers, cranes, and haul trucks) would increase the potential for an incidental release of hazardous material on Broad Breach. Additionally, the increase in construction equipment and construction personnel would result in increased inaccessibility and hazardous conditions during construction, slightly increasing the severity of adverse effects associated with Impact HAZ-3. These impacts would be reduced through implementation of AMMs HAZ-2, HAZ-3a, and HAZ-3b.
Traffic and Parking	Incremental Increase in Adverse Impacts	The landward relocation of the revetment would require an estimated 4,500 additional heavy haul truck trips as well as additional heavy construction equipment and construction

Table 4-2. Alternative 1 – Changes in Impact Severity

Resource Area	Relative Change in Impact Severity	Discussion
		personnel, which would likely increase traffic and congestion on Pacific Coast Highway (PCH) and in the Zuma Beach parking lot, potentially prolonging construction activities and incrementally increasing the severity of the adverse effects associated with Impact TR-1. These impacts would be reduced through implementation of AMM TR-1.
Environmental Justice	No Major Change in Adverse Impacts	There would be no appreciable difference in impacts relative to the Project.

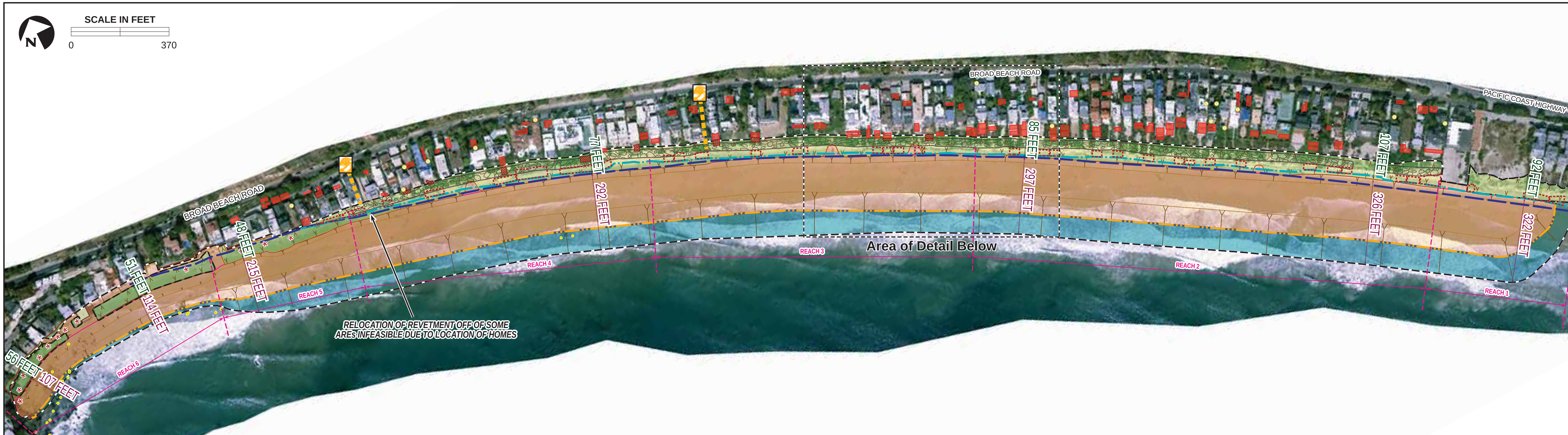
4.2.2 Alternative 2: Relocation of Improved Revetment Landward of Lateral Access Easements with Beach Nourishment and Dune Restoration

Description

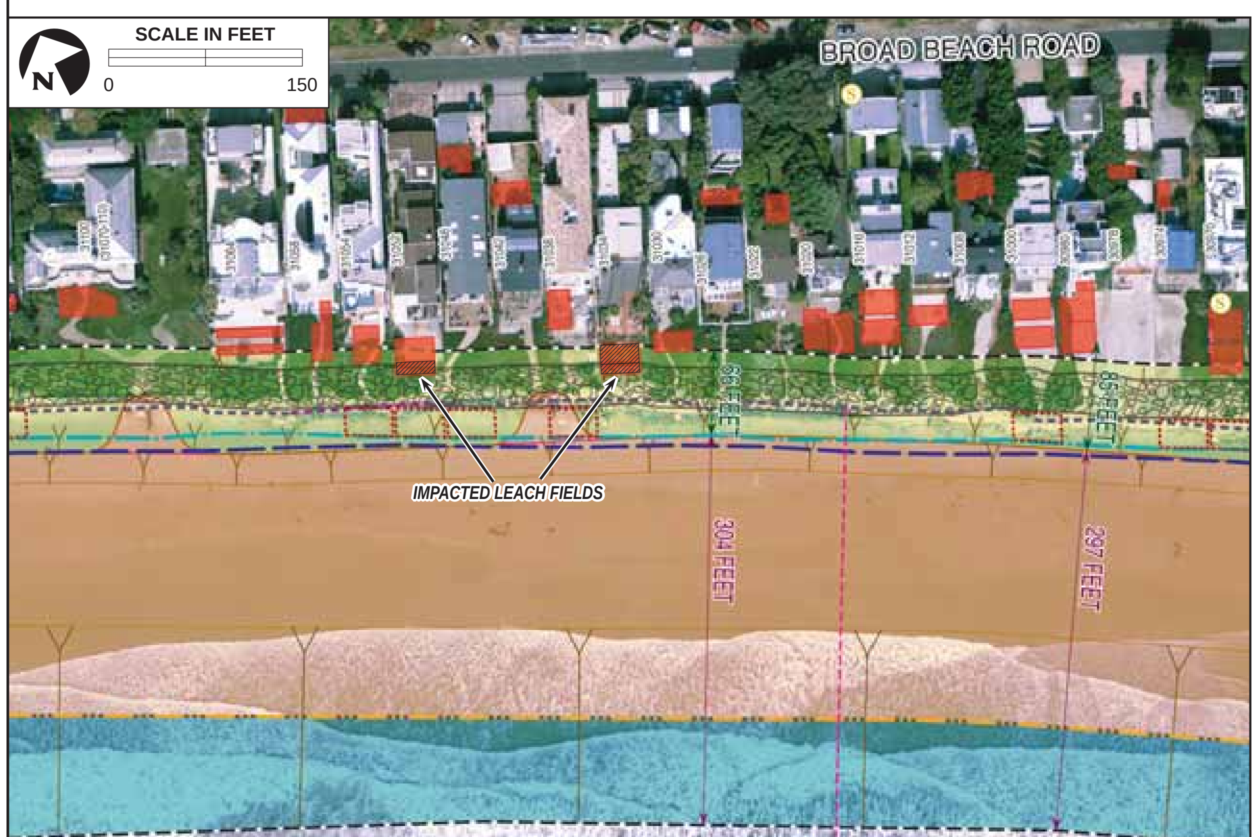
This alternative would be similar to the Project and Alternative 1 as it would include beach and dune restoration identical to the Project along with retention of a landward relocated revetment. Under this alternative, the revetment would be relocated substantially landward from its current location off of all public land below the January 2010 MHTL, including most of the existing LAEs dedicated for public lateral beach access. Landward relocation would include moving the revetment approximately 15 to 60 feet landward across portions of the beach, including the eastern 3,000 feet, where existing homes are set back further from the shoreline (see Figure 4-2). Limited space exists for landward relocation on the western portion of Broad Beach in front of the residences at 31350 and 31346 Broad Beach Road; consequently the current revetment location, approximately 50 feet in length, would be retained in this area.

