Revisions to the Point Arguello Field Development and Production Plans to Include the Rocky Point Unit Development

Supporting Information Volume

Submitted to:
The Minerals Management Service
Pacific OCS Region

Submitted by:
Arguello Inc.

May 18, 2001

Address Inquires To:

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Table of Contents

List of Attachments - NOT INCLUDED IN THIS PDF FILE

Revisions to the Point Arguello Field DPPs

Supporting Information Volume
Rocky Point Unit Reservoir Evaluation

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Table of Contents

List of Tables

List of Figures

All of the information presented in this section has been included in the public information copy. With the Freedom of Information Act (5 U.S.C. 552) and its implementing regulations (42 CFR Part 2) and as provided in 30 CFR 250.34-2, Section (a)(5), Arguello Inc. could make all of this information proprietary. However, in order to provide full disclosure to the public, Arguello Inc. has decided to make all of the reservoir evaluation data available to the public. This section of the Supporting Information contains a discussion of the Rocky Point Reservoir.

1.0 Introduction

The Rocky Point Unit is geographically located approximately eight miles northwest of the coastline at Point Conception, offshore California (see Figure 1). The Rocky Point Unit consists of Leases OCS-P 0451(E/2), 0452 and 0453 which together total 8,585.32 acres.

The Rocky Point Unit leases were acquired when Chevron USA Inc. (50 percent) and Phillips Petroleum Company (50 percent) submitted high bids on Block 465 ($168,485,750), Block 466 ($91,986,800) and Block 467 ($41,296,000) in OCS Sale No. 53, May 28, 1981. Chevron and Phillips were awarded Leases OCS-P 0451 (Block 465), P 0452 (Block 466) and P 0543 (Block 467) on July 1, 1981.

The remainder of this section provides information on the field history, reservoir description, and the development plans for the proposed drilling of this oil and gas field from the three existing Point Argeullo Platforms.

2.0 Exploratory Drilling

The Rocky Point Field was discovered in 1983 by the Chevron OCS-P 0451 No. 1 and further delineated by wells P 0451 No. 2, P 0452 Nos. 2, 3 and 5 (see Figure 2). The discovery well, OCS-P 0451 No. 1, spudded in 1983, successfully tested oil and gas from zones in the upper Monterey Formation and Lower Sisquoc Formation.

Chevron drilled an exploratory well, No. B-7 from Platform Hermosa to Rocky Point. Drilling of the No. B-7 well began in December 1987, reaching total depth in February 1988. On March 1, 1990 the MMS approved an extension of the Suspension of Production (SOP) and Subsequent Plan of Operation that provided time for the long-term test of the No. B-7 well. The approval stipulated that the well was to be abandoned at the end of the test period. However, on October 15, 1992 the MMS directed a SOP for the undeveloped leases in the Pacific Outer Continental Shelf for the period from January 1, 1993 to December 31, 1995. The SOP was directed to allow a study to be done of the various levels of development of the undeveloped leases and the onshore constraints to development. As a result of Chevron's participation in the study the MMS waived the obligation to test the No. B-7 well.

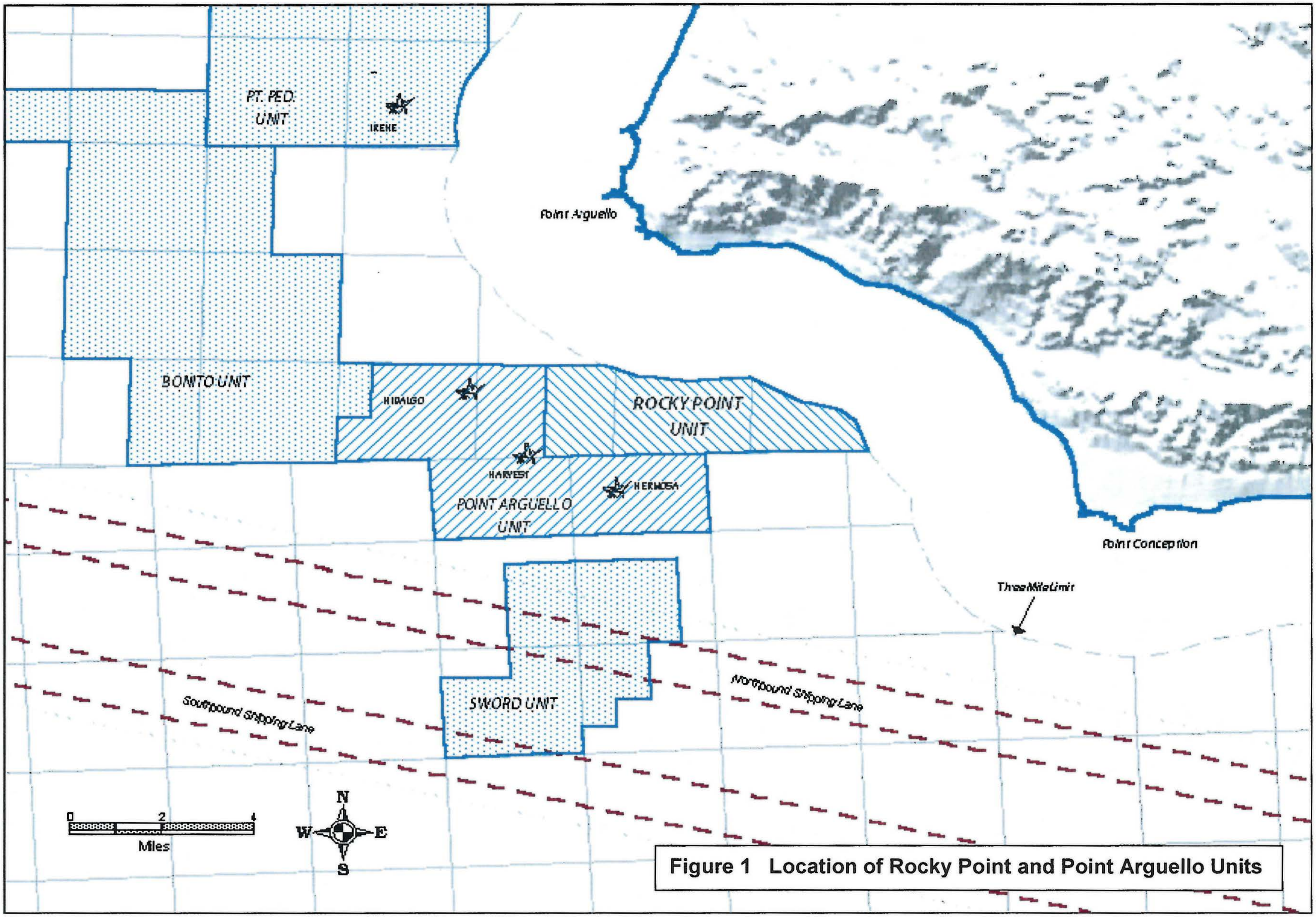
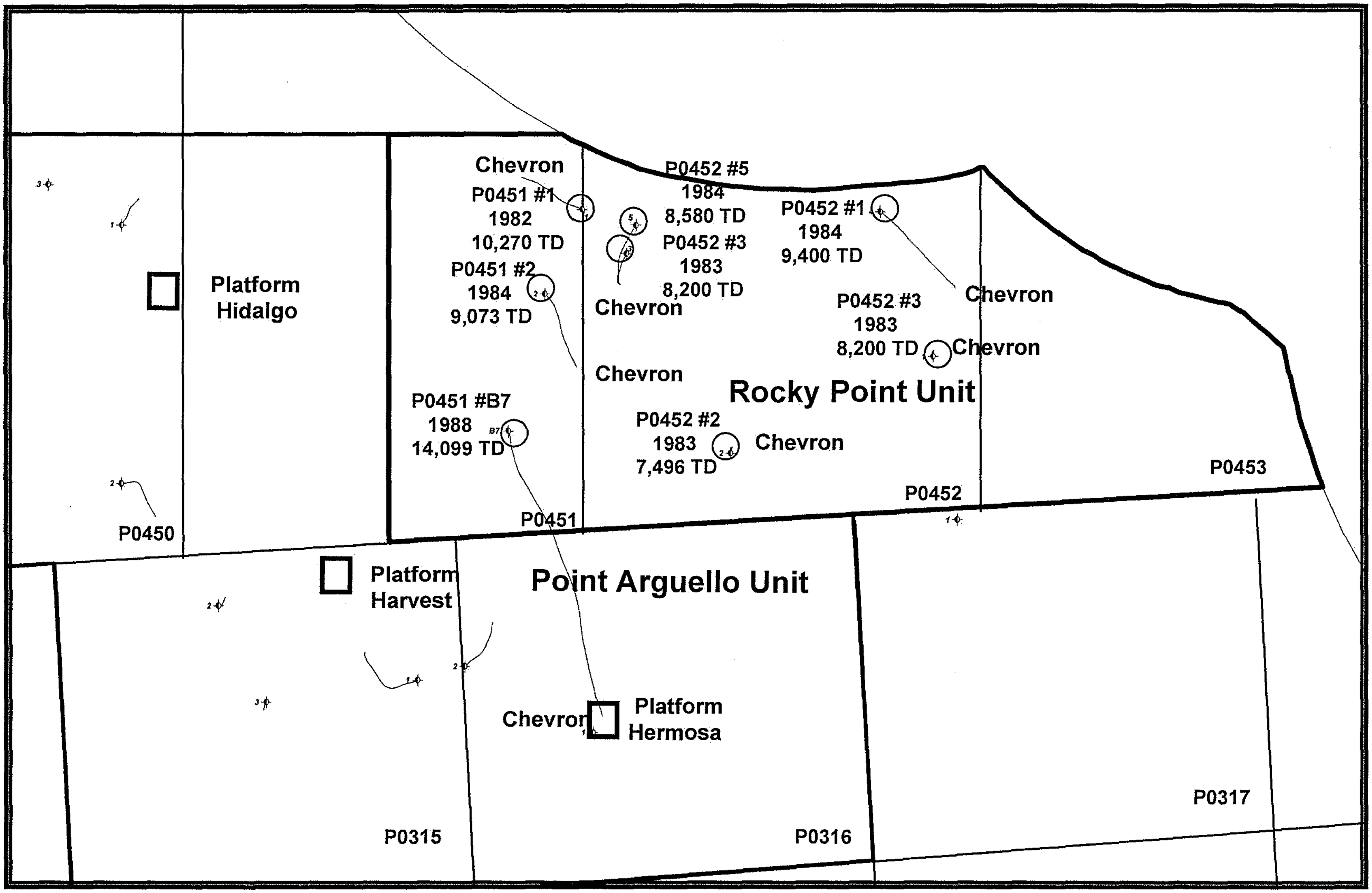


Figure 1 Location of Rocky Point and Point Arguello Units

Figure 2 Rocky Point Unit Exploratory Well Location Map



On August 3, 1993 the MMS approved Chevron's request to begin testing of the No. B-7 well, which was tested through the existing Point Arguello project infrastructure including platform production equipment, pipelines to shore, and the Gaviota Facility. The Rocky Point leases were removed from the directed SOP and held by test production during the testing period. On August 31, 1994 Chevron notified the MMS of the completion of testing the No. B-7 wells and requested reinstatement of the SOP. In October 1994 the MMS redirected the SOP for the Rocky Point leases.

3.0 Reservoir Description

The primary reservoir of the Rocky Point oil field is a fractured siliceous shale of the lower Sisquoc and Upper Monterey Formation. Both well and seismic data indicate that this reservoir rock is likely in the quartz silica phase. The anticlinal shape of the fault-bounded trapping structures is shown in Figure 3, which shows the structure contour map. This figure also shows the location of 14 preliminary bottom-hole locations.

4.0 Fluid Properties

Table 1 shows the estimated oil and gas properties from the Rocky Point development.

Table 1 **Estimated Oil and Gas Properties**

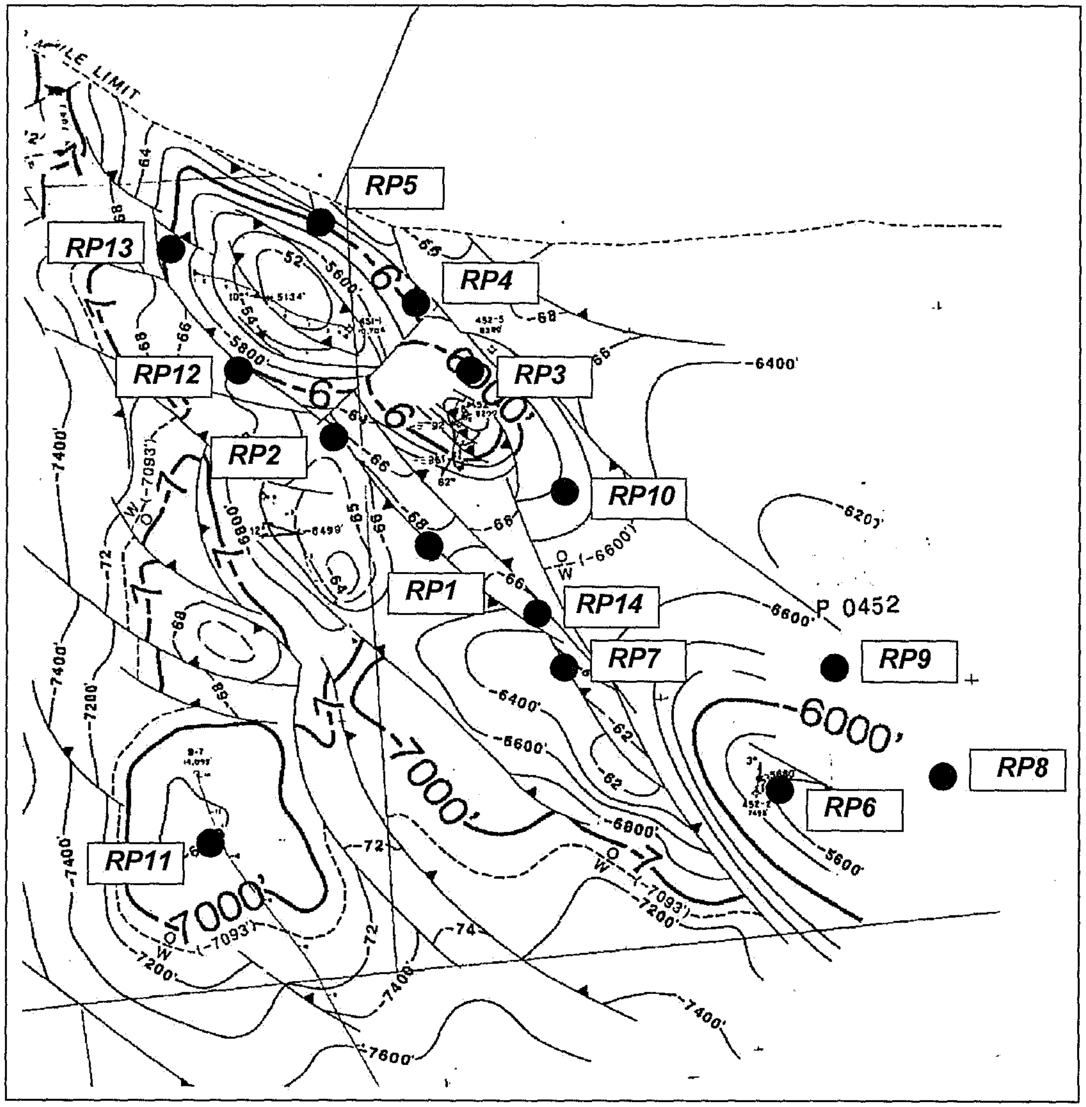
Property	Value
API Gravity	24-31
Kinematic Viscosity (cs @ $100^{\circ}F$)	6.0-1,000
Sulfur in Crude (wt%)	2-3
H_2S Content of Gas (ppm)	10,000-15,000

These values are estimates based upon data collected from some of the exploratory wells that were drilled into the Rocky Point Unit. The actual production data may be different. Actual hydrogen sulfide measurements of produced Rocky Point gas during the exploratory DST's indicated significantly lower levels than that shown above, including some tests with no hydrogen sulfide at all. The levels shown above are more typical of the Point Arguello Field and are used as conservative estimates.

5.0 Development Plan

This section presents the preliminary development plan for the Rocky Point Unit. The section discusses the Rocky Point reserves and basis for developing the recovery estimates, the drilling program, and the estimated oil and gas production rates for both Rocky Point and Point Arguello.

Figure 3 **Rocky Point Unit Structure Contours on S4c**



Approximate depths (TVD)
of expected productive fm.

RP1: 6660' - 7250' (Sisq.)
RP2: 6650' - 7250' (Sisq.)
RP3: 6710' - 7250' (Sisq./Mont.)
RP4: 6290' - 7230' (Sisq./Mont.)
RP5: 6480' - 7230' (Sisq./Mont.)
RP6: 6100' - 6510'(Sisq./Mont.)
RP7: 6520' - 7210' (Sisq./Mont.)
RP8: 6070' - 6510' (Mont.)
RP9: 6220' - 6510'(Mont.)
RP10: 6520' - 6720' (Sisq.)
RP11: 7000' - 7211' (Sisq.)
RP12: 6880' - 7230' (Sisq.)
RP13: 7030' - 7230' (Sisq.)
RP14: 6600' - 7250' (Sisq./Mont.)

● ***Preliminary bottomhole well locations***

Surface locations are on Platforms Harvest, Hermosa & Hidalgo (see Figure 4)

*S4c is a Sisquoc marker equivalent to Pt. Arguello stratigraphic marker PA17 (Interpreted Jan. 12, 1989)

5.1 Rocky Point Reserves/Recovery

The size of the Rocky Point Unit reservoir has been estimated from sparse exploratory well drilling and from seismic surveys conducted in the early 1980's. The seismic data has been reprocessed, and the initial reinterpretation is expected to be available by early spring, 2001. At this time, Arguello Inc. requests approval for up to 20 wells to develop the reservoir, but the actual number required will not be known until completion of the geophysical review and subsequent confirmation by initial well drilling. Current estimates of productive rock volume are approximately 1.5 million acre-feet. A commonly used factor for ultimate oil recovery (reserves) from the Monterey Formation is about 50 bbl/acre-foot, but only about one-quarter to one-third of the Rocky Point reservoir is Monterey rocks, with the majority being Sisquoc. Where the Monterey is found, it appears to be the less prolific upper section.

The Sisquoc is unproductive in most areas where the Monterey yields oil production, but tests at Rocky Point indicate that it is productive. We expect that the ultimate recovery from the Sisquoc will be considerably less than the Monterey, and have estimated it at one-half of the rule-of-thumb Monterey value. Based on drill stem test (DST) results in exploratory wells, we have assigned initial productivity to the Rocky Point wells at 2,500 bpd. This rate is then declined at 30 percent per year, which was the approximate rate of decline experienced by the adjacent Point Arguello Unit once full production had been reached.

A well is expected to decline until a production rate of some 200 bpd is reached, then it is assumed that the well is shut-in. The Rocky Point wells will be extended reach wells of very great measured depth, and will likely experience fairly high water cuts by that time. Gas lift efficiency will be relatively poor, and any problems that require well work will have a low probability of being economically justifiable. Continued operation of wells at these low rates is, in any case, a very minor contributor to additional ultimate recovery.

The economic model used for scoping purposes on this project assumes that oil prices escalate at 5 percent per year from current levels, and that field-operating costs are held constant. DST analysis indicated that Rocky Point Unit crude is of somewhat higher quality (higher API gravity) than Point Arguello Unit, so the increasing proportion of this oil in the sales stream will create a price structure which may make our assumption a conservative one. Operating costs have been lowered recently due to a variety of on and off-site efficiencies and equipment improvements, and we expect this trend to continue at a reduced pace, but one which will offset normal inflation.

Because of the high cost (roughly estimated at $8 to $10 million each) of these wells, only the most prospective parts of the reservoir will be targeted. Given the above production characteristics and life, the entire development would be expected to recover somewhere between 34 and 50 million bbls depending upon how many wells are drilled.

The wells are assumed to be split between the three Point Arguello platforms. Further geologic evaluation may indicate a particular well path orientation to take maximum advantage of dominant fracture trends, and may change the number of wells to be drilled from a given platform.

No enhanced recovery practices are planned at this time. Water flooding and gas injection have been attempted for Monterey enhanced recovery in the past and have not proved economic.

The recovery of oil and gas will be by a combination of pressure depletion and water influx from the underlying aquifer. Producing rates, and producing and shut in pressures will be monitored, to develop production practices that will assure optimum recovery of oil and gas. Artificial lift will be utilized, as practical, to meet drawdown goals for optimum recovery.

Development of the "Jalama Field" inside the Rocky Point Unit is not planned. Although this accumulation yielded one exploratory DST with an encouraging oil test rate, it also yielded a nearby dry hole. Given the high cost of the long reach wells required to penetrate this accumulation, limited accumulation size, and its exploratory history, the risk is assessed as being too high with presently available technology at current economic conditions.

5.2 Rocky Point Drilling Program

The current estimate is that 14 wells will be needed in order to develop the Rocky Point Unit. However, Arguello Inc. is requesting approval for 20 wells for the development of the Rocky Point Unit. The additional six wells, beyond the current estimate of 14 wells, are requested to account for the possibility of unexpected geologic success, or improved economics. Depending upon the geologic interpretations and economic conditions at the time, unsuccessful wells may be redrilled to offset locations. To account for this event we have added the six additional wells. It is proposed that a maximum of seven wells could be drilled from Platforms Hermosa and Harvest and a maximum of six wells from Platform Hidalgo.

The 20 wells will be drilled in three phases. The first phase will involve the drilling of ten wells, the second phase four wells, and if needed, the third phase would cover the remaining six wells. However, it should be noted that the exact number of wells needed to develop the Rocky Point Unit reserves will not be known until the first few development wells have been completed, placed on production, and evaluated. As part of these DPP revisions, Arguello Inc. has identified the approximate bottom hole locations of 14 wells. It may be possible to sidetrack a number of the existing Point Arguello wells, and/or use existing wellheads for development of the Rocky Point Unit wells once some of the Point Arguello wells have reached the end of their productive life.

The assumed proposed schedule of drilling is as follows.

- ***Phase 1*** – 4 wells at Hidalgo, then 2 wells at Harvest, then 4 wells at Hermosa.
- ***Phase 2*** – 3 wells at Hermosa, then 1 well at Harvest.
- ***Phase 3*** – 3 wells at Harvest, then 2 at from Hidalgo.

Basically, the Hidalgo wells will develop the northern portion of the field (northwest pool of northeastern block). Harvest will develop the central portion and Hermosa will develop the southern portion of the field. Additional wells, a maximum of six, are possible with the locations to be determined as needed at a later date. The maximum number of wells for each platform is seven for Harvest, seven for Hermosa and six for Hidalgo. It should be noted that the order and number of wells from each platform might be modified upon completion of the reprocessed 3D seismic data interpretation and/or actual production data from the initial wells drilled for Rocky Point.

Preliminary data on 14 of the proposed wells is provided in Table 2. The bottom-hole location of each of these wells is shown in Figure 4.

All of the wells will be drilled using extended reach drilling (ERD). ERD, sometimes called directional or slant drilling, is a method by which a well is drilled intentionally in a direction laterally away from the surface location. ERD has been practiced for a number of decades but in the last fifteen years there have been great advancements. Since exploration first occurred on the Rocky Point Unit, the maximum reach of a well (the lateral distance from the bottom of the well to the surface location) has increased dramatically. In 1986, the world record for reach was just over 15,000 feet, set by a well in Australia. Today, wells reaching 30,000 feet and beyond have been drilled and the distance is increasing on a regular basis.

Argeullo Inc. plans to utilize or take advantage of current field proven extended reach drilling and well intervention technologies for use in development of the Rocky Point Unit. One of the drilling technologies and tools that may be considered are use of a rotary steerable drilling system.

Many of the drilling challenges that ERD wells typically faced in the past, have been overcome with the use of new technology such as the rotary steerable drilling system or AutoTrack offered by Baker Hughes Inteq. The AutoTrack system is a fully rotary closed loop drilling system that offers the following features:

- Can change hole trajectory while rotating.
- Extendable stabilizer ribs create side forces at the bit, controlled downhole in closed-loop with MWD (Measurement While Drilling).
- Two-way communication between downhole and surface systems.
- Fully integrated MWD with directional, resistivity, gamma ray, vibration, and near bit inclination sensors.
- Optional Navi-Drill motor can deliver more torque.

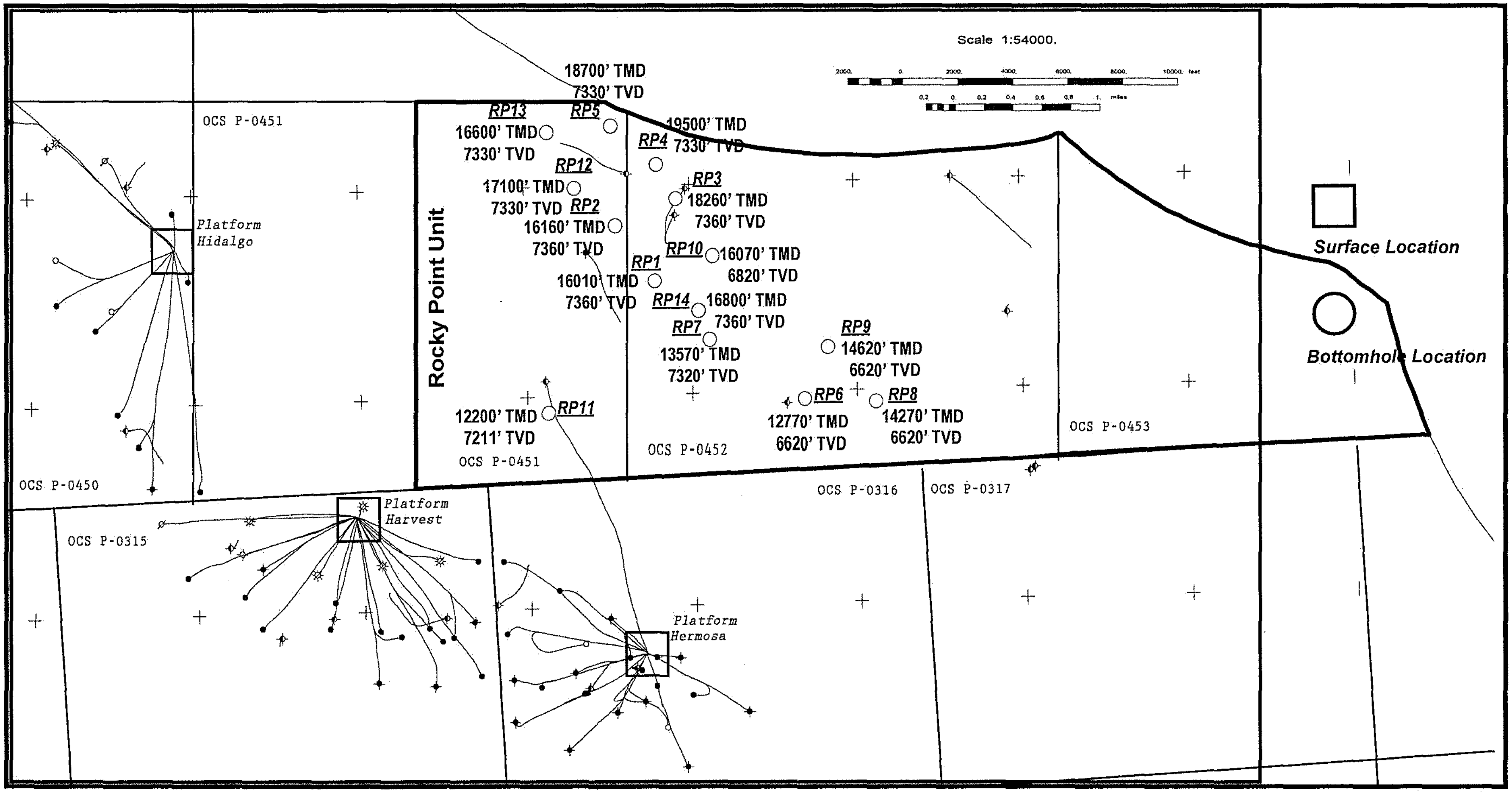
Table 2 Rocky Point Proposed Well Bottom Hole Locations and Distances for Initial Wells

Well #	Proposed Total Vertical Depth (ft)	Estimated Measured Depth (ft)	Bottom Hole Location UTM Zone 10				Distance from: (meters)	
			X (ft)	Y (ft)	X (m)	Y (m)		
RP1[a]	7,360'	16,010'	2,350,100	12,529,200	716,311.91	3,818,907.80	1,776.81 S of NW corner P-0452	311.91 E of W lease line P-0452
RP2[a]	7,360'	16,160'	2,348,650	12,531,100	715,869.95	3,819,486.92	1,313.08 S of N lease line, P-0451	130.05 W of E lease line P-0451
RP3[a]	7,360'	18,260'	2,350,850	12,532,050	716,540.51	3,819,776.48	908.13 S of NW corner P-0452	540.51 E of W lease line P-0452
RP4[c]	7,330'	19,500'	2,350,130	12,533,220	716,321.06	3,820,133.10	551.51 S of NW corner P-0452	321.06 E of W lease line P-0452
RP5[c]	7,330'	18,700'	2,348,470	12,534,550	715,815.09	3,820,538.48	261.52 S of N lease line, P-0451	184.91 W of E lease line P-0451
RP6[b]	6,620'	12,770'	2,355,600	12,525,100	717,988.32	3,817,658.12	3,026.49 S of NW corner P-0452	1,988.32 E of W lease line P-0452
RP7[b]	7,320'	13,570'	2,352,100	12,527,150	716,921.51	3,818,282.96	2,401.65 S of NW corner P-0452	921.51 E of W lease line P-0452
RP8[b]	6,620'	14,270'	2,358,200	12,525,020	718,780.80	3,817,633.73	3,050.88 S of NW corner P-0452	2,780.8 E of W lease line P-0452
RP9[b]	6,620'	14,620'	2,356,450	12,526,900	718,247.40	3,818,206.76	2,477.85 S of NW corner P-0452	2,247.4 E of W lease line P-0452
RP10[b]	6,820'	16,070'	2,352,200	12,530,050	716,951.99	3,819,166.88	1,517.73 S of NW corner P-0452	951.99 E of W lease line P-0452
RP11[b,d]	7,211	12,200	2,346,238	12,524,586	715,134.77	3,817,501.45	3,298.55 S of N lease line, P-0451	865.23 W of E lease line P-0451
RP12[c]	7,330'	17,100'	2,347,150	12,532,400	715,412.75	3,819,883.16	916.84 S of N lease line, P-0451	587.25 W of E lease line P-0451
RP13[c]	7,330'	16,600'	2,346,140	12,534,330	715,104.90	3,820,471.43	328.57 S of N lease line, P-0451	895.1 W of E lease line P-0451
RP14[a]	7,360'	16,800'	2,351,700	12,528,150	716,799.59	3,818,587.76	2,096.85 S of NW corner P-0452	799.59 E of W lease line P-0452

a. Distances figured from Platform Harvest center, X=713,013 m, Y=3,816,420 m UTM 10 (X=2,339,277', Y=12,521,038'); **X=664,622', Y=866,189' Lambert Cal 6**
b. Distances figured from Platform Hermosa center, X=716,211 m, Y=3,814,981 m UTM 10 (X=2,349,769', Y=12,516,317'); **X=674,783', Y=860,793' Lambert Cal 6**
c. Distances figured from Platform Hidalgo center, **X=710,975 m, Y=3,819,245 m UTM 10** (X=2,332,589', Y=12,530,307'); X=658,555', Y=875,876' Lambert Cal 6
d. RP11 is a sidetrack of OCS P-0451 well B007

Possible 6 additional locations to be determined later (3 from Harvest, 2 from Hidalgo & 1 from Hermosa).
Platform center XY's in **bold print** indicates the grid in which that respective platform exists, and are the coordinates that the MMS recognizes.
UTM coordinates have been used for Platforms Hermosa and Harvest in this table to allow for consistency across all three platforms.

Figure 4 Rocky Point Unit Proposed Well Locations



The drilling benefits that Arguello Inc. can realize for the using this technology are:

- Improved hole cleaning, less circulation time, less wiper trips.
- Extended run lengths by using polycrystalline diamond compact drilling bits.
- Improved hole quality for ease of logging and completion.
- Superior geometrical steering & geosteering to maximize production.
- Extended reach & extended horizontal sections to maximize production and to decrease the number of wells and platforms to develop a field.
- Higher rate of penetration and fewer bottom hole assembly changes.

Some economic impacts realized by using this type of ERD drilling technology are:

- Production operating cost impact of lower gas/water production:
  - Less water/gas handling: lower GOR/WOR per cumulative barrel produced.
  - Delayed or reduced workovers.
- Capital cost impact of longer wells and smoother wellbores:
  - May result in fewer total wells.
  - Reduce and/or delay surface facilities cost.
- Oil production impact:
  - Straighter wellbore provides higher critical flowrate yielding accelerated production.
  - Less water/gas means higher oil production rate in cases where total platform oil rate from multiple wells is constrained by surface processing capacity.
  - Accurately targeted wellbores provide accelerated production and the potential for higher cumulative oil recovery.

5.3 Oil and Gas Production Estimates

Oil and gas production levels at the Point Arguello platforms will be increased by development of the Rocky Point Unit. Figures 5 and 6 show the estimated production rates for oil and gas respectively.

Fuel gas consumption is anticipated to increase to 8 mmscfd in 2003, when oil volumes from Rocky Point Unit reach a level that demands additional compression power for gas lift. Combined production from both Point Arguello and Rocky Point is expected to decline after 2005. In 2008, fuel gas demand is expected to drop to 7 mmscfd, with further declines in 2011 and 2013 as oil output drops.

Point Arguello Unit's gas production situation is somewhat complex, because the "bubble" of accumulated gas injected since Reconfiguration I in late 1998 has communicated with producing wells and is now being produced and reinjected again. The speed with which this gas reappears, is compressed and reinjected (i.e., cycled) determines the daily gas production rate, and apparent GOR. Current (January 2001) gas rates of nearly 25 mmscfd are partially due to the cycling of this previously injected gas. Arguello Inc.'s plans to bring 3 mmscfd of sweetened gas to shore for consumption in cogen turbines at the Gaviota Plant, in combination with diversion of 5 mmscfd to be injected in the light pool via Platform Hidalgo, will deplete the accumulated heavy pool bubble by year-end 2002. Once this is achieved it is expected that heavy pool gas production will consist of solution gas only. Solution gas production from both Point Arguello and Rocky Point will exceed platform and Gaviota fuel demands until 2006. Until then increasingly smaller volumes will be injected into the light pool, and after that, the light pool will be drawn down to supply fuel demands in excess of solution gas production.

As shown in Figure 6, Arguello Inc. estimates that gas production in 2001 will average slightly more than 20 mmscfd, and will drop to about 16 mmscfd in 2002. This is based on the calculation of the rate at which the accumulated bubble is depleted.

