

EXECUTIVE SUMMARY

ES.1 INTRODUCTION

The Bureau of Safety and Environmental Enforcement (BSEE) and Bureau of Ocean Energy Management (BOEM) propose to allow the use of selected well stimulation treatments (WSTs) on the 43 current active leases and 23 operating platforms on the Southern California Outer Continental Shelf (OCS). Use of some WSTs may allow lessees to recover hydrocarbon resources (i.e., oil) that would otherwise not be recovered from the reservoirs in the lease areas that have been and continue to be accessed by existing wells as well as any new wells in the foreseeable future.

In accordance with the National Environmental Policy Act (NEPA) of 1969, BSEE and BOEM prepared this final programmatic environmental assessment (PEA) to evaluate the potential environmental impacts of the proposed approval of the use of WSTs on the 43 current leases and 23 platforms currently in operation on the Southern California OCS Planning Area. This PEA uses the term POCS throughout to refer to the Southern California OCS area with the 43 leases and associated oil and gas platforms in Federal waters. This final PEA analyzes the potential environmental effects of WSTs under various alternative actions that would meet the purpose and need for the proposed action. The evaluation in this final PEA of relevant environmental and other data identifies the potential nature and magnitude of environmental impacts that may be associated with the use of WSTs on the 43 active lease areas on the POCS. Information gathered here will also help ensure that the U.S. Department of the Interior (DOI) achieves its mission of efficient production and conservation of OCS energy resources and the receipt of fair market value from the leasing of public lands. This PEA will facilitate DOI meeting other environmental requirements related to future authorizations, requirements such as Endangered Species Act, Marine Mammal Protection Act, and Coastal Zone Management Act.

ES.2 PURPOSE AND NEED FOR THE PROPOSED ACTION

The purpose of the proposed action (use of certain WSTs, such as hydraulic fracturing) is to enhance the recovery of petroleum and gas from new and existing wells on the POCS, beyond that which could be recovered with conventional methods (i.e., without the use of WSTs). The use of WSTs may improve resource extraction from some existing wells, and in some future new wells, on the POCS. The need for the proposed action is the efficient recovery of oil and gas reserves from the POCS.

ES.3 PROPOSED ACTION AND ALTERNATIVES

The WSTs evaluated in this PEA include fracturing and non-fracturing treatments which may be used for enhancing production from existing or new wells where formation permeability and decreasing reservoir pressure are limiting oil recovery. This PEA adopts the definitions that are found in State of California Senate Bill No. 4 (SB-4) Oil and Gas: Well Stimulation. The

1 SB-4 definitions are applied to WST activities that are occurring in State waters and accessing
2 the same formations as those being accessed by offshore platforms on the 43 active Federal lease
3 areas, as well as being widely used on land in California. Adopting the SB-4 definitions allows
4 for straightforward comparisons of WST applications in Federal and State offshore operations
5 and in the analysis of the cumulative effects of all offshore operations.
6

7 Under the SB-4 definitions, *Well Stimulation Treatment* means any treatment of a well
8 designed to enhance oil and gas production or recovery by increasing the permeability of the
9 formation. WSTs include, but are not limited to, hydraulic fracturing treatments and acid well
10 stimulations. Routine well cleanout work, routine well maintenance, routine removal of
11 formation damage due to drilling, bottom hole pressure surveys, and routine activities that do not
12 affect the integrity of the well or the formation are not considered WSTs.
13

14 This PEA distinguishes between “fracturing WSTs,” in which WST fluids are injected at
15 pressures required to fracture the formation (i.e., greater than the formation fracture pressure),
16 and “non-fracturing WSTs,” in which the WST fluid is injected at less than the pressure required
17 to hydraulically fracture the formation. Diagnostic fracture injection tests (DFITs), hydraulic
18 fracturing, and acid fracturing are the fracturing WSTs analyzed in this PEA. Matrix acidizing is
19 the only non-fracturing WST analyzed. The four WSTs analyzed in this PEA are described as
20 follows:
21