Similar to Alternative 1, this alternative would also include laying relocated rock over geotextile filter fabric to reduce the chance of settling and strengthening the relocated revetment with an outer lining of 3- to 5-ton boulders over existing smaller rock. These measures would reduce chance of revetment damage or failure and mobilization of boulders if the revetment were to become exposed due to long-term wave action and persistent wave attack. The reinforced revetment would be no wider than the existing 38-foot width at its base with a crest elevation of approximately 15 feet above MLLW. Similar to Alternative 1, in order to minimize beach coverage and reduce impacts to OWTS leach fields, this would require removal of existing smaller stones, or incorporation of these smaller stones into a steeper reinforced revetment.

A key goal of this alternative is to reduce impacts to public lateral beach access. Lateral access along Broad Beach is affected by a complicated mix of public trust land, LAEs, and private property. In general, the area below the Ordinary High Water Mark (OHWM) constitutes tidal and submerged lands under the California Constitution and the Public Trust Doctrine, and is thus open for public use and enjoyment. Approximately 51 of the 121 private parcels along Broad Beach have granted and accepted easements, deed restrictions, or other legal documents providing the public with the right to lateral coastal access across the seaward edge of these private properties. The CSLC holds a total of 36 LAEs along Broad Beach; 16 are outside the revetment area (i.e., associated with properties on Broad Beach to the east or west of the revetment), and 20 are directly impacted by the revetment. LAEs vary in terms, but they mainly consist of dry sandy beach extending 25 feet inland from the “daily high water line” or the MHTL; in some cases LAEs are restricted on the landward side by set-back buffers from the residential structures. Most of these LAEs are currently partially or entirely covered by the emergency rock revetment and frequently extend landward of the revetment.

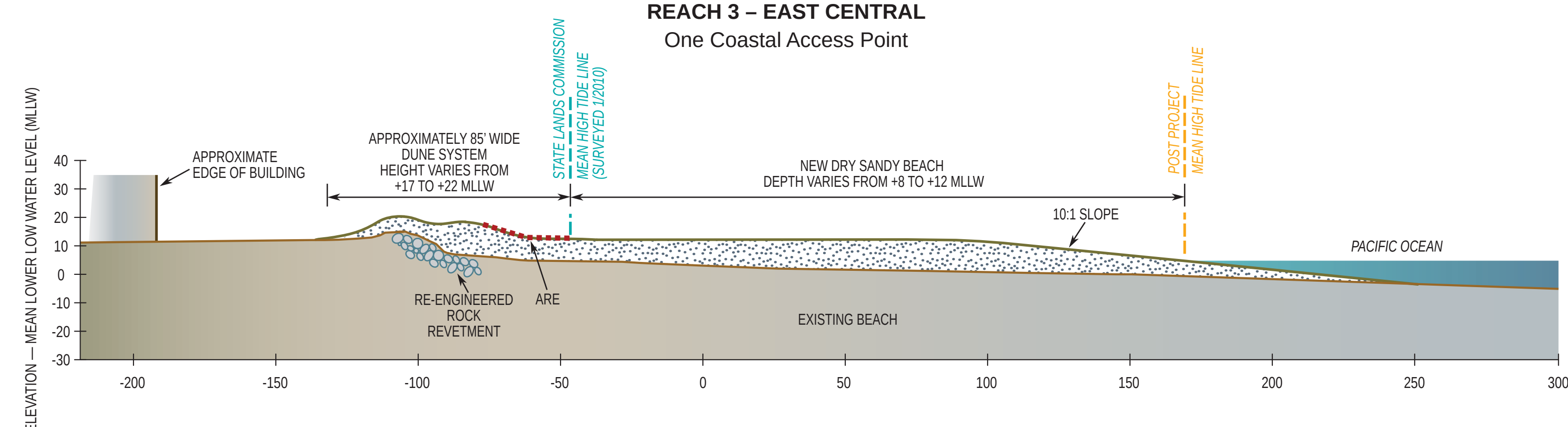


Detail



REACH 3 – EAST CENTRAL

One Coastal Access Point



LEGEND

- Existing Public Access
- Approximate Limits of Beach Nourishment/ New Beach
- Existing Emergency Revetment Relocated and Armored
- Proposed New Dry Sandy Beach
- Proposed New Intertidal Beach Area
- Proposed Restored Dune
- Area of Dune or Beach Face (3:1 and 10:1 slopes)
- State Lands Commission Mean High Tide Line (surveyed 1/2010)
- Applicant Mean High Tide Line (surveyed 10/15/2009)
- Post Project Mean High Tide Line
- Existing Septic Tank
- Existing Leach Field/Drain Field
- Impacted Leach Field
- Existing Lateral Access Easements (LAEs)
- Easement on file, but no dry beach to dedicate
- Surf Grass
- ###### Property Address

Note: Beach dimensions and post project average high water line reflect beach status immediately after completion of beach nourishment and construction/shaping activities; the equilibrium beach that would result from dynamics such as waves, tidal and wind action would likely be of somewhat different dimensions.

amec

Landward Relocation of Improved Revetment Landward of Easements with Beach Nourishment and Dune Restoration

FIGURE 4-2

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Beach nourishment, dune creation, and habitat restoration concepts would remain similar to those under the Project, with approximately 43,000 haul heavy trips being required to haul 600,000 cy of sand from inland quarry sources. The post-construction dry sand beach berm is projected to extend seaward of the dunes by 90 to 230 feet, with the beach narrower at the west end and wider in the central and eastern sections. For example, beach widths in Lechuza Cove would be as narrow as 90 feet while the entire area east of 31330 Broad Beach Road would be 200 feet wide or wider. This alternative would retain roughly the same profile of the sandy beach as the Project; however, dune width would be substantially increased from the currently proposed approximately 50-foot width. Under this alternative, the restored dune would extend up to 140 feet on the eastern end of Broad Beach. This would require the importation of up to 75,000 additional cy of sand from the inland sand sources, necessary to create the wider dune field. This would also require an additional 5,300 truck trips and incrementally increased construction period of approximately one month. Landward relocation of the revetment would result in the exposure of additional existing sand volume seaward of the revetment, potentially incrementally increasing the life of the initial nourishment event and reducing the probability of revetment exposure.

Similar to Alternative 1, public use and access would be permitted to the toe of the restored dunes, which would lie on public land where a line of rope or cable and signs would prohibit access to coastal dune ESHA. However, in contrast to the Project where the majority of the proposed dunes would be located on private land, under this alternative a major amount of the dune system would be located on public land over overlying LAEs. Additionally, similar to Alternative 1, rather than provide for 112 coastal access walkways across the restored dunes, this alternative would channel residential access across the dunes into shared walkways. The access proposal would be similar to that described for Alternative 1; however, in places, due to the limited setback between the relocated revetment and homes, more frequent beach access walkways would be required as insufficient room would exist for a backdune walkway.