Figure 5 **Estimated Oil Production from Rocky Point and Point Arguello Fields**

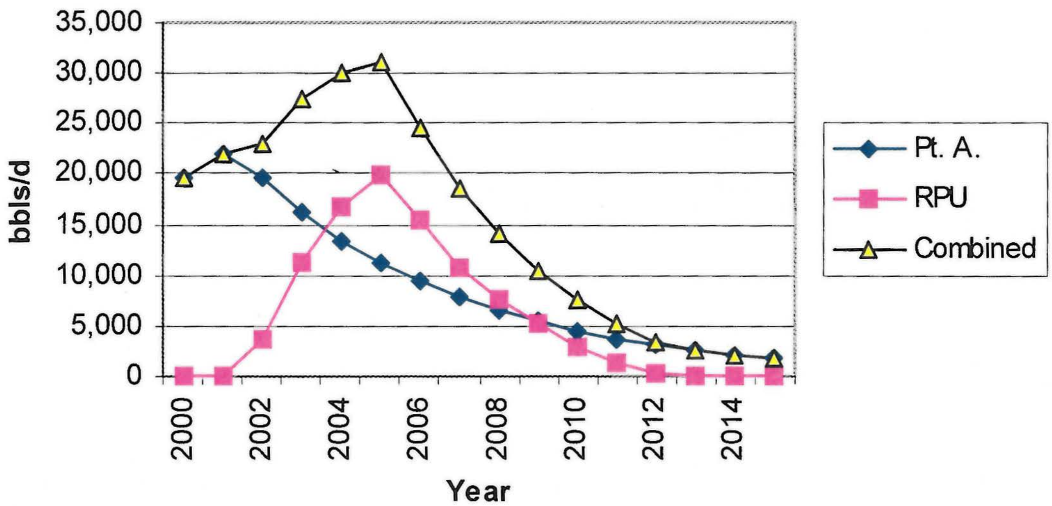
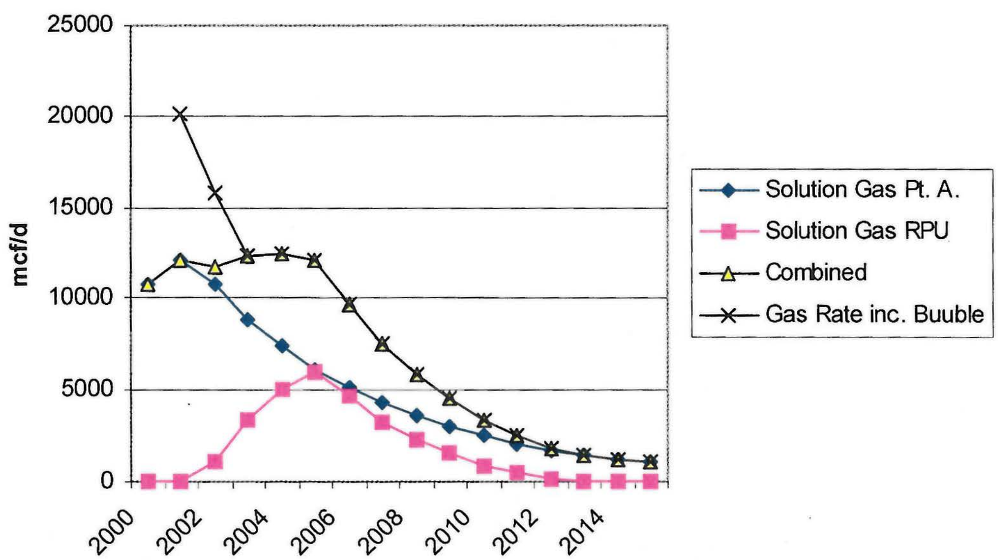


Figure 6 **Estimated Gas Production from Rocky Point and Point Arguello Fields**



Revisions to the Point Arguello Field DPPs

Supporting Information Volume
Rocky Point Unit Geology

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Table of Contents

List of Figures

1.0 Introduction

This section of the supporting information document addresses the Subsurface Geology associated with the Rocky Point Unit.

Regional and Near-Surface Geology are not affected by the Rocky Point Unit Development since no new platforms or facilities are proposed as part of the project. The Rocky Point Unit Development will utilize the existing Point Arguello Unit infrastructure, and therefore, there will be no new impacts to the Regional and Near-Surface Geology.

The development of the Rocky Point Unit will involve oil and gas production from a different offshore oil field(s). The Subsurface Geology associated with this oil and gas field is discussed below.

2.0 Subsurface Geology

The Rocky Point Field, located six miles northwest of Point Conception, is a series of complexly-faulted anticlines, which trend northwest-southeast across OCS tracts P-0451, P-0452, and P-0453. A structure map for the Rocky Point Field is shown in Figure 1, which identifies two cross sections. Figures 2 and 3 show the detailed cross sectional data. These doubly plunging anticlines are segregated into three major anticlinal blocks by a series of northwest-southeast trending high angle reverse faults. These blocks are referred to as the northeastern, central and southwestern blocks. The field consists of the northeastern and central blocks. The northeastern block is the structurally highest, most tightly folded and extends over a greater distance. At the southeast end of the block, the Monterey and Point Sal thin and unconformably overlie Cretaceous silts and shales of the Amberjack Ridge that marks the southern boundary of the offshore Santa Maria Basin. The northeastern block contains three proven accumulations of oil: the northwest pool, the central pool and the southeast pool. The central pool is separated from the northwest pool by a northeast-southwest trending fault and from the southeast pool by a low saddle. The stratigraphy of the area is described below.

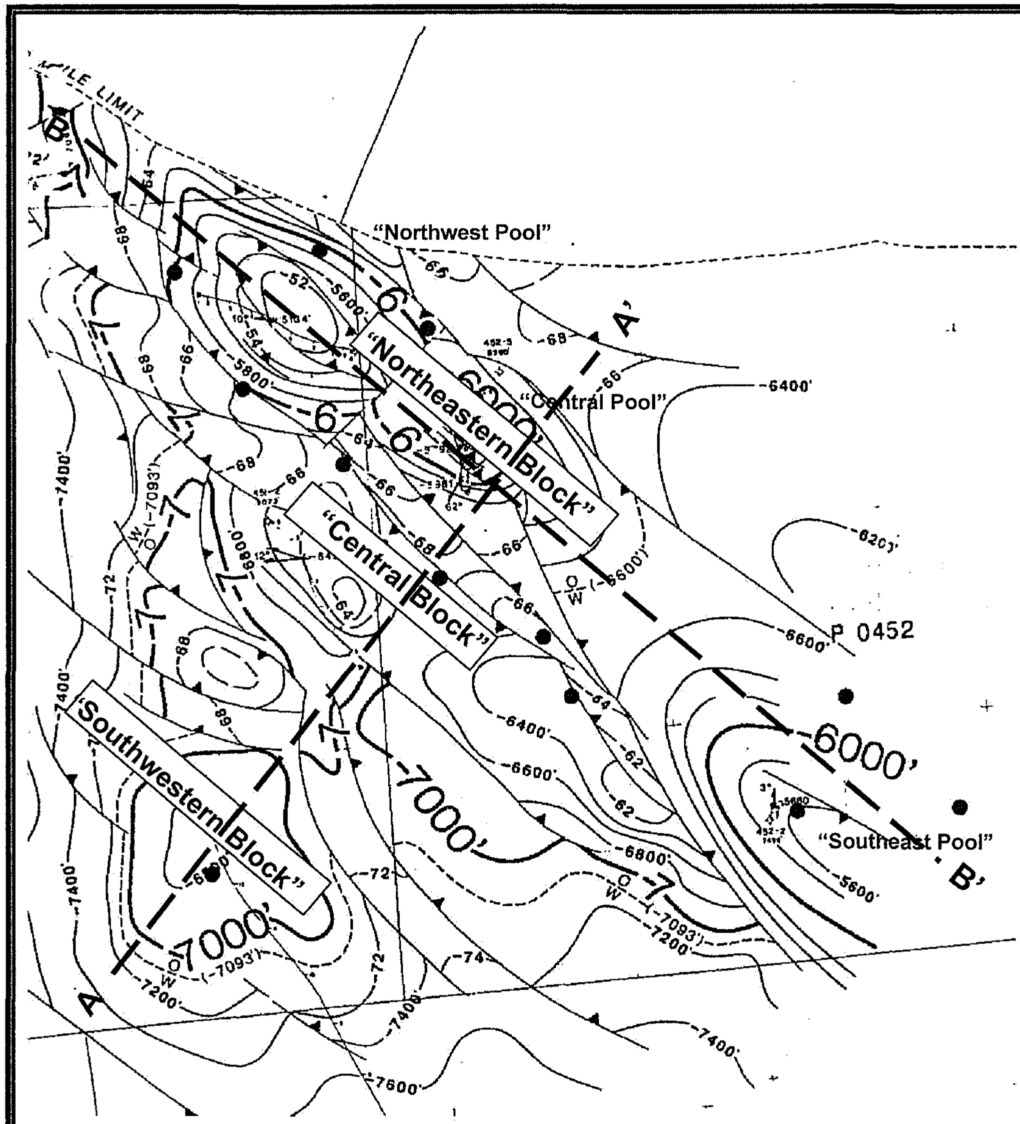
Pico Formation: The Pico sands, siltstones and claystones (also equivalent to the onshore Foxen Formation) comprise the Pliocene section (Repettian-Wheelerian). The section consists of unconsolidated, lithic, fine to medium grained sands with dark gray-brown claystones and mudstones.

Sisquoc Formation: The upper Miocene (Delmontian-late Mohnian) Sisquoc Formation is generally a continuous depositional sequence of clayey, partly laminated siltstone that grades to a diatomaceous mudstone/claystone. It contains porcelanites and resinous to microsucrosic dolostones. The lower section of Sisquoc (sometimes referred to as Santa Margarita) grades from mudstone/claystone to a laminated, silty, siliceous shale. Interbedded within the shales and mudstones or claystones are increasing amounts of dolostones and porcelanites, with decreasing amounts of siltstone and rare to common pyrite. The fractured reservoir of the lower Sisquoc is one of the objectives targeted for Rocky Point production. The DSTs in the lower section of the Sisquoc have tested as much as 3,500 bpd and 903 Mcf/D. Depths for the productive interval range from about 5,200 feet subsea to about 7,200 feet subsea.

Monterey Formation: The Monterey Formation is middle Miocene in age (early Mohnian-Luisian). The fractured Monterey is, with the lower Sisquoc, a reservoir targeted for production in the Rocky Point Field. In the Point Pedernales Field, to the northwest of Rocky Point, the Monterey has been subdivided into distinct zones based on lithology and wireline log curve character. These zones continue throughout the area, which includes the Point Arguello Field. The upper Monterey is similar lithologically to the overlying basal Sisquoc but is more resistive because of increased biogenic content with the fracture density and reservoir quality increasing. The upper Monterey is basically a banded, laminated, siliceous shale with waxy porcelanites, dolostones, abundant pyrite and a trace of chert. The lower Monterey becomes even more highly resistive and is characterized by abundant cherts and dolostones interbedded with the laminated siliceous shales and porcelanites. These highly resistive rocks are separated by a less resistive dark brown, phosphatic organic shale with minor amounts of cherts, dolostones and porcelanites. In some areas the basal part of the Monterey is dominated by a carbonate interval. Due to the abundance of brittle biogenic rocks, these zones are even more fractured than the upper zones and, in some cases, can be so highly brecciated that they have the appearance of a very angular sand. DST's in the upper Monterey interval tested 1,629 bpd and 570 Mcf/D. Depths for the productive interval range from about 6,000 feet subsea to about 7,200 feet subsea.

Point Sal Formation: The lower Miocene (Relizian) section that underlies the Monterey Formation is a limey mudstone with interbedded dolostones.

Figure 1 Rocky Point Unit Structure Contours on S4c*



● *Preliminary bottomhole well locations*

*S4c is a Sisquoc marker equivalent to Pt. Arguello stratigraphic marker PA17. Interpreted Jan. 12, 1989

Figure 2 Rocky Point Unit_Structural Section A-A'

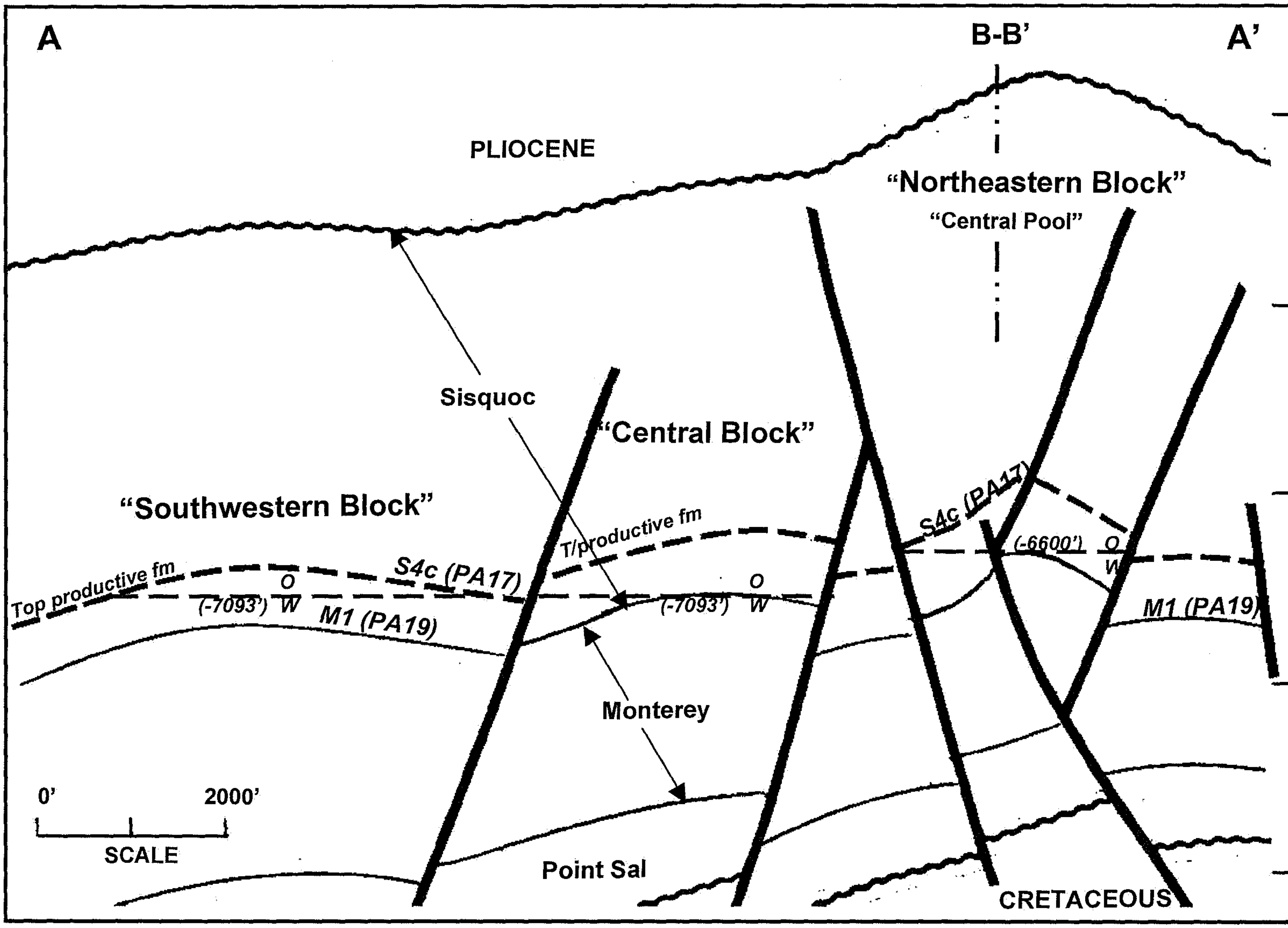
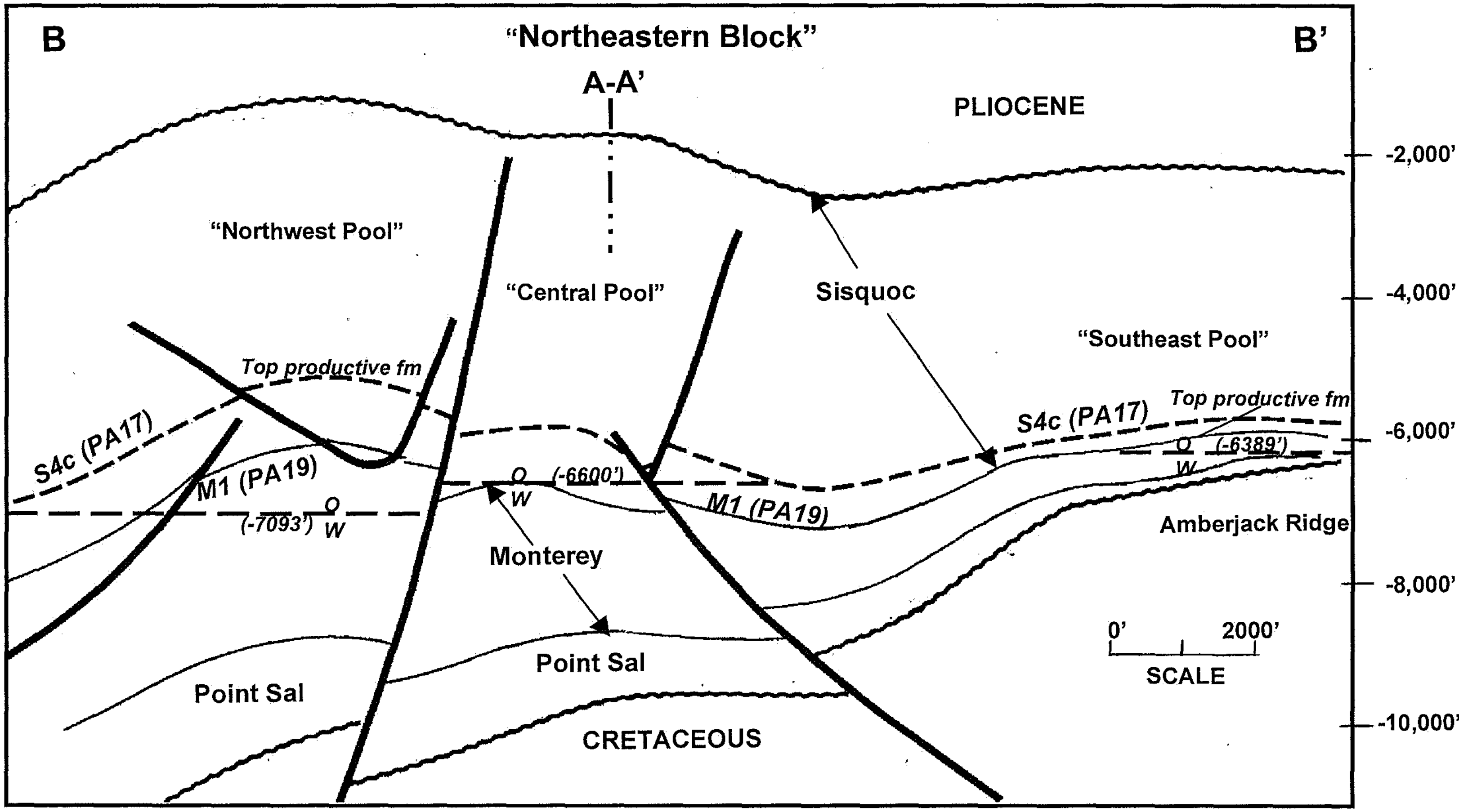


Figure 3 Rocky Point Unit Structural Section B-B'



Revisions to the Point Arguello Field DPPs

Supporting Information Volume
Cementing Program and Muds and Cuttings

Submitted to:
The Minerals Management Service
Pacific OCS Region

Submitted by:
Arguello Inc.

May 18, 2001

Address Inquires To:

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Table of Contents

List of Tables

List of Figures

1.0 Cementing Program

A cementing system will be used to force cement down the well to seal the annulus between the casing and the hole or between concentric casing strings. The cementing program details are provided in Table 1.

2.0 Mud System

A mud system is used to control well pressure, lubricate the drill pipe and bit, and return drill cuttings to the surface. It is possible that synthetic or oil based muds may be used for drilling the longer portions of the wells. In addition, muds containing additives not approved by the EPA, or containing concentrations above EPA limits will be taken ashore via boats. Oil or synthetic based muds will be collected on the platforms and sent ashore for recycling and/or disposal. Attachment B provides a more detailed description of the mud equipment. Attachment C contains the estimated mud composition for a sample well (RP-4).

Mud monitoring equipment will be installed and maintained for all drilling below the 24-inch diameter conductor casing, primarily for the purpose of well control. The equipment includes: sensors, which continuously record mud pit level and flowline flow; alarms at the driller's station will indicate lost circulation displacement volume; and on-bottom kicks.

The trip tank monitors fluid gain or loss from the wellbore while the drillstring is being pulled out of the hole.

As is evident by the lengthy production history of Point Arguello Field, it is not expected that any shallow gas will be encountered. However, it is possible that shallow gas could be found in the Foxen formation. Diligent efforts will be maintained to keep the wellbore full of fluid whenever possible.

3.0 Drilling Fluids and Cutting Disposal

The estimated water based cuttings and drilling fluid volumes for each of the 14 identified wells is provided in Figure 1 and 2 respectively. The information in this figure is based on use of an environmentally acceptable water base drilling fluid. All water-based drill cuttings and drilling fluid will be discharged into the ocean in accordance with the current approved NPDES permit assuming they contain concentrations below EPA approved limits. Table 2 provides an estimate of the properties of the water based drilling fluids that will be used for the drilling program.

Table 1 Cementing Program Details

Casing Diameter (in)	Type	Seawater or Fresh	Density (ppg)	Yield, (cft/sack)	Top of Cement[1] (feet) MD	Openhole Excess (%)	Number of Sacks	Blend
24	Lead	Seawater	15.8	1.16	835 (mudline)	100	1,463	Class G + 2% Calcium chloride + 2 ghs FP-6L
18.625	Lead	Seawater	11.6	2.7	0	100	156	Class G + 50 ghs A-3L + 2 ghs FP-6L
18.625	Tail	Seawater	16	1.13	1,285	100	479	Class G + 10 ghs A-7L + 10 ghs CD-31L + 2 ghs FP-6L
13.375	Lead	Seawater	11.6	2.7	0	25	1822	Class G + 50 ghs A-3L + 2 ghs R-8L + 2 ghs FP-6L
13.375	Tail	Seawater	16	1.12	6,000	25	416	Class G + 8 ghs CD-31L + 20 ghs FL-33L + 6 ghs R-8L + 2 ghs FP-6L
9.625	Lead	Seawater	11.6	2.7	13,000	25	502	Class G + 50 ghs A-3L + 10 ghs R-8L + 2 ghs FP-6L
9.625	Tail	Seawater	11.6	1.13	16,491	25	199	Class G + 22 ghs FL-63L + 6 ghs CD-31L + 3 ghs ASA-301L + 8 ghs R-8L + 2 ghs FP-6L
5.5	Lead	Seawater	12	2.4	16,691	25	271	Class G + 40 ghs A-3L + 12 ghs R-8L + 2 ghs FP-6L
5.5	Tail	Seawater	16	1.13	19,000	25	632	Class G + 28 ghs FL-63L + 6 ghs CD-31L + 1 ghs ASA-301L + 7 ghs R-8L + 2 ghs FP-6L

1. *Measured from rig floor. Numbers assume Harvest Platform.*

Nomenclature:

ghs – gallons per 100 sacks of cement
cft/sack – cubic feet per sack of cement
A-3L – liquid sodium metasilicate, extender
CD-31L – liquid cement dispersant, friction reducer
FL-33L – liquid fluid loss
FL-63L – liquid fluid loss
ppg – pounds per gallon
FP-6L – liquid foam preventer
A-7L – liquid calcium chloride, accelerator
FL-33L – liquid retarder
R-8L – liquid retarder
ASA-301L – liquid anti-setting

Figure 1 Estimated Volume of Water Based Cuttings

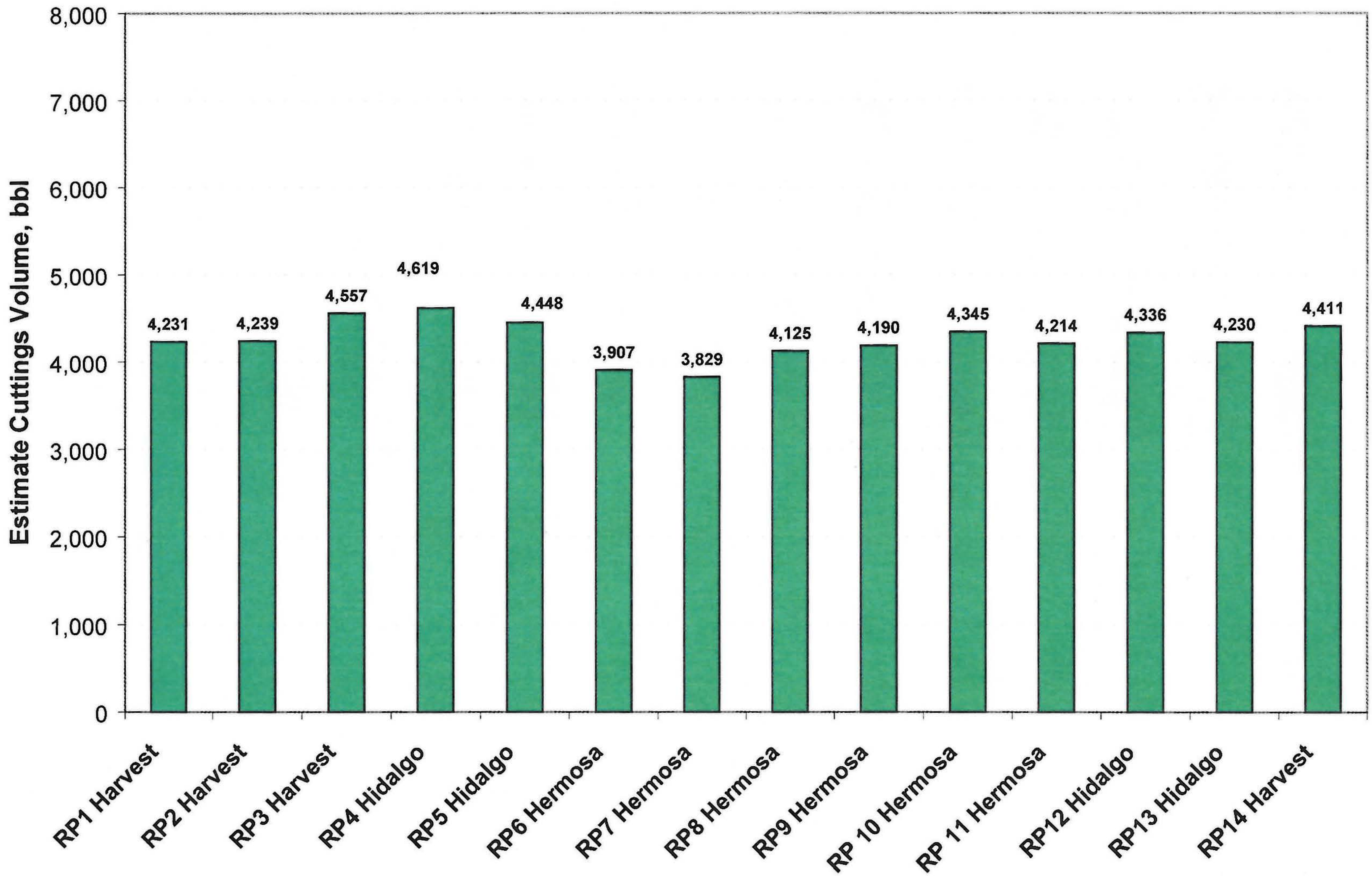

Figure 2 Estimated Volume of Water Based Drilling Fluids

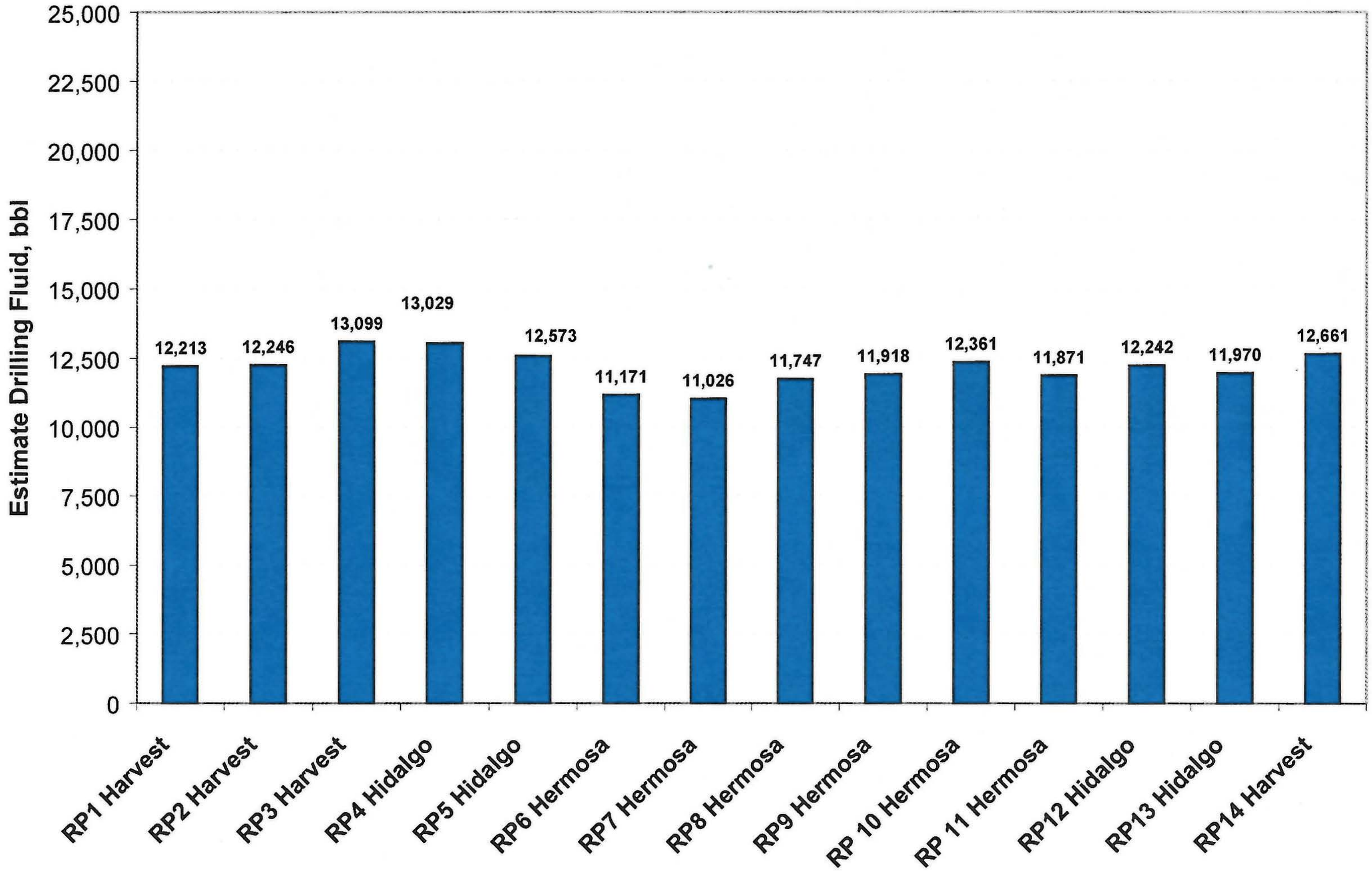

Table 2 Proposed Water Based Drilling Fluid Properties

Property	Drill Hole Size				
	30"	22"	17 1/2"	12 1/4"	8 1/2"
MW, ppg	8.6- 8.7	8.6 - 8.7	9.0 - 9.4	9.6 - 10.2	8.6 - 8.8
Visc (sec/qt)	100+	100+	50 - 58	45 - 55	45 - 50
Fluid Loss (cc 30 min)	NC	NC	<25	10 - 12	NC
3 RPM Reading	NC	22	15	> 12	> 10
Solids Content	NC	NC	<7 % LGS	< 7 % LGS	< 7 % LGS
Mud Components	Seawater Durogel Soda Ash	Seawater Durogel Soda Ash	Gel/Gelite Soda Ash Polypac Tek Mud	Gel/Gelite SP 101 Soda Ash XCD Polypac Tek Mud M-I Bar	Flo-Vis Greencide 26G

It is possible that oil or synthetic drilling fluids will be used to drill some of the longer portions of the wells. If synthetic or oil base drilling fluids are used, there will be no discharges of these drilling fluid or cuttings into the ocean. The drilling fluid company typically purchases the used drilling fluid. The oil base cuttings spoils will be disposed of at an approved onshore disposal site or facility. The cuttings will be collected in steel roll-off bins, then transferred to shore on regularly scheduled supply boat trips. The roll-off bins would be taken via roll-off truck to the designated disposal site. Used drilling fluid will be emptied into Coast Guard-approved closed top tanks and sent to shore via regularly scheduled supply boats. Once on shore, vacuum trucks will transport used drilling fluids to the drilling fluid suppliers' operations base.

Another possible option for disposal of the oil or synthetic drilling cutting is injection back into the underground formation. The typical process that is used for injection of cutting into an underground formation is described below. The cuttings are ground to a fine particle size and mixed with seawater in various ratios to obtain desired density (10.0-12.5 lb/gal) and viscosity (60-90 sec/qt funnel). In addition to slurried cuttings, typically all wash water, contaminated rain water and displacement interface fluids collected are injected along with the cuttings.

For a typical Rocky Point Unit well about 9,000 bbls of material will be injected into the underground formation. This would include approximately 2,000 bbls of cuttings and absorbed fluids for the oil or synthetic based portion of the well. About 450 bbls of interface and contaminated drilling fluid, about 3,000 bbls of seawater for building slurry, and about 3,550 bbls of wash water and contaminated deck drainage would be injected into the casing annulus.

The typical process for handling the cutting for injection is as follows. The cuttings are transported from the shale shakers, using a vacuum transfer system, into a slurry tank. The cuttings are then mixed thoroughly with water and circulated through a centrifugal shredding pump. Any particle larger than about 20 mesh equivalent is screened out over a shaker screen and returned to the slurry tank for further particle size attrition. Once the desired slurry properties are achieved, the fluid is transported into a holding tank. An injection pump is then used to inject the slurry down the casing annulus. If needed, the drill rig cement unit pump can be used as a backup for the injection pump.

For each Rocky Point Unit well the injection of the oil or synthetic based cuttings would occur over a period of approximately 60 to 70 days.

Figures 3 and 4 provide the estimated synthetic/oil based cutting and drilling fluid volumes for each of the 14 identified wells, respectively. This figure shows both the water-based and synthetic/oil based cutting and drilling fluid volumes that would be generated for each well. The water-based drilling fluids and cuttings would be discharged to the ocean in accordance to the current approved NPDES permit. The synthetic/oil based fluids and cutting would be taken ashore and handled as described above. Table 3 and 4 provide an estimate of the properties of the water/synthetic and water/oil based fluids respectively.