- 22 • **Diagnostic Fracture Injection Test (DFIT).** The DFIT is used to estimate
23 key reservoir properties and parameters that are needed to optimize a main
24 fracture job. It is a short duration procedure that involves the injection of
25 typically less than 100 bbl of fracturing fluid at pressures high enough to
26 initiate a fracture. Key parameters are estimated from the fluid volume
27 injected and the pressure dissipation profile. The fluid used in a DFIT is
28 typically the fluid that would be used in the main fracture treatment but with
29 no proppant¹ added, thus allowing the fracture to close naturally as pressure is
30 released.
31
- 32 • **Hydraulic Fracturing.** Hydraulic fracturing involves the injection of a
33 fracturing fluid at a pressure (as typically determined by a DFIT) needed to
34 induce fractures within the producing formation. The process generally
35 proceeds in three sequential steps: (1) injection of a fracturing fluid without
36 proppant to create fractures which extend out from the well; (2) injection of a
37 slurry of fracturing fluid and proppant; and (3) injection of breakers,
38 chemicals added to reduce the viscosity of the fracturing fluid. Upon release
39 of pressure, the fracturing fluid is allowed to flow back (the flowback fluid) to
40 the surface platform. Key fluid additives include polymer gels which increase
41 the viscosity of the fluid and allow it to more easily carry proppant into the
42 fractures, crosslinker compounds that help further increase the fluid viscosity,
43 and breaker chemicals which break down the crosslinked polymers and allow

¹ A proppant is a solid material, typically sand, treated sand, or man-made ceramic materials, designed to keep an induced fracture open during or following a fracture treatment.

1 them to return more readily to the surface after fracturing is completed. Other
2 important additives may include pH buffers, clay control additives, microbial
3 biocides, and surfactants to aid in fluid recovery. In offshore applications, the
4 base fracturing fluid is filtered seawater.

- 5
- 6 • **Acid Fracturing.** Acid fracturing is similar to hydraulic fracturing except that
7 instead of using a proppant to keep fractures open, an acid solution is used to
8 etch channels in the rock walls of the fractures, thereby creating pathways for
9 oil and gas to flow to the well. As with a hydraulic fracturing WST, a pad
10 fluid is first injected to induce fractures in the formation. Next, the acid
11 fracturing fluid is injected at pressures above the formation fracture pressure
12 and allowed to etch the fracture walls. The acid fracturing fluid is typically
13 gelled, cross-linked, or emulsified to maintain full contact with the fracture
14 walls. Fifteen percent hydrochloric acid (15% HCl) solutions are typically
15 used in carbonate formations such as limestone and dolomite, while
16 hydrofluoric acid (HF) solutions and HCl/HF mixtures are used in sandstone
17 and Monterey shale formations and in other more heterogeneous geologic
18 formations, typically at levels of 12% and 3%, respectively. The fracturing
19 fluid typically also includes a variety of additives at a combined concentration
20 on the order of 1% or less, such as inhibitors to prevent corrosion of the steel
21 well casing, and sequestering agents to prevent formation of gels or iron
22 precipitation which may clog the pores.
 - 23
 - 24 • **Matrix Acidizing.** In matrix acidizing, a non-fracturing treatment, an acid
25 solution, is injected into a formation where it penetrates pores in the rock to
26 dissolve sediments and muds. By dissolving these materials, existing channels
27 or pathways are opened and new ones are created, allowing formation fluids
28 (oil, gas, and water) to move more freely to the well. Matrix acidizing also
29 removes formation damage around a wellbore, which also aids oil flow into
30 the well. The acid solution is injected at pressures below the formation
31 fracture pressure and is thus a non-fracturing treatment. Three distinct fluids
32 are commonly used sequentially: (1) an HCl acid preflush fluid; (2) a main
33 acidizing fluid generated from mixing HCl and ammonium bifluoride to
34 produce an HCl/HF mud acid at typically 12% and 3%, respectively (some
35 operations use mud acid while some operations primarily use 15% HCl); and
36 (3) an ammonium chloride overflush fluid. The acidizing fluid also includes a
37 variety of additives at a combined concentration of on the order of 1% or less,
38 similar to those used in acid fracturing.
 - 39

40 This PEA analyzes the following alternatives that meet the purpose and need of the
41 proposed action:

- 42
- 43 • **Alternative 1: Proposed Action—Allow Use of WSTs.** Under this
44 alternative, BSEE technical staff and subject matter experts will continue to
45 review applications for permit to drill (APDs) and applications for permit to
46 modify (APMs), and, if deemed compliant with performance standards

1 identified in BSEE regulations at Title 30, *Code of Federal Regulations*,
2 Part 250, subpart D (30 CFR Part 250, subpart D), will approve the use of
3 fracturing and non-fracturing WSTs at the 22 production platforms located on
4 the 43 active leases on the POCS. Based on the historic record and expected
5 future industry requests, the Bureaus developed a reasonable forecast of up to
6 five WSTs per year for any of the action alternatives evaluated under this PEA
7 (i.e., Alternatives 1 through 3).
8