This alternative would also recognize the public's rights to pass along public land below the January 2010 MHTL and across existing LAEs. This would ensure that over the long-term after nourishment ceases, the revetment is removed, and the beach and dunes erode, the public would continue to have access across the beach. Public access to and along these LAEs would be available when the sensitive dune habitats that overlie these LAEs eventually erode over the long-term and public access to these LAEs becomes necessary and available.

This alternative would involve additional new major construction activities associated with revetment armoring as described for Alternative 1. In addition, because the revetment would be located further landward, patio and landscape removal, as well as potential abandonment/removal and relocation of existing septic systems, would also entail additional excavation and construction. These activities may be scheduled concurrently with or preceding beach nourishment and thus would extend the projected construction horizon beyond the proposed 8 months by at least 1 additional month. Further, the quarrying and transport of additional sand would result in 5,350 truck trips in addition to the 4,500 additional truck trips required for boulder armoring stone transport.

Relocation and armoring of the revetment may disrupt existing OWTS, up to 14 patios, landscaping, and other private improvements (see Illustration 4-2). This alternative would require potential landward relocation of as many as 22 OWTS or steepening or the landward slope or narrowing of the reinforced revetment in these locations. If landward movement of these systems were not possible the revetment would have to be redesigned fronting these residences or potentially relocated landward, but still partially on or in front of the January 2010 MHTL in these areas. This decision would result in potential tradeoff between impacts to recreation and utilities and service systems.

Illustration 4-2: *The landward relocation of the revetment off of all public trust lands, including those below the MHTL as well as most LAEs, would have major adverse effects as it would require the relocation of private landscape improvements (i.e., patios), as well the decommissioning of up to 22 OWTS.*

Similar to the Project, approximately 7 acres of the west end of Zuma Beach, including Parking Lot 12 and the beach fronting this area, would be used for construction staging. Equipment storage and staging would occur within the parking lot, sand storage, handling and transfer would occur on the beach. Heavy equipment and truck haul routes would be established on the beach. Most of Broad Beach and western Zuma Beach would remain closed to public access during weekday construction periods. Major components of this alternative would include:

- Relocating of the existing revetment anywhere from 15 to 60 feet landward off of public lands and LAEs using heavy cranes and bulldozers;
- Demolishing and reconstructing up to 14 patios and potentially relocating up to 22 OWTS;
- Importing large 3- to 5-ton boulders via an estimated 4,500 heavy haul truck trips and potentially exporting a portion of the smaller rock;
- Placing new larger boulders over and at the toe of the existing revetment using heavy cranes and bulldozers, exporting smaller armor stone and/or steepening and narrowing the revetment on certain properties as needed ;

- Transport of an estimated 675,000 cy of sand from the inland quarries and to Broad Beach via an estimated 48,350 truck trips;
- Transporting the sand from storage areas on Zuma Beach up coast via heavy truck or scraper up coast to Broad Beach;
- Redistributing sand on Broad Beach as needed with earthmoving equipment, such as bulldozers, and grading the beach fills to required dimensions;
- Constructing a wider sand dune system up to 140 feet wide in the east to be planted with native dune species;
- Creating a system of shared walkways to provide private lateral and vertical private coastal access for homeowners across the new dune system;
- Providing two vertical public access trails across the dunes to connect existing access points to the widened beach and ensuring public lateral access along the widened beach seaward of the January 2010 MHTL
- Performing backpassing of the sand from the east to west end of the beach using heavy equipment such as scrapers and bulldozers on a roughly annual basis based on beach profile and width measurement trigger; and
- Initiating one future major renourishment event of approximately 450,000 cy in approximately 10 years.

<u>Potential Impacts to Public Trust Resources</u>

This alternative would include landward relocation of the revetment off of public land and the majority of LAEs. Implementation of Alternative 2 would have similar impacts to Alternative 1 in terms of coastal processes and geological resources, which would be reduced when compared to the Project. Additionally, similar to the Alternative 1, this alternative would also result in additional construction activities, including use of additional heavy equipment and construction personnel, resulting in greater impacts than the Project. The effects would be somewhat more severe than Alternative 1 due to major additional landward movement of the revetment as well as potential relocation of up to 22 OWTS and demolition of 14 patios. This alternative would also require a longer period of construction and importation of additional sand. These activities would incrementally increase construction related impacts, particularly to terrestrial biological resources. Resource areas with major changes to impacts relative to the Project are discussed in detail below, while the resource areas with negligible changes to impacts are summarized in Table 4-4 at the end of this subsection.

Air Quality and Greenhouse Gases Under Alternative 2, there would be a major increase in criteria pollutant emissions relative to the Project. Similar to Alternative 1, this increase in emissions would be directly associated with the almost 10,000 additional heavy haul truck trips, necessary to transport armor stone and additional sand, the operation of additional heavy equipment to relocate and improve the revetment and to demolish and reconstruct private improvements (e.g., patios). Major revetment relocation would also incrementally increase emission from operation of heavy equipment relative to Alternative 1. These emissions would increase the severity of Impact AQ-1, particularly for emissions of VOCs which would exceed SCAQMD and VCAPCD thresholds for project-level significance and for NO_x which would exceed SCAQMD and VCAPCD thresholds for onsite and project-level significance similar to the Project, including SCAQMD LSTs for construction activities. Emissions of both of these criteria pollutants would substantially increase under this alternative when compared to the Project due to additional construction activities and a 20 percent increase in heavy haul truck trips (Appendix G). Additionally, there would be an incremental increase in other criteria pollutants including CO, SO_x, and PM. This increase in emissions relative to the Project, particularly the increase in VOC and NO_x emissions, would require additional AMMs such as use of newer haul trucks with clean-burning diesel engines. Greenhouse gas (GHG) emissions described in Impact AQ-2 would be incrementally increased but would remain below SCAQMD and VCAPCD thresholds. Finally, increased truck traffic and heavy equipment operation associated with reinforcement and relocation of the rock revetment would incrementally increase toxic air contaminant emissions; however Impact AQ-3 would remain minor as thresholds would not be exceeded.

Coastal Processes, Sea Level Rise, and Geologic Hazards: Similar to Alternative 1, reinforcement of the revetment with 3- to 5-ton armor stones would reduce the potential impacts of coastal processes on existing private improvements including septic systems across the length of the 4,100-foot revetment. Erosion of the beach and dunes after cessation of nourishment would continue as described under the Project, with the benefits of nourishment enduring for an estimated 10 to 20 or more years and the revetment then becoming exposed as a result of persistent wave action.[5] Anticipated SLR of approximately 8.5 inches by 2030 would further exacerbate erosion effects, including increased frequency and intensity of storm surges and wave attack. However, after the revetment is exposed, potential impacts of coastal processes on the revetment identified in Impact CP/GEO-2 would be reduced as the revetment would be substantially strengthened by addition of heavier armor stones. Consequently, impacts to public trust resources identified in Impact CP/GEO-3 (e.g., water quality) due to damage to homes, OWTS, and accessory structures from coastal erosion would be reduced. The reengineered revetment would also provide long-term protection for this existing development from coastal erosion.