Figure 3 Estimated Volume of Synthetic/Oil Based Cuttings

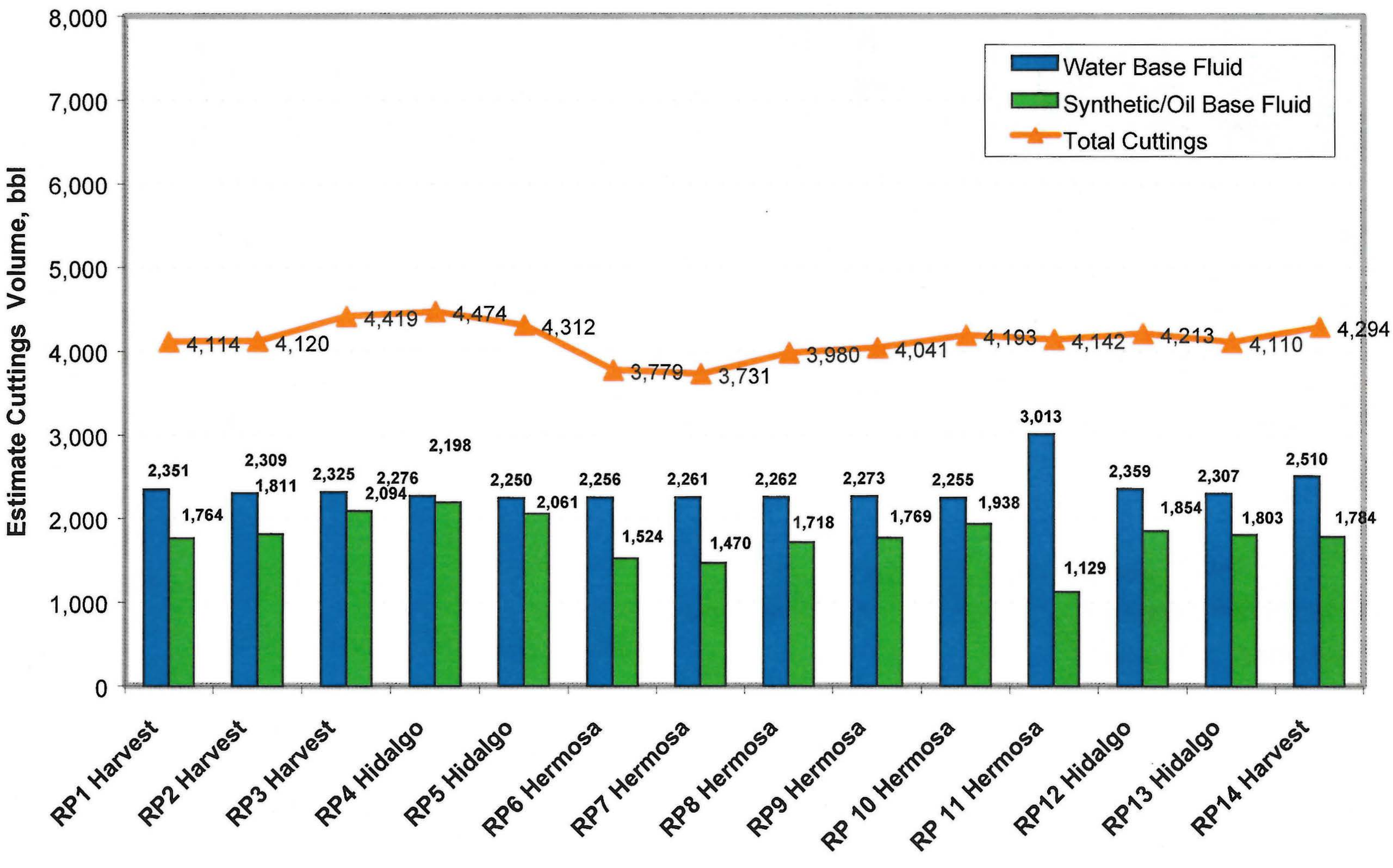

Figure 4 Estimated Volume of Synthetic/Oil Based Drilling Fluids

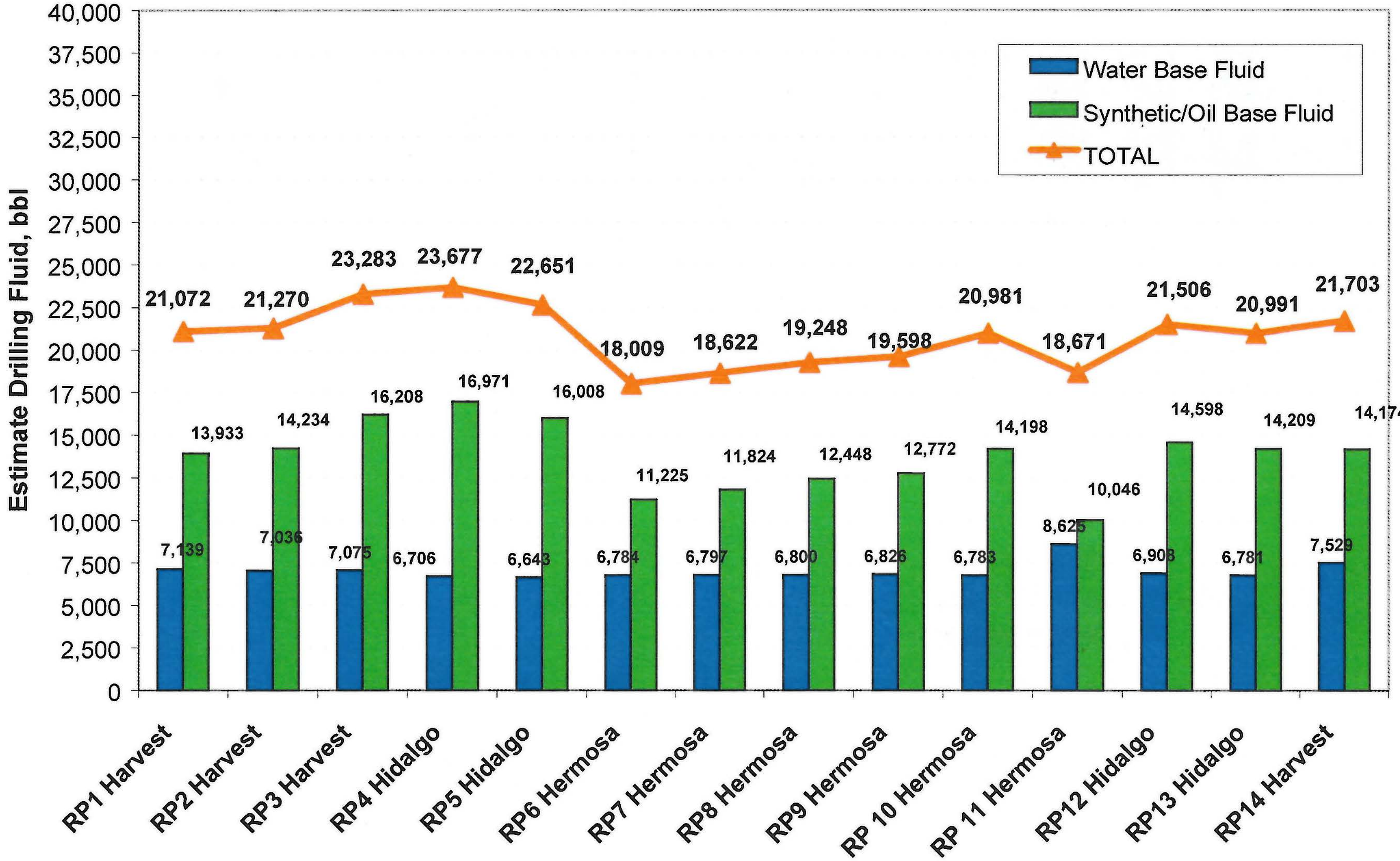

Table 3 Proposed Water and Synthetic Based Drilling Fluid Properties

Property	Drill Hole Size				
	30"	22"	17 1/2"	12 1/4"	8 1/2"
MW, ppg	8.6- 8.7	8.6 - 8.7	9.0 - 9.4	9.6 - 10.2	8.6 - 8.8
Visc (sec/qt)	100+	100+	50 - 58	55 - 65	40 - 50
Fluid Loss (cc 30 min)	NC	NC	<25	NA	NA
HTHP @ 300 F	NA	NA	NA	6 - 8	NC
3 RPM Reading	NC	22	15	> 8	> 6
Solids Content	NC	NC	<7 % LGS	< 6 % LGS	< 6 % LGS
Mud Components	Seawater Durogel Soda Ash	Seawater Durogel Soda Ash	Gel/Gelite Soda Ash Polypac Tek Mud	Novamul Novawet VG plus Novamod Lime CaCl2 HRP M-I Bar	Novamul Novawet VG plus Novamod Lime CaCl2 HRP M-I Bar

Table 4 Proposed Water and Oil Based Drilling Fluid Properties

Property	Drill Hole Size				
	30"	22"	17 1/2"	12 1/4"	8 1/2"
MW, ppg	8.6- 8.7	8.6 - 8.7	9.0 - 9.4	9.6 - 10.2	8.6 - 8.8
Visc (sec/qt)	100+	100+	50 - 58	55 - 65	40 - 50
Fluid Loss (cc 30 min)	NC	NC	<25	NA	NA
HTHP @ 300 F	NA	NA	NA	6 - 8	NC
3 RPM Reading	NC	22	15	> 8	> 6
Solids Content	NC	NC	<7 % LGS	< 6 % LGS	< 6 % LGS
Mud Components	Seawater Durogel Soda Ash	Seawater Durogel Soda Ash	Gel/Gelite Soda Ash Polypac Tek Mud	Versamul Versacoat VG plus Ecotrol Lime CaCl2 HRP M-I Bar	Versamul Versacoat VG plus Ecotrol Lime CaCl2 HRP M-I Bar

Revisions to the Point Arguello Field DPPs

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Table of Contents

List of Figures

1.0 Introduction

The Rocky Point Development Project will not result in any modifications at the Gaviota Facilities compared to what is occurring today with the Point Arguello Field production. With the development of the Rocky Point Unit, there will be an increase in the volume of oil heated and metered at the Gaviota Facility. However, this volume will be substantially less then the peak Point Arguello oil production level, and the production level analyzed in the 1984 EIR/EIS for the Point Arguello Field Project. The Gaviota Facility is located 28 miles west of the City of Santa Barbara. Figure 1 shows the location of the Gaviota Facility.

As part of the Point Arguello Project, Arguello Inc. has received approval from the County of Santa Barbara for a Final Development Permit modification to allow the shipment of sweet gas from Platform Hermosa to the Gaviota Facility for sale to the onshore partnership for use as fuel in the onshore turbine generators. If the Rocky Point Unit is developed some of the gas will be sold to the Gaviota Facility for use as fuel.

This section of the document provides a general description of the oil heating and metering operations that currently occur at the Gaviota Facilities. The section also contains information on the recently approved Sales Gas Project. This information is included as part of the DPP supplemental information to assist the reader in understanding the activities that occur at the Gaviota Facilities, since the Rocky Point production will use these existing facilities.

2.0 Onshore Oil Handling

The Rocky Point and Point Arguello crude oil will be co-mingled on the platform at the production well head manifold. The co-mingled production is then dehydrated and stabilized offshore before it is pumped to the Gaviota Facility via the PAPCO pipeline. Once the oil reaches the Gaviota Facility it is metered as part of the PAPCO leak detection system. The oil then passes through a heat exchanger where it is heated to about $125^{O}F$ using waste heat from the onshore cogeneration units. The oil is then metered at the dry LACTs before being transferred via pipeline to the Gaviota Terminal Company storage tanks located on the south side of Highway 101. From the Gaviota Terminal Company storage tanks the oil is sent to the All American Pipeline for transport to various refining destinations.

The only operations that are occurring at the Gaviota Facility are crude oil metering and heating. Oil processing no longer occurs at the Gaviota Facility. None of the operations at the Gaviota Facility will change with the Rocky Point production. No modifications at the Gaviota Facility will be needed to handle the Rocky Point production.

The following oil handling operations occur at the Gaviota Facility.

Pigging Operations. The existing Gaviota oil pig receiver remains in service at the Gaviota Facility. Pig receiver drains would be sent to T-25, the oily water tank. The pig receiver vents are routed to the flare.

Metering. LACT metering operations and SCADA/Leak Detection functions continue to operate as they always have.

Heating. The crude oil is heated in heat exchangers using waste heat from the cogeneration units.

Oily Water Handling. All the process drains from the facility are collected in T-25, the oily water tank, where the oil and water are separated. The oil is routed to GTC, and the water is routed to a wastewater disposal system. The T-25 vents are routed to the flare. The oil wastewater from T-25 is sent to a set of filters to remove any solids. The water is then routed to a set of pumps, which are used to inject the water into disposal wells. These wells have been used for the entire life of the Gaviota Facility for handling oily water. The water is injected into an old oil and gas reservoir located near the Gaviota Facility.

Power Generation. Currently gas from the Point Arguello Field is used to fuel the cogeneration system, which produces electricity and provides heat for the crude oil and other facility systems.

Other ancillary systems that would continue to be operated at the Gaviota Facility include impoundment basins, utility and instrument air, nitrogen system, desalinization system, fresh water system, firewater system, fuel gas system, sewage treatment system, control room, administration building, and the flare.

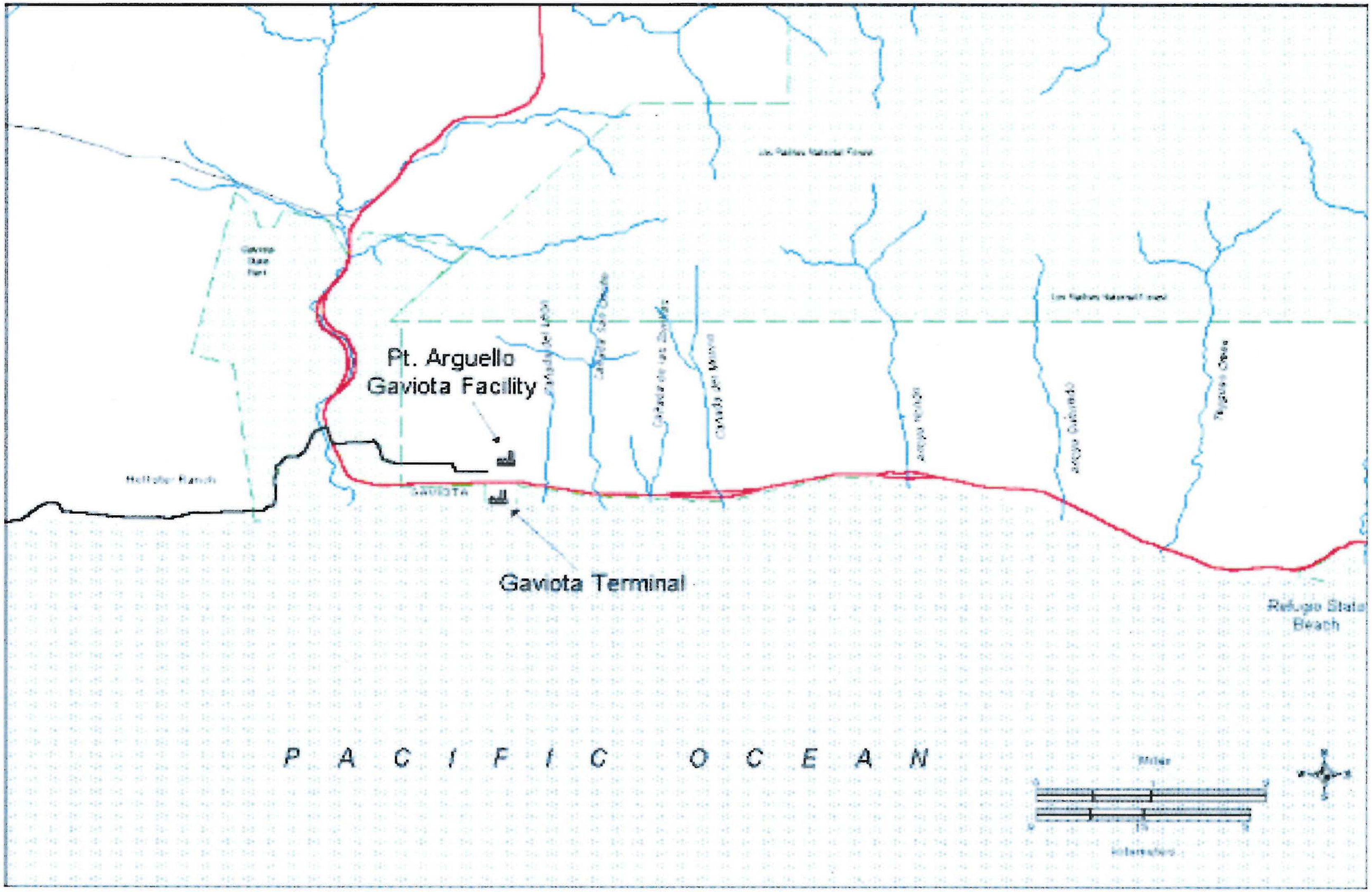
3.0 Onshore Gas Handling

The gas plant at the Gaviota Facility ceased operating in October of 1998 when the Point Arguello partners began injecting the gas in the reservoir. Since that time no produced gas has been sent to the Gaviota Facility from the Point Arguello platforms.

As discussed above, Arguello Inc. has recently received an FDP modification from the County of Santa Barbara to allow sweet sales gas to be shipped from Platform Hermosa to the Gaviota Facility for use as fuel in the cogeneration system. This project was approved as part of the Point Arguello Project.

The Sales Gas Project was implemented in order to comply with the MMS directive requiring Arguello Inc. to sell gas from the Point Arguello Unit. The sweet gas will be used to fuel up to three of the power generating turbines and to meet the heat needs of the facility.

Figure 1 Location of Point Arguello Gaviota Facilities



A recent directive by the MMS requires that Arguello Inc. place a high priority on accomplishing sales of sweet gas from the project rather than the current gas injection. The MMS believes gas sales should be the predominant gas disposition method after fuel use on the platforms and should be the focus of any long-term production plan. The MMS determined that the transfer of gas from the Point Arguello Unit to the Point Arguello Pipeline Company (PAPCO) for use as fuel constitutes "gas sales" and is a legitimate royalty bearing sale. The gas sales has been accomplished by moving the existing gas sales meter from downstream of the Gaviota Gas Plant to upstream of PAPCO. The sales gas is being priced on a competitive basis with royalty based on valuation in accordance with MMS regulations.

The purpose of the Sales Gas Project is to reduce the volume of gas that is being injected back into the Point Arguello reservoir, thereby complying with the MMS directive to initiate sales gas onshore from the Point Arguello Project. In addition, the project is reducing operating costs by eliminating the need to purchase/source natural gas from The Gas Company to fuel the turbines. The project, when fully implemented will supply the electrical grid system with approximately 10 megawatts (MW) of power. Given that the demand for electricity in California is greater than the supply, the addition of 10 MW of electrical power is viewed as a net benefit to the state.

With the Sales Gas Project, produced gas from the Point Arguello Field is sweetened (i.e., the H_2S and CO_2 removed from the gas) on Platform Hermosa. The sweet gas is then shipped via the Point Arguello Natural Gas Pipeline (PANGL) to the Gaviota Facility, where the gas is metered and fed to the turbines to generate electrical power and heat. The Sales Gas Project was implemented with only minor piping changes at the Gaviota Facility.

The Sales Gas Project was implemented in two phases. Phase I consisted of bringing enough fuel gas onshore to fire one of the turbine units at Gaviota. One turbine unit provides electricity and utility steam for the Gaviota facilities, with some additional electricity being delivered to the public utilities grid. Phase II consists of bringing enough fuel gas onshore to fire up to three cogeneration turbine units at Gaviota. The additional electricity generated is delivered to the public utility grid.

3.1 Phase I Sales Gas Project

Incoming gas to Gaviota is routed through V-1000 to allow liquids to drop out, in the unlikely event that liquids form in the gas during transport through the PANGL pipeline.

The gas from V-1000 is routed through existing piping to an existing meter run on the outlet of V-1000 that has been modified for royalty accounting purposes. The gas is then routed through the two existing gas plant fuel meters for distribution. One of the meters measures the gas going to the cogeneration unit and other existing users on the lower level of the plant, such as the facility flare. The second meter is used to measure gas that is sent to the upper level of the plant.

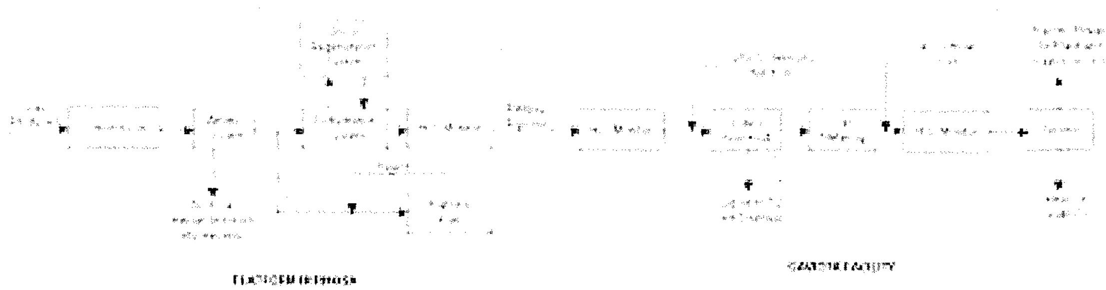
In the unlikely event that liquids drop out of the gas during transport through the PANGL pipeline, they accumulate in V-1000. The accumulated liquids from V-1000 are drained to Relief Knock Out Drum V-50. Liquids from V-50 are then pumped to T-2. The vapors from V-50 go to the flare. The liquids from T-2 are handled in the existing oil or wastewater disposal systems.

The Gaviota Facility has five cogeneration turbines, each one with a nominal capacity of about 3.7 MW. The current electrical load at the Gaviota Facility is about 0.8 MW. Under Phase I of the project approximately 1.15 mmscfd of sweet gas is shipped from Platform Hermosa to the Gaviota Facility. The electricity generated is used as needed at the Gaviota facilities (approximately 0.8 MW) with the excess being sold to the public utility grid (approximately 2.9 MW). It should be noted that the amount of fuel used and the amount of power generated is dependent on a number of factors such as the BTU content of the fuel, and the atmospheric conditions. Given that these factors will vary with time, the fuel use and electrical power generating numbers presented in this document are on a nominal basis.

The waste heat from the turbine is used to generate steam, which is used at the Gaviota facilities to heat the oil and for other in plant utilities such as the deaerator and flare assist.

Figure 2 shows a simplified block flow diagram of the Point Arguello Sales Gas Project.

Figure 2 Block Flow Diagram of Point Arguello Sales Gas Project



The only construction that was needed for implementing the Phase I project was the installation of a 20 foot long, 4-inch diameter pipe spool, and the installation of a sulfur scavenging injection skid. The pipe spool was required to allow for isolation of the plant fuel system from The Gas Company buy-back meters, which are used to measure the quantity of gas purchased from The Gas Company. Arguello Inc. needs to maintain the ability to purchase gas from The Gas Company in the event that sweet gas is not available from Platform Hermosa or for blending with the PANGL gas to meet the required sulfur limit in the fuel to the turbines.

The sulfur scavenging injection skid included a small pump and a tote that holds the sulfur scavenging material. The sulfur scavenging material is injected just prior to V-1000 to control the total sulfur in the gas going to the turbines to 4-ppm or less.

The sulfur scavenging material was needed upon start-up of the system, since the PANGL pipeline H_2S level was around 10 ppm. Use of this system would continue until the H_2S level in the pipeline is brought below 4 ppm. The sulfur scavenging material might also have to be used in the future if there are upsets with the offshore amine unit on Platform Hermosa to assure that the H_2S content of the gas to the turbines is below 4 ppm. It should be noted that the normal operating mode would have the PANGL gas at less than 4 ppm total sulfur.

The proposed Phase I operations are almost identical as what was occurring at the Gaviota Facility prior to the implementation of the Sales Gas Project. The only changes have been the source of the gas for the turbine, and the fact that the one turbine could run at a higher load.

Gas from The Gas Company has been replaced by sweet gas from Platform Hermosa. When the turbine is run at a higher load, then excess steam is vented to the atmosphere. With one turbine at full load approximately 14,000 lbs. per hour of steam is vented to atmosphere.

3.2 Phase II Sales Gas Project

In Phase II of the project, additional gas volumes are sweetened on Platform Hermosa and sent ashore to the Gaviota Facility via the PANGL pipeline. The additional gas volume are used to fuel up to two additional turbines at the Gaviota Facility. Under Phase II of the project an additional 2.3 mmscfd of sweet gas is shipped from Platform Hermosa to the Gaviota Facility to fuel two more turbine generators. The electricity generated is sold to the public utility grid (approximately 7.4 MW). It should be noted that the amount of fuel used and the amount of power generated depends on a number of factors such as the BTU content of the fuel, and the atmospheric conditions. Given that these factors will vary with time, all of the fuel use and electrical power generating numbers presented in this document are on a nominal basis.

The process description for Phase II operations is the same as described above for the Phase I operations. The only difference is that a larger quantity of gas is be passed through V-1000 and the gas plant fuel meters.

With Phase II of the proposed project, the turbines generate heat in excess of the amount required to meet the needs of the Gaviota Facility. The excess heat is used to generate steam, which is then condensed in existing air-cooled heat exchangers located in the Gaviota plant. Four to six existing air-cooled heat exchangers are needed to condense the steam depending on the load.

The second option for handling the excess steam, that may be implemented in the future, would be to replace the existing catalyst in the SCR system with a new high temperature catalyst. This would eliminate the need to generate and condense steam. With this option, the exhaust from the turbines would not be routed through the boilers to generate steam, but rather would be sent directly to the SCR unit and then vented to the atmosphere.

The only construction requirements at Gaviota for the Phase II Sales Gas Project was associated with minor piping modifications that were needed to route the excess steam to the existing air-cooled heat exchangers. The piping modifications involved the re-routing of existing idle pipelines within the facility to allow the steam and condensate to move between the boilers to the air-cooled exchangers.

If the option of using a new high temperature SCR catalyst is implemented in the future, the required work needed would be to modify the mounting brackets holding the old catalyst, remove the existing catalyst and replace it with the new one. This catalyst replacement operation would also take a four-man crew about four weeks to complete. The old catalyst would be taken to a facility where it would be regenerated and resold for use at another facility.

Arguello plans to bring all three turbines online as quickly as possible in order to provide needed electrical power to the grid. There will be a period of time when all three turbines are operating prior to having the piping modification in place for use of the fin-fan coolers to condense the excess steam. During this period of time, the excess steam is vented to the atmosphere. With all three turbines running at full load, the quantity of excess steam that is vented to the atmosphere is approximately 56,000 lbs. per hour.

3.3 Operational Contingency Plan

Both Phases I and II provide for a contingency option to run all turbines with gas purchased from The Gas Company in the event that gas is not available from the offshore platforms. This option would allow the Gaviota facilities to continue to operate if problems occur offshore that would prevent the delivery of sweet gas ashore. The operational contingency plan would also allow for the venting of steam in the event of a fin-fan cooler system failure. This would occur until such time as the fin-fan cooler system was fixed and returned to service.

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Table of Contents

List of Tables

Table of Contents (continued)

Table of Contents (continued)

Page

List of Figures

1.0 Introduction

This document contains an analysis of environmental impacts associated with the DPP revisions that are being proposed by Arguello Inc. for the Point Arguello Field Platforms Hermosa, Harvest and Hidalgo. The proposed revisions to the DPPs cover the following.

- Development and production of oil and gas from all three platforms of the Rocky Point Unit,
- Injection of Rocky Point Unit gas at Platforms Hidalgo and Harvest, and
- Injection of Point Arguello Unit gas at Platform Hidalgo.

The injection of gas on Platform Hidalgo will be accomplished using existing compressors and wells on the platform. The compressors were used in the past for gas lift. The only change on the platform will be a change in use of existing equipment. Since all of the equipment that will be used for gas injection on Hidalgo has been in operation in the past, there are no new environmental impacts associated with this portion of the proposed DDP revisions.

The other portion of the proposed DPP revisions is the development and production of Rocky Point oil and gas reserves from the three existing Point Arguello platforms. Development of the Rocky Point Unit oil and gas reserves will not require any new equipment on the platforms or at the Gaviota Facility. The proposed drill rig that will be used for the Rocky Point Unit wells will be similar in size to other rigs that have been used previously on the Point Arguello platforms. As such, the drill rig would not be considered new equipment.

All of the wells will be directionally drilled using existing well slots on the platforms. Drilling of the Rocky Point Unit wells is expected to last approximately four to six years with production lasting approximately 10 to 12 years. With drilling and production expected to be concluded in this timeframe, the Rocky Point Unit reserves will be produced within the remaining productive life of Point Arguello platforms. This will maximize the reserves recovered in the shortest period of time and within the environmental time frame and footprint of the existing Point Arguello facilities as actually foreseen and evaluated in the Point Arguello/Southern Santa Maria Basin Area Study EIS/EIR.

Arguello Inc., operator of both the Point Arguello and Rocky Point Units, is proposing to drill development wells from Platforms Hermosa, Harvest and/or Hidalgo. The proposal is to drill a maximum of 20 wells for development of the Rocky Point Unit reserves. Up to seven wells will be drilled from Platforms Hermosa and Harvest and six from Platform Hidalgo. The 20 wells will be drilled in three phases. The first phase will involve the drilling of ten wells, the second phase four wells, and if needed, the third phase would cover the remaining six wells. However, it should be noted that the exact number of wells needed to develop the Rocky Point Unit reserves will not be known until the first few development wells have been completed, placed on production, and evaluated. As part of these DPP revisions, Arguello Inc. has identified the approximate bottom hole locations of 14 wells. It may be possible to sidetrack a number of the existing Point Arguello wells, and/or use existing wellheads for development of the Rocky Point Unit wells once some of the Point Arguello wells have reached the end of their productive life.

The Environmental Evaluation has been conducted assuming that all 20 wells are developed for the project in three phases, and that each of these wells have new wellheads. This represents a "worst case" for the environmental impacts.

All Rocky Point Unit oil production will be combined with Point Arguello Unit oil and transported to Gaviota in the existing PAPCO oil pipeline. From Gaviota, combined Rocky Point Unit and Point Arguello Unit oil will be transported to refineries in the existing All America Pipeline.

Rocky Point Unit gas will be combined with Point Arguello Unit gas on the production platforms. The combined gas will be sweetened for platform use or sale to shore via the existing PANGL pipeline. Gas volumes in excess of platform needs or sales to shore will be re-injected into the producing reservoir for later recovery and use or sales. Sweetened Rocky Point Unit gas that is sent to shore, along with Point Arguello Unit gas, will be used as fuel for the PAPCO turbine generators that produce steam for oil heating and electricity for facility use and sales to the grid. Development and production of Rocky Point Unit gas will enable sales of electricity for a longer period of time beyond that which electricity can be produced with Point Arguello Unit gas alone.

In brief, the development and production of Rocky Point Unit oil and gas reserves will be accomplished by drilling extended reach wells from the existing Point Arguello Unit platforms using existing wells slots, pipelines, equipment and facilities. Development of the Rocky Point Unit reserves will be accomplished within the expected lifetime of the Point Arguello Field. The total number of Point Arguello and Rocky Point Unit wells will be significantly less than the number of wells originally anticipated and approved for the Point Arguello Unit alone.

This document has been prepared to provide some of the additional supporting information required by 30 CFR 250.204(b). The remainder of the document addresses the environmental impacts associated with the development and production of the Rocky Point Unit oil and gas reserves.

This Environmental Evaluation is divided into four major sections that include the following.

- ***Introduction*** – Provides an overview of the project and an outline of the Environmental Evaluation document.

- ***Proposed Project Description*** – This section provides a general description of the proposed Rocky Point Unit development.

- ***Scope and Approach to the Environmental Evaluation*** – This section presents the scope and approach to the project-specific and cumulative environmental impact evaluation.

- ***Proposed Project Environmental Evaluation*** – This section discusses the environmental baseline, the environmental impacts of the proposed Rocky Point Unit development. This section also presents mitigation measures for the project. The analysis in this section is presented by issue area.

The Supporting Information Volume also contains a number of attachments that serve to support the environmental evaluation presented in this document.

Based upon the evaluation included in this document, the proposed Rocky Point Unit Development activities complies with the State of California's approved coastal management program and will be conducted in a manner consistent with such program.

2.0 Proposed Project Description

This section provides a brief description of the proposed Rocky Point Unit development. The reader is referred to the Development and Production Plan (DPP) revisions for a detailed description of the project.

The Rocky Point Unit is geographically located approximately 8 miles northwest of the coastline at Point Conception, Offshore California (see Figure 2-1). The Rocky Point Unit consists of Leases OCS-P 0451(E/2), 0452 and 0453 which taken together total 8,585.32 acres. The Rocky Point Field was discovered in 1982 by the Chevron OCS-P 0451 #1 exploratory well and further delineated by wells P 0451 #2, P 0452 Nos. 2, 3 and 5.

The proposed project is to develop the Rocky Point Unit from the three existing platforms in the Point Arguello Unit (Platforms Hermosa, Harvest and Hidalgo). No new offshore structures will be needed to develop the Rocky Point Unit. It is anticipated that wells will be drilled from all three of the platforms using extended reach drilling (ERD) technology. Table 2.1 provides general information on the three Point Arguello platforms Figure 2-1 shows the location of the platforms.

Table 2.1 Point Arguello Platform General Data

Platform/Location	Harvest	Hermosa	Hidalgo
Water Depth at Platform, ft	675	603	430
Platform Location	Lambert Zone 6(ft) X=664,622 Y=866,189	Lambert Zone 6(ft) X=674,783 Y=860,793	UTM 10(m) X=710,975 Y=3,819,245
Well Slots	50	48	56
Number of Well Slots Used for Arguello Field Development	18	17	17
Projected Number of Well Slots Needed for Rocky Point Unit Development[1]	0-7	0-7	0-6
Projected Future Well Slots for Point Arguello[1]	6	6	6
Well Slots Available for Future Development	19-26	18-25	26-33
OCS Lease	P-0315	P-0316	P-0450

1. Actual number of new wells will depend on analysis of seismic data, and results for initial production wells.

Platforms Harvest and Hermosa were installed in 1985 and Platform Hidalgo was installed in 1986. All three platforms were installed for the development and production of Point Arguello Field oil and gas reserves. Production peaked from the Point Arguello Field in August 1993 at 89 mbd of oil and 27 mmscfd of gas. In August 1998 production from the field was approximately 23 mbd of oil and 3.6 mmscfd of gas. Current (March 2001) oil production from the Point Arguello Field is 21 mbd.