- 9 • **Alternative 2: Allow Use of WSTs with Subsurface Seafloor Depth**
10 **Stipulations.** Under this alternative, no use of fracturing WSTs would be
11 approved at depths less than 2,000 ft (610 m) below the seafloor surface. This
12 alternative is intended to reduce the likelihood that a fracturing WST would
13 produce fractures that could intersect an existing fault, fracture, or well and
14 potentially create a pathway to the seafloor surface and result in a
15 hydrocarbon release to the ocean.
16
- 17 • **Alternative 3: Allow Use of WSTs but No Open Water Discharge of WST**
18 **Waste Fluids.** Under this alternative, no WSTs would be approved that use
19 open ocean disposal of any WST-related waste fluids (such as the flowback)
20 or of produced water comingled with WST waste fluids. This alternative is
21 intended to eliminate any potential effects of discharges of WST-related
22 chemicals on the marine environment. Currently permitted open water
23 discharge of produced water could continue when produced water does not
24 contain WST-related chemicals. When WST-related chemicals are present,
25 produced water would need to be disposed by alternative means such as
26 through injection. Additional injection wells could be needed at one or more
27 of the platforms where disposal currently occurs only via permitted open
28 water discharge.
29
- 30 • **Alternative 4: No Action—Allow No Use of WSTs.** Under this alternative,
31 none of the four WSTs identified for the proposed action would be approved
32 for use in any current or future wells on the 23 platforms associated with
33 active lease areas on the Southern California OCS. This alternative would
34 eliminate all effects of the use of WSTs. Production at some wells may be
35 expected to decline sooner than under the proposed action, as reservoir
36 pressures continue to decline with primary production. Routine well
37 maintenance activities (e.g., wellbore cleanup) and enhanced oil recovery
38 techniques (e.g., water flooding) that fall outside of the SB-4 definitions of
39 WSTs would continue (as they would under any of the other three
40 alternatives). For example, well maintenance conducted with the well tree
41 installed, which may not require specific BSEE approval, would continue,
42 including (1) acid wash (a form of acid cleanup treatment), (2) solvent wash
43 (a chemical method of cutting paraffin), (3) casing scrape/surge (a method of
44 scale or corrosion treatment and swabbing), and (4) pressure/jet wash
45 (a method of bailing sand and a scale or corrosion treatment). In addition, well

1 maintenance operations that require removal of the tree, which are not
2 considered routine and need an approved APM, would also continue.
3
4