Similar to the impact of the existing revetment, the reengineered revetment would also impact coastal processes by incrementally increasing wave refraction when exposed and negligibly depriving down coast beaches (e.g., Zuma Beach) of a minor source of

[5] The additional nourishment of 75,000 cy of sand for dune creation at the east end of the beach may prolong beach life by 2 or more years in that area.

sand from dune erosion. However, Impact CP/GEO-7 would remain beneficial as effects of the longshore currents on nourishment and renourishment of sand in the short- to mid-term include both erosion of sand from Broad Beach and accretion of sand at down coast beaches. This beneficial impact would be incrementally increased under Alternative 2 as additional sand would be exposed seaward of the relocated revetment. There would be slightly more exposed sand relative to Alternative 1 as the revetment would be relocated further landward off all public lands, including most LAEs. However, over the long-term, longshore currents would transport this sand farther down coast and possibly offshore.

Under Alternative 2, the reinforced revetment with larger boulders as armoring would increase the structural stability of the revetment, reducing potential adverse impacts under the Project associated with persistent wave attack. Similar to Alternative 1, this alternative would substantially reduce the adverse effects associated with Impact CP/GEO-1. However, if the revetment could not be keyed into the bedrock located at 16 feet below ground level (SubSurface Designs, Inc. 2006), the risk of liquefaction, seismic settlement, and lateral spreading in the event of an earthquake would still exist as described for the Project. Impacts related to sand compatibility (CP/GEO-4), wave height and direction, tides, and currents (CP/GEO-5), and sea level rise (CP/GEO-8) would be similar to those described for the Project. Short- and medium-term beneficial impacts to wave run-up (Impact CP/GEO-6) would remain similar, but may be extended due to the addition of more sand.

Terrestrial Biological Resources: The relocation of the existing 4,100-foot revetment would require use of heavy cranes and bulldozers that would have major adverse effects on the existing, but often degraded southern foredune habitat fronting the homes along Broad Beach, increasing the impacts identified in Impact TBIO-2. Although much of the habitat in these areas has been subject to landscaping with non-native and invasive plant species associated with adjacent residential development, this area consists of southern foredunes, a habitat type identified as rare by the California Natural Diversity Database (CNNDB) and the California Native Plant Society (CNPS). Moreover, due to the rarity and biological significance of dune habitat in Southern California, southern foredunes are designated as ESHA under the Malibu City LCP.

Installation of large boulders in these existing degraded dunes would create potential adverse impacts to native southern foredune vegetation and/or sensitive wildlife. As the revetment would be relocated up to 60 feet further landward under this alternative relative to the Project, the relocation and reinforcement of the revetment would substantially increase the impacts to existing degraded southern foredune habitat; however, much of the highest quality remaining dune habitat at the east end of Broad Beach was eroded and destroyed by wave action in the winter of 2013-2014, particular during the storm of March 2, 2014. Adverse effects to ESHAs resulting from this alternative would be substantially more severe than those that occurred from past installation of the existing revetments described in Impact TBIO-1, although this impact would be largely offset by successful dune creation. Impact TBIO-4 may also become more severe due to operation of additional heavy equipment within ESHAs necessary to relocate the revetment. This alternative would also slightly increase the short-term impacts of TBIO-5 as additional sand would be exposed seaward of the relocated revetment. However, the potential beneficial effects of dune restoration associated with Impact TBIO-6 would still occur and may incrementally increased due to the additional sand volume required under this alternative, offsetting adverse impacts to existing degraded ESHA. Additionally, requiring shared private coastal access walkways would also substantially reduce disturbance of the proposed dune system described in Impact TBIO-7, protecting this newly established and restored dune habitat. Impacts related to backpassing operations (TBIO-3), and long term erosion of the newly created dune habitat (TBIO-8) would remain largely similar to those described for the Project.

Recreation and Public Access: This alternative would result in the operation of additional pieces of heavy equipment by additional construction personnel, which would increase short-term adverse effects to public access associated with Impact REC-1. This alternative incorporates the public's rights to pass along public land below the January 2010 MHTL and across existing LAEs. This would ensure that over the long-term after nourishment ceases, the revetment is removed, and the beach and dunes erode, the public would continue to have access across the beach. Public access to and along these LAEs would be available when the sensitive dune habitats that overlie these LAEs eventually erode, thus, this alternative would also address Impact REC-4.

Landward relocation of the revetment off of all public trust lands would improve Project consistency with coastal public use and recreation policies. Under this alternative the revetment would cover a negligible area of LAEs fronting 31350 and 31346 Broad Beach Road, where space for landward relocation of the revetment is limited. Additionally, after the 10- to 20- or more year Project life, nourishment sand would be washed away and the beach would recede back to the new revetment, leaving little to no dry-sand beach area for recreation without continued renourishment. However, a maximum landward relocated revetment combined with increased dune width at the beaches' east end would provide additional room for public beach use, particularly at low and moderate tides. This may be gradually offset by SLR after 2050. Backpassing operations and associated impacts to recreational users identified in Impact REC-2 would be similar to those described for the Project. Additionally, medium- and short-term benefits to public recreation opportunities due to a wide sandy beach berm and increased lateral access would remain similar to those identified for the Project in Impact REC-3.

Marine Water Quality: Installation of a properly engineered revetment would substantially reduce potential impacts to Marine Water Quality. Potential damage to homes, OWTS, and accessory structures from coastal erosion, and beneficial impacts to public trust resources identified in Impact MWQ-3 would be increased, as the reengineered revetment would provide long-term protection of existing development from coastal erosion. However, leach fields west of 30970 Broad Beach Road would be located within 15 feet of the wave uprush limit calculated by Moffatt & Nichol (2013). Consequently, after cessation of beach nourishment and erosion of the newly widened beach in 10 to 20 or more years these leach fields may experience splashing or minor seawater intrusion from waves overtopping the improved revetment during large 100-year storm events which may incrementally impact near shore water quality. However, this would also require waves to erode the overlying seaward end of the dune system. Further, after cessation of nourishment and erosion of the beach in 10 to 20 or more years, the CSLC would consider disposition of all improvements on state sovereign lands and those overlying LAEs and any actions associated with lease extension or termination needed to protect marine water quality. Construction-related impacts to impairment of area waters and the possibility of sand contaminant resuspension would be slightly increased due to the additional construction activities associated with relocation and reinforcement of the revetment and the additional volumes of sand to be added.

Utilities and Service Systems: As previously described, relocation of the revetment inland of the January 2010 MHTL would require potential landward relocation of as many as 22 OWTS or the steepening of the landward slope or narrowing of the reinforced revetment in these locations. If landward movement of these systems were not possible the revetment would have to be redesigned fronting these residences or potentially relocated landward, but still partially on or in front of the public lands in these areas. This decision would result in potential tradeoff between impacts to recreation and utilities and service systems. Based on aerial imagery, it appears that it is infeasible to relocate at least three of the OWTS fronting 31138 and 31122 Broad Beach Road. Additionally, it appears only potentially feasible for seven of the remaining 20 residences. Further, this aerial analysis does not take into consideration underlying utilities that may further complicate or preclude landward relocation of the OWTS.