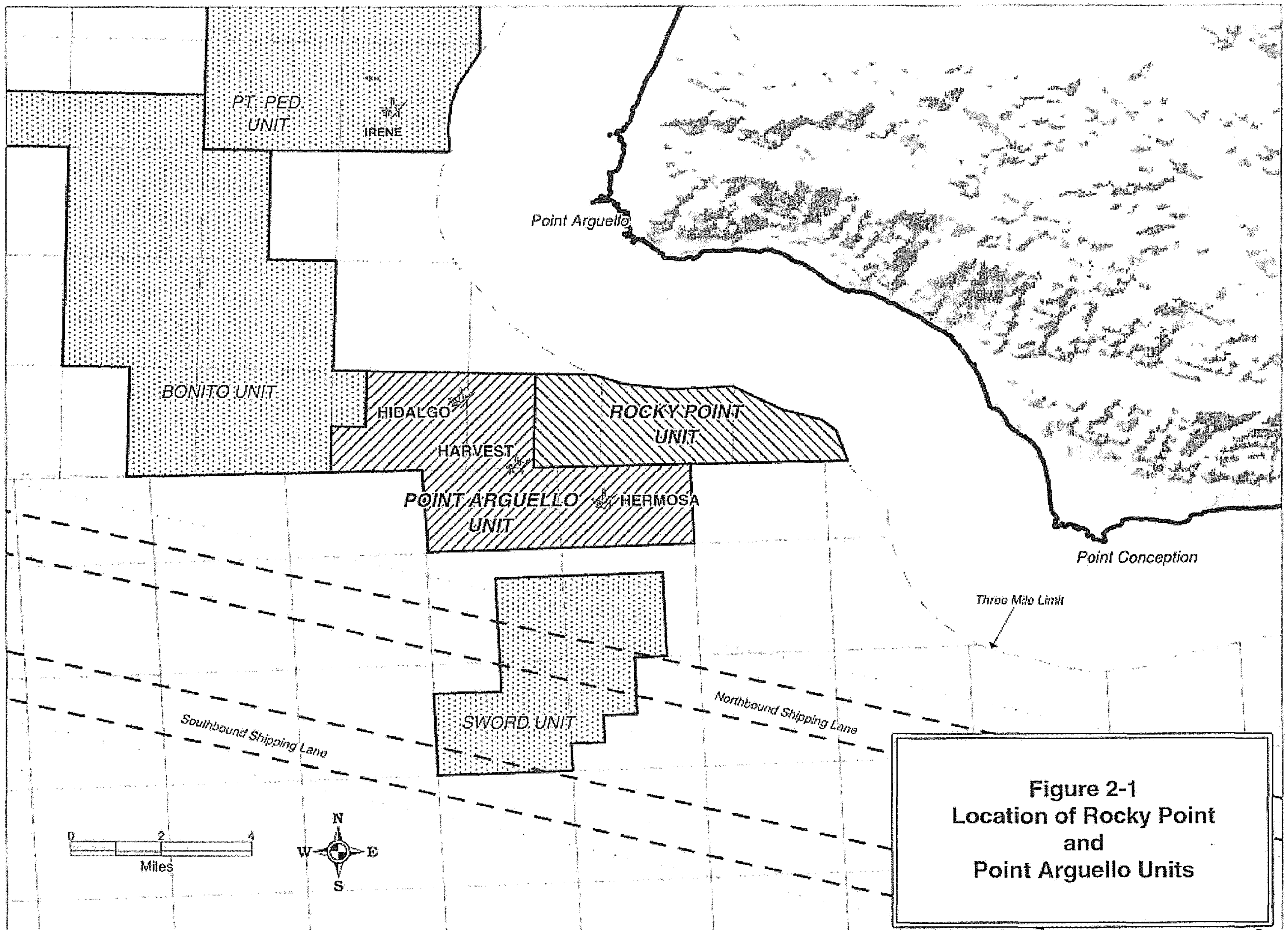


Figure 2-1
Location of Rocky Point and Point Arguello Units

2.1 Drilling Program

The current estimate is that 14 wells will be needed in order to develop the Rocky Point Unit. However, up to 20 wells may be used to develop the Rocky Point Unit reserves. The exact number of wells will not be known until completion of the geophysical review and subsequent confirmation by initial well drilling. In assessing the impacts of development and production of the Rocky Point Unit, it has been assumed that all 20 wells are developed. (Seven wells from Platforms Hermosa and Harvest and six wells from Platform Hidalgo).

The Rocky Point wells will be drilled from the three existing Point Arguello platforms. The drilling program has been divided into three phases. During Phase 1, it is expected that four wells will be drilled from Platform Hidalgo, then two wells from Platform Harvest and then four wells from Platform Hermosa. In Phase 2, it is anticipated that three additional wells will be drilled from Platform Hermosa and then one drilled from Platform Harvest. Basically, the Hidalgo wells will develop the northern portion of the field (northwest pool of northeastern block). Harvest will develop the central portion and Hermosa will develop the southern portion of the field. In Phase 3, a maximum of six additional wells is possible with the locations to be determined as needed at a later date. The maximum number of wells for each platform is seven for Harvest, seven for Hermosa and six for Hidalgo. The order and number of wells from each platform may be modified upon completion of the reprocessed 3D seismic data interpretation and actual production data from the initial Phase 1 and Phase 2 wells drilled for Rocky Point.

All of the wells will be drilled using extended reach drilling (ERD). Extended reach drilling, sometimes called directional or slant drilling, is a method by which a well is drilled intentionally in a direction laterally away from the surface location. ERD has been practiced for a number of decades but in the last fifteen years the advancements have been great. Since exploration first occurred on the Rocky Point Unit, the maximum reach of a well (the lateral distance from the bottom of the well to the surface location) has increased dramatically. In 1986, the world record for each was just over 15,000 feet, set by a well in Australia. Today, wells reaching 30,000 feet and beyond have been drilled and the distance is increasing on a regular basis.

The drilling crew required for the drilling program will consist of 12 men for each 12-hour shift. In addition to the drilling crew, a contract-drilling supervisor, two directional drilling engineers, two measurement while drilling (MWD) engineers, two mudloggers, a mud engineer, and a crane operator will provide continuous supervision on a 24-hour basis. Specialty personnel such as directional drilling engineers or mud loggers will be on site on an as needed basis; in addition, other specialty contractors such as casing crew, cementing crews, wellhead specialists, logging engineers, etc. will be on site as their services are needed.

2.2 Muds and Cuttings

Arguello Inc. is proposing the possible use of three different muds for drilling the Rocky Point Unit wells. The first is to use a water based mud. All water based drill cuttings and drilling fluid will be discharged into the ocean in accordance with the current approved NPDES permit assuming they contain concentrations below EPA approved limits. The second option would use synthetic based muds for drilling the longer reach portions of the wells. With this option water based muds would be used to drill a portion of the well and then the mud would be switched to synthetic based mud. The synthetic based muds and cuttings would be collected and shipped ashore via supply boat for onshore recycling and disposal. The third option is to use oil based muds in place of the synthetic muds discussed for the second option above. The oil based muds and cuttings would be collected and shipped ashore via supply boat for onshore recycling and disposal. Table 2.2 provides an estimate of the muds and cutting volumes for each of the options by platfrom. Table 2.3 provides a breakdown of the muds and cutting volumes by drilling phase.

Table 2.2 Estimated Muds and Cutting Volumes by Platform

	Option 1 Water Based Muds Only		**Options 2 and 3 Water Based Muds in Combination with Synthetic/Oil Based Muds**			
			Water Based		**Synthetic/Oil**	
Wells	**Drilling Fluid (bbls)**	**Cuttings (bbls)**	**Drilling Fluid (bbls)**	**Cuttings (bbls)**	**Drilling Fluid (bbls)**	**Cuttings (bbls)**
Hermosa – Six Identified Well Locations	70,094	24,610	42,615	14,321	72,513	9,546
Hermosa –One Future Well	11,682	4,102	7,103	2,387	12,086	1,591
Total Hermosa	*81,776*	*28,712*	*49,718*	*16,708*	*84,599*	*11,137*
Harvest – Four Identified Well Locations	50,219	17,437	28,780	9,494	58,548	7,452
Harvest –Three Future Well	37,664	13,078	21,585	7,121	43,911	5,589
Total Harvest	*87,883*	*30,515*	*50,365*	*16,615*	*102,459*	*13,041*
Hidalgo – Four Identified Well Locations	49,815	17,632	27,038	9,192	61,786	7,917
Hidalgo –Two Future Well	24,907	8,816	13,519	4,595	30,893	3,958
Total Hidalgo	*74,722*	*26,448*	*40,557*	*13,787*	*92,679*	*11,875*
Total All Platforms	*244,381*	*85,675*	*140,640*	*47,110*	*279,737*	*36,053*

Note: Volume for future wells based upon average of the identified wells at each platform.

Table 2.3 Estimated Muds and Cutting Volumes by Drilling Phase

	Option 1 Water Based Muds Only		**Options 2 and 3 Water Based Muds in Combination with Synthetic/Oil Based Muds**			
			Water Based		**Synthetic/Oil**	
Wells	**Drilling Fluid (bbls)**	**Cuttings (bbls)**	**Drilling Fluid (bbls)**	**Cuttings (bbls)**	**Drilling Fluid (bbls)**	**Cuttings (bbls)**
Phase 1 Drilling	120,135	42,153	68,421	22,903	138,222	17,971
Phase 2 Drilling	49,014	17,217	29,586	9,980	52,537	6,751
Phase 3 Drilling	75,232	26,305	42,633	14,227	88,978	11,331
Total	*244,381*	*85,675*	*140,640*	*47,110*	*279,737*	*36,053*

Notes: Phase 1 – Four wells on Hidalgo, two wells on Harvest and four wells on Hermosa.
Phase 2 – Three wells on Hermosa and one well on Harvest.
Phase 3 – Four wells on Harvest and two wells on Hidalgo.

The oil/synthetic based drill cuttings would be loaded into sealed and lined roll off bins. Each bin would be capable of holding approximately 20 tons of cuttings. These bins would be taken ashore to Port Hueneme via regularly scheduled supply boat trips. The roll off bins would be loaded onto roll off trucks and taken to an approved disposal site in Kern County. Possible disposal sites would include Terrain Technology in McKittrick California, Safety-Kleen in Buttonwillow California and Chemical Waste Management in Kern County California.

The oil/synthetic drilling fluid would be emptied into Coast Guard-approved closed top tanks and sent to shore via regularly scheduled supply boats. Once ashore, vacuum trucks will transport used drilling fluids to the drilling fluid suppliers' operations base.

Another possible option for disposal of the oil or synthetic drilling cutting is injection back into the underground formation. The cuttings will be ground to a fine particle size and mixed with seawater in various ratios to obtain desired density (10.0-12.5 lb/gal) and viscosity (60-90 sec/qt funnel). In addition to slurried cuttings, all wash water, contaminated rain water and displacement interface fluids collected will be injected.

For a typical Rocky Point Unit well about 9,000 bbls of material will be reinjected. This would include about 2,000 bbls of cuttings and absorbed fluids for the oil or synthetic based portion of the well. About 450 bbls of interface and contaminated drilling fluid, about 3,000 bbls of seawater for building slurry, and about 3,550 bbls of wash water and contaminated deck drainage will be injected into this annulus.

The typical process for handling the cutting for injection is as follows. The cuttings will be transported from the shale shakers, using a vacuum transfer system, into a slurry tank. The cuttings will be mixed thoroughly with water and will be circulated through a centrifugal shredding pump. Any particle larger than 20 mesh equivalent will be screened out over a 20 mesh shaker screen and returned to the slurry tank for further particle size attrition. Once the desired slurry properties are achieved, the fluid will be transported into a holding tank. A triplex injection pump is then used to inject the slurry down the casing annulus. If needed, the drill rig cement unit pump can be used as a backup for the triplex injection pump.

For each Rocky Point Unit well the injection of the oil or synthetic based cuttings would occur over a period of approximately 60 to 70 days.

2.3 Transportation Requirements

Drilling personnel will be transported via helicopter from the Santa Maria Airport, which is the current departure point for personnel working offshore at the Point Arguello Field. They will be transported using the existing regularly scheduled helicopter trips. Once drilling is complete, no additional crew will be needed above the current requirements for the Point Arguello Field.

The drilling rig, heavy drilling equipment, rig supplies, and bulk drilling mud and cement materials will be shipped to the platform via supply boat. During drilling rig installation and removal, the supply boat will make approximately 20 round trips from Port Hueneme to the first and last platform for rig transport. Each round trip will take approximately two days. It is estimated that between 40 and 60 days will be required for each mobilization and demobilization of the rig and associated equipment to and from the shore base facility at Port Hueneme. When the drill rig is moved from one platform to another an additional 20 round trips will be required between each platform. Moving of the rig and associated equipment between each platform is expected to last about 10 to 15 days.

Supplies will be transported to the platforms by supply boat from Port Hueneme. Boat traffic to and from the platform, with the exception of drilling rig installation and removal, is projected to consist of two or three round trips per week for the supply boat. On return trips, the supply boat will transport any waste material generated from onboard activities requiring onshore disposal such as oil or synthetic based muds and associated cuttings. The roll off bin used to move oil/synthetic based cuttings will be lined and covered. The oil/synthetic based drilling fluids will be shipped to the fluid suppliers' location in vacuum trucks. A possible option for the oil/synthetic based cuttings would be to inject them into a formation at the platform. If this option is implemented, the truck trips associated with transportation of the oil/synthetic cuttings would be eliminated.

There will be no need for modification or expansion of supply yards to accommodate this project, nor will there be any demand for additional support personnel. Support services will be staged out of Ventura areas from existing service companies using existing industry bases. Table 2.4 provides estimates of the number of incremental truck trips and workers that will be needed for the Rocky Point Unit Development.

Table 2.4 Estimated Truck Trips and Workers for the Rocky Point Unit Development

	Drilling					
Item	**Average Frequency**	**Phase 1 Quantity[1]**	**Phase 2 Quantity[2]**	**Phase 3 Quantity[3]**	**Total Quantity**	**Production**
Truck Trips for Drill Rig Delivery/Removal	20/event	20	0	20	40	0
Truck Trips for Drilling Supplies	4/week	603	249	353	1,205	0
Truck Trips for Oil/Synthetic Based Cuttings Removal[4,5]	2-3 per week	452	187	265	904	0
Truck Trips for Oil/Synthetic Based Mud Removal[1] (based upon 100 bbl trucks)	7 per week	1,055	436	618	2,109	
Number of Workers	21 per 12-hour shift	42	42	42	42	0

1. Duration for Phase 1 drilling is 2.9 years.
2. Duration for Phase 2 is 1.2 years.
3. Duration for Phase 3 is 1.7 years.
4. Assumes that all 20 wells use oil based muds.
5. These truck trips would not be needed if the oil/synthetic based cuttings are injected into a formation at the platform.

2.4 Oil and Gas Processing

No new equipment will be required on the platforms for handling the production from the Rocky Point Unit. The Rocky Point wells will be tied into the production manifold on the platforms. The oil will be dehydrated and stabilized and then sent to the Gaviota Facility via the Point Arguello Pipeline Company (PAPCO) pipeline. The dehydrated and stabilized oil from Rocky Point will be sent to the Gaviota Facility along with the Point Arguello production via the PAPCO pipeline. Once the oil reaches the Gaviota Facility it is metered as part of the PAPCO leak detection system. The oil then passes through a heat exchanger where it is heated to about 125°F using waste heat from the onshore cogeneration units. The oil is then metered at the dry LACTs before being transferred via pipeline to the Gaviota Terminal Company storage tanks located on the south side of Highway 101. From the Gaviota Terminal Company storage tanks the oil is sent to the All American Pipeline for transport to various refining destinations.

Some of the commingled gas from Point Arguello and Rocky Point will be sweetened on the platforms and used for fuel in the offshore turbine generators on all three platforms. A portion of the gas sweetened on Platform Hermosa will be sent ashore via the PANGL pipeline as sales gas for use in the congeneration system at the Gaviota Facility. The remainder of the gas will be dehydrated and then injected at Platforms Harvest and/or Hidalgo.

2.5 Produced Water

The produced water that is generated from the Rocky Point Unit will be handled in the same manner as the existing produced water from the Point Arguello Field. No new equipment will be needed to handle the Rocky Point Unit produced water. Development of the Rocky Point Unit will result in the increased volumes of produced water that will be treated and discharged to the ocean in accordance with the existing NPDES permit. Any produced water that does not meet the NPDES permit discharge limits will be injected back into the reservoir, which is the current practice.

Table 2.5 provides estimates of the peak produced water discharge rates that are expected from each of the three Point Arguello platforms for the Point Arguello Unit only, the combined Point Arguello and Rocky Point Units, and the maximum allowable discharge rate from the currently proposed NPDES permit.

Table 2.5 Estimated Peak Produced Water Discharge Rates

Platform	Currently Proposed NPDES Limit (bbls/day)	Point Arguello Unit Only (bbls/day)	Point Arguello and Rocky Point Units (bbls/day)
Harvest	68,500	19,700	19,700
Hermosa	50,000	22,600	24,500
Hidalgo	45,200	9,500	16,800

Table 2.5 shows that the development of the Rocky Point Unit will result in increased levels of produced water discharge at Platforms Hermosa and Hidalgo. Produced water discharge rates are not expected to increase at Platform Harvest over the peak for the Point Arguello Unit only. In all cases the produced water discharge rates will be considerably less than the NPDES limit.

The estimated produced water composition for Point Arguello and Rocky Point is shown in Table 2.6 along with various dilution ratios. These data are based upon produced water samples from the Point Arguello Field. The table also provides the allowable concentrations from the current NPDES permit.

At the request of the MMS, produced water discharge modeling was conducted as part of this evaluation to estimate the concentration contours, within the 100 meter mixing zone, associated with various constituents contained in produced water from the three Point Arguello Field platforms. This data was then used to assess the impacts to marine resources within the 100 meter mixing zone. In conducting the discharge modeling the following ambient conditions were used.

- Current Speed – 0.115 m/s
- Ambient Density at Discharge Port – 1025.6 kg/m^3
- Ambient Density Gradient – 0.01 $kg/m^3/m$

These are the conditions contained in the proposed general NPDES permit, and have been accepted by EPA Region 9. Table 2.7 provides the various produced water discharge parameters for each of the platforms.

Table 2.7 Produced Water Discharge Parameters

Platform	Flow Rate (bbls/day)	Effluent Salinity (psu)	Process Temperature (°C)	Exit Temperature (°C)	Pipe/Pile Diameter (in)	Pipe/Pile Depth (ft)	Water Depth (ft)
Harvest	68,500	16.2	76.7	74.5	8	200	675
Hermosa	50,000	25.1	77.1	74.0	48	150	630
Hidalgo	45,200	20.18	75.0	71.9	48	150	427

The discharge scenarios modeled for this evaluation were based upon the currently proposed NPDES permit limit, since they represent a worst case. The "process temperature" column shows the temperature of the produced water entering the discharge pipe/pile. The "exit temperature" column is the temperature of the produced water as it exits the pipe/pile. The exit temperature accounts for the cooling of the water as it transits the pipe/pile.

The Offshore Operators Committee (OOC) discharge model was used to simulate the discharges listed in Table 2.5 using the ambient conditions listed above. The area of interest was the near-field (within 100 meters). Water column cross-sections were defined in the OOC model so that concentration contours could be produced for longitudinal and transverse cross-sections of the plume. The results from the modeling are shown in graph form, with the contours expressed in percent of the initial effluent concentration (following EPA practice).

Table 2.6 Estimated Peak Produced Water Discharge Composition

	Percent Effluent	Concentration (mg/L) 5.00%	1.00%	0.50%	0.10%	0.05%	0.01%	
Constituent	End of Pipe Concentration (mg/L)							Current NPDES Permit Limits (mg/L)
Ammonia	1.40E+02	7.00E+00	1.40E+00	7.00E-01	1.40E-01	7.00E-02	1.40E-02	NA
Arsenic	6.16E+00	3.08E-01	6.16E-02	3.08E-02	6.16E-03	3.08E-03	6.16E-04	3.20E-02
Cadmium	2.05E-03	1.02E-04	2.05E-05	1.02E-05	2.05E-06	1.02E-06	2.05E-07	1.20E-02
Copper	4.38E+00	2.19E-01	4.38E-02	2.19E-02	4.38E-03	2.19E-03	4.38E-04	2.00E-02
Cyanide	3.07E-02	1.54E-03	3.07E-04	1.54E-04	3.07E-05	1.54E-05	3.07E-06	2.00E-02
Lead	8.19E-03	4.09E-04	8.19E-05	4.09E-05	8.19E-06	4.09E-06	8.19E-07	3.20E-02
Mercury	1.23E-01	6.14E-03	1.23E-03	6.14E-04	1.23E-04	6.14E-05	1.23E-05	5.60E-04
Nickel	7.98E-02	3.99E-03	7.98E-04	3.99E-04	7.98E-05	3.99E-05	7.98E-06	8.00E-02
Silver	3.30E-01	1.65E-02	3.30E-03	1.65E-03	3.30E-04	1.65E-04	3.30E-05	1.80E-03
Zinc	1.64E+01	8.21E-01	1.64E-01	8.21E-02	1.64E-02	8.21E-03	1.64E-03	8.00E-02
Benzene	1.70E+00	8.50E-02	1.70E-02	8.50E-03	1.70E-03	8.50E-04	1.70E-04	NA
Benzo(a)anthracene	5.00E-03	2.50E-04	5.00E-05	2.50E-05	5.00E-06	2.50E-06	5.00E-07	NA
Benzo(a)pyrene	5.00E-03	2.50E-04	5.00E-05	2.50E-05	5.00E-06	2.50E-06	5.00E-07	NA
Chrysene	1.00E-02	5.00E-04	1.00E-04	5.00E-05	1.00E-05	5.00E-06	1.00E-06	NA
Benzo(k)fluoranthene	1.00E-02	5.00E-04	1.00E-04	5.00E-05	1.00E-05	5.00E-06	1.00E-06	NA
Benzo(b)fluoranthene	1.00E-02	5.00E-04	1.00E-04	5.00E-05	1.00E-05	5.00E-06	1.00E-06	NA
Dibenzo(a,h)anthracene	1.00E-02	5.00E-04	1.00E-04	5.00E-05	1.00E-05	5.00E-06	1.00E-06	NA
Phenolic compounds	6.70E-02	3.35E-03	6.70E-04	3.35E-04	6.70E-05	3.35E-05	6.70E-06	1.20E-01
Toluene	1.50E+00	7.50E-02	1.50E-02	7.50E-03	1.50E-03	7.50E-04	1.50E-04	NA
Ethylbenzene	2.70E-01	1.35E-02	2.70E-03	1.35E-03	2.70E-04	1.35E-04	2.70E-05	NA
Naphthalene	1.30E-01	6.50E-03	1.30E-03	6.50E-04	1.30E-04	6.50E-05	1.30E-05	NA
2,4-Dimethylphenol	3.00E-02	1.50E-03	3.00E-04	1.50E-04	3.00E-05	1.50E-05	3.00E-06	NA
Total Chromium	6.70E-03	3.35E-04	6.70E-05	3.35E-05	6.70E-06	3.35E-06	6.70E-07	8.00E-03

NA - These compounds are not regulated under the current NPDES permit.

Figure 2-2 shows the longitudinal cross-sections for each of the three platforms. The graphs in this figure show the concentration profiles as a function of distance downcurrent and depth. Figures 2-3 through 2-5 show the transverse cross-sections for Platforms Harvest, Hermosa and Hidalgo, respectively. The transverse cross-sections consist of a set of vertical concentration profiles in which concentrations are reported at regular intervals between two prescribed depths. Each figure provides transverse cross-sections at 10, 20, 40, 60, 80 and 100 meters.

2.6 Rocky Point Unit Production Estimates

Table 2.8 shows the estimated oil and gas properties from the Rocky Point development.

Table 2.8 Estimated Oil and Gas Properties

Property	Value
API Gravity	24-31
Kinematic Viscosity (cs @ $100^{O}F$)	6.0-1,000
Sulfur in Crude (wt%)	2-3
H_2S Content of Gas (ppm)	10,000-15,000

These values are estimates based upon data collected from some of the exploratory wells that were drilled into the Rocky Point Unit. The actual production data may be different.

Production from the Rocky Point Unit is expected to peak at around 20,000 BPD and 6 MMSCFD of gas 48 months after production starts. It is expected that the combined production from Rocky Point and Point Arguello will peak at around 30,000 BPD 24 months after production begins from Rocky Point. The combined fields should maintain this level of production for two years. At that point the combined production will begin to decline.

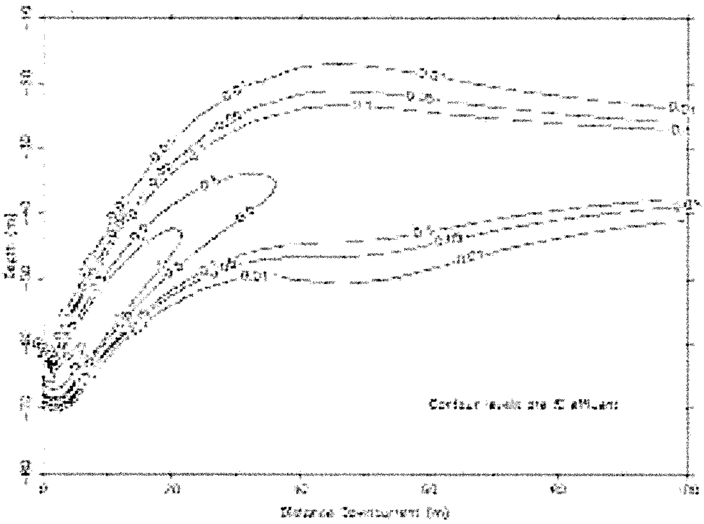
2.7 Rocky Point Unit Development Schedule

Figure 2-6 shows the projected schedule for development of the Rocky Point Unit.

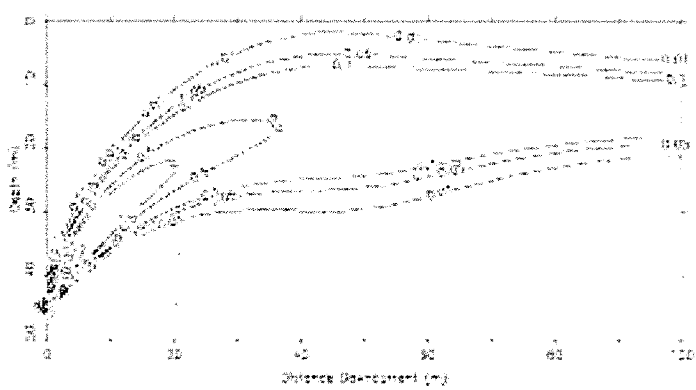
The schedule shows drilling of the first well beginning in June of 2002, with production beginning three to four months after the start of the first well. The Phase 1 and 2 drilling program should be complete by the middle of 2006, assuming permit approvals allow drilling to commence as stated above. If the Phase 3 drilling program were needed, then drilling would continue until the middle of 2008.

Figure 2-2 Produced Water Discharge Longitudinal Plume Cross-Sections

Platform Harvest – 68,500 bbls/day



Platform Hermosa – 50,000 bbls/day



Platform Hidalgo – 45,200 bbls/day

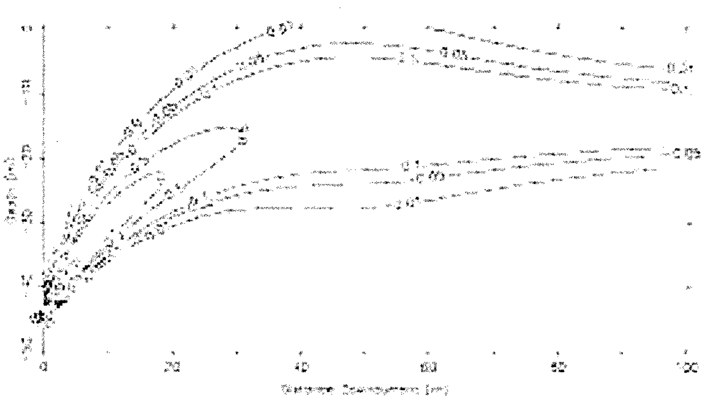
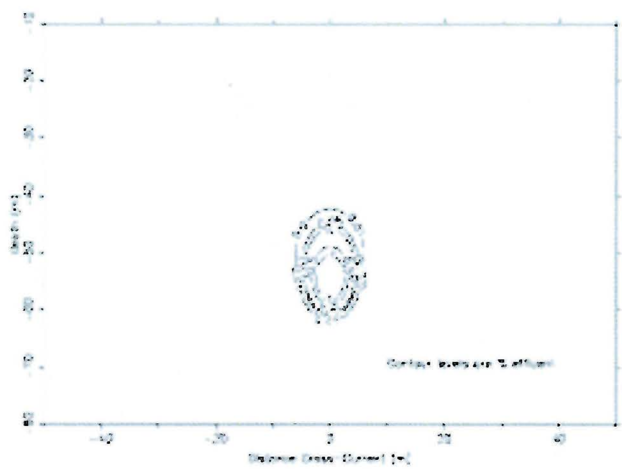
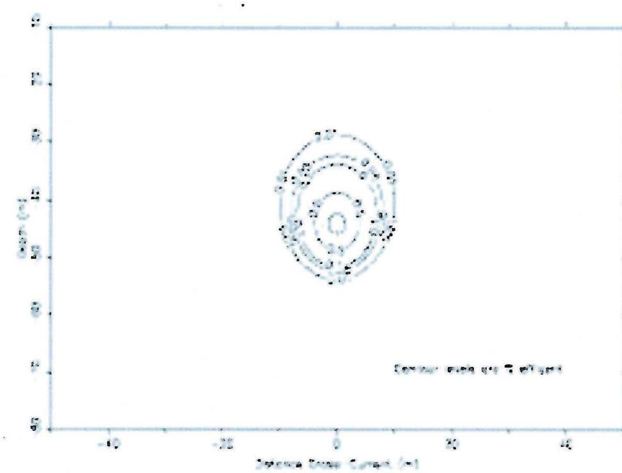


Figure 2-3 Platform Harvest Produced Water Discharge Transverse Sections (68,500 bbls/day)

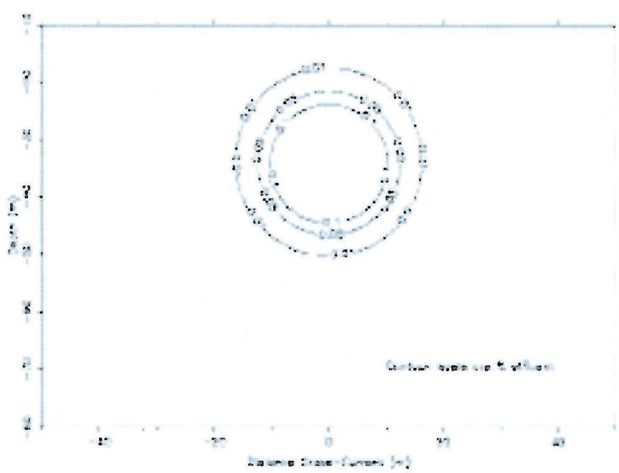
10 meters downcurrent



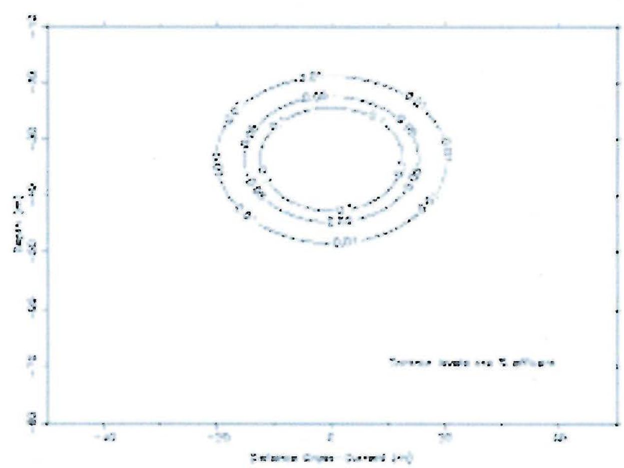
20 meters downcurrent



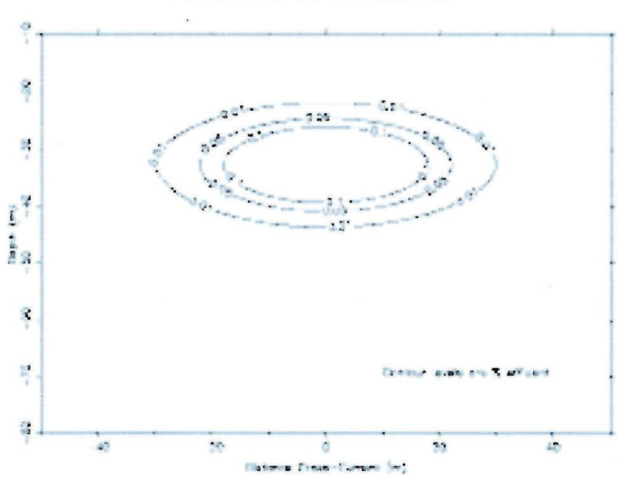
40 meters downcurrent



60 meters downcurrent



80 meters downcurrent



100 meters downcurrent

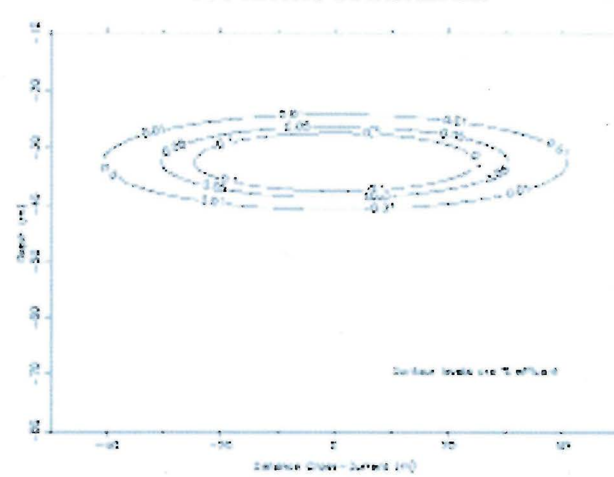


Figure 2-4 Platform Hermosa Produced Water Discharge Transverse Sections (50,000 bbls/day)

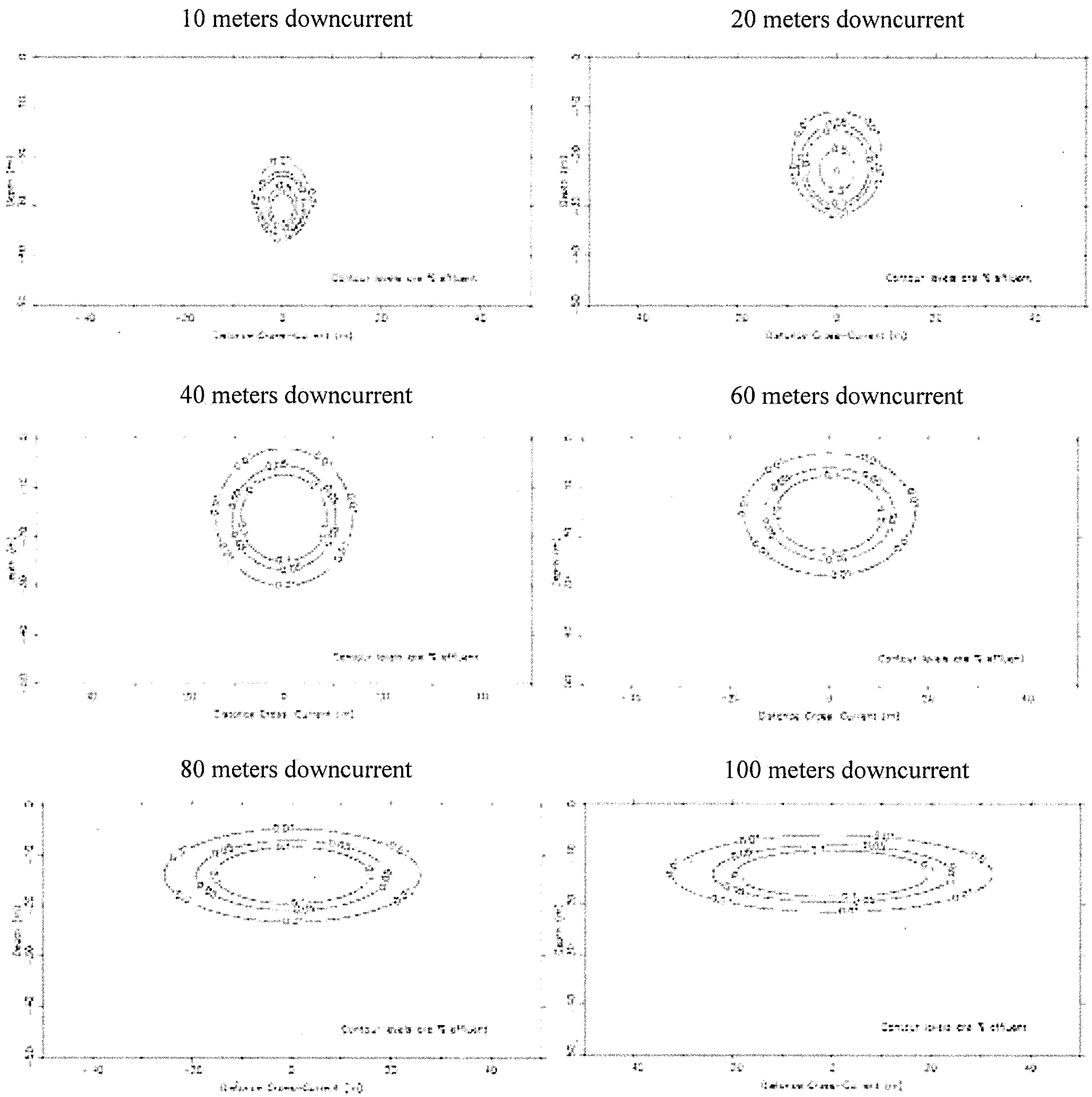


Figure 2-5 Platform Hidalgo Produced Water Discharge Transverse Sections (45,200 bbls/day)