5 **ES.4 AFFECTED ENVIRONMENT**

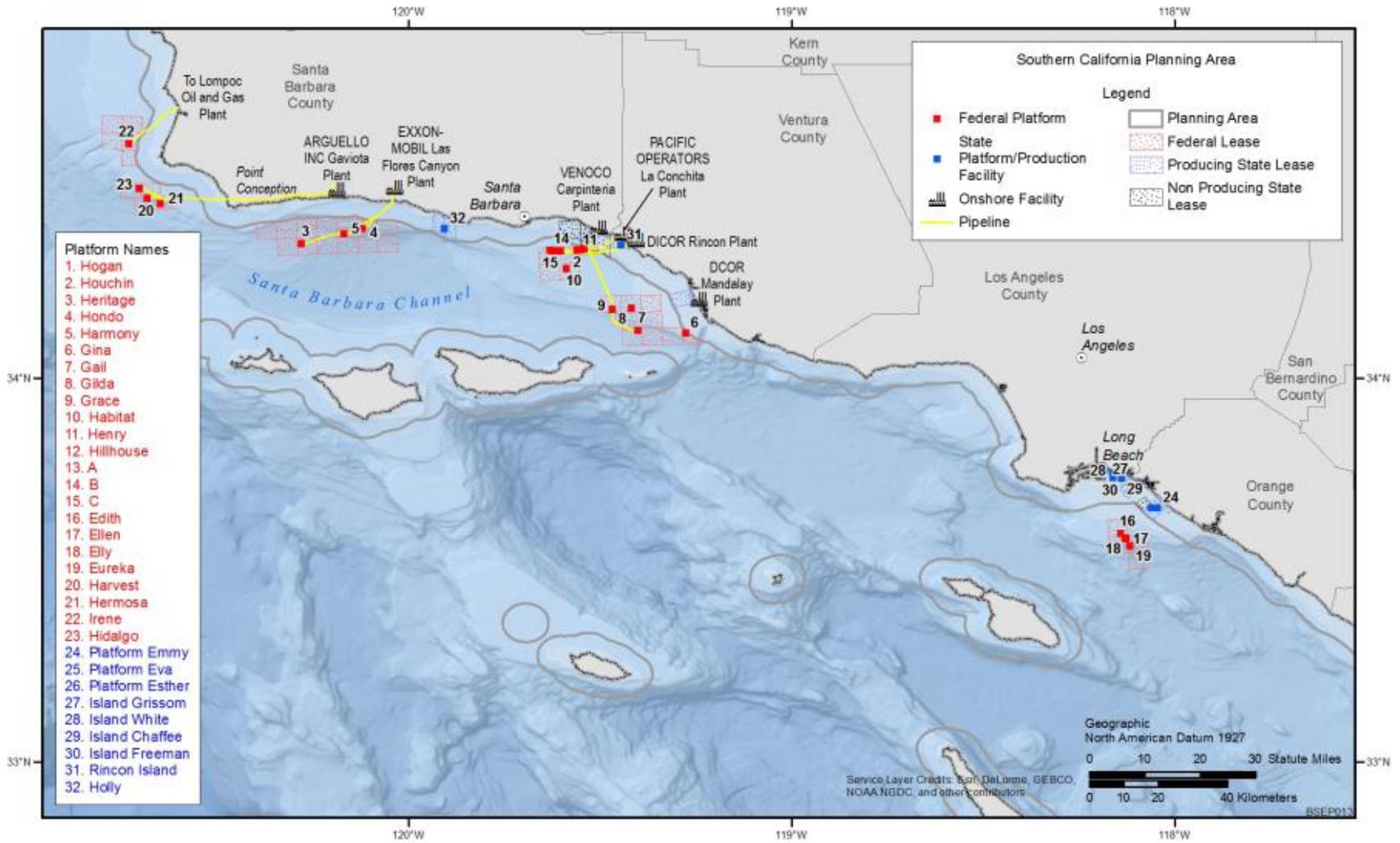
6

7 The 43 lease areas where WSTs may be carried out represent the project area for the
8 proposed action. Figure ES-1 shows the project area and the platforms in Federal and State
9 waters. The geographic scope of the affected environment includes the project area and the
10 surrounding area, to the extent that potential effects from the proposed action could extend
11 beyond the project area.
12

13 The following potential effects on resources of WST activities carried out in the project
14 area were evaluated:
15

- 16 • *Air quality*: Potential impacts due to contributions to elevated photochemical
17 ozone from ozone precursor emissions from diesel pumps and support vessels;
18 contributions to visibility degradation from emissions of particulate matter;
19 and contributions of greenhouse gas emissions associated with routine WST
20 activities; temporary effects on air quality from releases of WST fluids and
21 hydrocarbons under potential accidents; and from potential emissions during
22 drilling of new injection wells which may be needed under Alternative 3.
23
- 24 • *Water quality*: Potential impacts of routine WST operations on water quality
25 and marine life from open ocean discharges of WST waste fluids as permitted
26 under the U.S. Environmental Protection Agency (EPA) National Pollutant
27 Discharge Elimination System (NPDES) General Permit; potential impacts on
28 water quality from the release of WST fluids or hydrocarbons from potential
29 accidents; and temporary and localized decreases in water quality that may
30 occur as a result of bottom-disturbing activities that may occur under
31 Alternative 3.
32
- 33 • *Geologic resources/seismicity*: Potential that WSTs may stimulate seismic
34 activity in seismically active areas such as the Santa Barbara Channel, and
35 thus result in an increase in seismic hazard in the vicinity of the wells where
36 fracturing WSTs are being implemented.
37
- 38 • *Benthic resources (including special status species)*: Potential lethal,
39 sublethal, or displacement impacts on benthic communities following ocean
40 disposal of WST waste fluids or the accidental release of WST fluids or
41 hydrocarbons from potential accidents; and contamination of Endangered
42 Species Act (ESA)-designated critical habitat with hydrocarbons and WST
43 fluids following an accidental release. Benthic resources may also be affected
44 by bottom-disturbing activities under Alternative 3.
45

ES-6



1

2 **FIGURE ES-1 Locations of Current Lease Areas and Platforms Operating on the Southern California OCS Planning Area (Also shown**
 3 **are platforms and production facilities in offshore State waters adjacent to the Federal OCS.)**