Potential for relocation of OWTS may be limited due to space restraints and code issues. Additionally, relocation of the revetment landward of the landward of the January 2010 MHTL and most LAEs west of 30970 Broad Beach Road may cause future permitting issues with the city of Malibu and potentially other agencies as all properties must comply with city code if repairs or upgrades are made to an existing treatment system. Such repairs are required for major remodels or home expansion and also for resale and as such have cited such relocation as infeasible (Ensitu 2013). However, as discussed Section 3.7.6, *Utilities and Service Systems*, the city of Malibu Municipal Code does not appear to directly conflict with this alternative for the majority of affected homes. Further, the feasibility of revetment relocation off public lands does not consider ability to expand existing homes, but rather the ability of the OWTS to serve the existing

Table 4-3. Alternative 2 – Potential for Landward Relocation of OWTS

Address	Number of Affected OWTS	Potential for Landward Relocation Behind Revetment[1]	Potential for Relocation Landward of Home [2]
31324	1	Potentially Feasible	Insufficient Area
31316	1	Feasible	Feasible
31280	1	Potentially Feasible	Insufficient Area
31250	3	Feasible	Feasible
31228	1	Feasible	Insufficient Area
31138	1	Not Feasible	Insufficient Area
31122	2	Not Feasible	Insufficient Area
31058	1	Feasible	Feasible
31054	1	Potentially Feasible	Insufficient Area
31052	2	Potentially Feasible	Insufficient Area
31034	2	Feasible	Insufficient Area
30970	2	Potentially Feasible for at Least One Component	Insufficient Area
30966	1	Feasible	Insufficient Area
30952	1	Feasible	Feasible
30928	1	Potentially Feasible	Insufficient Area
30842	1	Feasible	Insufficient Area
Total Affected Properties	**Total Affected System Components**	**Number of OWTS Feasible to Relocate Landward of Revetment**	**Number of OWTS Feasible to Relocate Landward of Home**
16	22	8	4

Source: Topanga Underground 2012.
[1]Feasibility determined via aerial imagery and CAD files provided by the city of Malibu.
[2]Feasibility determined via the recommendations of Topanga Underground (2012).

home. Under this Alternative, it appears that at least six existing homes may lose that ability to dispose of wastewater without major alterations to the relocated revetment alignment and design. Finally, Applicant-prepared studies have also identified a requirement for septic system leach fields to be setback a minimum of 15 feet from a wave uprush zone. As noted above, such uprush is projected to occur only during a 100 year event and after erosion of the beach and overlying dune system in 10 to 20 or more years. Further, the reinforced revetment would limit, but not fully eliminate the size and intensity of such wave uprush. Limited amounts of water overtopping the revetment would likely have only moderate effects on water quality as contact with any released septic effluent with marine waters would be limited by the revetment.

Maintaining or relocating the OWTS for the impacted homes is necessary because there are no feasible opportunities to connect to a centralized public or private sewer system. In order to address potential impacts to the operation of existing leach fields the revetment's design location could be altered to allow space for existing OWTS that cannot be relocated. Altering the revetment's design would require narrowing of the revetment or moving the revetment location seaward where it would again impact and cover LAEs. While the latter is feasible, it would be contrary to the intent of this alternative. Further, revetment design does not permit or allow for sharp breaks in direction, so any adjustment for one house would affect LAEs on adjacent parcels.

Under this alternative, beach nourishment and to a greater degree reinforcement of the existing revetment would reduce potential impacts to Utilities and Service Systems. This alternative would substantially increase the beneficial impacts associated with UTL-1. Potential damage to OWTS from coastal erosion, and associated indirect impacts to public trust resources identified in Impact UTL-2, including adverse effects to water quality and public use and enjoyment of the beach and ocean, would be greatly reduced, as the reinforced revetment would provide long-term protection of existing OWTS from coastal erosion. However, leach fields west of 30970 Broad Beach Road would be located within 15 feet of the wave uprush limit calculated by Moffatt & Nichol (2013) after cessation of nourishment activities and erosion of the newly widened beach and dune system in 10 to 20 or more years. Consequently, these leach fields may experience splashing or minor seawater intrusion from waves overtopping the improved revetment during large 100-year storm events. Relocation of the revetment closer inland would also result in similar public drainage-related impacts of the Project as discussed in Impact UTL-3 as construction of the restored dunes and beach nourishment will bury or obstruct public drainages. Similar to the Project, Impact UTL-3, such impacts would be a minor adverse effect with implementation of AMM UTL-3 (Master Drainage Plan).

Other Resource Areas: This alternative would have similar impacts to the Project in terms of its effects on scenic resources, marine biological resources, historic, and paleontological resources, and environmental justice. Effects on transportation, traffic, parking, and noise would be somewhat more severe due to increase levels of vehicular activity and congestion related to construction phases. Effects on public health and safety hazards and historic resources may be incrementally increased due to increased construction activity associated with the relocation and reinforcement of the revetment (Table 4-4).

Table 4-4. Alternative 2 – Changes in Impact Severity

Resource Area	Relative Change in Impact Severity	Discussion
Scenic Resources	No Major Change in Adverse Impacts	Additional construction equipment associated with landward relocation of the revetment may intensify the adverse impacts associated with temporary construction activities, with a slight increase in the severity of adverse effects associated with Impact SR-2 and SR-4. Similar to the Project, permanent authorization of the revetment through a long-term lease and approval of CDPs would create the potential for long-term degradation of the visual environment of Broad Beach after nourishment activities end and natural coastal erosion causes the revetment to become exposed as described in Impact SR-1.

Table 4-4. Alternative 2 – Changes in Impact Severity

Resource Area	Relative Change in Impact Severity	Discussion
Marine Biological Resources	Incremental Decrease in Indirect Adverse Impacts	Placement of sand and potential burial of rocky intertidal and subtidal marine biological resources would have a major adverse effect to intertidal habitats and offshore habitats of Broad Beach similar to the Project as described in Impacts MB-1, MB-2, MB-3, MB-4, MB-5, and MB-8. Additionally, similar to the Project, impacts to down coast habitats would be negligible as discussed in Impact MB-7. Potential indirect impacts associated with water pollution from coastal erosion damage to OWTS would be reduced along the length of the existing revetment. The potential for fuel or oil release described in Impact MB-6 would be slightly increased due to increased construction activities.
Cultural and Paleontological Resources	Incremental Increase in adverse Impacts	Disturbance of the near shore environment associated with the landward relocation of the revetment would result in a slightly increased potential to disturb cultural resources, resulting in an additional adverse impact similar in type to Impact CR-1. Implementation of standard BMPs would reduce this impact.
Noise	Incremental Increase in Adverse Impacts	A temporary increase in noise due to additional construction associated with the landward relocation of the revetment would result in adverse impacts to beach users and receptors along affected roadways. Consequently, this alternative would result in slight increases in adverse effects associated with Impact N-1. Impacts would be reduced through implementation of AMM N-1a, similar to the Project.
Public Health and Safety Hazards	No Major Change in Adverse or Beneficial Impacts	This alternative would result in a slight increase in the adverse effects associated with Impact HAZ-2, as additional heavy construction equipment (i.e., bulldozers, cranes, and haul trucks) would increase the potential for an incidental release of hazardous material on Broad Breach. Additional construction equipment and construction personnel would also increase inaccessibility and hazardous conditions during construction, slightly increasing the severity of adverse effects associated with Impact HAZ-3. These impacts would be reduced through implementation of AMMs HAZ-2, HAZ-3a, and HAZ-3b.
Traffic and Parking	Incremental Increase in Adverse Impacts	Landward relocation of the revetment and a wider dune system on the beach's east end would require an estimated 10,000 more heavy haul truck trips and additional heavy construction equipment and construction personnel, which would likely increase traffic and congestion on PCH and in the Zuma Beach parking lot, incrementally increasing the severity of adverse effects associated with Impact TR-1. These impacts would be reduced through implementation of AMM TR-1.
Environmental Justice	No Major Change in Adverse Impacts	There would be no appreciable difference in impacts relative to the Project.