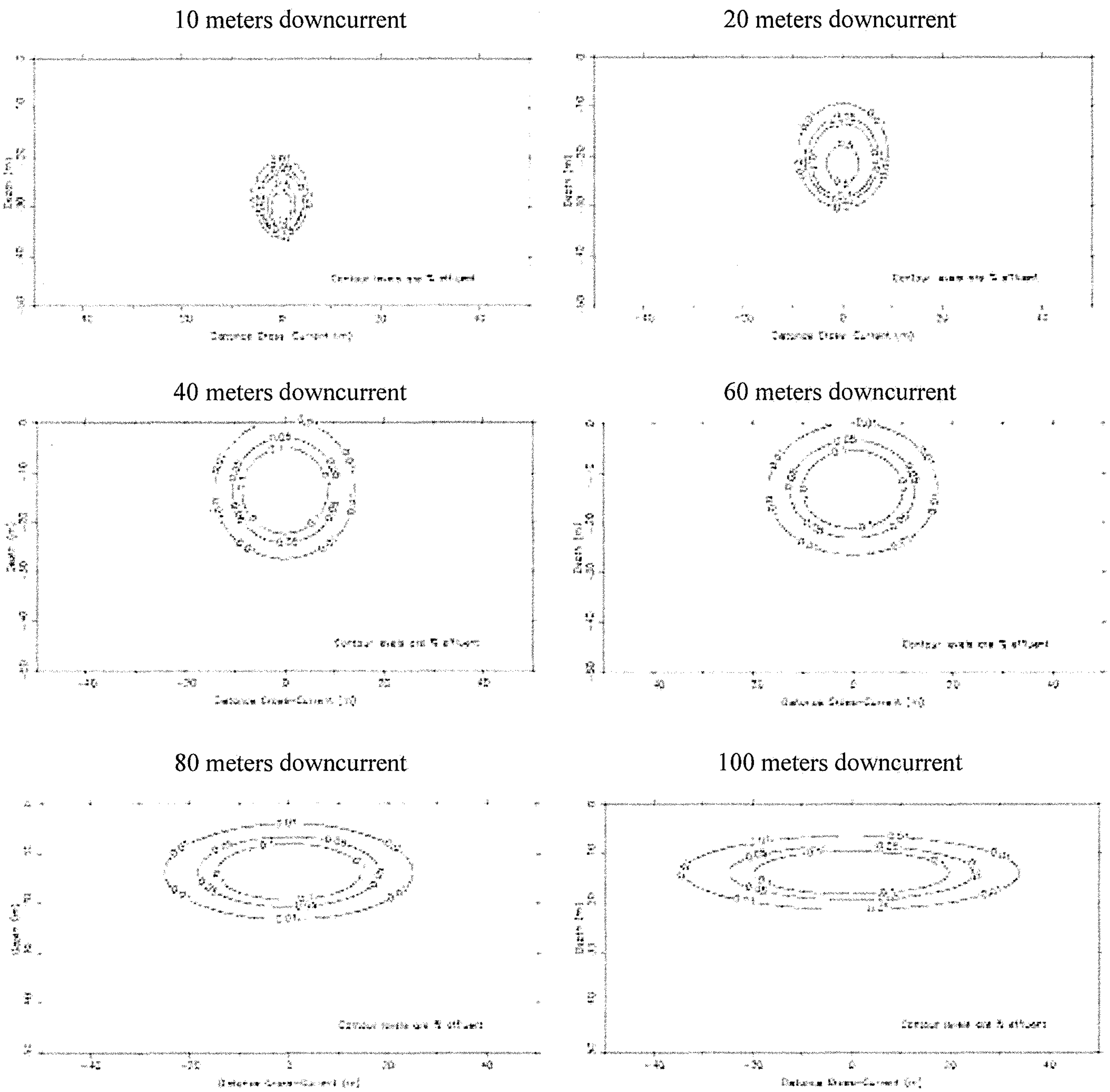
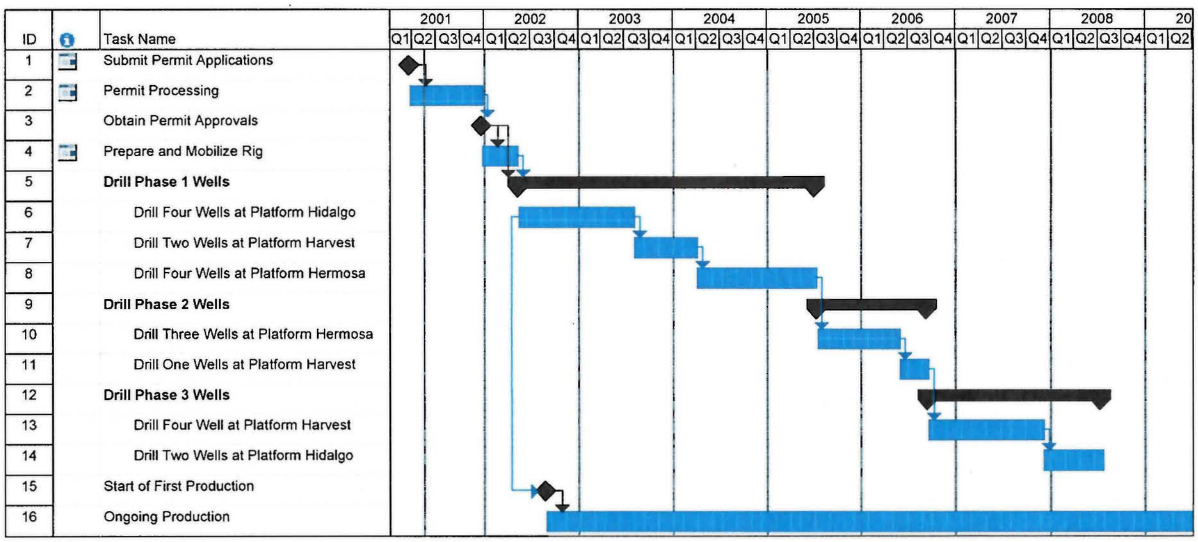


Figure 2-6 Estimated Rocky Point Development Schedule



The order and number of wells drilled from each platform may be modified upon completion of the reprocessed 3D seismic data interpretation and/or actual production data from the initial Phase 1 and Phase 2 wells drilled for Rocky Point.

Based upon current data, Arguello Inc. has estimated that 14 wells will be needed to develop the Rocky Point Unit Field. However, Arguello Inc. requests approval for a total of 20 wells to account for the possibility of unexpected geologic success, or improved economics. Depending on geologic interpretation and economic conditions at the time, unsuccessful wells may be redrilled to offset locations. In view of the extended reach of the initial wells, drilling times will likely limit the number drilled and completed per year to between three (3) and four (4), which in turn sets the drilling and production schedule. With a June 1, 2002 first spud date, and the estimated 6 to 7 year life of a typical well, drilling should be complete by the middle of 2008, and the last well should finish its productive life around 2014. These dates assume that all three phases (20 wells) of the drilling program are complete. Currently, it is expected that only Phase 1 and 2 (14 wells) will be required to develop the Rocky Point Unit reserves. With only 14 wells, drilling would be completed by the middle of 2006, and production from Rocky Point would end around 2012.

At the end of production for Rocky Point (2012 to 2014), Point Arguello Unit production will be fairly low, (forecast approximately 3,000 bpd)., However, due to the lower operating cost of the normal-reach wells in that field, and their gradual late life decline, it is expected that production will be economic for at least one to three years further.

3.0 Scope and Approach to the Environmental Evaluation

The first step in the environmental evaluation is to determine what issue areas could be impacted by the Rocky Point Unit development project. An initial screening of a range of issue areas was conducted to assess the potential for environmental impacts. The results of this screening analysis are presented in Table 3.1. In addition, the geographic scope associated with each issue area was evaluated along with the time frame over which the issue area could be impacted.

The Rocky Point Unit development project is a unique project in that the development will utilize existing infrastructure. No new facilities will be required to develop the Rocky Point reserves. The only new infrastructures that will be needed are the development wells. Once the wells are drilled the existing infrastructure on the platforms will be used to process, ship and inject gas and dehydrate and stabilize the oil. The oil will then be sent though the PAPCO pipeline for metering and heating at the Gaviota Facility. If approved by the County of Santa Barbara, sweet sales gas will be sent ashore to Gaviota via the PANGL pipeline for use as fuel. No modifications will be needed to any of the facilities to handle the Rocky Point Unit production.

The approach to the environmental evaluation was to identify issue areas where the Rocky Point Unit development could lead to new environmental impacts above and beyond those identified for the Point Arguello Project. If the Rocky Point Unit development project was not found to increase an environmental impact that exists for the Point Arguello Project, it was assumed there was no impact since the impacts associated with the Point Arguello Project are considered part of the environmental baseline. Including the Point Arguello Project in the baseline is consistent with NEPA guidelines since the project is approved and has been operating for a number of years and it's impacts are reflected in the baseline data.

It is against this baseline that the impacts of the Rocky Point Unit development have been assessed. It should be noted that for many of the issue areas, Point Arguello Project impacts were a result of the construction of the offshore and onshore infrastructure. Since no new infrastructure is needed for the development of the Rocky Point Unit, these impacts would not occur. In addition, many of the operational impacts of the Point Arguello Project result from the project facilities regardless of throughput. As such, the handling of the Rocky Point Unit production will not increase many of the operational impacts identified for the Point Arguello Project.

A review of the data presented in Table 3.1 shows that the only issue areas where there is potential for new significant environmental impacts are marine resources, air quality, public safety and oil spill risk. For all other issue areas, the impacts identified for the Point Arguello Project would remain the same, and would not be significantly affected by the Rocky Point Unit development. The reader is referred to the Point Arguello Project EIR/EIS for additional information on the impacts associated with that development.

The environmental evaluation has been based upon the assumption that 20 new wells will be needed to develop the Rocky Point Unit. However, it should be noted that the exact number of wells needed to develop the Rocky Point Unit reserves will not be known until the first few development wells have been completed, placed on production, and evaluated.

In addition, it may be possible to sidetrack a number of the existing Point Arguello wells for development of the Rocky Point Unit once some of the Point Arguello wells have reached the end of their productive life. Another possible option would be to use existing Point Arguello wellheads for some of the new Rocky Point wells, once some of the Point Arguello wells have reached the end of their productive life. The environmental evaluation has been conducted assuming that all 20 wells are developed for the project, and that each of these wells have new wellheads. This represents a "worst case" for the environmental impacts.

Table 3.1 Results of Issue Area Screening Analysis

Issue Area	Environmental Impact Screening Analysis Results	Geographic Scope for Issue Area	Time Frame for Impact Analysis
Marine Resources	Development of Rocky Point will result in increase mud discharges to the ocean during drilling and increases in produced water discharges to the ocean during production. There is also the potential for an oil spill during drilling of the wells and during the period when the wells are flowing under natural pressure. The impacts would be less than what was analyzed for the Point Arguello Project since fewer wells will be drilled. All of these have the potential for environmental impacts to marine resources. There will also be increased supply boat trips during drilling which could impact marine mammals.	• Based upon modeling done for the discharge of muds, cutting and produced water from the Point Arguello platforms, the impacts are limited to an area about 6.8 kilometer around the platforms. • Impacts due to boat traffic would be limited to routes the boats travel. • Based upon the MMS OSRA model results, oil spill impacts would cover the southern Santa Maria Basin and the western part of the Santa Barbara Channel. This is consistent with the oil spill trajectories in the Oil Spill Contingency Plan. However, based upon limited drifter data one cannot rule out the possibility of oil from a spill moving north into the Santa Maria Basin.	• ***Muds and Cutting*** – during the four-year drilling program. • ***Produced water*** - during production. • ***Oil spill*** – during the first five years of production when wells have positive pressure.
Air Quality	During the drilling of the production wells additional load will be placed on the turbine generators that provide electrical power to the platform. This increased load will result in an increase in air emissions during the drilling phase only. The turbine emissions have been offset and are permitted with the SBCAPCD. The drilling operations will also generate additional emissions due to a number of internal combustion engines that will be associated with the drill rig. There will also be an increase in air emissions associated with supply boats during drilling since additional supply boat trips will be needed. Supply boat emissions have been offset and are permitted with the SBCAPCD. However, additional offsets may be needed if the combined Point Arguello and Rocky Point drilling supply boat needs exceed the current allowable maximum. The increase demand for supply boat trips is	The air quality impacts would be limited to the southern Santa Barbara County/Ventura County airshed.	Air quality impact due to the Rocky Point Unit development would be limited to drilling and production.

Table 3.1 Results of Issue Area Screening Analysis (continued)

Issue Area	Environmental Impact Screening Analysis Results	Geographic Scope for Issue Area	Time Frame for Impact Analysis
	expected to last four to six years depending upon how many wells are drilled. Once drilling is complete the additional supply boat trips will not be needed. During production there will be fugitive emissions associated with the new well head piping. The air quality impacts would be less than what was analyzed for the Point Arguello Project since fewer wells will be drilled.		
Onshore Geology	There would be no geologic impacts associated with the Rocky Point Unit development since no new infrastructure will be needed. For the Point Arguello Project the geologic impacts were associated with the construction of the pipelines and the Gaviota Facility.	This does not apply to the Rocky Point Unit development since there are no impacts in this issue area.	This does not apply to the Rocky Point Unit development since there are no impacts in this issue area.
Onshore Water Resources	There would be no onshore water impacts associated with the Rocky Point Unit development since no new infrastructure will be needed, and no new water supplies will be needed for handling the production. For the Point Arguello Project the onshore water impacts were associated with the construction of the pipelines and the Gaviota Facility, and the potential for impacts due to an oil spill from the pipelines or at the Gaviota Facility. Water use at the Gaviota Facility is not an issue since an onsite desalinization unit supplies water. The Rocky Point Unit development will not increase the oil spill risk or spill volumes over what is currently occurring for the Point Arguello Field, which is considered part of the environmental baseline. This is because the spill volumes are driven by the capacity of the pipeline and equipment at Gaviota and not the throughput.	This does not apply to the Rocky Point Unit development since there are no impacts in this issue area.	This does not apply to the Rocky Point Unit development since there are no impacts in this issue area.
Cultural Resources	There would be no cultural resource impacts associated with the Rocky Point Unit development since no new infrastructure will be needed. For the Point Arguello Project the cultural resource impacts were associated with the construction of the pipelines and the Gaviota Facility. The development of the	This does not apply to the Rocky Point Unit development since there are no impacts in this issue area.	This does not apply to the Rocky Point Unit development since there are no impacts in this issue area.

Table 3.1 Results of Issue Area Screening Analysis (continued)

Issue Area	Environmental Impact Screening Analysis Results	Geographic Scope for Issue Area	Time Frame for Impact Analysis
	Rocky Point Unit will not result in any impacts to offshore cultural resources since no new infrastructure will be installed offshore other then development wells. The development wells will only penetrate the seafloor in the area directly beneath the platforms, which are free of offshore cultural deposits based upon surveys done as part of the original installation of the Point Arguello platforms.		
Historic Resources	There would be no historic resource impacts associated with the Rocky Point Unit development since no new infrastructure will be needed. For the Point Arguello Project the historic resource impacts were associated with the construction of the pipelines and the Gaviota Facility.	This does not apply to the Rocky Point Unit development since there are no impacts in this issue area.	This does not apply to the Rocky Point Unit development since there are no impacts in this issue area.
Transportation	The Rocky Point Unit development will generate additional 14 truck trips per week, which are associated with the movement of drilling supplies and waste material to and from Port Hueneme during the drilling phase only. There would be no net increase in the truck traffic over what is currently occurring for the Point Arguello Project once drilling is complete. For the Point Arguello Project the transportation impacts were associated with the construction of the pipelines and the Gaviota Facility. The 1984 EIR/EIS did not identify any transportation impacts associated with truck traffic servicing Port Hueneme. Given that the transportation requirements for the Rocky Point Unit development are considerably less than for Point Arguello, the transportation impacts are considered insignificant. The 14 truck trips per week assume that all the wells use oil or synthetic based muds for the longer reach portions, and that all these cuttings are brought ashore for disposal. If oil/synthetic based muds are not used or the cuttings are injected into a formation at the platform the number of truck trips would decrease by as much as 10 per week.	The geographic scope of the transportation impacts for Rocky Point would be limited to the area around Port Hueneme.	The time frame for the transportation impacts from the Rocky Point would be limited to the drilling phase only.

Table 3.1 Results of Issue Area Screening Analysis (continued)

Issue Area	Environmental Impact Screening Analysis Results	Geographic Scope for Issue Area	Time Frame for Impact Analysis
Recreation	The major recreational impact from the Point Arguello Project was due to the impacts that could result from a potential oil spill. The Rocky Point Unit development will increase the likelihood of an oil spill over what is currently occurring for the Point Arguello Field due to the addition of up to 20 new wells. This increase is due to the remote possibility of a well blowout during the first five years when the wells are flowing on natural positive pressure. Oil spill volumes would not increase with the addition of the Rocky Point wells. This is because the spill volumes are driven by the capacity of the pipeline, Gaviota Facility and platform equipment, and not the throughput. Based upon the analysis present in Section 4.3, Public Safety/Oil Spill Risk, the probability of a blowout during drilling and production for the Rocky Point Unit has been estimated to be 0.35%. Given this low level of probability, the incremental impacts on recreation from the Rocky Point Unit development are considered to be insignificant. In addition, while the Rocky Point Unit development would slightly increase the probability of an oil spill, the impacts would not change from what exists for the Point Arguello Platforms and pipeline. Therefore, there would be no new impacts.	Based upon the MMS OSRA model results, oil spill impacts would cover the southern Santa Maria Basin and the western part of the Santa Barbara Channel. This is consistent with the oil spill trajectories in the Oil Spill Contingency Plan. However, based upon limited drifter data one cannot rule out the possibility of oil from a spill moving north into the Santa Maria Basin.	Oil spill impacts would be limited to drilling and the first five years of production when the wells are flowing on natural positive pressure.
Land Use	The oil production from the Rocky Point Unit will be metered and heated at the Gaviota Facility which is one of the two Santa Barbara South Coast consolidated sites allowed to handle offshore oil and gas production. Therefore, the Rocky Point Development would not result in any land use impacts. The County of Santa Barbara is currently conducting an R-1 review of the Gaviota site. One of the outcomes of this review could be the removal of Gaviota as consolidated oil and gas process sites. Under this scenario, metering and heating of oil production from the Point Arguello platforms would be allowed to continue for the life of the platforms. Once	This does not apply to the Rocky Point Unit development since there are no impacts in this issue area.	This does not apply to the Rocky Point Unit development since there are no impacts in this issue area.

Table 3.1 Results of Issue Area Screening Analysis (continued)

Issue Area	Environmental Impact Screening Analysis Results	Geographic Scope for Issue Area	Time Frame for Impact Analysis
	production from these platforms had ceased, the facility would be abandoned. Even under this scenario, Rocky Point Unit production would be allowed since the wells would be drilled from one of the existing Point Arguello platforms.		
Energy Use	Development of the Rocky Point Unit will result in a beneficial impact to energy use since it will result in an increase in oil, gas and electricity production. The only increase in energy use associated with the project would be for drilling the production wells and for the increased supply boat trips needed during drilling. Therefore, there would be no adverse impacts to energy use associated with development of the Rocky Point Unit.	Geographic scope is not applicable to energy use.	The life of the Rocky Point Unit development.
Public Safety	Public safety impacts are related to impacts to the public associated with acute exposure to hazardous materials that could lead to injury or fatalities. For oil and gas development projects, public safety impacts can result from releases of toxic or flammable materials. The main issue for Rocky Point is the injection of the produced gas. During the peak year Rocky Point will generate approximately 6 mmscfd of gas that will be injected back into the reservoir. It is not anticipated that any new infrastructure will be needed to handle this volume of gas. The existing gas injection capacity for Point Arguello should be sufficient. Since the Rocky Point Unit development will not require any new infrastructure, the public safety impacts will not increase over what exists for the Point Arguello Project, which is considered part of the environmental baseline. Therefore, there will be no new public safety impacts associated with the Rocky Point Unit development. It should be noted that with the shutdown of the gas plant at Gaviota, the majority of the risk to public safety has been eliminated.	Limited to an area of 600 feet from the platforms.	For the productive life of the Rocky Point Unit.

Table 3.1 Results of Issue Area Screening Analysis (continued)

Issue Area	Environmental Impact Screening Analysis Results	Geographic Scope for Issue Area	Time Frame for Impact Analysis
Oil Spill Risk	The Rocky Point Unit development will increase the likelihood of an oil spill over what is currently occurring for the Point Arguello Field due to the addition of up to 20 new wells. This increase is due to the remote possibility of a well blowout during the first five years when the wells are flowing on natural positive pressure. Oil spill volumes would not increase with the addition of the Rocky Point wells. This is because the spill volumes are driven by the capacity of the pipeline, Gaviota Facility and platform equipment, and not the throughput.	Based upon the MMS OSRA model results, oil spill impacts would cover the southern Santa Maria Basin and the western part of the Santa Barbara Channel. This is consistent with the oil spill trajectories in the Oil Spill Contingency Plan. However, based upon limited drifter data one cannot rule out the possibility of oil from a spill moving north into the Santa Maria Basin.	Oil spill impacts would be limited to drilling and to the first five years of production when the wells are flowing on natural positive pressure.
Public Services	There would be no public services impacts associated with the Rocky Point Unit development since no new infrastructure will be needed. For the Point Arguello Project the public services impacts were associated with the operation of the pipelines and the Gaviota Facility. These public services impacts were primarily for fire protection and emergency response. These impacts were mitigated through the construction of Fire Station 18, which is located next to the Gaviota Facility. The impacts identified for the Point Arguello Project would not change with the addition of the Rocky Point Unit development.	This does not apply to the Rocky Point Unit development since there are no impacts in this issue area.	This does not apply to the Rocky Point Unit development since there are no impacts in this issue area.
Onshore Biology	The major onshore biological impact from the Point Arguello Project was due to the impacts that could result from a potential oil spill. The Rocky Point Unit development will increase the likelihood of an oil spill over what is currently occurring for the Point Arguello Field due to the addition of up to 20 new wells. This increase is due to the remote possibility of a well blowout during the first five years when the wells are flowing on natural positive pressure. Oil spill volumes would not increase with the addition of the Rocky Point wells. This is because the spill volumes are driven by the capacity of the pipeline, Gaviota Facility and platform equipment, and not the throughput.	Based upon the MMS OSRA model results, oil spill impacts would cover the southern Santa Maria Basin and the western part of the Santa Barbara Channel. This is consistent with the oil spill trajectories in the Oil Spill Contingency Plan. However, based upon limited drifter data one cannot rule out the possibility of oil from a spill moving north into the Santa Maria Basin.	Oil spill impacts would be limited to drilling and the first five years of production when the wells are flowing on natural positive pressure.

Table 3.1 Results of Issue Area Screening Analysis (continued)

Issue Area	Environmental Impact Screening Analysis Results	Geographic Scope for Issue Area	Time Frame for Impact Analysis
	Based upon the analysis present in Section 4.3, Public Safety/Oil Spill Risk, the probability of a blowout during the first five years of drilling and production for the Rocky Point Unit has been estimated to be 0.35%. Given this low level of probability, the incremental impacts on onshore biology from the Rocky Point Unit development are considered to be insignificant. In addition, while the Rocky Point Unit development would slightly increase the probability of an oil spill, the impacts would not change from what exists for the Point Arguello platforms and pipeline. Therefore, there would be no new impacts. The potential biological impacts from an oil spill are discussed in the Marine Resources Section.		
Commercial Fishing	For the Point Arguello Project the commercial fishing impacts were associated with the installation of the platform and offshore pipeline and the resulting preclusion of fishing area around the platforms. These impacts would not occur with the development of the Rocky Point Unit. In addition there was potential for commercial fishing impacts in the unlikely event of an oil spill. The Rocky Point Unit development will increase the likelihood of an oil spill over what is currently occurring for the Point Arguello Field due to the addition of up to 20 new wells. This increase is due to the remote possibility of a well blowout during the first five years when the wells are flowing on natural positive pressure. Oil spill volumes would not increase with the addition of the Rocky Point wells. This is because the spill volumes are driven by the capacity of the pipeline and platform equipment, and not the throughput. Based upon the analysis present in Section 4.3, Public Safety/Oil Spill Risk, the probability of a blowout during drilling and production for the Rocky Point Unit has been	Based upon the MMS OSRA model results, oil spill impacts would cover the southern Santa Maria Basin and the western part of the Santa Barbara Channel. This is consistent with the oil spill trajectories in the Oil Spill Contingency Plan. However, based upon limited drifter data one cannot rule out the possibility of oil from a spill moving north into the Santa Maria Basin.	Oil spill impacts would be limited to drilling and the first five years of production when the wells are flowing on natural positive pressure.

Table 3.1 Results of Issue Area Screening Analysis (continued)

Issue Area	Environmental Impact Screening Analysis Results	Geographic Scope for Issue Area	Time Frame for Impact Analysis
	estimated to be 0.35%. Given this low level of probability, the incremental impacts on onshore biology from the Rocky Point Unit development are considered to be insignificant. In addition, while the Rocky Point Unit development would slightly increase the probability of an oil spill, the impacts would not change from what exists for the Point Arguello platforms and pipeline. Therefore, there would be no new impacts.		
Socioeconomic	The Rocky Point Unit development will not have any socioeconomic impacts on Port Hueneme and the surrounding community. No new support infrastructure will be needed to support the Rocky Point development. As discussed above, there will be some additional transportation requirements (14 truck trips per week), which equate to a 5 percent increase from the 1997 levels estimated in the COOGER study. For the study period 2001-2005 COOGER estimated for Scenario 2 that there would be 565 truck trips per week. The Rocky Point Development would only represent 2.5 percent. The 14 truck trips per week assume that all the wells use oil or synthetic based muds for the longer reach portions, and that all these cuttings are brought ashore for disposal. If oil/synthetic based muds are not used or the cuttings are injected into a formation at the platform the number of truck trips would decrease by as much as 10 per week. With regard to workers, it has been estimated that only 36 additional workers will be needed during the drilling phase. The COOGER Report estimated that the 1997 direct employment associated with offshore oil development at 1,068. The Rocky Point Unit development would represent an increase of about 3 percent. The Rocky Point Unit development is expected to generate two to three supply boat trips a week during drilling. This compares	The socioeconomic impacts would be limited to Port Hueneme and the surrounding community.	The duration of the impact would be for the four years of drilling.

Table 3.1 Results of Issue Area Screening Analysis (continued)

Issue Area	Environmental Impact Screening Analysis Results	Geographic Scope for Issue Area	Time Frame for Impact Analysis
	with 52 per week during 1997 (COOGER, Report). This represents an increase of about 6 percent. However, the COOGER study estimated the 2001-2005 supply boat trips at 32, therefore even with the addition of Rocky Point the total trips would be less in 2001 than for 1997. It should also be noted that supply boats already in use for Point Arguello will be used for the Rocky Point Unit development. No new helicopter trips will be needed to handle the Rocky Point Unit development. Given the very low level of activity associated with the Rocky Point Unit development, the incremental socioeconomic impacts are considered insignificant.		
Environmental Justice	The only onshore area where there will be incremental onshore impacted from the Rocky Point Unit due to normal drilling and production activities is Port Hueneme. This activity will be associated with the handling of supplies and wastes. No new infrastructure will be needed at Port Hueneme. This increase in activity will be limited to the drilling phase and will provide an economic benefit to the area. A review of the data shown in Attachment I shows that within a five mile radius of Port Hueneme the percent of the population that is considered a minority is 39% which is similar to the California state average of 31%. With regard to education, 40% of the population has some college experience, compared with 53% for the State. In the area of employment, the Port Hueneme area has the same unemployment rate as the State, which is 7%. It is clear from this data that the use of Port Hueneme would not represent an increase in environmental impacts on an area where there is a high percentage of minorities, or low education, or low employment. Therefore, the development of the Rocky Point Unit would not have any environmental justice impacts.	This does not apply to the Rocky Point Unit development since there are no impacts in this issue area.	This does not apply to the Rocky Point Unit development since there are no impacts in this issue area.

4.0 Proposed Project Environmental Evaluation

This section of the document presents the environmental baseline, project-specific significant impacts for the issue areas that were identified as having the potential for new environmental impacts. For each issue area the potential impacts are discussed along with mitigation measures.

4.1 Marine Environment

This section covers the issue area for marine resources, which include marine biology and marine water quality.

4.1.1 Oceanographic Setting

The project area is located in an oceanographically complex region. Three existing production platforms, Hidalgo, Harvest, and Hermosa lie immediately southwest of the Rocky Point Unit where a sharp change in coastline orientation occurs between Point Arguello and Point Conception (Figure 4-1). This large-scale change in coastal configuration induces much of the complexity in wind, wave, and oceanic flow fields near the project area. The southern Santa Maria Basin (SMB) lies immediately north of the project area where coastal isobaths are aligned along a north-south axis. The Santa Barbara Channel (SBC) lies to the west of the project area where the coastline is oriented along an east-west axis. The SBC is bounded to the south by three Channel Islands. The project area lies in the transition zone between the SMB and SBC. Near the project area isobaths are aligned along a northwest-southeast axis.

This coastal transition zone is influenced by markedly different physical processes than those that dominate within the two adjacent regions. Along the central California coast to the north, physical processes are strongly influenced by seasonally varying winds that blow uniformly to the south over a wide geographic area. The large-scale oceanic flow field beyond the continental slope is dominated by the southward-directed California Current. Waves generated over a large fetch impinge on the coastline from directions that encompass an azimuth of effectively 180 degrees. In contrast, the SBC is sheltered from waves generated by distant storms to the north and the Channel Islands limit wave propagation from the south. Similarly, the east-west coastal configuration blocks the large-scale southward-directed winds that prevail outside the SBC. Finally, the California Current separates from the coast near Point Arguello leaving other processes to control the flow within the Channel.

Despite their complexity, it is important to quantify physical processes within the project area. Surface flow fields determine the transport of spilled oil and the likelihood of impingement on adjacent coastlines. Subsurface flows dictate the transport and dispersion of produced waters and drilling fluids that will be discharged from the Harvest, Hermosa and Hidalgo Platforms during

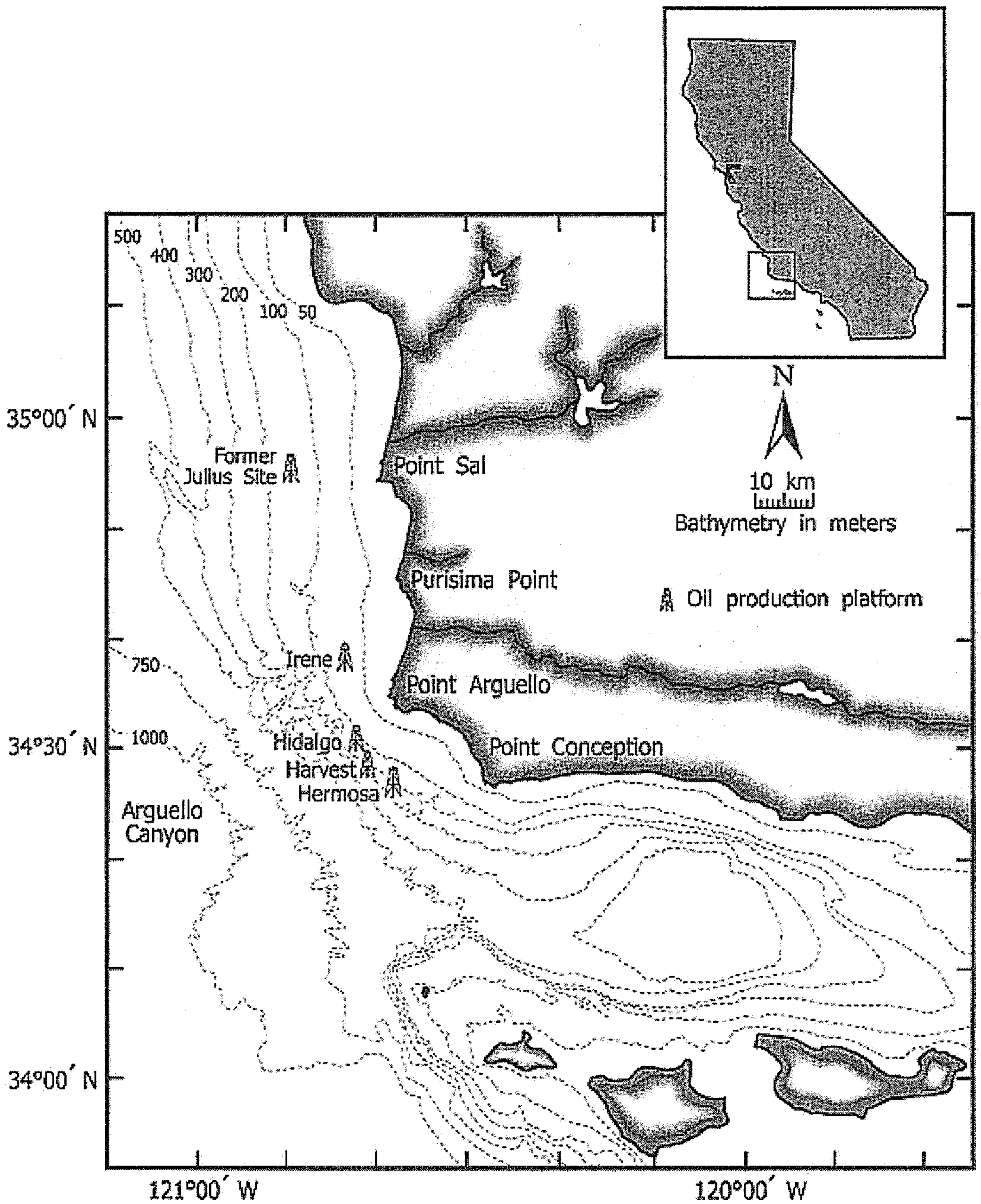


Figure 4-1 Locations of the Four Offshore Platforms in the Study Region

the proposed ERD drilling. Finally, the seastate, as determined by prevailing winds and waves, affects the efficacy of oil-spill contingency plans that rely on chemical dispersants or containment for cleanup.