4

- 1 • *Marine and coastal fish (including special status species) and essential fish*
2 *habitat*: Potential lethal, sublethal, or displacement impacts on fish following
3 ocean disposal of WST waste fluids or the release of WST fluids or
4 hydrocarbons from potential accidents; contamination of Essential Fish
5 Habitat (EFH) and ESA-designated critical habitat with hydrocarbons and
6 WST fluids following an accidental release. Marine and coastal fish may also
7 be affected by bottom-disturbing activities that may occur under Alternative 3.
8
- 9 • *Marine and coastal birds (including special status species)*: Potential lethal or
10 sublethal effects following ocean disposal of WST waste fluids or the
11 accidental release of WST fluids or hydrocarbons from potential accidents.
12
- 13 • *Marine mammals (including special status species)*: Potential lethal or
14 sublethal effects following ocean disposal of WST waste fluids or release of
15 WST fluids and hydrocarbons from potential accidents; vessel strikes. Marine
16 mammals may also be affected by noise from bottom-disturbing activities that
17 may occur under Alternative 3.
18
- 19 • *Sea turtles*: Potential lethal or sublethal effects following ocean disposal of
20 WST waste fluids or release of WST fluids or hydrocarbons from potential
21 accidents; and vessel strikes, noise, and other disturbances associated with
22 WST operations. Sea turtles may also be affected by bottom-disturbing
23 activities that may occur under Alternative 3.
24
- 25 • *Commercial and recreational fisheries*: Potential impacts due to preclusion
26 from fishing areas due to interference with vessels transporting WST materials
27 and equipment; localized closure of fisheries due to accidental release of WST
28 fluids or hydrocarbons; and reduced abundance of fishing resources due to
29 exposure to accidental release of WST fluids or hydrocarbons or to routine
30 disposal of WST waste fluids.
31
- 32 • *Areas of Special Concern*: Potential impacts if water quality is affected; some
33 biological resources potentially affected as identified above.
34
- 35 • *Recreation and Tourism*: Potential impacts if water quality is affected and use
36 of recreational areas is affected.
37
- 38 • *Environmental Justice*: A reduced use of coastal and offshore areas by
39 minority and low-income populations following accidental release of WST
40 fluids and waste fluids.
41
- 42 • *Archaeological Resources*: Potential effects from cleanup activities in the
43 event of a crude oil release; potential effects from bottom-disturbing activities
44 under Alternative 3.
45
46

1 ES.5 ENVIRONMENTAL CONSEQUENCES

4 ES.5.1 WST Operations

6 Each of the four WSTs included in the proposed action have been used in Federal and
7 State waters off of southern California. Of the more than 1,450 exploration and development
8 wells that have been drilled in Federal waters on the POCS between 1982 and 2014, there have
9 been only 21 hydraulically fractured completions, and these were conducted on only 4 of the
10 23 platforms in Federal waters on the OCS. Three of these were in the Santa Barbara Channel,
11 and the fourth was in the Santa Maria Basin. Only three matrix acidizing treatments, as defined
12 as WSTs under SB-4, occurring in OCS waters during a similar time frame (between 1985 and
13 2011) have been identified in records, and these were conducted on only 2 of the 23 platforms.
14

15 Given the historic record for WST use on the POCS and the indicated plans for industry
16 known at this time, a reasonable foreseeable forecast of WST use on the POCS in the future is up
17 to five WST applications per year. This estimate is conservative in its approach, given that this
18 potentially overestimates the potential for impacts since there is no year on record where five
19 WSTs were approved. However, given the small number of operating platforms and the current
20 level of oil and gas activities generally on the POCS, a higher number of WSTs proposed in a
21 single year is not reasonably foreseeable. Therefore, the analysis of Alternative 1 in this PEA
22 analyzed up to five WST approvals per year, and neither Alternative 2 nor Alternative 3 were
23 considered to change the number of WSTs expected to be proposed in any given year.
24

25 The application of any of the WSTs included in the proposed action follows three basic
26 steps: (1) the delivery of WST materials (i.e., WST chemical additives and proppant [typically
27 sand]) to a platform; (2) the injection of WST fluids into the well undergoing treatment; and
28 (3) the collection, handling, and disposal of WST-related waste fluids. Implementation of any of
29 the WSTs included in the proposed action would largely use existing infrastructure, would
30 require no construction of new infrastructure (e.g., no new pipelines, no new platforms), and
31 would not result in bottom-disturbing activities (e.g., trenching), except potentially the drilling of
32 new injection wells under Alternative 3. Some minor equipment changes may occur that would
33 not entail any seafloor disturbance (e.g., replacement of existing platform injection pumps or
34 fluid storage tanks with higher capacity equipment).
35

36 Materials for WSTs would be delivered to platforms via platform service vessels (PSVs)
37 which routinely bring materials, supplies, and personnel to and from the platforms. Additional
38 PSV trips may be needed to bring WST-related materials to a platform, which would represent a
39 short-term, localized, and minor increase in PSV traffic. All WST-related materials would be
40 transported in shipping containers designed and certified for marine and offshore transport. Bulk
41 liquids could be transported in 350-gal or 500-gal stainless-steel totes, and non-liquid materials
42 (e.g., proppant) could be transported in appropriate steel transport pods, all designed for marine
43 transport and in compliance with all applicable shipping and safety requirements.
44

45 During a WST, chemical additives and proppant, if required, are mixed into a base
46 injection fluid, filtered seawater, which is sourced at each platform. WST fluid components are

1 mixed as they are injected. WSTs are conducted under the conditions, for example, of pressure
2 and volume, specified in the APD or APM for a particular WST. Pumping time will vary by the
3 type of WST being conducted and the number of stages needed for completion. Pumping time
4 may be as little as 10 minutes for a DFIT, and up to 4 hr per stage for a hydraulic fracturing
5 treatment.