4.2.3 Alternative 3: Maximum Pull-back of Seawall with Beach Nourishment and Dune Restoration

<u>Description</u>

Under this alternative, the existing emergency revetment would be removed and replaced with a vertical seawall located on private property as far landward and as close to the existing primary residences as physically feasible, while also maintaining a minimum setback of 6 feet seaward from the existing OWTS, including septic tanks, leach fields, and other treatment infrastructure. Although the seawall could be feasibly located more closely to the OTWS and their leach fields, this 6-foot setback would decrease potential impacts of wastewater pooling behind the seawall, which would affect the structure's stability and prevent reliable percolation of wastewater effluent. Similar to the Project, the installation of the seawall would be accompanied by beach nourishment and dune restoration, annual backpassing activities, and a follow-up renourishment event (see Figure 4-3).

Construction of a new 2-foot thick, 20-foot high, 4,700-foot long seawall could be accomplished by one of two approaches: 1) use of steel sheet piles with a concrete cap, or 2) use of poured and formed concrete. In either case, the seawall would be fronted by a 10-foot-wide subsurface boulder toe apron to prevent foundation scour by wave action and potential wall collapse (refer to Figure 4-3). A sheet pile seawall would be preferred due to the smaller construction footprint and the close proximity of OWTS and leach fields. Construction of a cast-in-place concrete seawall would require a larger footprint and may not be able to protect existing systems in place. Construction of a cast-in-place concrete seawall would likely require the relocation of OWTS, which may be feasible in some instances, limited in others due to space constraints and code issues as described for Alternatives 1 and 2, and further described below.

Construction of either type of seawall in such close proximity to the residences or OWTS would eliminate area available for dune restoration landward of the seawall. Consequently, all restored dunes would be located seaward of the seawall. Further, the seawall could rise as much as 3 feet above the level of the proposed dunes because the seawall must be taller than a revetment to avoid wave overtopping and potential pooling of seawater behind the wall following complete erosion of the nourished beach.

The new seawall would be constructed through existing backyards, patios, and remnant disturbed dune habitat (see Illustration 4-3). While the existing buildings fronting Broad Beach are unevenly set back from the OHWM, the engineered design of the seawall must be as linear as possible to maximize strength of the wall and to minimize erosion. The proposed seawall would be located no less than 6 feet from the existing leach fields, entirely on private land; however, the distance of the seawall from each residence would vary depending on the location of existing leach fields. The average setback from the toe of the seawall would extend 45 feet and the maximum setback would be about

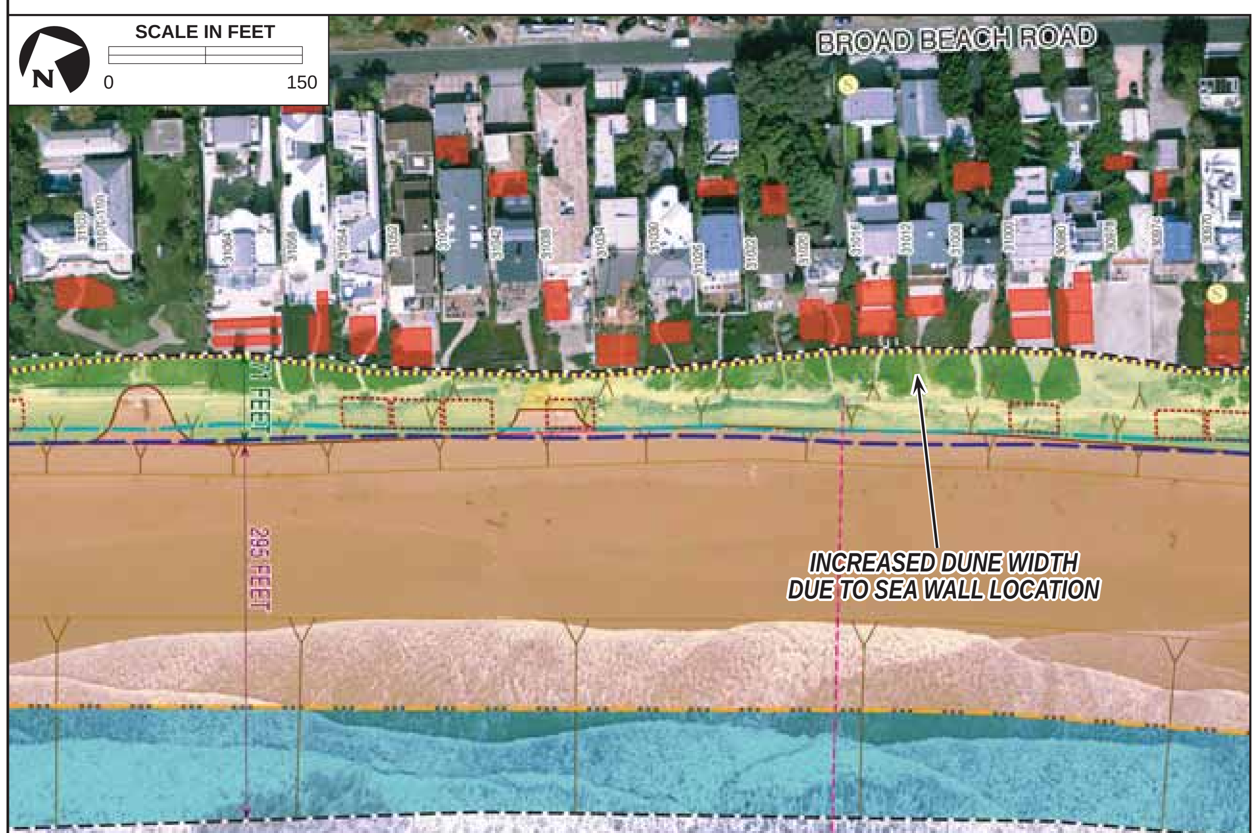
Illustration 4-3: *Construction of a seawall approximately 6 feet from the homes along Broad Beach would require major increases in construction activities. A large number of patios would require demolition and reconstruction. Additionally, a large number of OWTS would require relocation and or abandonment, which would also substantially increase adverse impacts at Broad Beach.*