A. Sources of Oceanographic Data

Fortunately, a number of major oceanographic studies have been conducted in this oceanographically complex project area. This subsection describes the pertinent individual studies that have been conducted near the Rocky Point Project area since the Point Arguello Field Development Plans EIR/EIS was submitted (Anikouchine, 1984). Taken as a whole, these studies provide an accurate characterization of the regional oceanic processes as well as the oceanographic characteristics close to the Rocky Point Project area. Individual studies are not comprehensive enough for a complete environmental evaluation and their limitations are outlined below. Technical results from these individual studies, insofar as they pertain to the oceanographic issues concerning the development of the Rocky Point Unit, are assimilated in the subsections that follow.

- **Santa Barbara Channel – Santa Maria Basin Coastal Circulation Study (SBC-SMB CCS).** This multi-year observational study is being conducted by Scripps Institution of Oceanography under the auspices of the Minerals Management Service (MMS). Measurements, which include current-meter moorings, surface drifters, and hydrographic transects, emphasized a description of the surface circulation within the SBC. The results have been summarized by Dever *et al.* (1998), Harms and Winant (1998), Hendershott and Winant (1996), and Winant *et al.* (1999). Results from these measurements have been incorporated in the MMS Oil Spill Risk Analysis (OSRA) numerical model used to compute oil-spill trajectories and risk of impingement on coastlines. As described in the following sections, there remain discrepancies between the model results and drifter data.

- **Santa Barbara Channel Circulation Model and Field Study (SBCCMFS).** As with the SBC-SMB CCS, this MMS-sponsored field and modeling investigation emphasized a determination of the flow regime within the SBC (Gunn *et al.*, 1987). As such, results are not strictly applicable to the transition region where the Rocky Point Project area lies. Nevertheless, oil spills associated with the proposed project could be transported into the SBC so an understanding of the flow within the SBC is pertinent to this evaluation. Also, potential spills from the existing offshore oil facilities within the SBC could have a cumulative effect on the marine environment along the shorelines surrounding the proposed Rocky Point Project. Fifteen current-meter moorings were deployed in the SBC during 1984 as part of the SBCCMFS. These data were augmented by five hydrographic surveys and three surface-drifter studies.

- **Wave Information Study (WIS).** In late 1976, the US Army Corps of Engineer's Waterways Experiment Station embarked upon a Wave Information Study (WIS) to establish the wave climatology for US coastal waters. In March 1989, the seventeenth in a series of reports was published which presented hindcast shallow-water wave data for 134 shoreline segments north of Point Conception (Jensen *et al.*, 1989). Coastline Section Numbers 133 and 134 extend between Point Arguello and Point Conception along the shoreline adjacent to the project area. Wave statistics were computed at a depth of 10 m from atmospheric pressure and wind velocity data collected over a 20-year period. These near-shore wave statistics were derived from offshore wave climatology that excluded waves generated by distant tropical storms and Southern Hemisphere swell.

- **Platform Harvest.** A directional wave gauge array was installed on Platform Harvest in 1992. Although the wave record is limited compared to the WIS, it measures all incident waves regardless of origin, including those from tropical and southern Hemisphere Storms. Also, the array is capable of high directional resolution on the order of 1 degree (°). Seymour (1996) provided a deep-water summary of wave climatology based on data from this and other wave gauges.

- **NOAA Data Buoy Center (NDBC).** Two NOAA Data Buoy Center (NDBC) ocean buoys have collected meteorological and oceanographic data over a long period near the Rocky Point Project area. NDBC buoy 46063 is closest to the project area in a water depth of about 600 m. Wind climatology from this and other buoys has been summarized by Caldwell *et al.* (1986), Miller *et al.* (1991), Dorman and Winant (1995), and Winant and Dorman (1997).

- **California Cooperative Oceanic Fisheries Investigations Program (CalCOFI).** The California Cooperative Oceanic Fisheries Investigations (CalCOFI) program was organized in the late 1940s and provides one of the most extensive long-term hydrographic data sets in existence. CalCOFI Line 80 is a cross-shelf transect that extends offshore from the project area. Data on salinity, temperature, oxygen, nutrients (silicate, phosphate, nitrate, and nitrite), and primary productivity have been collected for decades at CalCOFI Stations 80.51 and 80.55 that are adjacent to the Rocky Point Project area (SIO, 1990). Between 1955 and 1971, drift bottles were released in the vicinity of the project area and those data are summarized by Crowe and Schwartzlose (1972), Schwartzlose and Reid (1972), and Reid (1965). More recently, the CalCOFI hydrographic data has been used to describe the central-coast flow regime by Chelton (1984) and Hickey (1979).

- **Organization of Persistent Upwelling Structures Program (OPUS).** The Organization of Persistent Upwelling Structures (OPUS) program was designed to synoptically sample the physical and biological processes associated with a localized persistent upwelling system near Point Arguello (Atkinson *et al.*, 1986). Current meter moorings were deployed offshore of Purisima Point and hydrographic observations and current-velocity profiles were collected in the winter of 1983 when anomalous oceanographic conditions associated with an El Niño were extant (Brink and Muench, 1986; Barth and Brink, 1987; Dugdale and Wilkerson, 1989).

- **California Monitoring Program (CaMP).** The Minerals Management Service and the National Biological Service have performed long-term oceanographic studies in the southern Santa Maria Basin between 1983 and 1995. This California Monitoring Program (CaMP) investigated the fate and effects of petroleum development activities in the region between Point Arguello and Point Conception (Hyland *et al.*, 1990). Long-term current-current meter moorings were deployed to augment water quality, sediment chemistry, and marine biological measurements. The influence of wind forcing and transient eddies on the local flow regime and upwelling was examined by SAIC and MEC (1995), Savoie *et al.* (1991), Bernstein *et al.* (1991), and Coats *et al.* (1991).

- **Central California Coastal Circulation Study (CCCCS).** The MMS-sponsored Central California Coastal Circulation Study (CCCCS; Chelton *et al.*, 1987) was conducted along the central California continental shelf and slope between Point Conception and San Francisco Bay. Extensive hydrographic (water property) surveys were conducted over 18 months in 1984 and 1985 in conjunction with moored current meter and surface drifter deployments along the south central coast. Results from the CCCCS were presented by Chelton *et al.* (1988) and drifter data was presented by Chelton (1987).

B. Ocean Circulation

General Circulation

The flow field near the project area is influenced by a number of competing physical processes. Processes operating on the open-ocean flow field at distant locations exert their influence through the major ocean currents operating throughout the North Pacific Ocean. Beyond the continental slope (>100 km), the diffuse southward-flowing California Current represents the eastern limb of the clockwise-flowing gyre that covers much of the North Pacific Basin. Before turning south to form the California Current, subarctic water is carried along at high latitudes and is exposed to atmospheric cooling, nutrient regeneration, and precipitation. As a result, waters off the California Current are characterized by a seasonably-stable low salinity (32 to 34%), low temperature (13°C to 20°C), and high nutrient concentrations. They undergo less seasonal variation than surface waters at similar latitudes on the eastern seaboard.

Immediately shoreward of the California Current, along the central California continental slope and shelf, is a northward flowing counter current that carries water from the southern California Bight. These southern waters are warmer, more saline and less oxygenated than offshore waters. This northward-flowing Davidson counter current exhibits strong seasonal variability in intensity but maintains a sustained northward flow at depth near the project area despite reversals observed elsewhere along the California Coast (Chelton *et al.*, 1988; Coats *et al.*, 1991).

Seasonal variability in the Davidson Current near the project area coincides with large-scale fluctuations in coastal winds along the central California coast north of Point Conception. On average, winds are directed toward the south, parallel to the coast (Dorman and Winant, 1995). The northward-flowing Davidson Current is strongest when these southward winds relax between December and February. A rapid spring transition to stronger southward winds occurs between March and June when the Davidson Current weakens and can even turn southward near the sea surface. These strong southward winds in the spring induce intense upwelling near Point Arguello. During upwelling, surface water near the coast is transported offshore and is replace by cool, nutrient-rich water from deep offshore.

Significant interannual (year-to-year) variations in oceanographic properties and marine zoogeography also occur near the Rocky Point Project area. These large amplitude variations are associated with the El Niño - Southern Oscillation, which cycles at a period of 3 to 5 years (Graham and White, 1988). During El Niño periods, such as between 1997 and 1998, basin-wide changes in the dynamic balance of wind-driven currents results in modified flow patterns along the coastline of western North and South America (Chelton *et al.*, 1982). Changes near the project area include an anomalous strengthening of Davidson Current outflow from the Southern California Bight. This increased outflow carries warm, saline sub-tropical waters northward into the SMB. It coincides with increased winter storm activity, reductions in zooplankton biomass, and the introduction of tropical marine organisms typically found much farther south.

Superimposed on these large-scale oceanic flows are a variety of transient phenomena including intense eddies, swirls, filaments, meanders, and narrow jets of flow. These turbulent features have been observed near the project area and are capable of transporting significant quantities of heat, nutrients, and pollutants to offshore waters (Savoie *et al.*, 1991). Winds, tides, and waves also mix and transport nearshore waters within the surfzone. Tidal currents mix ocean waters near the project area, although they are not responsible for significant net transport. At shorter periods, shoaling internal and surface gravity waves also mix coastal water properties in both the horizontal and vertical directions. Upwelling that is driven by southward directed winds in the spring and summer brings deep cool nutrient-rich water to the surface. Because of the semi-arid climate, substantial drainage from onshore is rare and regional water properties are largely determined by oceanographic processes. Nevertheless, river runoff during intense winter storms can significantly impact marine waters within localized areas along the California coast (Hickey, 2000).

Long-term current monitoring near Point Arguello has yielded a consistent picture of the flow near the project area (SAIC and MEC, 1995; Savoie *et al.*, 1991; Bernstein *et al.*, 1991; Coats *et al.*, 1991). While subsurface currents are directed toward the northwest throughout the year, monthly-averaged surface currents reverse during spring upwelling when southward directed winds intensify. Between about April and June, isolated two-to-five-day events of intense southward winds are followed, after about 17 hours, by southward current flow that has an offshore component (Savoie *et al.*, 1991). The intensification of southward winds also causes upwelling that can be seen in satellite imagery as a cold-water plume extending offshore near Point Conception (Svejkovsky, 1988; Shears and Kenyon, 1989). These distinct upwelling events increase the rate of new biological production (Dugdale and Wilkerson, 1989) and affect the distribution of water-mass properties (Reid, 1965).

The project-area flow regime differs from that along the California coast to the north, where surface flows are predominantly southward throughout the year (Strub *et al.*, 1987ab). It also differs from the counterclockwise flow within the SBC where weaker diurnal winds allow remote forcing, in the form of sea-level differences, to influence flow patterns (Caldwell *et al.*, 1986; Brink and Muench, 1986; Harms and Winant, 1998). Sea-level differences are particularly important in determining flow within the SBC when southward-directed upwelling winds along the central coast relax (Hendershott, 2000).

Oil-Spill Transport
The trajectories of surface drifters released near the project area reflect the flow patterns measured by long-term current-meter moorings (Crowe and Schwarzlose, 1972; Schwartzlose

and Reid, 1972; Chelton, 1987; Winant *et al.*, 1999). Namely, northwestward transport is observed throughout much of the year except during strong upwelling events that are most prevalent between April and June. Prevailing winds between Point Arguello and Point Conception are directed to the southeast except during brief, three-to-four-day periods when winter storms disrupt the normal pattern as they pass through the region. Surface currents near the project area are generally directed to the northwest, in opposition to, and uncoupled with variation in the prevailing southeastward winds (Savoie *et al.*, 1991; SAIC and MEC, 1995). During the spring and early summer, brief episodes of intensified southward-directed winds result in a reversal of surface currents. For periods of up to a week, near-surface flows turn toward the southeast in opposition to the northwestward current direction that is maintained throughout most of the water column at depth.

The opposing directions of the wind and surface currents between Point Arguello and Point Conception are evident in drifter studies. CalCOFI drifter bottles released north of the SBC in December 1969 migrated northward at speeds exceeding 15 cm s^{-1}. However at other times of the year, drift bottles released near Point Conception were recovered both to the north and to the south near San Diego. For release points near Point Arguello in 1984, many of the CCCCS surface drifters traveled south in response to strong southward directed winds (Chelton, 1987). It was only during a brief period of weak southward winds in July that the majority of drifters moved northward. However, the CCCCS drifter design is susceptible to a downwind motion of about 0.5% of the wind speed and thus may not accurately represent surface currents alone.

The drifters used in the SBC-SMB CCS were designed to minimize the influence of wind and wave drift in favor of tracking surface currents over a depth of about 1 m (Davis *et al.*, 1982). As a result, flow statistics derived from the drifters compared well with that of the moored current meters (Dever *et al.*, 1998). Beginning in January 1995, many of these drifters were deployed within the SMB, including locations near the Rocky Point Project area. Few of the drifters released near the Point Arguello – Point Conception region beached before exiting the region (Dever *et al.*, 2000; Winant *et al.*, 1999). In a manner consistent with the long-term current meter data collected as part of CaMP, initial offshore movement was followed by northward movement into the SMB in fall and winter. Spring and summer deployments were more likely to show southward flow toward San Miguel Island. Few drifters moved westward to enter the SBC.

The complex interaction between winds and surface currents near Point Conception makes predictions of oil spill trajectories difficult. During much of the year, but especially in the fall and winter, the northwestward surface flow is in direct opposition to the prevailing winds. Certainly surface flow, as determined by current meters and drifters, has a direct bearing on the fate and effects of potential oil spills resulting from the proposed project. However, winds also influence the spread and trajectory of oil slicks on the sea surface. Empirical data from the open ocean suggests that leading edge of an oil slick will drift at about 3% of the wind speed and oil-following drifters have been evaluated based on their ability to match this "*3% rule*" (Reed *et al.*, 1988). However, there is no rigorously defensible theoretical basis or empirical data to support the application of this rule in coastal flow regimes such as near the project area.

The oil-spill risk analyses described in this evaluation were performed using the MMS numerical (OSRA) model for the SBC area. It calculates probabilities of shoreline impact after applying a drift equivalent to 3.5% of the prevailing wind velocity in its trajectory computations. Because of the heavy influence of southward-directed winds near Point Conception, the model results indicate that the probability of shoreline impacts along the Channel Islands to the south is far higher than at sites along the central coast to the north. The influence of southward directed winds in the model effectively overcomes the northwestward surface currents observed over much of the year in the field programs. This contrasts with SBC-SMB CCS drifters which tend to travel toward the south only about 31% of the time and only about 15% of these intersect the shoreline (Browne, 2000). In Browne's analysis, northward transport has a slight edge with 32% of the trajectories traveling to the north and contacting the coast about 23% of the time.

Clearly, the complexity of opposing winds and currents near the project area makes the reconciliation between OSRA model results and observations difficult. Because the applicability of the "*3% wind rule*" in complex coastal flow regimes has not been rigorously quantified, this environmental evaluation should entertain the possibility for spilled oil to travel from the project area toward the north and into the SMB.

Similarly, the environmental evaluation for the proposed project should not rely solely on shoreline impact probabilities determined exclusively from available drifter trajectories. Drifters, with their measurable mass and finite vertical profile below the sea surface, cannot capture the behavior of an oil slick that is typically only a few millimeters thick (Reed *et al.*, 1988). Furthermore, dispersion and weathering affects the spread of oil on the sea surface, and buoys cannot capture the changing slick dynamics across a wide range of winds, waves, and currents. Goodman *et al.* (1995) and Simecek-Beatty (1994) tested the oil-tracking ability of several drifter designs, including the Davis *et al.* (1982) design used in the SBC-SMB CCS study. They found that Davis-type drifters lagged behind simulated oil slicks presumably because they are optimized to track surface currents with minimal influence by winds and waves. In cases where winds opposed surface currents, the Davis-type drifters moved into the prevailing wind and in a direction opposite of the simulated oil slicks made from wood chips. This is similar to the case in the project area where the northward-flowing Davidson current often opposes the prevailing southward-directed winds.

Drill Mud Transport

Drill-mud transport estimates are not subject to the same discrepancies between observations and modeling. The subsurface flow in the project area is predominantly toward the northwest, regardless of the intensity of the southward-directed upwelling winds (Savoie *et al.*, 1991). Drilling mud discharged at depth from the platforms will be preferentially transported to the northwest. This finding has been independently confirmed through a comparison of mud-trajectory modeling and drill-mud accumulations within seafloor sediment traps near the project area (Coats, 1991).

C. Wave Climatology

As with currents, the wave climatology of the project area represents a transition from the sheltered environment of the SBC and the exposed coastal region of the SMB. Maximum design wave heights for 100-year return periods along the central California are 60 feet compared to 45 feet in the SBC because of sheltering effects from the Channel Islands and the orientation of the coastline (API, 1987). Without the benefit of island sheltering, the project area is likely to experience a comparatively high flux of wave energy although the influence of intense winter storms to the north is limited by the orientation of the coastline. Along the adjacent shoreline, energetic wave action forms a harsh intertidal environment for benthic organisms. As a result, intertidal organisms tend to be burrowers adapted to high turbidity and mechanical disturbance.

The ambient sea state at the time of an oil spill determines the effectiveness of dispersants (Lunel, 1995) and booms deployed to contain the oil offshore. Upon reaching the coastline, high surf determines the intertidal distribution of oil and the ability of cleanup crews reach the affected area.

Deepwater Wave Climatology

Four primary meteorological sources generate waves offshore the project area: extratropical winter cyclones in the northern hemisphere, northwesterly winds during the spring transition and summer, tropical disturbances offshore Mexico, and extratropical storm swell generated in the southern hemisphere during summer. The first two are the primary sources for the wave climate along the central California coast although the last two occasionally generate significant swell events from the south.

- **Winter Storm Waves.** These waves are generated by extratropical winter cyclones and are often accompanied by local rainfall along the coast. Extratropical storms are associated with low-pressure systems that develop along the polar front in the Pacific Ocean and propagate westward toward the central coast. Thus, major wave events often coincide with an increased marine discharge of terrestrial sediments eroded by heavy rainfall. These storms occur predominantly in winter (December through March; Noble Consultants, 1995).
- **Northwesterly Winds.** With the exception of major winter storm events, the predominant mechanism for generating waves over the central California continental shelf is prevailing northwesterly winds. These winds dominate during the spring and summer when a high-pressure system is established over the eastern North Pacific Ocean. The winds are highly coherent over the project area (Chelton *et al.*, 1987) and generate wind waves over a large fetch. These locally generated waves tend to be of shorter period and smaller significant wave height than those generated by major winter storms.
- **Southerly Swell.** Large swell generated to the south can occur on occasion during summer months. One large event occurred in late July 1996 from a storm 400 miles south of Tahiti. The Harvest Platform wave gauge recorded significant wave heights of over 2 m. These long period waves (20-s significant period) arrived from directions ranging between 200°T (degrees from True north) and 230°T.

Major wave events arriving from south are rare, so deepwater wave climatology is directionally bimodal with the majority of events arriving directly from the west (270°T) or from the northwest (300°T) (Seymour, 1996).

Coastal Wave Climatology

Deepwater waves arriving from certain directions never reach some coastal locations depending on the coastline orientation and the presence of major coastal promontories such as Point Arguello and Point Conception. Coastal WIS Stations 133 (Point Arguello) and 134 (Point Conception) are adjacent to the project area and have respective coastline orientations of 118°T and 148°T (Jensen *et al.*, 1989). Blocking by the two adjacent major promontories limits the respective wave windows to 158 - 298°T and 178 - 328°T. In the project area, deepwater waves arriving from the northwest are blocked by the coastline so that almost all of the waves (>90%) arrive directly from west (about 270°T). These waves impinge on the coastline at an oblique angle and drive much of the longshore circulation within the littoral zone.

Overall, about 10% of the waves in 30-foot water depths exceed 10 feet and have a dominant period of 14 seconds. For return periods between 5 and 20 years, maximum significant wave heights are close to 18 feet. Offshore oil-spill cleanup operations involving a boom and skimmer have been hampered in 8- to 10-foot seas (McDonald, 1995). This suggests that offshore cleanup operations will be limited about 10% of the time and on occasion, it would be untenable.

4.1.2 Marine Resources

The offshore biological communities in the project area are described in detail in the initial Development Plan EIR/EIS prepared for the Point Arguello Field and Gaviota Processing Facility. As such, the environmental descriptions provided below present the reader with an overview and supplement rather than an exhaustive literature review on biological topics pertaining to the region. Whenever possible, updates to the literature are provided and whenever possible, attention is given to the biological issues raised by MMS in the letter dated August 13, 1999 pertaining to the suspension of operations (SOO) for the Rocky Point Unit.

A. Plankton

Plankton are organisms that have limited or no swimming ability and generally drift or float with ocean currents. The two broad categories of plankton are phytoplankton and zooplankton. Phytoplankton, or plant plankton, form the base of the food web by photosynthesizing organic matter from water, carbon dioxide, and light. They are usually unicellular or colonial algae and support zooplankton, fish, and through their decay, large quantities of marine bacteria.

Zooplankton are the animal plankton. Holoplankton spend their entire life as plankton while meroplankton spend a portion of their life cycle as plankton and are larval stages of benthic invertebrates. Ichthyoplankton are larval stages of fish. Zooplankton are a primary link between phytoplankton and larger marine organisms in marine food webs.

Plankton distribution, abundance, and productivity are dependent on several environmental factors. Factors include light, nutrients, water quality, terrestrial runoff, and upwelling. Plankton distribution tends to be very patchy and characterized by high seasonal and inter-annual variability. Because phytoplankton are photosynthetic, they are generally limited to the photic zone while zooplankton can occur throughout the water column from surface to bottom.

Phytoplankton
The phytoplankton community off the California coast primarily consists of diatoms, dinoflagellates, silicoflagellates, and coccolithophores (Hardy, 1993). Standard measures for describing phytoplankton communities are productivity, standing crop, and species composition.

Productivity, which is a measure of growth or new plant material per unit time, is extremely variable off the California coast (Owen, 1980). Generally, the highest productivity levels occur within about 50 km of the coastline (Owen, 1974) and tends to be the highest or about six times higher in upwelling areas than the open ocean Riznyk (1974). Springtime primary production levels are approximately 5 times higher than summer and 10 times higher than winter (Oguri and Kanter, 1971).

Standing crop, or the amount of phytoplankton cells present in the water, is also extremely variable and heterogeneous off the California coast. Owen (1974) reports highest standing crop values during the summer (range of 2.50 to 3.00 mg/m^3) and lowest values during the winter months (range of 0.30 to 0.40 mg/m^3). Palaez and McGowan (1986) also report high densities of phytoplankton in spring and summer that lessen in the fall and become the lowest in the late fall and early winter. They attributed the seasonal differences to ocean circulation patterns and the low nutrient content of waters off the California coast during the winter months.

Phytoplankton biomass have been reported to be higher near Point Conception than in locations north or south because of greater upwelling off the Point (Owen, 1974). Biomass reached peak levels during summer (July to September) and decreased from October to December and with distance from shore. Highest biomass values were reported during August and in the upper 20 m of the water column (Owen and Sanchez, 1974).

Data from several studies indicate that the composition of the phytoplankton community is similar along the entire coast of California (e.g., Bolin and Abbott, 1963; Allen, 1945). The diatom *Chaetoceros* was the most abundant species found along the coast (Bolin and Abbott, 1963; Cupp, 1943). Other dominant species included the diatoms *Skeletonema*, *Nitzschia*, *Eucampia*, *Thalassionema*, *Rhizosolenia* and *Asterionella*, and the dinoflagellates *Ceratium*, *Peridinium*, *Noctiluca*, and *Gonyaulax* (Bolin and Abbott, 1963).

Zooplankton
Zooplankton are those animals that spend part (meroplankton) or all (holoplankton) of their life cycle as plankton. Their temporal and spatial distributions are dependent on a number of factors including currents, water temperature, and phytoplankton abundance (Loeb *et al*., 1983). Spring blooms occur for both meroplankton and holoplankton while fall blooms tend to be restricted to the holoplankton. The meroplankton include the larvae of many commercial species of fish, lobster, and crabs. Like phytoplankton, spatial distribution of zooplankton is extremely patchy.

Based on data collected by the California Cooperative Oceanic Fisheries Investigations (CalCOFI), McGowan and Miller (1980) reported a high degree of variability in species composition in offshore waters and that dominant species vary widely even from sample to sample. Fleminger (1964) reported 190 species and 65 genera of calanoid copepods. Kramer and Smith (1972), estimated that 546 invertebrate and 1,000 species of fish larvae occur in the California Current System. Major zooplankton groups off the California coast include copepods, euphausiids, chaetognaths, mollusks, thaliaceans, and fish larvae.

In studies conducted at Diablo Canyon, Icanberry and Warrick (1978) identified 94 taxonomic zooplankton categories. Dominant categories included calanoid copepod nauplii and copepodites, thalicians, *Oikopleura*, *Euphausia*, calyptopis, cyclopoid and harpacticoid copepodites, and the copepod *Acartia tonsa*. Seasonal studies at Diablo Canyon indicate that zooplankton production is highest during June and July and in early Spring during periods that coincide with upwelling periods and increased levels of phytoplankton (Icanberry and Warrick, 1978; Smith, 1974).

Ichthyoplankton

Ichthyoplankton, or fish eggs and larvae, are a component of the zooplankton community. With the exception of a few fish species (e.g., the embiotocidae or surfperches that bear live young), most fish that occur in central California are present as larvae or eggs in the plankton community. The spatial and temporal distribution and composition of the ichthyoplankton are generally due to the spawning habits and the requirements of the adults. Seasonal patterns of ichthyoplankton in nearshore waters are influenced by the spawning cycles of demersal fish species and the northern anchovy, *Engraulis mordax*, while further offshore, composition is influenced by pelagic and migratory species and rockfish (*Sebastes* spp). Like phytoplankton and zooplankton, the spatial distribution of ichthyoplankton is patchy and influenced by several environmental factors.

In CalCOFI samples collected offshore California, ichthyoplankton densities were found to be at the highest during January to March (Loeb *et al*., 1983). This was due to the peak spawning season for the northern anchovy, Pacific hake, Pacific mackerel, and the Pacific sardine. Larvae of these species comprised up to 84 percent of the samples. Generally, they found that ichthyoplankton densities decreased from north to south and inshore to offshore between San Francisco and Baja California.

In a summary of CalCOFI fish larvae data Ahlstrom (1965) found that twelve taxa made up over 90 percent of the larvae collected. The most abundant was the northern anchovy, *Engraulis mordax*. Other common larval species were the Pacific hake, *Merluccius productus*; rockfish, *Sebastes* spp.; flatfish, *Citharichthys spp.*; and the California smoothtongue, *Leuroglossas stilbius*. Anchovy and rockfish larvae were abundant from the winter to spring seasons. Spawning varied by season with no discernible pattern within the California Current system (Kramer and Ahlstrom, 1968; Ahlstrom *et al*., 1978).

In a year-round study off of Pt. Arguello, the white croaker, *Genyonemus lineatus*, and the northern anchovy, *Engraulis mordax* were the most abundant fish larvae collected (Chambers Consultants, 1980).

B. Fish

Fish resources in the project area consist of both year-round residents and seasonal migrants. Over 600 species of fish have been reported in the Pacific OCS region (USDOI, 1996). Large numbers of shellfish and other invertebrate species also occur in the area with the most important being crabs, shrimp, bivalves, and squid. A wide variety of habitats are available in the region for fish resources and the distribution of fishes in the area fluctuates in accordance with food availability, environmental conditions, and migration (USDOI, 1996).

With respect to fish distribution in the area, the offshore environment can generally be divided into two zones. They are the benthic or shelf and pelagic zones. Demersal or benthic species are those that live on or near the sea floor while pelagic fish species occur in the water column.

Demersal Fish

The offshore benthic environment generally consists of sandy, muddy, or rocky substrates. Important commercial or recreational fish species found beyond the tidal and wave zone include flatfishes, rockfishes, lingcod, and cods. In shallower water, common fish species are the perches, smelts, skates, rays, and flatfishes. Several researchers (e.g., Bence *et al.*, 1992; Wakefield, 1990; Caillet *et al.*, 1992) have reported that demersal fish species distributions are based on depth or depth-related factors. General depth distributions for fish common to the project area are summarized in Table 4.1.

Table 4.1 Depth Distribution of Demersal Fish Common to the Project Area

Water Depth			
50 – 200 m	**200 - 500 m**	**500 - 1200 m**	**1200 - 3200 m**
Sand dabs *Citharichthys sordidus*	Sablefish *Anoplopoma fimbria*	Thornyheads *Sebastolobus* spp.	Rattails *Coryphaenoides filifer*
English sole *Pleuronectes vetulus*	Pacific hake *Merluccius productus*	Pacific hake *Merluccius productus*	Thornyheads *Sebastolobus* spp.
Rex sole *Errex zachirus*	Slickhead *Alepocephalus tenebrosus*	Slickhead *Alepocephalus tenebrosus*	Finescale codling *Antimora microlepis*
Rockfish *Sebastes* spp.	Eelpouts *Lycenchelys jordani*	Rattails *Coryphaenoides filifer*	Eelpouts *Lycenchelys jordani*
Pink surfperch *Zalembius rosaceus*	Rockfish *Sebastes* spp.		
Plainfin midshipman *Porichthys notatus*	Thornyheads *Sebastolobus* spp.		
White croakers *Genyonemus lineatus*			

Fish densities on the continental shelf between 50 and 200 m water depth are generally high, with flatfish densities being highest for species such as Pacific sanddabs and English and Dover sole. Rockfish, as a group, have historically been extremely abundant on the shelf and at depths to 270 m (Bence *et al.*, 1992). However, significant declines have been reported for many rockfish species in recent years (Love *et al.*, 1998; Ralston, 1998). While specific reasons for the decline have been debated, there is little doubt that rockfish biomass and commercial harvests have decreased since the 1960's (Bloeser, 1999). Fish densities and biomass on the upper and middle slope are relatively high with rockfish, sablefish, and flatfish such as Dover sole dominating (SAIC, 1992). At deeper depths (greater than 1,500 m), the numbers of fish species, densities, and biomass are typically low. Rattails and slickheads are the most common species at this depth (SAIC, 1992).

Pelagic Fish

Pelagic fish are those species associated with the ocean surface or the water column. Distribution of pelagic fish is generally governed by water depth, distance from shore, and other environmental factors. Oceanic waters up to depths of approximately 200 m are referred to as the epipelagic zone. Epipelagic zone waters are typically well lighted, well mixed, and support photosynthetic algal communities. Water depths from 200 to approximately 1,000 m is referred to as the mesopelagic zone, while depths greater than 1,000 m is called the bathypelagic zone. With increasing depths, light, temperature, and dissolved oxygen concentrations decrease as pressure increases. Hence, the bathypelagic zone, is characterized by complete darkness, low temperature, low oxygen concentrations, and high pressure.

Pelagic fishes in the project area are a mix of year-round residents and migrants from several different habitats. Species include large predators (e.g., tunas, sharks, swordfish) and forage fish (e.g., northern anchovy, Pacific sardine, Pacific saury, Pacific whiting). The distributional ranges for pelagic fishes are generally quite extensive and cover much of the coastal California region. Many fish in the pelagic zone such as albacore tuna and Pacific salmons migrate over vast areas in the Pacific.

Common epipelagic fish in the region include the mackerel, *Scomber japonicus*; and salmon, *Onchorhyncus* spp.; and schooling fish such as Pacific herring, *Clupea pallasii*; northern anchovy, *Engraulis mordax*; and rockfish, *Sebastes* spp. Bence *et al.* (1992) reported approximately 140 epipelagic species from midwater trawls. In those trawls, juvenile rockfish, Pacific herring, and northern anchovy were the dominant species. Other epipelagic species common to the area included medusafish, *Icichthys lockingtoni*; Pacific sardine, *Sardinops sagax*; Pacific saury, *Cololabis saira*; Pacific argentines, *Argentina sialis*; and tunas (ARPA, 1995). Epipelagic species such as albacore tuna (*Thunnus alalunga*) and salmon are important commercial and recreational fish species.

Less is known on the pelagic fish in the mesopelagic and bathypelagic zones. Typical species in the area include the blacksmelt, *Bathylagus milleri*; northern lampfish, viperfish, and the lanternfish (Cross and Allen, 1993). Example bathypelagic fish include dragonfish, hatchetfish, and bristlemouth (Cross and Allen, 1993).

Oil and Gas Production Platforms

Offshore platforms provide habitat for marine organisms including a wide variety of fish. Results from fish surveys conducted by Love *et al.* (1999), at the four platforms in the Santa Maria basin indicate a large amount of spatial and temporal variability at each of the platforms. The number of species present at each of the platforms decrease in a west to east direction. Of the four platforms, Irene, located north of Point Arguello was inhabited by the highest number of species. Of the 21 species, 44 percent were rockfish. Sardines were the only pelagic species observed at

Irene. Twenty species were reported for Platform Hidalgo, 16 species at Platform Harvest, and 13 species at Platform Hermosa (Love *et al.*, 1999).

Different fish communities are found at mid-water versus bottom habitats beneath the platforms (Love *et al.*, 1999). Although rockfish was the dominant species at both depths, the mid-water community was comprised largely of young-of-the-year (YOY) or juveniles while the bottom assemblage consisted largely of adults or subadults. Fewer species were present in the mid-water than the bottom (Love *et al.*, 1999).

Endangered and Threatened Fish Species

The steelhead, *Oncorhynchus mykiss*, was listed as an endangered species in the Southern California ESU (from the Santa Maria River south to Malibu Creek) in August, 1997 (NMFS, 1999). Steelhead are migratory anadromous rainbow trout. They hatch in fresh water, descend to the ocean, and return to fresh water to spawn. Depending on the stream, steelhead can be either summer or winter migrators but regardless of migration period, spawning usually takes place from March to early May (NMFS, 1999). NMFS (1999) identifies river reaches and estaurine areas as critical habitats for the steelhead. Steelhead can migrate extensively at sea (Eschmeyer and Herald, 1983).

The tidewater goby, *Eucylogobius newberryi*, is restricted to the low salinity waters (<10 ppt) found in coastal wetlands and lagoons. It is currently listed as a federally endangered species in California north of Orange County. The tidewater goby lacks a marine life history phase; hence, genetic exchange between coastal populations is restricted and the potential for natural recolonization of a local population after extirpation is extremely limited (USDOI, FWS, 1994). Studies have also revealed that certain populations of tidewater gobies are genetically distinct, indicating a fairly long period of isolation. Generally, tidewater gobies occur in loose aggregations consisting of a few to several hundred individuals in shallow water less than 1 m. Nesting activities occur in late April to May.

The tidewater goby is discontinuously distributed along the California coastline. Its range extends from Del Norte County south to San Diego County. The tidewater goby has been extirpated from 50 percent of the lagoons within its historical range and 74 percent of the lagoons south of Morro Bay, CA. It has been reported in several coastal lagoons and tidal streams at onshore locations adjacent to the project area (e.g., Santa Ynez River estuary) (USDOI, FWS, 1994).