6
7 WST operations produce waste fluids containing WST-related chemicals recovered
8 during production, and air emissions associated with the operation of WST-related equipment
9 (e.g., injection pumps, blending units) and with the transport of WST materials and supplies to
10 and from platforms (e.g., PSV traffic). Following completion of a WST, waste fluids containing
11 WST-related chemicals are recovered, typically comingled with formation water (referred to as
12 produced water) and recovered oil. This comingled fluid is collected, and the oil phase is
13 separated from the water phase for later refining and sale. A fraction of the injected WST
14 chemical additives is typically recovered and becomes part of the produced water waste stream
15 following separation. Chemical additives are largely consumed during treatment or retained in
16 the formation. The water phase is treated and disposed of in the same manner as that used for
17 produced water during routine (non-WST) oil and gas production, via NPDES-permitted open
18 water discharge, or by reinjection.

21 **ES.5.2 Potential Releases from WST-Related Accidents**

22
23 The three categories of accidents considered and analyzed in this PEA were accidents
24 occurring during (1) the transport of WST chemicals and fluids to platforms; (2) WST fluid
25 injection; and (3) the handling, transport, treatment, and disposal of WST-related waste fluids.
26 Some accident scenarios may be applicable to each of the four WSTs included in the proposed
27 action, while other scenarios are applicable to only some of the WSTs.

28
29 An accidental release of WST chemicals could occur with any of the four WST types
30 during the delivery of required materials and their subsequent offloading to a platform. Required
31 WST chemicals would generally be delivered to a platform via a PSV and transported in sealed
32 steel containers designed for marine transport and in compliance with applicable packaging and
33 shipping requirements. In some cases, acids may be delivered in dedicated transport vessels
34 within internal storage tanks. Release of the contents of shipping containers (or internal storage
35 tanks) would require the loss of control of the container and a breach of container integrity. Such
36 a release during PSV transport under the expected infrequent use of WSTs on the POCS is
37 considered to be very unlikely for the foreseeable future. A release of small quantities of WST
38 chemical additives from a container during crane transfer from a PSV to platform storage is
39 considered unlikely, but reasonably foreseeable.

40
41 During WST fluid injection, the accidental release of WST-related chemicals could occur
42 as a result of equipment malfunction on the platform during fluid blending and injection.
43 Malfunctions of blending units, injection pumps, manifolds, and other platform equipment could
44 release small quantities of WST chemicals and result in a surface spill of WST chemical
45 additives. Any such malfunctions would tend to be quickly detected and WST activities halted,
46 and any releases would be quickly addressed through implementation of existing spill

1 containment and cleanup measures. Thus, although such accidental releases may occur, they
2 would likely result in the release of only small quantities of WST chemicals that may or may not
3 reach the open ocean. This accident scenario is considered to have a low probability of
4 occurrence but is still reasonably foreseeable.

5
6 For the fracturing WSTs, accidental releases of WST chemicals and formation
7 hydrocarbons may occur as a result of well casing failure during injection after repeated
8 pressurization and depressurization events, thus providing a pathway for well fluids to pass along
9 the outside of the well casing, migrate upward, and be released from the seafloor. Such an
10 accident scenario, while possible, is considered to have a very low probability of occurrence and
11 is not reasonably foreseeable.

12
13 An accidental release of WST chemicals may also occur during a fracturing WST if a
14 new fracture contacts an existing pathway (e.g., an existing fault or other well) to the seafloor.
15 Such an occurrence could result in the accidental release of WST chemicals, hydrocarbons, and
16 produced water via a seafloor surface expression. Given BSEE requirements that all APDs and
17 APMs include information on known fractures, faults, and wells in the vicinity of the proposed
18 WST, and requirements for continuous monitoring of injection pressures during a fracturing, the
19 injection of fracturing fluids would be halted if a pathway to the seafloor was suspected, thus
20 greatly reducing the potential of a seafloor surface expression to the ocean. This accident
21 scenario, referred to as a surface expression, is considered to have a very low probability of
22 occurrence and is not reasonably foreseeable.