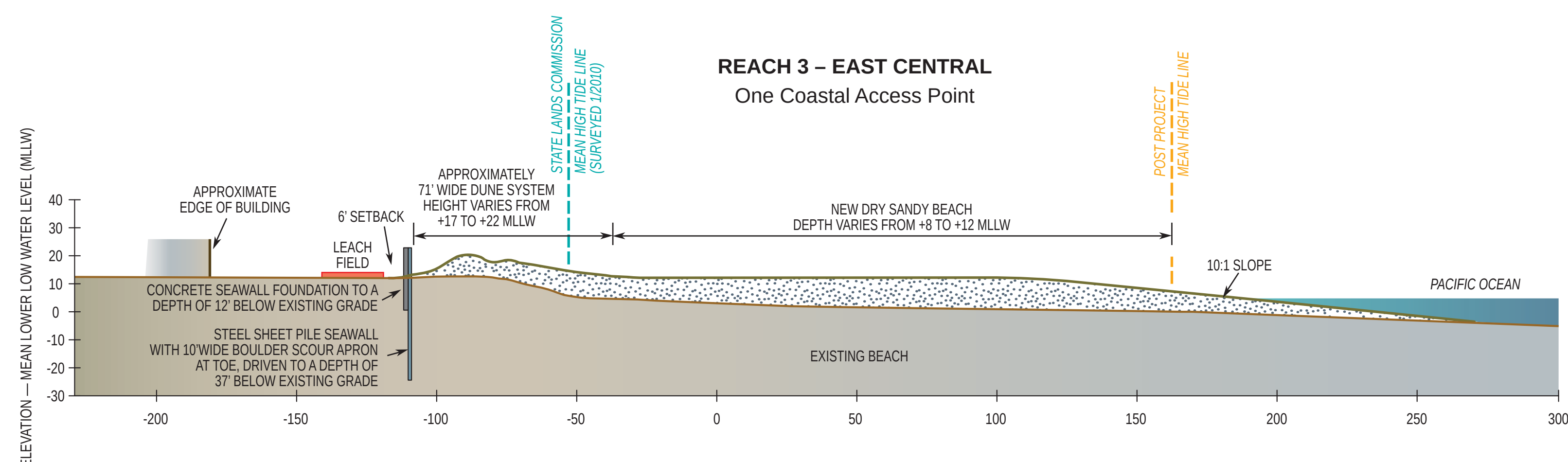
110 feet. Construction of a seawall using either method would require major disruption or removal of existing private improvements, including a number of patios, pools, landscaping, and other accessory use improvements. Construction of the seawall would not necessitate removal or relocation of any portion of primary structures, such as habitable spaces within existing residential units.

Beach nourishment, dune creation, and habitat restoration would be included under this alternative and habitat restoration concepts would remain similar to those proposed under the Project. However, in this scenario, dune restoration would be confined to the seaward side of the seawall. However, the proposed seawall would be constructed as far inland of the OHWM and the boundary between public and private land as possible while also maintaining a 6-foot setback from existing leach fields. On the eastern side of Broad Beach, this would result in a large landward setback from the OHWM compared to the location of the existing revetment, with increasingly small amounts of landward movement along the central and west beach areas. In some locations near the western end of the existing revetment, the seawall alignment would match the existing revetment location since the revetment is already located 6 feet from the existing leach fields.

This alternative would generate beach and dune design and access management issues regarding how best to redesign the Project to achieve the objectives while also accommodating the seawall. In particular, within the eastern and central segments of the beach, approximately 100 to 150 feet of private property that currently supports backyards, patios, and walkways would be located on the ocean-side of the seawall. This alternative would narrow availability of private property to approximately 0 to 20 feet toward the west-central end of the beach. Several approaches to this issue are possible and are discussed in detail in Appendix L, *Alternatives Screening*.

Detail





LEGEND

- Existing Public Access
- Approximate Limits of Beach Nourishment/ New Beach
- Seawall Alternative
- Proposed New Dry Sandy Beach
- Proposed New Intertidal Beach Area
- Proposed Restored Dune
- Area of Dune or Beach Face (3:1 and 10:1 slopes)
- State Lands Commission Mean High Tide Line (surveyed 1/2010)
- Applicant Mean High Tide Line (surveyed 10/15/2009)
- Post Project Mean High Tide Line
- Existing Septic Tank
- Existing Leach Field/Drain Field
- Existing Lateral Access Easements (LAEs)
- Easement on file, but no dry beach to dedicate
- Surf Grass
- Property Address

Note: Beach dimensions and post project average high water line reflect beach status immediately after completion of beach nourishment and construction/shaping activities; the equilibrium beach that would result from dynamics such as waves, tidal and wind action would likely be of somewhat different dimensions.

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Maximum Pull-back of Seawall with Beach Nourishment and Dune Restoration

FIGURE 4-3

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This alternative includes the creation of a wider dune system along the central and eastern reaches of Broad Beach due to the increased setback of the seawall behind the OHWM relative to the existing emergency rock and sand bag revetment. This approach would increase the width of the dune system and habitat restoration area over all private land seaward of the seawall, while also continuing to provide the same wide sandy beach as described under the Project. However, this alternative would require major additional sand (120,000 cy) for dune creation, with an associated 8,500 additional haul truck trips. This alternative may also pose issues regarding the management of public and private property delineated on either side of the seawall. However, this approach would be the most consistent with overall Project objectives.

Under this alternative, the profile of the sandy beach would be the same as that described in the Project, with a beach width of approximately 100 feet on the west, increasing to over 200 feet in the central and eastern areas of Broad Beach. However, the dune width would be substantially increased from the currently proposed approximately 50feet and would instead range from approximately 220 feet wide in the east to approximately 125 feet wide in the central west section, tapering down to approximately 70 feet on the west.

Full public access would be permitted along the entire beach, but restricted from the dunes where a line of rope or cable and signs would prohibit access to ESHA. This rope or cable system, combined with the dune system would also ensure resident privacy. This alternative would channel resident access across the dunes into unpaved shared walkways spaced every 300 feet (each combining access for up to six homes). These shared walkways traversing the dune system from the beach would be connected to a back dune walkway lined with low fencing, located adjacent to the ocean side of the seawall due to limited space available on the landward side. The back dune walkway would be inland of, and parallel to, the restored dunes to restrict or inhibit access by residents and pets into this potential ESHA. However, because the seawall may extend 3 feet above the finished grade, this alternative may require up to 112 stairways (one stairway for each private primary structure at Broad Beach) be constructed up and over the seawall to connect to the private properties at Broad Beach.

This alternative would also recognize the public's rights to pass along public land below the January 2010 MHTL and across existing LAEs. This would ensure that over the long-term after nourishment ceases, the revetment is removed, and the beach and dunes erode, the public would continue to have access across the beach. Public access to and along these LAEs would be available when the sensitive dune habitats that overlie these LAEs eventually erode over the long-term and public access to these LAEs becomes necessary and available.