Sebastes paucispinis or bocaccio, is presently a candidate species for listing under the Endangered Species Act (ESA). Presently, it has no protection status under the ESA. Bocaccio commonly occurs at platforms in the Santa Barbara Channel and Santa Maria Basin.

C. Marine Mammals

Dohl *et al.* (1983a) reported 27 marine mammal species in central California. The three broad categories he reported in central California were: 1) migrants that pass through the area on their way to calving or feeding grounds, 2) seasonal visitors that remain for a few weeks to feed on a particular food source, or 3) residents of the area. Of the 27 species, 21 were cetaceans (i.e., whales, dolphins, and porpoises), five were pinnipeds (i.e., seals and sea lions), and one was a fissiped (the sea otter). Generally, marine mammals are characterized by extensive distributional ranges (Gaskin, 1982). The central California area represents a region of overlap. It is an area where populations of marine mammals having different biogeographic affinities intermingle (Dohl *et al.*, 1983a). Several marine mammal species reach the southern limit of their ranges in central California while other species are at their northern range limits (Hubbs, 1960; Bonnell and Daily, 1993).

Boreal species, which are marine mammals found in the cooler waters of the North Pacific occur in central California during winter through early summer. They are found in areas of coastal upwelling and in the coolest waters of the California current. Example boreal species include Dall's porpoises, harbor porpoises, and the northern fur seals.

In late summer and autumn, marine mammals found in warmer waters to the south are found in central California. Examples include the California sea lions and northern elephant seals, bottlenose dolphins and pilot whales.

Some species, for example the southern sea otter, is endemic to coastal central California and occurs year-round. Several species are largely restricted to the waters of the California Current and occur in high numbers off of central California. These species include the California sea lion, northern elephant seal, and during its migration, the California gray whale (Dohl *et al.*, 1983a).

Bonnell and Dailey (1993) list 39 species of marine mammals in the eastern North Pacific. Of the 39 species, 32 of them are cetaceans followed by six species of pinnipeds and one species of fissiped, the sea otter. A listing of these species and their abundance and status is provided in Table 4.2.

Cetaceans

Cetaceans (whales, dolphins, and porpoises) occur in project waters year-round. The numbers and species vary from season to season and from year to year, but there are cetaceans always utilizing the waters offshore central California. Cetacean population levels are at their lowest in spring and are at their highest level during the autumn (Dohl *et al.*, 1983a). Five species of porpoises represent the major cetacean fauna found off of central California. They are the Pacific white-sided dolphin *Lagenorhynchus obliquidens*, the northern right whale dolphin *Lissodelphis borealis*, Risso's dolphin *Grampus griseus*, Dall's porpoises *Phocoenoides dalli*, and the harbor porpoise *Phocoena phocoena*. Collectively, these five species accounted for more than 95 percent of cetaceans observed off the central California coast. These species vary in their patterns of usage of the area and periods of peak abundances (Dohl *et al.*, 1983a).

Numerically, baleen whales are not a major component of the area's cetacean fauna. Four species have been reported, the California gray whale *Eschrichtius robustus*, the humpback whale *Megaptera novaeangliae*, the blue whale *Balaeoptera musculus*, and the fin whale *B. physalus* (Dohl *et al.*, 1983a). The majority of these whales use the coastal waters as migratory routes twice a year. The whales often pause to feed along the coast during their migration. The

Table 4.2 Cetaceans of the Eastern North Pacific and Their Status off South Central California (Adapted from Bonnell and Dailey, 1993; Barlow et al., 1997; Forney et al., 1999)

Common Name	Scientific Name	Abundance	Status
Cetaceans Baleen Whales (Suborder Mysticeti)			
Blue whale	*Balaeoptera musculus*	Historically rare offshore CA. However, there is evidence that abundance offshore CA has increased in recent years. Population highest in summer	E*
Fin whale	*B. physalus*	Historically rare offshore CA. However, there is evidence that abundance offshore CA has increased in recent years. Population highest in summer	E
Sei whale	*B. borealis*	Rare. Seen only during summer months during migration	E
Bryde's whale	*B. edeni*	Rare. Very few sightings occur offshore CA	NA
Minke whale	*B. acutorostrata*	Migratory population; common, peak abundance during spring and summer	NA
Humpback whale	*Megaptera novaeangliae*	Migratory and/or resident population offshore CA. Occasionally observed	E
Gray whale	*Eschrichtius robustus*	Common during migration in winter and spring	NA
Northern right whale	*Balaena glacialis (also referred to as Eubalaena glacialis)*	Rare. Only two sightings in southern CA.	E
Order Cetacea Tooth Whales (Suborder Odontoceti)			
Sperm whale	*Physeter macrocephalus*	Occasionally observed on continental shelf but more abundant in deeper waters. Occur year-round offshore CA	E
Common dolphin	*Delphinus delphis*	Common. Year-round resident	NA
Northern right-whale dolphin	*Lissodelphis borealis*	Common in the winter and spring	NA
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	Common. Year-round resident	NA
Risso's dolphin	*Grampus griseus*	Common. Year-round resident with peak population in summer and autumn	NA
Dall's porpoise	*Phocoenoides dalli*	Common. Year-round resident with peak population in autumn and winter	NA
Bottlenose dolphin	*Tursiops truncatus (also referred to as T. gilli)*	Common. Year-round resident	NA
Harbor porpoise	*Phocoena phocoena*	Occur from Pt. Conception to Alaska. Year-round resident in the area but not commonly observed	NA

Table 4.2 Cetaceans of the Eastern North Pacific and Their Status off South Central California (Adapted from Bonnell and Dailey, 1993; Barlow et al., 1997; Forney et al., 1999) (continued)

Common Name	Scientific Name	Abundance	Status
Short-finned pilot whale	*Globicephala macrorhynchus (also referred to as G. scammonii)*	Small year-round population with increases during winter	NA
Killer whale	*Orcinus orca*	Occasional visitor to area from northern latitudes. Not common	NA
False killer whale	*Pseudorca crassidens*	Occurs primarily in tropical to warm temperate waters. Occasional visitor to area	NA
Cuvier's beaked whale	*Ziphius cavirostris*	Occurs in tropical and warm temperate waters. Have been recorded in area	NA
Baird' beaked whale	*Berardius bairdii*	Rare. Endemic to Arctic and cool temperate waters	NA
Hubb's beaked whale	*Mesoplodon carhubbsi*	Rare. Known primarily from stranding records	NA
Ginkgo-toothed beaked whale	*M. ginkgodens*	Rare. Known primarily from stranding records	NA
Hector's beaked whale	*M. hectori*	Rare. Known primarily from stranding records	NA
Blainville's beaked whale	*M. densirostris*	Rare. Possible visitor to area	NA
Bering Sea beaked whale	*M. stejnegeri*	Rare. Possible visitor to area	NA
Dwarf sperm whale	*Kogia simus*	Occurs in tropical and warm temperate waters. Sightings and strandings have occurred in California	NA
Pygmy sperm whale	*K. breviceps*	Occurs in tropical and warm temperate waters. Sightings and strandings have occurred in California	NA
Striped dolphin	*Stenella coeruleoalba*	Occasional visitor to area. Known from sightings and strandings	NA
Spinner dolphin	*S. longirostris*	Occurs in tropical waters; possible visitor to area	NA
Spotted dolphin	*S. attenuata*	Occurs in tropical waters; possible visitor to area	NA
Rough-toothed dolphin	*Steno bredanensis*	Occurs in tropical waters; possible visitor to area	NA

NA = Not Applicable; E = Endangered

California gray whale is the most common baleen whale that passes through the area twice each year on their annual migration. Most of the world population of this species make the biannual trip along the California coastline and the majority are found close to shore over continental shelf waters (Herzing and Mate, 1984; Reilly, 1984; Rice *et al.* 1984; Rugh, 1984; Dohl *et al.*, 1983a; Sund and O'Connor, 1974). During the migrations from 1983 through 1985, the majority of the animals were 1.5 to 1.8 kilometers offshore (0.8 to 1 nautical miles) and less than 20 percent were as close as 0.9 kilometer (0.5 nautical mile).

Peak periods of abundance of baleen whales occur during the winter and spring migration seasons. However, as overall populations of certain species increase (e.g., gray whales and humpback), larger numbers are becoming resident to areas offshore California (Dohl *et al.*, 1983a). Both species have historically appeared off central California as they primarily migrate through the area to winter off of Baja California. Blue and fin whales are also observed on a regular basis offshore central and southern California. Since 1980, there is indication that their abundance has increased in California coastal waters. However, it is not certain if the increase is due to growth of the stock or an increased use of California waters as a feeding area (Barlow *et al.*, 1997).

Pinnipeds

Five pinniped species occur off central California (Table 4.3). The pinnipeds are the California sea lion *Zalophus californianus*, the Northern (Steller) sea lion *Eumetopias jubatus*, the northern fur seal *Callorhinus ursinus*, the northern elephant seal *Mirounga angustirostris*, and the harbor seal *Phoca vitulina* (Bonnell *et al.*, 1983). The total population size for the continental shelf is

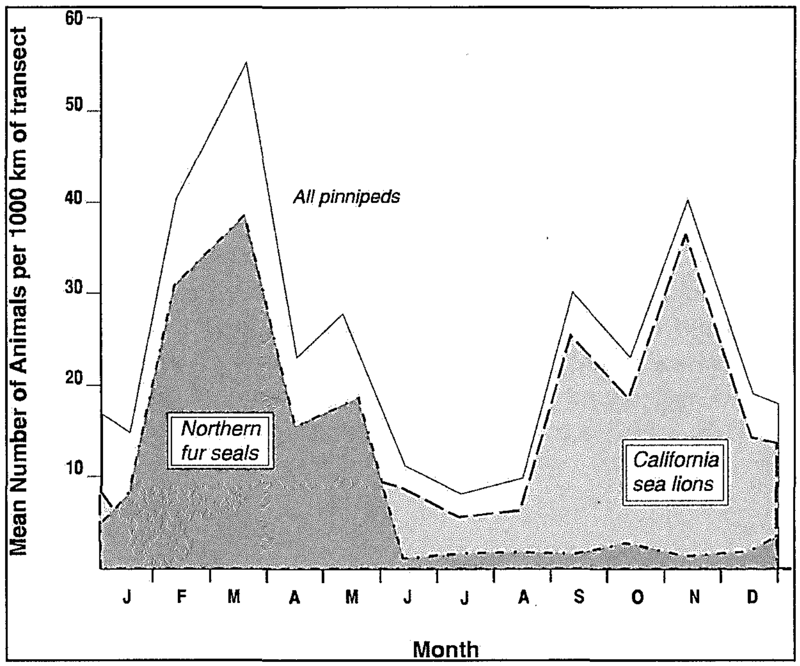
Table 4.3 Pinnipeds of the Eastern North Pacific and Their Status Off California (Adapted from Bonnel and Dailey, 1993)

Carnivora Pinnipeds (Suborder Pinnipedia)			
California sea lion	*Zalophus californianus*	Abundant, year-round resident	NA
Northern (Steller) sea lion	*Eumetopias jubatus*	Occasional visitor to area from northern latitudes. Not common	T
Northern (Steller) sea lion	*Eumetopias jubatus*	Occasional visitor to area from northern latitudes. Not common	NA
Northern fur seal	*Callorhinus ursinus*	Common, year-round resident	NA
Guadalupe fur seal	*Arctocephalus townsendi*	Occasional visitor to area from southern breeding grounds. Not common	T
Northern elephant seal	*Mirounga angustirostris*	Year-round resident. Common	NA
Pacific harbor seal	*Phoca vitulina*	Year-round resident. Common	NA

T = Threatened Species; NA = Not Applicable

estimated to exceed 50,000 animals in the fall and nearly 50,000 animals during the spring. At least 30,000 pinnipeds are estimated to occur in the area all year-round. The pinniped population at sea is predominately composed of northern fur seals or California sea lions. When one population is at its peak, the other is at its low for the area (Bonnell *et al.*, 1983). Northern fur seals reach their peak in winter and spring, as migrants from the Bering Sea arrive to overwinter in California waters. California sea lions reach their peak in fall (Figure 4-2), as the breeding population disperses northward from rookery islands in the Southern California Bight.

Figure 4-2 Seasonal Abundance of Pinnipeds in the Waters of Central and Northern California (from Bonnell et al., 1983)



Three pinniped species maintain breeding populations off central California. They are the Steller sea lion, the northern elephant seal, and the harbor seal.

Fissipeds

During the past 15 years, sea otters (*Enhydra lutris*), have generally ranged from approximately Point Año Nuevo in the north to about Pt. Conception in the south (Bonnell *et al.*, 1983). It is a remnant population which, during pre-exploitation, numbered about 150,000 animals ranging from about Prince William Sound in Alaska to Morro Hermoso in Mexico (Kenyon, 1969). The present population of sea otters off the central California coast is descendent from a small remnant group estimated at 100 to 150 animals initially sighted at Bixby Creek. Substantial changes have occurred in the distribution and density of sea otters within the California range in the last 20 years. The changes have generally been unidirectional shifts in population distribution and indicate increases in the use of some areas and the decline in the use of others (Bonnell *et al.*, 1983). The changes are expected for a resource-dependent species. Sea otters, a federally and state-protected species, have recently been observed as far south as Carpinteria (USGS, 1999).

The sea otter population undergoes seasonal migration twice a year. The migrations are attributed to the breeding season (June to November) and the non-breeding season (November to May). During the breeding season, the size of the southernmost group declines dramatically, presumably because of a northward movement of animals towards the center of the range (Bonnell *et al.*, 1983; Estes and Jameson, 1983). This movement of males from the population fronts into the more established areas occupied by females during the summer and fall breeding season is a feature of the sea otter's annual cycle (Bonnell *et al.*, 1983).

In California, sea otters feed almost entirely on macroinvertebrates (Ebert, 1968; Estes *et al.*, 1981). In rocky areas along the central California coast, major prey items include abalones, crabs, and sea urchins. In sandy areas, prey items include clams, snails, octopus, scallops, sea stars, and echiuroid worms (Boolootian, 1961; Ebert, 1968; Estes, 1980; Estes et. al., 1981; Wendell *et al.*, 1986).

In recent otter surveys coordinated by the US Department of Interior (USGS, 1997, 1998, 1999) off the coast of California, the total number of sea otter counts have decreased. For example, Spring sea otter counts offshore California have ranged between 2,095 in 1995 to 1,858 in 1999. Since 1997, sea otter counts east of Point Conception have increased. In the Spring survey, 60 independent sea otters were counted east of Point Conception, including 38 near Cojo Bay and 9 east of Coal Oil Point. During a survey in February 1999, a high of 153 otters was counted east of Point Conception. Two otters were observed as far east as Carpinteria (USGS, 1999).

D. Sea Turtles

Although infrequent, sea turtles have occasionally been reported in coastal California. Over the years, four species have been reported in the project area. The four species are the green turtle *Chelonia mydas*, the Pacific ridley turtle *Lepidochelys olivacea*, the leatherback turtle *Dermochelys coriacea*, and the loggerhead turtle *Caretta caretta* (Hubbs, 1977).

Of the four species, three of them (Pacific ridley, leatherback, and green) are listed as endangered species under the U.S. Endangered Species Act. The loggerhead is listed as a threatened species under the same act.

Although marine turtles are not common to the project area, they have occasionally been reported. According to the California Marine Mammal Stranding Network Database, 14 marine turtles strandings were reported on Santa Barbara County beaches during the 1982-1995 period. Of the 14 strandings, 9 were leatherbacks, 3 were loggerhead, and 2 were green turtles(NOAA, 1997). At the nearby Diablo Canyon Nuclear Power Plant, 1 green turtle was reported in 1994 and 1997 (NOAA, 1997; Port San Luis Harbor District, 1997). General distribution information for marine turtles is provided below.

Green Sea Turtles (Chelonia mydas)

Generally, green sea turtles occur worldwide in waters above 20°C. Central California represents the northern end of their range so they are infrequent visitors to the area. However, green turtles have been reported as far north as Redwood Creek in Humboldt County and off the coast of

Washington and Oregon (Green *et al.*, 1991; Smith and Houck, 1983). The green sea turtle is thought to nest on the Pacific coasts of Mexico, Central America, South America, and the Galapagos Islands (Mager, 1984). The only known nesting location in the continental U.S. is on the east coast of Florida. The green sea turtles are herbivores, feeding on algae and sea grasses. In Santa Barbara County, green turtle strandings were reported on a Santa Barbara beach and in Summerland. At the Diablo Canyon Nuclear Power Plant green turtles were reported in 1994 and as recently as 1997 (NOAA, 1997; Port San Luis Harbor District, 1997).

Pacific Ridley Sea Turtle (Lepidochelys olivacea)
The Pacific ridley is an infrequent visitor to the California coast. In the past, they have been reported as far north as Washington, Oregon, and California (Green *et al.*, 1991; Houck and Joseph, 1958; NOAA, 1997). In the eastern North Pacific, the primary range of the Pacific ridley extends from Columbia to Mexico (USDOI/MMS, 1996). The Pacific ridley sea turtle is omnivorous, feeding on crustaceans, fish, jellyfish, sea grasses and algae (Ernst and Barbour, 1972). There have not been sightings of Pacific ridley turtles in the project area in recent years (NOAA, 1997).

Leatherback Sea Turtle (Dermochelys coriacea)
Leatherback sea turtles range farther north than any of the other sea turtles. This is due to their ability to maintain warmer body temperatures in colder waters (Frair *et al.*, 1972, USDOI/MMS, 1996). These turtles have been sighted as far north as Alaska and British Columbia (Mager, 1984; Smith and Houck, 1983).

Leatherback sea turtles are the most common sea turtle off the coast of California (Dohl *et al.*, 1983a; Green *et al.*, 1989). During a three-year survey, leatherback sea turtles were occasionally sighted off the coast of central California (Dohl *et al.*, 1983a). The majority of their sightings occurred during the summer and fall seasons in deeper waters over the continental slope. Nine strandings of leatherback sea turtles were reported on Santa Barbara County beaches between 1982 and 1995 (NOAA, 1997).

Leatherback sea turtles are omnivores and but feed principally on soft prey items as jellyfish and tunicates (Mager, 1984).

Loggerhead Sea Turtles (Caretta caretta)
Loggerhead turtles primarily occur in subtropical to temperate waters and are generally found over the continental shelf (Mager, 1984; USDOI/MMS. 1996). Southern California is considered to be the northern limit of loggerhead sea turtle distribution (Stebbins, 1966). However, loggerheads have stranded on beaches as far north as Washington and Oregon (Green *et al.*, 1991). Loggerhead sea turtles are omnivorous and feed on wide variety marine life including shellfish, jellyfish, squid, sea urchins, fish, and algae (Carr, 1952; Mager, 1984). Three loggerhead stranding was reported on Santa Barbara County beaches between 1982 and 1995 (NOAA, 1997).

E. Seabirds

The seabird fauna of central California is large and diverse. Species found off the Point Conception area are far ranging species and come from all corners of the Pacific Ocean, Bering Sea, Arctic Ocean, inland North America, and the North Atlantic. Jones *et al.* (1981) reported 102 species of seabirds in central California. In a three-year survey for seabirds off of central and northern California, Dohl *et al.* (1983b) and Briggs *et al.* (1987) have reported from thirty to thirty-five common or dominant species and thirty-four uncommon or rare species. Dohl *et al.* (1983b) also reported that the seabird fauna of central California is dominated by cool-water species (e.g., boreal North Pacific) but also includes subtropical species during the late summer and autumn. According to Dohl (1983b), the numbers of seabirds present in central California is similar to that found in Oregon, the Gulf of Alaska, and Bering Sea and is higher than those published for southern California. Generally, of all California offshore regions, seabird density is highest off the central coast. At times of maximal abundance (fall and winter), the population is estimated to reach 4 to 6 million seabirds (Briggs *et al.*, 1987).

Seabirds occur year-round in the project area and the species present vary according to the season (Briggs *et al.*, 1981). Dohl *et al.* (1983b) reported the highest density of seabirds during the summer and autumn is due to the presence of migrants, winter visitors, and nesting residents at the same time. The lowest density of seabirds occurred during the winter. The dominant species in the area, by season, are provided in Table 4.4 (Dohl *et al.*, 1983b).

Table 4.4 Seasonal Distribution of Coastal Seabirds in the Project Area (Dohl et al., 1983b)

Winter	Spring	Summer	Autumn
Arctic Loon	Arctic Loon	Sooty Shearwater	Arctic Loon
Cassins's Auklet	Sooty Shearwater	Phalaropes	Sooty Shearwater
Common Murre	Phalaropes	Brown Pelican	Phalaropes
Western Gull	Bonaparte's Gull	Brandt's Cormorant	Cassin's Auklet
Western Grebe	Western Grebe	Western Gull	Common Murre
Brandt's Cormorant	Brandt's Cormorant	Heerman's Gull	California Gull
Pelagic Cormorant	Surf Scoter		Western Gull
Surf Scoter	Western Gull		Western Grebe
California Gull	Common Murre		Brown Pelican
			Brandt's Cormorant
			Heerman's Gull
			Bonaparte's Gull

Briggs *et al.* (1981, 1987) reported over 93 seabird species off the coast of California. Coastal upwelling, the upwelling frontal zone, and the stratified waters of the California Current constitute the three main open water habitats off California and each support different species assemblages (Briggs *et al.*, 1987). Gulls, terns, and storm petrels were reported over large distances in the California Current, whereas murres, auklets, and phalaropes tended to aggregate in coastal upwelling areas. One of the areas having a high concentration of seabirds included the Point Conception area. Common nearshore species he reported were the California gull, herring gull, western gull, Bonaparte's gull, Brandt's cormorant, surf scoter, western grebe, and northern phalarope.

According to Souls *et al.* (1980), 17 seabird species nest on the central and northern California coastline. The most numerous of the nesting residents are the murre, Cassin's Auklet, Brandt's Cormorant, and the Western Gull. The largest nesting sites are located in northern California with the Farallon Islands being the most important location. In central California, Souls *et al.* (1980) estimated that about 7 percent of the seabird population breed between Ventura and Monterey counties; but that the majority occurs on the Channel Islands. The important nesting sites in the project area identified by Carter *et al.* (1992) include San Miguel Island, Santa Barbara Island, Anacapa Island, and San Nicolas Island. About 15% of the total seabird breeding population of California is estimated to occur on these islands (Carter *et al.*, 1992). Seabird species that nest on San Miguel, Santa Barbara, Santa Cruz, and Anacapa Islands are listed in Table 4.5. In the area from Morro Bay south to Point Conception, Chambers Consultants and Planners (1980) reported that very few seabirds breed in coastal mainland habitats due to human disturbances.

Table 4.5 Seabird Species that Nest on San Miguel, Santa Barbara, Santa Cruz, and Anacapa Islands (Carter et al., 1992; Baird, 1993).

San Miguel Island	Santa Barbara Island	Santa Cruz Island	Anacapa Island
Ashy Storm Petrel	Ashy Storm Petrel	Brandt's Cormorant	Western Gull
Brandt's Cormorant	Black Storm Petrel	Western Gull	Brown Pelican
Cassin's Auklet	Brown Pelican	Cassin's Auklet	Double Crested Cormorant
Rhinoceros Auklet[1]	Western Gull	Ashy Storm Petrel	Pelagic Cormorant
Tufted Puffin[1]	Xantus' Murrelet	Brown Pelican	
Common Murre[1]	Brandt's Cormorant	Pelagic Cormorant	
Double Crested Cormorant	Double Crested Cormorant	Double Crested Cormorant	
Pelagic Cormorant	Pelagic Cormorant		
Least Storm Petrel	Cassin's Auklet		
Leach's Storm Petrel			

[1] Southern range limit

Endangered or Threatened Seabirds

The California brown pelican (*Pelecanus occidentalis californicus*) is a federally and state listed endangered species and ranges from British Columbia to southwest Mexico. In the US, the California brown pelican nests only on Anacapa and Santa Barbara Islands off the southern California coast.

The listing of California brown pelican was based primarily on serious declines in the southern California population due to bioaccumulation of chlorinated hydrocarbon pesticides (DDT, DDE, dieldrin, and endrin) in the pelican's food chain (USDOI/MMS, 1996). Bioaccumulation of these pesticides resulted in serious eggshell thinning and poor reproductive success (Schreiber and Risebrough, 1972). Food scarcity, primarily anchovies, also contributed to the species' decline (Keith *et al.*, 1971).

The breeding season for California brown pelicans extends from March through early August. Preferred nesting habitat is on offshore islands. In 1991, about 12,000 breeding birds were reported at two colonies on Anacapa and Santa Barbara Islands (Carter *et al*., 1992). The California brown pelicans occur in coastal areas as far north as British Columbia and as far south as southwestern Mexico. Offshore rocks and coastal habitats as rocky shores, sandy beaches, piers, provide important roost sites in the project area. They feed by plunge diving from heights of up to 15 to 20 m above the ocean surface and feed primarily on small schooling fish (e.g., anchovies) (USDOI, FWS, 1982). Pelicans return to specific roosts each day and do not normally remain at sea overnight. These roosts are usually in regions of high oceanic productivity and isolated from predation pressure and human disturbances.

The California least tern (*Sterna antillarum*) is a federally listed endangered species. The California least tern occurs along coastal beaches and ranges from San Francisco Bay to Baja California. This species is usually present in the project area from May to September. It typically feeds along the coast by skimming the sea surface as it flies or by diving for small fish. The California least tern nests in coastal foredune habitats and has historically been reported in northern Santa Barbara County and in the Point Arguello region (VAFB). The most recent nesting in the Guadalupe dunes in northern Santa Barbara County was 1994.

The western snowy plover (*Charadrius alexandrinus nivosus*) is a federally listed threatened species. Although not a seabird, the western snowy plover occurs primarily on coastal beaches from southern Washington to southern Baja California. Based on recent surveys, 28 snowy plover breeding sites occur on the Pacific Coast of the US. Twenty of the sites occur in coastal California (USDOI, FWS, 2000). It is estimated that eight of the sites support 78 percent of the California breeding population. The sites include the San Francisco Bay, Monterey Bay, Morro Bay, the Callendar-Mussel Rock Dunes area, Point Sal to Point Conception area, the Oxnard lowland, Santa Rosa Island, and San Nicolas Island (USDOI, FWS, 2000).

Western snowy plovers can occur year-round in coastal California. However, the majority winter south of Bodega Bay, CA. The overall population of the western snowy plover in California has declined in recent years. It is estimated that between 1981 and 1989, the breeding population has declined at least 11 percent.

The onshore area adjacent to the project area between Point Sal and Point Conception is one of the important western snowy plover breeding sites in California. Approximately 200 of these shorebirds are estimated to nest and winter in this area (USDOI, FWS, 1997). Since 1997, a management plan was implemented on Vandenberg Air Force Base beaches to protect this species and their habitat.

F. Benthic Invertebrates

The benthos consists of organisms that live in or on the ocean floor. Benthic habitats are often classified according to substrate type, either unconsolidated sediments (e.g., gravel, sand, or mud) or rock. The former category is often referred to as soft bottom and the latter hard bottom or rocky substrate. Each support their own characteristic biological community. In addition to substrate type, water depth and water temperature play important roles in the distribution of benthic organisms. Distance from shore, food availability, and water quality are also important factors which influence the distribution of benthic organisms. Benthic organisms can be epifaunal (attached or motile species that inhabit rock or sediment surfaces) or infaunal (live in rock or soft sediments) (Thompson *et al.*, 1993). Generally, more is known about intertidal and shallow subtidal benthic species (<30 m) than those of deeper areas (>30 m).

Intertidal and Shallow Subtidal – Soft Substrate

Sandy beaches occur along shoreline segments of the project area. Because of the inherent difficulties in conducting ecological studies in sand, far less is known about invertebrate communities that live there than those found on rocky substrates. Sand dwelling organisms are very motile, difficult to mark, and cannot be easily monitored over time. Immigration and emigration rates are high and often contributes to the high level of temporal and spatial patchiness in density that is often reported (Thompson *et al.*, 1993). Studies are also difficult to conduct in unstable sediments in a high-energy environment.

Although not obvious, vertical zonation of invertebrates occurs on sandy beaches. The invertebrates that live in sand (infauna) are quite motile and change position with respect to tidal level. Also, certain species will be found higher or lower than others. Common invertebrates in the upper intertidal are several species of amphipods in the genus *Orchestoidea*; the predatory isopod, *Excirolana chiltoni*; and several species of polychaetes (e.g., *Excirolana chiltoni*, *Euzonus mucronata*, and *Hemipodus borealis*). The middle intertidal is characterized by species such as the sand crab, *Emerita analoga* and the polychaete *Nephtys californiensis*. *Emerita* is generally the most abundant of the common middle intertidal organisms often comprising over 99 percent of the individuals on a given beach (Straughan, 1983).

In the low intertidal, polychaetes and nemerteans dominate (Straughan, 1982). Also, the large sand crab, *Blepharipoda occidentalis*, and the Pismo clam, *Tivela stultorum* can be found. *Tivela,* however, was once more abundant in the intertidal. Its present reduction in population is probably the result of overharvesting and predation.

In shallow water <10 m, epifaunal (organisms which live on the sediment or rock surfaces) communities are generally well developed (Thompson *et al.*, 1993). With increasing depth, the density of epifaunal species decline while that of infauna increases probably because of the greater stability of sediments (Barnard, 1963). Also, with depth, polychaetes become more dominant over crustaceans (Oliver *et al.*, 1980). Physical changes to nearshore subtidal habitats are associated with increasing depth. One of the most important is a decrease in wave surge and as a result, finer sediments which influences the distribution of epifaunal species in nearshore environments (Thompson *et al.*, 1993). Merrill and Hobson (1970), have shown that shoreward limit of the sand dollars (*Dendraster excentricus*) occurs near the break line with the inner most population consisting of small juveniles. Seaward, they found that sand dollars become progressively larger and more abundant.

The effects of wave action on benthic infauna are not well known. However, several studies indicate the declines in the abundance of tube-building polychaetes in shallow water (< 10 m) to increasing substrate disturbance (Oliver *et al.*, 1980; Davis and VanBlaricom, 1978).

The composition of invertebrate assemblages on a sandy beach correlate to slope and sand texture. Within a beach, crustaceans and molluscs tend to be more common on steeper, coarser, and dryer upper intertidal zone. Polychaetes and nemerteans are the dominant invertebrates in the lower intertidal where slope is not as steep and the sand usually finer and wetter (Wenner, 1988; McLachlan and Hesp, 1984; Straughan, 1982).

Straughan (1982) conducted comprehensive intertidal surveys in central and southern California over a 12-year period. At a sampling site in northern Santa Barbara County, annelids and crustaceans dominated along a transect extending from the supratidal to intertidal areas. Common species she reported are listed in Table 4.6.

Table 4.6 List of Intertidal Species Collected at a Northern Santa Barbara Location (from Straughan, 1982)

Annelida	*Annelida (con't)*	Insecta/Arachnida
Cerebratulus californiensis	*Scoloplos armiger*	Anthomyiidae
Dispio uncinata	*S. acmeceps*	Calliphoridae larvae
Eteone dilatae	*Zygeupolia rubens*	Cyclorrhapha larvae
Euzonus dillonensis		Ephydridae larvae
E. mucronata	Crustacea	Sarcophagidae pupae
Hemipodus californiensis	*Archaeomysis grebnitzki*	
Lumbrineris zonata	*A. maculata*	Mollusca
Lumbrineridae	*Emerita analoga*	*Collisella strigatella*
Nemertea sp.	*Eohaustorius sawyeri*	*Siliqua patula*
Nephtys californiensis	*E. washingtonianus*	
Nephtys sp.	*Excirolana chiltoni*	
Opheliidae	*Lepidopa californica*	
Orbinia johnsoni	*Orchestoidea benedicti*	
Orbiniidae	*O. columbiana*	
Paranemertes californica	*O. corniculata*	
Pygospio californica	*Synchelidium sp.*	

At offshore monitoring stations located at 18 m water depth in central California, approximately 97 benthic infaunal species were found (ABC, 1995). Rank order and the relative abundance of these species which are commonly found in central California are listed in Table 4.7. Annelid worms were the most abundant group found at the stations.

Epifaunal species collected at these stations include the echinoderms, *Amphiodia occidentalis* and *Dendraster excentricus*; the arthropod, *Heterocrypta occidentalis*; and the molluscs, *Nassarius fossata*, *N. perpinguis*, *Olivella baetica*, and *Polinices lewisii* (ABC, 1995).

Intertidal and Shallow Subtidal – Rocky Substrate

California rocky intertidal areas are characterized by diverse assemblages of algae, invertebrates, and fish (Ricketts *et al.*, 1985; Foster *et al.* 1991). The majority of intertidal species are restricted to certain elevations along the shoreline. While the vertical distribution of intertidal species are largely determined by the ability to withstand desiccation, other important factors that determine vertical zonation are competition, predation, and available microhabitats. On wave-exposed shores, wave run-up and splash enable species to survive at higher elevations than those normally found in protected, non-splash areas.