23
24 Finally, an accidental release of any recovered WST-related chemicals in waste fluids
25 may occur if a break occurs in a pipeline that is carrying such waste fluids as part of the
26 produced water or the crude oil/produced water mixture (before separation) and these fluids are
27 released to the ocean. Given the expected low frequency of WST use on the southern California
28 OCS and required regular inspection of pipelines, such an accident has a very low probability of
29 occurrence and is considered not reasonably foreseeable.

30 31 32 **ES.5.3 Summary of Impacts on Resources**

33
34 Evaluations of potential effects on resources characterize such effects with regard to how
35 widespread any impacts might be (e.g., localized around platforms or affecting a much larger
36 portion of the POCS), the magnitude of any potential effect (e.g., small or large increase in air
37 pollutants, individual biota or populations affected), and the duration of any potential effects
38 (e.g., short-term [days or weeks] or long-term [months or longer]).

39
40 Impacting factors associated with WST activities include transport of WST materials and
41 supplies to the platforms (potentially affecting air quality, sea turtles, and marine mammals),
42 WST fluid injection (potentially affecting air quality and geology/seismicity), injection of WST
43 waste fluids (potentially affecting geology/seismicity), discharge of produced water containing
44 WST waste fluids (potentially affecting water quality, benthic resources, marine and coastal fish
45 and EFH, sea turtles, marine and coastal birds, marine mammals, areas of special concern,

1 recreation and tourism, commercial and recreational fisheries, environmental justice, and
2 socioeconomics).

3
4 Alternatives 1 through 3 include all four WST types analyzed; thus the nature of any
5 potential WST-related impacts will be largely similar among these alternatives in most respects.
6 Alternative 2 includes a minimum depth requirement that may reduce, in comparison to
7 Alternatives 1 and 3, the likelihood of an accidental surface expression occurring. Alternative 3,
8 which would prohibit ocean discharge, may have additional potential impacts should drilling of
9 new injection wells occur as a result of the prohibition of ocean discharge, while any potential
10 effects from ocean discharge of WST-related chemicals would be eliminated. Alternative 4, No
11 Action, would eliminate all impacts of WSTs. Because impacts from routine operations and the
12 risk of accidents are low for Alternative 1, there is only a marginal decrease in risk and potential
13 impacts under Alternatives 2 through 4.

14
15 Table ES-1 presents a comparison of impacts on resources under the alternatives from
16 routine operations. Table ES-2 presents a comparison of the likelihood of various accidents
17 under the alternatives. During WST implementation, Alternative 1 would have only negligible,
18 localized, and temporary effects on air quality and water quality. Impacts on air quality, water
19 quality, benthic resources, marine and coastal fish, sea turtles, marine and coastal birds, marine
20 mammals, and recreational and commercial fisheries would be negligible. Although there would
21 be the potential for some marine biota to be exposed within the NPDES mixing zone to very low
22 concentrations of WST-related chemicals and formation-related trace metals, organics, and
23 radionuclides following permitted open-water discharge, such discharges (and associated
24 exposures) would occur infrequently, be very localized, and be of short duration. Exposure levels
25 within the 100-m mixing zones would be highest around discharge locations, while exposure
26 concentrations at the mixing zone boundary would be as much as 2,000 times lower than at the
27 discharge locations due to dilution. There would be no impacts on seismicity, areas of special
28 concern, archaeological resources, recreation and tourism, or socioeconomics. WST use would
29 not impact minority or low-income populations. The probability for an accidental release of
30 WST related chemicals to occur is low, and reasonably foreseeable for only two accident
31 scenarios considered (i.e., during the transfer by crane of WST chemicals from a platform supply
32 vessel to a platform, and during injection due to platform equipment malfunction). All other
33 accidental release scenarios were identified to have a very low probability of occurring and to be
34 not reasonably foreseeable. In the event that an accidental release occurs, the release would
35 likely be small and any effects would be limited and short term.

36 37 38 **ES.6 CUMULATIVE IMPACTS**

39
40 Given the estimated negligible to small potential impacts of future WST activities on
41 various resources in the POCS off southern California, incremental impacts from the proposed
42 action are not expected to result in any cumulative effects on resources of the POCS and adjacent
43 coastal and mainland areas, when added to past, current, and foreseeable future impacts on these
44 resources from other sources within and in the vicinity of the POCS.