Initially, construction would require use of additional bulldozers and a crane. This alternative would also require approximately 1,794 new trips by heavy haul trucks to remove a major portion of the existing emergency revetment while retaining some of the rocks for use in the boulder toe apron of the seawall.[6] This would be followed by the excavation of a foundation for the seawall, which would cover approximately 8 to 12 feet in both depth and width. This foundation would be necessary to support a poured concrete seawall or to permit emplacing the rock toe apron for the steel sheet pile seawall. For the poured concrete seawall, construction would be accompanied by excavation and recompaction of sand dunes and soil behind the wall to provide stability for the seawall to withstand wave action. Activities associated with this approach would require an approximately 40-foot-wide construction corridor. If a concrete seawall were installed, up to approximately 3,920 cement truck trips would be required for foundation and wall construction. In contrast, construction of the steel sheet pile seawall would require only a 20-foot-wide corridor to permit access of heavy equipment necessary to drive the sheet piles down into deep sand or bedrock using vibratory hammers suspended from cranes. Seawall construction would also include a major increase in the number of construction workers, vehicles, and equipment relative to the Project.

The proposed seawall would be 20 feet high in order to prevent wave overtopping and therefore, would rise up to approximately 8 feet taller than the existing revetment, which currently ranges in height from 12 to 15 feet. Given that the dune system would range in height from 17 to 20 feet along the eastern and central portion of the beach, up to 3 feet of the seawall would be exposed. The increased height of the seawall when compared to the revetment is necessary because revetments tend to absorb wave energy into spaces between boulders while seawalls repel waves, leading to greater impact forces from waves and potential overtopping, if and when the seawall becomes exposed.

This alternative would require installation of many of the same improvements as the Project and associated construction activities. Major components would include:

- Removing most of the existing rock revetment using heavy cranes, bulldozers and an estimated 1,794 haul truck trips to transport sand bags, and other materials composing the existing revetment off of the beach, while retaining some of the rocks for use in the boulder toe apron;
- Redistribution of beach sand within the sand bags and removal of sand bag liners and other remaining debris;
- Importing steel sheet piles on flatbed semi-trucks, or pre-mixed concrete in 3,920 cement trucks;
- Constructing approximately 4,700 feet of seawall using cranes and vibratory hammers to force steel sheet piles 37 feet into sand and bedrock; or excavation of a trench, measuring 8- to 12-feet in depth and width to accommodate the foundation and installation of forms, rebar and concrete to create the seawall;

[6] The number of trips is an estimate, as an unknown number of the existing larger 2-ton stones would be retained to construct the seawall's rock toe apron.

- Use stone from the existing emergency revetment to construct a 10-foot-wide boulder toe apron fronting the seawall using heavy cranes and bulldozers;
- Transport of an additional estimated 120,000 cy of sand from the inland quarries to Broad Beach via an estimated 8,560 truck trips for a total of approximately 51,560 sand haul truck trips;
- Redistributing the sand as needed with earthmoving equipment, such as bulldozers, and grading the beach fills to required dimensions;
- Constructing a system of sand dunes up to approximately 220 feet wide at the east end of the beach to be planted with native dune species;
- Creating a system of shared walkways to provide private lateral and vertical coastal access across the new dune system, including up to 112 stairways on the on the face of the seawall to connect private properties to the shared walkways;
- Providing two vertical public access trails up and over the seawall and across the dunes to connect existing access points to the widened beach and ensuring public lateral access along the widened beach seaward of the OHWM
- Performing backpassing of the sand from the east to west end of the beach based on triggers and using heavy equipment such as scrapers and bull dozers; and
- Initiating one future major renourishment event of approximately 450,000 cy in roughly 10 years following initial nourishment activities.

<u>Potential Impacts to Public Trust Resources</u>

This alternative would include removal of a major portion of the existing emergency revetment while retaining some of the rocks for use in the boulder toe apron of the seawall, as well as the installation of a seawall entirely within the private property boundary of the residences fronting Broad Beach. This alternative is the most construction-intensive alternative of any included in this APTR. . This alternative would also involve demolition of up to approximately 55 patios and relocation of up to 54 OWTS, if the cast-in-place seawall were selected. This alternative would also require a longer period of construction of up to an additional 2 to 3 months for revetment removal, seawall construction and transport and distribution of the additional 120,000 cy of inland sand. These activities would incrementally increase construction related impacts, particularly those related to terrestrial biological resources. Resource areas with major changes to impacts relative to the Project are discussed in detail below, while the resource areas with negligible changes to impacts are summarized in Table 4-6 at the end of this subsection.

Air Quality and Greenhouse Gases: There would be a major increase in air pollutant and GHG emissions associated with increased heavy haul and cement truck trips and the operation of additional heavy equipment during Project construction. Similar to Alternatives 1 and 2, emissions of VOCs and NO_x would be increased under this alternative; however, due to the major increase in construction required under this alternative, Impact AQ-1 would be substantially more severe than under the Project, including under SCAQMD's LSTs for construction activities. Given the potential impacts to air quality, this alternative would require the use of AMMs as outlined in the Project (e.g., use of new trucks with clean-burning engines); however, total impacts to air quality would still increase above those associated with the Project (Appendix G). Greenhouse gas (GHG) emissions described in Impact AQ-2 would be incrementally increased but would remain below SCAQMD and VCAPCD thresholds. Finally, increased truck traffic and heavy equipment operation associated with reinforcement and relocation of the rock revetment would incrementally increase toxic air contaminant emissions; however impact AQ-3 would remain minor as thresholds would not be exceeded.

Whereas implementation of Alternative 3 would substantially increase the severity of construction-related air quality impacts over the short-term, this alternative may incrementally reduce the severity of construction-related air quality emissions from backpassing. As previously described, additional beach width would be made available with the landward construction of the seawall as close to the existing leach fields as possible. This would incrementally delay the exposure of the seawall after the initial nourishment event based on a continued average estimated sand loss rate of between 30,000 and 45,000 cy per year (Moffatt & Nichol 2013). However, while the need for backpassing may be incrementally reduced, backpassing would still be required to maintain the evenly distributed wide sandy beach, and air pollutant and GHG emissions would still be considered a major adverse impact.

Coastal Processes, Sea Level Rise, and Geologic Hazards: Construction of a seawall far landward of the January 2010 MHTL accompanied by a much wider dune system would change potential impacts to coastal processes relative to those described for the Project. Erosion of beach and dunes after the cessation of nourishment would continue as described under the Project; however, in the central and eastern segments of the beach, the substantially wider restored dune system may extend the beneficial effects identified in Impact CP/GEO-3 beyond the estimated 10 to 20 or more years associated with the Project. Anticipated SLR of approximately 8.5 inches by 2030 would further exacerbate erosion effects, including increased frequency and intensity of storm surges and wave attack. In addition, adverse impacts associated with Impact CP/GEO-2 would be greatly reduced, including potential damage to homes, OWTS and accessory structures from coastal erosion. Further, associated indirect impacts to public trust resources identified in Impact CP/GEO-2, such as adverse effects on water quality, would also be greatly reduced. The seawall would provide long-term protection of existing OWTS, primary structures, and relocated patios; however, construction of a cast-in-place concrete seawall would require relocation of up to 54 OWTS, which appears to be infeasible due to space limitation and city code requirements.