1 **TABLE ES-1 Comparison of Potential Effects among Alternatives from Routine Use of WSTs**

Resource	Alternative 1 Proposed Action – Allow Use of WSTs	Alternative 2 – Allow Use of WSTs with Depth Stipulation	Alternative 3 – Allow Use of WSTs with No Open Water Discharge of WST Fluids	Alternative 4 – No WST Use on Existing OCS Leases
Air quality	No discernable WST-related impacts on regional air quality expected. Negligible emissions of greenhouse gases.	Same as Alternative 1.	Same as Alternative 1. Additional air emissions if new injection well drilling and pipeline trenching occur.	No WST-related impacts.
Water quality	No discernable WST-related impacts expected; although slight localized and temporary reduction in water quality at surface water discharge location.	Same as Alternative 1.	Similar to Alternative 1, but no reductions in water quality from WST chemicals in discharges to surface water. Temporary and localized reduction in water quality if new injection well drilling and/or pipeline trenching occur.	No WST-related impacts.
Induced seismicity	No induced seismicity expected.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Benthic resources	No discernable WST-related impacts expected. Potential for some individuals to be temporarily exposed to highly diluted concentrations of WST-related chemicals within the NPDES discharge mixing zone.	Same as Alternative 1.	Same as Alternative 1. Localized and temporary benthic habitat disturbance likely if new injection well and/or pipeline trenching occur.	No WST-related impacts.
Marine and coastal fish and essential fish habitat; sea turtles, marine and coastal birds, marine mammals	No discernible WST-related impacts expected; potential for some individuals to be temporarily exposed to highly diluted concentrations of WST-related chemicals within the NPDES discharge mixing zone. Short-term and localized disturbance in behavior and/or distribution of individuals during WST implementation possible but effects negligible.	Same as Alternative 1.	Similar to Alternative 1 but with no potential for exposure to WST chemicals in discharges to surface water. Localized and temporary habitat disturbance and/or displacement of individuals likely if new injection well and/or pipeline trenching occur.	No WST-related impacts.

TABLE ES-1 (Cont.)

Resource	Alternative 1 Proposed Action – Allow Use of WSTs	Alternative 2 – Allow Use of WSTs with Depth Stipulation	Alternative 3 – Allow Use of WSTs with No Open Water Discharge of WST Fluids	Alternative 4 – No WST Use on Existing OCS Leases
Commercial and recreational fisheries	No discernible WST-related impacts expected.	Same as Alternative 1.	Same as Alternative 1. Localized and temporary habitat disturbance and/or displacement of individuals likely if new injection well and/or pipeline trenching occur.	No WST-related impacts.
Areas of special concern, recreation and tourism, archaeological resources, environmental justice	No WST-related impacts expected.	Same as Alternative 1	Same as Alternative 1. Localized and temporary habitat disturbance and/or displacement of individuals likely if new injection well construction occurs.	No WST-related impacts.
Socioeconomics	No WST-related impacts or benefits expected.	Same as Alternative 1	Same as Alternative 1. Platform operators may incur additional costs if new injection wells or disposal pipelines are needed.	No WST-related impacts. Decommissioning costs may be incurred at some wells that become unproductive in the absence of WST use.

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1 **TABLE ES-2 Comparison of Likelihood of Occurrence of WST-Related Accidents among**
 2 **Alternatives**

Accident	Likelihood			
	Alternative 1 Proposed Action – Allow Use of WSTs	Alternative 2 – Allow Use of WSTs with Depth Stipulation	Alternative 3 – Allow Use of WSTs with No Open Water Discharge of WST Fluids	Alternative 4 – No WST Use on Existing OCS Leases
WST chemical release during transport following loss of transport container integrity	Applicable to all four WST types. Very low probability and not reasonably foreseeable.	Same as Alternative 1.	Same as Alternative 1.	Will not occur.
WST chemical release during crane transfer	Applicable to all four WST types. Low probability and reasonably foreseeable.	Same as Alternative 1.	Same as Alternative 1.	Will not occur.
WST chemical release during injection from platform equipment malfunction	Applicable to all four WST types. Low probability and reasonably foreseeable.	Same as Alternative 1.	Same as Alternative 1.	Will not occur.
Seafloor expression of WST chemicals due to well casing failure	Applicable only to fracturing WSTs. Very low probability and not reasonably foreseeable.	Same as Alternative 1.	Same as Alternative 1.	Will not occur.
Seafloor expression of WST chemicals due to fracture intercept with existing surface pathway	Applicable only to fracturing WSTs. Very low probability and not reasonably foreseeable.	Reduced probability compared to Alternative 1.	Same as Alternative 1.	Will not occur.
Release of WST chemicals due to rupture of pipeline conveying produced water containing WST chemicals	Applicable to all WSTs. Very low probability and not reasonably foreseeable.	Same as Alternative 1.	Same as Alternative 1.	Will not occur.

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