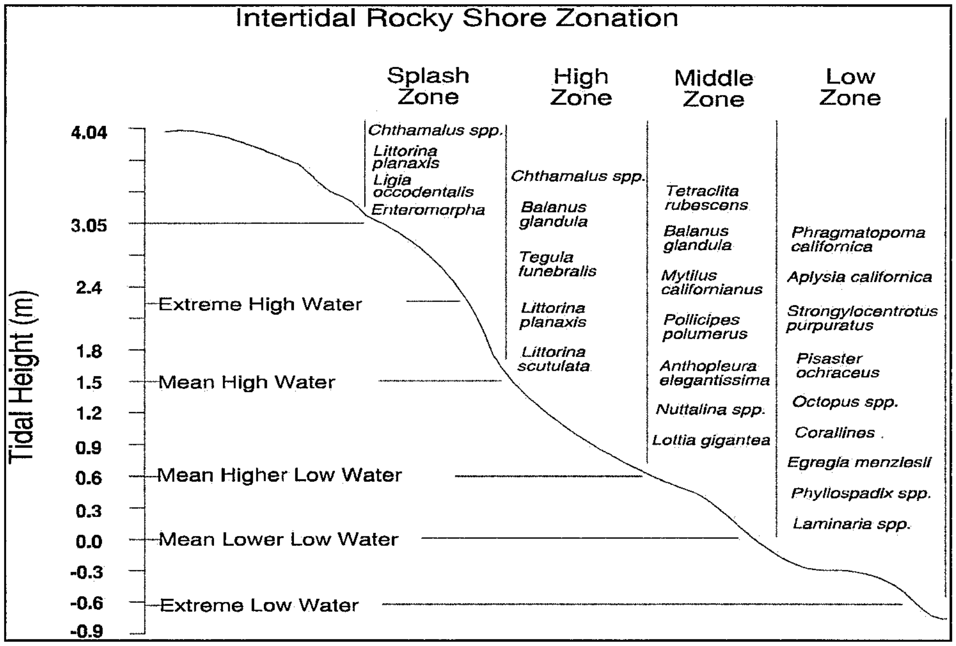
Table 4.7 **Dominant Infauna Species Reported From Five Monitoring Stations Located in Central California (N = Nemertea, A = Annelida, M = Mollusca, Ar = Arthropoda) (ABC, 1995)**

Species	Total	Percent of Total
Carinoma mutabilis (N)	407	13.9
Lumbrineris tetraura (A)	377	12.9
Tellina modesta (M)	372	12.7
Magelona sacculata (A)	292	10.0
Prionospio pygmaea (A)	281	9.6
Glycera capitata (A)	144	4.9
Glycinde picta (A)	109	3.7
Nephtys caecoides (A)	74	2.5
Odostomia sp. (M)	74	2.5
Leitoscoloplos pugettensis (A)	57	1.9
Chaetozone setosa (A)	55	1.8
Chione undatella (M)	51	1.7
Typosyllis fastigiata (A)	46	1.5
Nemertea sp. (N)	32	1.0
Macoma secta (M)	30	1.0
Mediomastus californiensis (A)	30	1.0
Spiophanes bombyx (A)	30	1.0
Chone magna (A)	27	1.0
Onuphis vexillaria (A)	22	1.0
Photis macinerreyi (Ar)	21	1.0
Thalenessa spinosa (A)	21	1.0

The diversity of algae and invertebrate species tends to increase from high to low elevations. Generally, because the high intertidal is only occasionally wet, it is sparsely covered by species such as the blue-green algae, *Bangia* sp. and *Enteromorpha* sp. In these areas, *Littorina* sp. (periwinkle snail) can be found in rock crevices and *Tegula funebralis* (turban snail) and *Pachygrapsus* (shore crab) can be found in the shade or crevices. The rock lice, *Ligia occidentalis* can also be found in the splash zone. In the intertidal, algal cover is more conspicuous with clumps of *Fucus* and *Pelvetia* (rockweeds) and *Endocladia* (red algae). The intertidal can also be inhabited by a variety of limpets, *Chthamalus* sp. (acorn barnacle), *Mytilus californianus* (mussels), *Pisaster ocraceus* (starfish), and various encrusting algae. In the lower intertidal, species such as *Mazzaella flaccida* and *Mastocarpus papillatus* are present. Beneath the blades of upright algae, rock-encrusting algae, *Pagurus* (hermit crab), *Haliotus cracherodii* (black abalone), other snails, motile and tube-forming worms, encrusting bryozoans, sponges, tunicates, and *Strongylocentrus* sp. (urchins) can be very abundant. In the low intertidal, fish species such as *Xiphister* sp. (prickleback) can be found under cobbles, in pockets of water, and under dense algal cover. In the lower intertidal, red algae increase and species such as *M. flaccida*, *M. papillatus*, *Gastroclonium subarticulatum* and *Chondracanthus canaliculatus* are common. *Phyllospadix* sp. (surfgrass) can fringe the shoreline at the lower boundary of the intertidal zone.

The vertical zonation of typical rocky intertidal organisms along the California coast is shown in Figure 4-3.

Figure 4-3 Intertidal Zonation of a Rocky Shore in Southern California (modified from Dailey et al., 1993)



Deep-Benthic Assemblages – Soft Bottom

In a comprehensive three-year benthic infauna study slightly north, offshore Point Conception (California Monitoring Program Phase II), Hyland *et al.* (1991) reported over 886 species representing 15 phyla. The 10 most abundant species reported by Hyland *et al.* (1991) for a transect located just north of the Point Arguello platforms is provided in Table 4.8.

Table 4.8 Ten Most Abundant Infauna Species, by Water Depth, off the Coast of Point Arguello (A = Amphipoda, C = Cumacea, O = Oligochaeta, Op = Ophiuroidea, P = Polychaeta, S = Scaphopoda, T = Tanaidacea (Hyland et al., 1991)

Station R-4 (90 m)	**Station R-5 (180 m)**	**Station R-6 (410 m)**
Photis lacia (A)	*Mediomastus ambiseta* (P)	*Chloeia pinnata* (P)
Mediomastus ambiseta (P)	*Chloeia pinnata* (P)	*Nephtys cornuta* (P)
Myriochele sp. M (P)	*Tharyx* spp. (P)	*Tectidrilus diversus* (O)
Chloeia pinnata (P)	*Photis californica* (A)	*Chaetozone* nr. *setosa* (P)
Photis spp. (A)	*Minuspio lighti* (P)	*Huxleyia munita* (P)
Photis californica (A)	*Spiophanes berkeleyorum* (P)	*Cossura rostrata* (P)
Typhlotanais sp. A (T)	*Photis lacia* (A)	*Maldane sarsi* (P)
Sphiophanes missionensis (P)	*Prochelator* sp. A (I)	*Minuspio sp.* A (A)
Praxillella pacifica (P)	*Spiophanes missionensis* (P)	*Cossura candida* (P)
Minuspio lighti (P)	*Levinsenia gracilis* (P)	*Cossura pygodactyla* (P)
All Fauna (419 species)	All Fauna (358 species)	All fauna (215 species)

Crustaceans (34 percent) and polychaetes (31 percent) were the most dominant taxa followed by gastropods (10 percent) and bivalves (8 percent). Together these four classes accounted for 83 percent of all taxa. Hyland *et al.* (1991) revealed patterns of decreasing infaunal abundances and diversity with increased water depth. Similar patterns have also been reported by Fauchald and Jones (1978) and SAIC (1986) in the CAMP Phase I reconnaissance study.

The project area in the Santa Maria Basin, is located at the boundary separating the Oregonian and Californian Provinces. Therefore, the composition of the infauna found in the CAMP Phase II Monitoring Program show affinities with each province (Hyland *et al.*, 1990). The majority of species (67 percent) occurring in the project area have northern faunal affinities (Oregonian Province), 27 percent with primarily southern affinities (Californian Province), while 31 percent are endemic to the region (Hyland *et al.*, 1990).

Deep-Benthic Assemblages – Hard Substrate

Hard-bottom habitats in the project area near Platforms Hidalgo, Harvest, and Hermosa are rare. Generally, they are discontinuous patches of exposed rock separated by soft bottom composed of mud and fine sands (BBA/ROS, 1986; Steinhauer and Imamura, 1990; SAIC and MEC, 1995). Several qualitative surveys of hard-bottom communities in this region of the Santa Maria Basin have been conducted over the years (e.g., Nekton, 1981; Dames and Moore, 1982; 1983; Nekton and Kinnetic Laboratories, 1983; and SAIC, 1986). However, during the comprehensive MMS sponsored California Offshore Monitoring Program (CAMP), Phases II and III, nine rocky reefs were quantitatively surveyed for 10 years from 1986 to 1995. The goal of the hard-bottom studies was to determine the cumulative effects of offshore drilling and production activities on the hard-substrate communities. Impacts to hard-bottom communities, especially epifauna, were of particular interest, because of the greater sensitivity of many of these species to increased particulate flux, the importance of their trophic role, and the general rarity of these communities in the area.

From CAMP Phase II, Hardin *et al.* (1994) reported 263 taxa from low-relief (<0.5 m) and 222 taxa from high-relief (>1.0 m) structures. The ten most dominant species (mean percent cover), is provided in Table 4.9.

No one taxon dominates in percent cover on the hard-substrate in the project area. However, most of the cover that was found consists of a turf composed of komokoiacea foraminerferans and hydroids. The turf varies in percent cover depending on structure but generally, it occupies most of the rock surfaces that were absent megafauna. The 15 most abundant taxa in low-relief habitats totalled about 19.3 percent cover, and the 15 most abundant taxa in high-relief habitat total about 26.6 percent cover (Hardin *et al.*, 1994). Despite the lack of dominance by any one taxa, of the 22 taxa comprising the 15 most abundant species, 10 were anthozoans. Anthozoans were followed by poriferans, ophiuroids, polychaetes, and urochordates.

Table 4.9 The Ten Most Abundant Hard-Bottom Taxa in Low Relief (0.2-0.5 m) and High Relief (>1.0 m) Habitats Near Platform Hidalgo (adapted from Hardin et al., 1994)

Taxa	Taxon Group	Mean Percent Cover
Low Relief		
Ophiuroidea, unidentified	Ophiuroidea	5.8
Florometra serratissima	Crinoidea	2.7
Paracyathus stearnsii	Anthozoa	1.5
Metridium giganteum	Anthozoa	1.2
Sabellidae, unidentified	Polychaeta	1.1
Ophiacantha diplasia	Ophiuroidea	1.1
Caryophyllia sp.	Anthozoa	1.0
Pyura haustor	Urochordata	0.8
Terebellidae, unidentified	Polychaeta	0.8
Sponge, white encrusting	Porifera	0.7
High Relief		
Amphianthus californicus	Anthozoa	4.6
Ophiuroidea, unidentified	Ophiuroidea	3.5
Sabellidae, unidentified	Polychaeta	2.4
Desmophyllum cristagalli	Anthozoa	2.1
Galatheidae, unidentified	Decapoda	1.7
Metridium giganteum	Anthozoa	1.7
Lophelia californica	Anthozoa	1,6
Sponge, white encrusting	Porifera	1.5
Stomphia didemon	Anthozoa	1.6
Florometra serratissima	Crinoidea	1.3

Two surveys of hard-bottom habitats in the northern Santa Maria Basin off the coast of the Point San Luis - Montana de Oro area were conducted in 1999. The goal of the surveys was to characterize hard-bottom communities in submarine cable corridors proposed for installation in 2000. The more extensive of the two surveys was conducted by MRS for five proposed MCI/Worldcom cables. Twenty-two transects were photo-surveyed at water depths ranging from 35 to 125 m. Relief height ranged from 0.5 m to 35+ m. While the epibiota residing on these structures have no direct bearing to this proposed project, they may influence decisions regarding lease tracts located further north in the Santa Maria Basin.

Generally, the species in the survey area bear similarities to those found near Platform Hidalgo on the CAMP Phase II. However, there are substantial differences in dominant species and epifaunal percent cover. While anthozoans were the most common taxa as found in CAMP Phase II, percent cover of species such as *Stylantheca porphyra* (purple encrusting hydrocorals), *Balanophyllia elegans* (orange cup coral), *Paracyathus stearnsii* (brown cup coral), *Corynactis california* (club-tipped anemone), *Epizoanthus* sp. (zoanthid anemones) typically reach 100 percent. At higher relief locations, these species (especially *Corynactis*) form solid carpets that extend for hundreds of meters. *Stylaster californicus* (formerly *Allopora californica*) or California hydrocoral, which was responsible for tracts deletions offered for lease in previous OCS Sales, commonly occur at water depths <45 m. Although not intended, the photographs taken during this survey has initiated preliminary discussions among some agencies to extend the boundary of the Monterey Bay Marine Sanctuary southward to include some of the sites surveyed. The status of these discussions is currently unknown.

4.1.3 Project Impacts and Mitigation Measures

The sections below present the incremental marine resource impacts and mitigation measures associated with the Rocky Point Unit development.

4.1.3.1 Project Impacts

Impacts described in the Development Plan EIR/EIS for the Point Arguello Field and Gaviota Process Facility were evaluated with respect to their applicability to the proposed Rocky Point Unit project. The category of impacts described in the Point Arguello DP EIR/EIS and those anticipated from Rocky Point are compared in Table 4.10. Activities that are proposed for Rocky Point have essentially been analyzed in the Point Arguello Field DP. Issue areas identified by MMS in recent correspondence or updates to impacts are identified in Table 4.10 as Impact Numbers 1 – 4 and are discussed below.

Table 4.10 Comparison of Impacts Contained in the Arguello Project DP EIR/S and Additional Impacts Potentially Caused by the Proposed Rocky Point Project

Impact/Issue	Addressed in Arguello Project DP EIR/S	Additional Impact Caused by Rocky Point
Impacts to marine biological communities resulting from construction activities (pipeline installation, processing facility, trenching, and platform installation)	Yes	No construction activities proposed for Rocky Point.
Impacts to biological communities resulting from discharge of drilling mud and drill cuttings	Yes	No additional impacts caused by drilling mud or drill cuttings discharges are anticipated. Additional information pertaining to drilling mud and drill cuttings discharges in hard-bottom areas and implication of these discharges to the Monterey Bay National Marine Sanctuary is provided as Impact No. 1.
Impacts to biological communities resulting from oil spills	Yes	Projected spill volumes do not increase as a result of the project. Updated information provided for potential impacts to marine organisms and sea otters as Impact No. 2.
Impacts to biological communities caused by noise	Yes	Geophysical surveys are not proposed for Rocky Point Project. Impacts caused by noise from supply vessels are included in the Point Arguello Project DP EIR/S. Updated information is provided as Impact No. 3.

Impact/Issue	Addressed in Arguello Project DP EIR/S	Additional Impact Caused by Rocky Point
Impacts to marine biological caused by produced water discharges	Yes	No additional impacts caused by produced water discharges are anticipated. The volume proposed for discharge is below estimates provided in the Pt. Arguello Project DP EIR/S. Additional information provided as Impact No. 4.

Impact No. 1. Impact of drilling mud and drill cutting discharges on hard-bottom communities and implication of discharges to the Monterey Bay National Marine Sanctuary.

Between 1986 and 1989 39 development wells were drilled from the platforms residing on the Point Arguello Field (Table 4.11). The effects of drilling mud and drill cuttings discharged as a result of these wells on neighboring hard-bottom epifauna were studied in detail during the comprehensive California Monitoring Program (CAMP) Phases II and III, which lasted from 1986 to 1995. The final conclusion provided in the Phase III report was that platform discharges have not caused changes to nearby hard-bottom communities (Diener and Lissner, 1995). Equal numbers of positive and negative effects were indicated for dominant taxa, and there was no consistent pattern of response for a single taxon over the three habitat types (deep high and low relief, and shallow low relief). Statistical tests concluded that the cumulative distribution of responses could have been due to chance alone (Diener and Lissner, 1995). Based on the results of CAMP Phases II and III, adverse impacts to hard-bottom epibiota as a result of drilling mud and drill cuttings discharges from the proposed Rocky Point Project are not expected to occur even though the total quantities to be discharged are greater. It should be noted that if synthetic or oil based drilling fluids are used, the total quantity of drilling fluids and cutting discharged to the ocean will be considerably less.

Table 4.11 Volume of Drilling Fluid and Drill Cuttings Discharged from Platforms Harvest, Hermosa, and Hidalgo from 1986 to 1989 and from the Proposed Rocky Point Project for Water Based Drilling Fluids Only

Platform	Historical [1]			Proposed Rocky Point [2]		
	No. Wells	Drilling Fluid (bbl)	Cuttings (bbl)	No. Wells	Drilling Fluid (bbl)	Cuttings (bbl)
Harvest	19	102,780	NA	7	87,883	30,515
Hermosa	13	102,990	19,590	7	81,776	28,712
Hidalgo	7	50,090	14,430	6	74,722	26,448
Total	39	255,860	34,020	20	244,381	85,675

[1] From: Steinhauer, Imamura, Barminski, Neff; Oil and Gas Journal, May 4, 1992.
[2] Based upon data provided in Table 2.2 of this Environmental Evaluation.

Discharges from the Point Arguello platforms for the proposed Rocky Point Project will occur in accordance with the current National Pollutant Discharge Elimination System (NPDES) General

Permit for Offshore Oil and Gas Exploration, Development, and Production Operations for Southern California.

The cumulative depositional patterns and transport of drilling fluid discharged from Platforms Harvest, Hermosa, and Hidalgo were also examined during CAMP Phase II. The deposition of drilling fluid releases was computed for four time periods as described in Coats (1994). The first time span encompassed two years of nearly continuous drilling from February 1987 through January 1989. Throughout this time, at least one of the three platforms was actively drilling. The trajectory computations included calculations of plume dynamics, current transport, wave-current resuspension, and utilized the drilling fluid discharge volumes reported on daily log sheets by each platform's mud engineer.

Because drilling-fluid discharge volumes and energetic short-term currents exhibit substantial daily variability, stochastic trajectories for individual plumes over several months were examined to provide depositional patterns (e.g., Figure 4-4). The calculations were supported by depositional patterns that were measured in sediment traps that were deployed throughout the CAMP study area.

The trajectory computations revealed a general transport of drilling fluid plumes toward the northwest; hence, high particulate flux was observed at Platform Hidalgo. Prevailing currents alone transport the majority of drilling fluid to the northwest of Platform Hidalgo as supported by sediment-trap observations (Coats, 1994).

The cumulative patterns reported in Coats (1994) cannot be used to provide absolute measures of drilling-fluid transport distances. However, it provides a statistical measure of the depositional pattern of drilling-fluid discharges. Transport of drilling-fluid plumes to distances of 6.8 km for the discharges from the three Point Arguello Field platforms was reported by Coats (1994). Based on these calculations, drilling-fluid discharges are not likely to impinge upon Monterey Bay National Marine Sanctuary waters.

Impact No. 2. Oil spill impacts to sea otters and the marine environment.

Oil spill trajectories and probabilities for shoreline impact along various locations north and east of Point Conception, and the Channel Islands were analyzed in the Point Arguello Project DP EIR/EIS. Updated probabilities from OSRA are provided in an earlier section of this document.

An oil spill could occur as a result of a well blowout, pipeline rupture, or from other accidental events. The significance of any impacts from the spill will be a function of the type and quantity of oil spilled, trajectory and location of oil landfall, and the effectiveness of response measures.

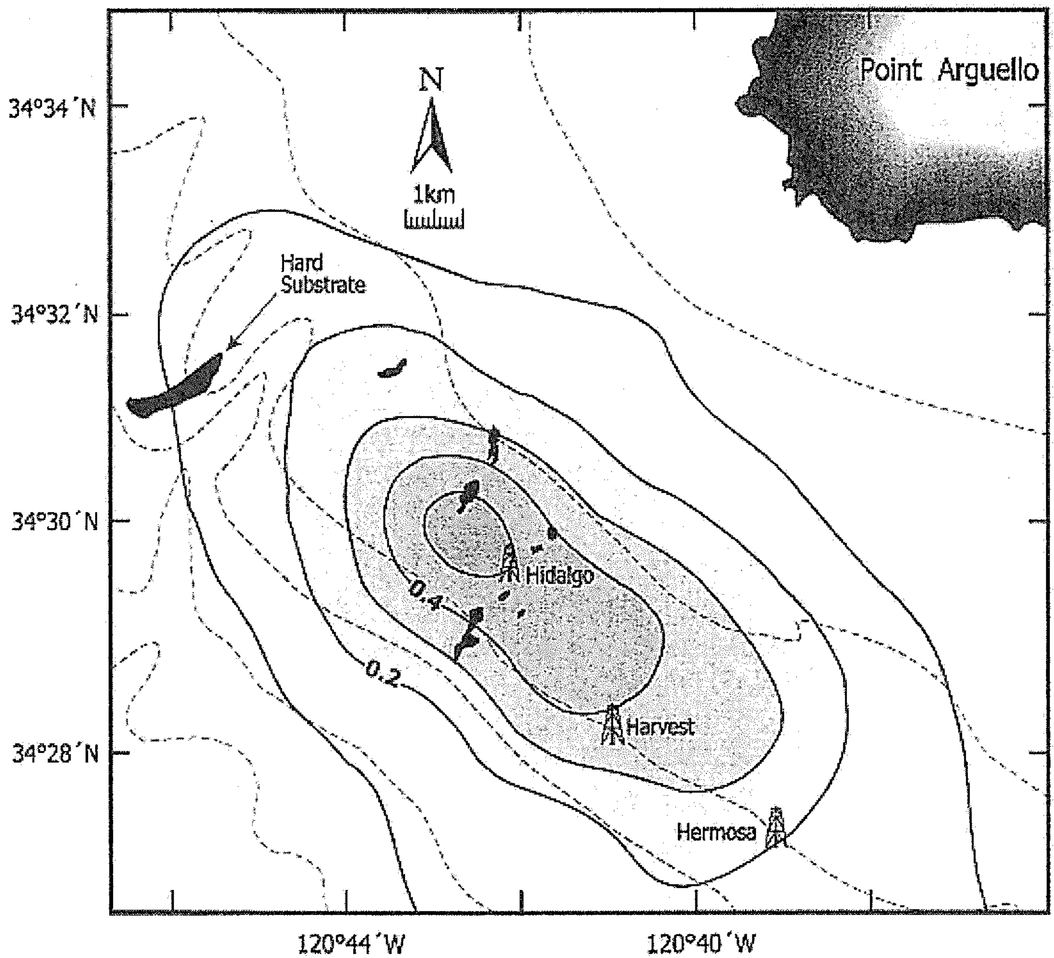


Figure 4-4 Depositional pattern (g m^{-2} day^{-1}) of the discharges from three production platforms for the two-year drilling period (2/87-1/89)

The natural degradation processes that are responsible for removal of oil from the marine environment after a spill are spreading, drift, evaporation, dissolution, dispersion, emulsification, sedimentation, biodegradation, and photooxidation (Wheeler, 1978). These degradation processes, also called weathering, contribute to decreases in oil-spill volume and increases in viscosity and specific gravity of the oil and influence the significance and duration of impacts from a spill.

Oil may induce sublethal or lethal effects in marine organisms through exposure and accumulation of toxic oil components or through coating and smothering. Fatalities or risk from exposure to toxic oil components is higher during the early stages of a spill and decrease in time due to the degradation process that occurs in the marine environment. Fatalities due to coating and smothering are a primary concern from oil impacting intertidal areas or where birds and marine mammals are present.

Toxic components of crude oil generally occur in the low molecular weight aromatic compounds. These compounds make up about 20 to 50 percent of crude oils. They tend to be soluble in seawater but due to their high volatility, the majority can be lost to evaporation within 24 to 48 hours (Jordan and Payne, 1980). Oil that is not removed by evaporation or dissolution undergoes further physical, chemical, and biological change. Oil that is not physically removed will remain for extended periods of time and eventually form tar balls which may float or sink, or wash ashore. Oil in such asphaltic form may remain in the environment for many years but will gradually be removed by weathering processes.

Based on wind and current conditions that can cause spilled oil to reach shore, releases from the Point Arguello Field project area were computed by the OSRA model. Trajectory results indicate shoreline contact from the Point Sal region in the north to the Point Arguello/Point Conception area to the south. Shoreline contact is also indicated for San Miguel, Santa Rosa, and Santa Cruz Islands to the south. Drifter data obtained from an ongoing study in the Santa Maria Basin area indicate that under certain conditions and times of the year, spilled oil may impact shorelines north of the Point Arguello area. Impacts from oil spills are described in detail in the Point Arguello Project DP EIR/EIS. A summary utilizing updated information follows.

Studies have shown that spilled oil can have measurable effects upon marine phytoplankton and zooplankton communities. Effects noted in phytoplankton include reduced growth and reduced photosynthesis and impacts upon zooplankton include mortality and a variety of sublethal effects such as lowered feeding and reproductive rates and altered metabolism (Spies, 1985). Early life stages of zooplankton (e.g., eggs, embryos, and larvae) are considered to be more vulnerable to oil spills than adults because of their higher sensitivity to toxicants and prolonged exposure to oil at the air-water interface. Lethal and sublethal effects on plankton depend upon the occurrence and persistence of high concentrations of oil in the water column. Effects are likely to be short-lived because of the limited residence time of oil in the open ocean environment.

Fish populations can be affected by oil spills due to ingestion of oil, uptake through gills or epithelia, effects on their embryonic or larval stages, or due to mortality of prey species (NRC, 1985). Both lethal and sublethal effects of oil have been studied in the laboratory. Typical responses to toxic hydrocarbon concentrations include a period of increased activity, followed by reduced activity, twitching, narcosis, and death (NRC, 1985). Among fishes, benthic species are apparently more sensitive than pelagic species, and intertidal species are the more tolerant (Rice *et al.*, 1979). Toxicity tests indicate that early life stages of fish (embryos and larvae) are more sensitive to oil than later life stages such as juveniles or adults (Fucik *et al.*, 1994).

Despite the apparent sensitivity of fish to oil, few effects have been observed following major oil spills. In a few instances, large fish kills have been associated with an oil spill. Examples include the *Florida* spill at West Falmouth, MA, and the *Amoco Cadiz* spill of the coast of Brittany. Sublethal responses were also documented. Following the *Florida* spill, killifishes from contaminated marshes had a lower rate of lipogenesis than those from uncontaminated marshes and following the *Amoco Cadiz* spill, a large number of histological abnormalities were noted in estuarine flatfish (*Pleuronectes platessa*) (Sabo and Stegeman, 1977; Haensly *et al.*, 1982). There was no indication of fish kills or other evidence of effects on fishes following the 1969 Santa Barbara Channel oil spill (Straughan, 1971).

Should oil contact coastal estuaries and lagoons inhabited by the endangered tidewater goby, high mortality can occur. Populations of tidewater gobies are restricted to shallow and enclosed marsh or lagoon systems where oil can become entrapped if contaminated by oil. Since tidewater gobies are also restricted to low-salinity water, little avoidance opportunities are available to this species. Cleanup of fragile marsh habitats may also cause catastrophic impacts to this species.

Marine mammals that could be affected by oil spills in the project area include cetaceans, pinnipeds, and sea otters. Marine mammals have varying sensitivities to oil contamination depending upon their mode of thermoregulation, activity patterns, and food items (Geraci and St. Aubin, 1990). Marine mammals unable to avoid contact with oil could suffer from fouling, inhalation, or ingestion. Indirect impacts of oil include contamination of food items or reduction of habitat. Detailed reviews of the effects of oil on marine mammals have been provided by Geraci and St. Aubin (1982, 1985, 1990), Englehardt (1983), and the NRC (1985).

The impacts to sea otters in the project area as described in the DP EIR/EIS do not change. However, because sea otter populations have steadily increased in numbers and have extended their range eastward, an oil spill could potentially impact a higher number of individuals in the Point Arguello and Point Conception regions.

Oil spill impacts to sea otters are well documented (Costa and Kooyman, 1982; Siniff, 1982; Davis *et al.*, 1988). After exposure to oil, death usually results from either an increase in metabolic rate or inhalation of volatile vapors (Geraci and Williams, 1990). An oil spill that occurs during the non-breeding season (November to May), will most likely kill more sea otters than an oil spill that occurs during the breeding season (June to November). During the non-breeding season, sea otters extend their range and have been reported as far east as Carpinteria. The range of this southernmost group, which consists mostly of young males, retracts to the center of the range north of Point Arguello during the breeding season from June to November (USGS, 1997, 1998, 1999). Nevertheless, sea otters in the Point Arguello and Point Conception region are highly vulnerable to oil spills. Transport of spilled oil north of the Point Arguello and Point Conception area can be expected to impact a higher number of sea otters where a larger number of animals reside. Of the 364 oiled otters that were processed at oiling centers following the *Exxon Valdez* oil spill, only 53 percent were rehabilitated (Geraci and Williams, 1990). Nearly 1,000 sea otter carcasses were recovered within a few months of the *Exxon Valdez* spill (Loughlin *et al.*, 1996). Total sea otter fatalities from this spill were estimated at 2,800 (Garrott *et al.*, 1993).

Although laboratory studies indicate that oil is highly toxic to pinnipeds resulting in death, large scale mortality has seldom been observed after an oil spill (St. Aubin, 1990). Investigators such as Davis and Anderson (1976) and LeBoeuf (1971) found no difference in the growth and mortality of oiled and unoiled seal pups following exposure to oil. Also, marine mammal deaths could not be linked to the Santa Barbara blowout (Brownell, 1971; Geraci and Smith, 1977). Geraci and Smith (1977) have reported that surface contact with oil has a much greater effect on seals than absorption of the petroleum. Following experiments in which seals were exposed to floating oil resulted in reversible eye damage. Brief periods of exposure in clean seawater eliminated indications of irritation or damage to sensitive eye tissue. However, following the *Exxon Valdez* oil spill, several investigators recorded deaths of harbor seals attributable to the spill (Loughlin *et al.*, 1996). Four different types of lesions characteristic of hydrocarbon toxicity were found in the brains of oiled seals.

Secondary impacts to seals could also result from response activities following a spill. DeLong (1975) found that seals disturbed on land retreated into the sea and did not return for several days. Such impacts could be significant during the breeding season (Davis and Anderson, 1976). Abandonment of seal hauling or rookery sites would be expected with the level of disturbance associated with oil spill cleanup activities in the Point Arguello and Point Conception area. Due to the proximity of several harbor seal haul-out or rookery sites in the area, an oil spill could have deleterious effect on harbor seals that could be present. Animals could be exposed to recently released oil and unweathered oil containing a high percentage of volatile and toxic components. Onshore cleanup would also be extremely disruptive resulting in very significant impacts.

For pinnipeds that are furred, experimental studies indicate that surface fouling will decrease the insulative value of the pelt, and possibly lead to thermal and energetic stress and eventual death (St. Aubin, 1990).

It is unlikely that spilled oil will substantially impact cetaceans. Some observations and studies suggest that cetaceans may detect and avoid surfacing in oil slicks or change their respiratory pattern and stay submerged when traveling through oil slicks (Geraci and St. Aubin, 1982). However, contact with oil can result in fouling of the baleen, toxicity from ingestion, respiratory difficulties, and irritation of the eyes, skin, and mucous membranes. Unless a cetacean was confined within an oil spill area, it would sustain only minor impacts from oil contact and would recover from these effects (USDOI, MMS, 1983). Oil does not tend to adhere to and foul cetacean skin as it does with the pelage of sea otters and seals. Studies indicate that the levels of oil fouling by skin contact and ingestion would not reach toxic levels and irritation would likely be temporary (Geraci and St. Aubin, 1982).

Oil spills pose a significant threat to marine and shore birds. The effects of oil on seabirds have been extensively reviewed (e.g., Bourne, 1976; Fry, 1987; Leighton, 1991; Burger and Fry, 1983). Because of the migratory nature of many bird species in the region, the significance of any impacts from a spill will depend on the time of year, species present, and the numbers of birds.

The immediate danger of oil on a bird is to clog or mat the fine structure of the feathers. The fine structure of the feathers is responsible for maintaining water repellency and heat insulation. Oiled birds are subject to hypothermia, loss of buoyancy, impaired ability to fly, and reduction in foraging ability. In addition to coating by oil, birds are also subject to chronic, long-term effects from oil that remains in the environment. Small amounts of oil on a bird's plumage that is transferred to the eggs during incubation have been shown to kill developing embryos (Albers, 1978; Szaro *et al.*, 1978). Birds can also accumulate oil in the diet and through preening. Holmes and Cronshaw (1977) and Brown (1982) have reviewed physiological stresses that can result from ingestion. An oil spill that affects important bird habitats (e.g., coastal marshes), even during periods of low use, may pose long-lasting problems. Birds have been observed to leave an area that has been affected by a spill (Hope *et al.*, 1978; Chapman, 1981; Albers, 1984). Albers (1984) suggests that such movements would cause severe impacts during the breeding season.

The endangered brown pelican, the California least tern, and the threatened western snowy plover are present in the project area and may suffer mortality in the event of an oil spill. As an offshore feeder, the brown pelican is susceptible to oil ingestion and fouling. Effects of oil contamination on the overall population could be significant as the population is still recovering from prior DDT contamination. The species is sensitive to disturbance and breeding success is highly variable. The California least tern as a coastal inhabitant and offshore feeder, is also susceptible because its feeding behavior includes skimming over the ocean surface for prey and occasional diving.

Should an oil spill reach the tern's coastal habitats, significant mortality could occur. This would also be true for the western snowy plover which feeds along shoreline habitats. The western snowy plover could also be adversely affected if cleanup activities were to occur on nesting beaches.

Nesting locations for the endangered California least tern and threatened snowy plover occur in the coastal dunes in northern Santa Barbara County. Nesting for both species has been reported in the Point Arguello and Point Conception area and the endangered brown pelicans nest on the northern Channel Islands. Both locations have been identified by OSRA as locations where shoreline may be impacted by oil spills.

Rocky intertidal habitats could be smothered by oil if a spill were to occur in the project area. Exposure to volatile toxic components released from the oil and shoreline remediation methods may also severely impact intertidal organisms. Recovery times for rocky intertidal areas damaged by oil and cleanup vary according to the species present and the intertidal zone that are impacted. The intertidal community in Prince William Sound, Alaska, recovered in two to three years following the *Exxon Valdez* oil spill (Coats *et al.*, 1999). Mussel bed assemblages may require up to 10 years for full recovery (USDOI, MMS, 1984).

The impact from oil spills on a sandy beach community depends on the residence time of oil in the area. Oil spill cleanup activities could also potentially destroy sandy intertidal communities. Impacts on sandy beaches from oiling and cleanup, however, are not considered to be long-lasting with full recovery occurring in two to three years (Coats *et al.*, 1999).

Impact No. 3. Project generated sounds, noise, and marine traffic impacts to marine organisms.

Noise caused by supply and support vessels may potentially disturb marine mammals. The degree of noise impact will depend on the emitted sound level and the proximity to marine mammals.

Noise from vessels has been shown to elicit a startled reaction from gray whales or mask their sound reception capabilities. Although sensitivity varies with whale activity, avoidance and approach responses have been observed in field studies (Watkins, 1986; Malme *et al.*, 1989; Richardson *et al.*, 1991). Migrating gray whales have been observed to avoid the approach of vessels to within 200-300 m (Wyrick, 1954) or to within 350-550 m (Bogoslovskaya *et al.*, 1981). There is very little data on the sound levels involved but effects on gray whales from vessels are hence expected to be limited to within 200-550 m of the vessel, to be sublethal, and temporary in nature.

Few authors have described responses of regional pinnipeds to offshore noise generated by boats or ships. Johnson *et al.* (1989) report that Northern fur seals show avoidance at distances of up to one mile. Wickens (1994), however, reported that fur seals can be attracted to fishing vessels to feed. Sea lions in the water can tolerate close and frequent approaches by vessels, especially around fishing vessels. Sea lions hauled-out on land are more responsive and react when boats approach within 100-200 m (Peterson and Bartholomew, 1967). Harbor seals often move into the water in response to boats. Even small boats that approach within 100 m displace harbor seals from haulouts; less severe disturbance can cause alert reactions without departure (Bowles and Stewart, 1980; Allen *et al.*, 1984; Osborn, 1985).

Dolphins of many species often tolerate or even approach vessels, but members of the same species show avoidance at other times. Reactions to boats often appear related to the dolphins' activity; resting dolphins tend to avoid boats, foraging dolphins ignore them, and socializing dolphins may approach them (Richardson *et al.*, 1995).

Sea otters often allow close approaches by small boats but avoid high activity areas (Riedman, 1983). Riedman also noted that some rafting sea otters exhibit mild interest in boats passing at a distance of a few hundred meters and were not alarmed. Garshelis and Garshelis (1984) reported that sea otters in Alaska tend to avoid waters with frequent boat traffic. Udevitz *et al.* (1995) reported that sea otters tend to move away from approaching boats.

The literature indicates that while marine mammals hear man-made noises and sounds generated by vessels, there is no indication that they are affected deleteriously by the noise (Richardson *et al.*, 1995). Because noise and vessel sounds generated from this project are highly localized and short-term in nature, adverse impacts to marine mammals from noise are not expected. The literature indicates that some species such as dolphins may be attracted to vessels, but the majority will maintain distances of 100-200 m. As described in the Point Arguello Project DP EIR/EIS, supply vessels, although unlikely, may collide with marine mammals.

Impacts caused by noise to other marine species are as described in the Point Arguello Project DP EIR/EIS.

Impact No. 4. Produced water impacts to marine biological communities.

Produced water refers to the total water discharged from the oil and gas extraction process. It is the largest single source of material discharged during oil and gas operations. Typically, produced water consists of formation water, injection water, and chemicals used in the oil and water separation process (USDOI/MMS, 1996).

Produced water generally represents a small portion of the initial fluid extracted from a well. As a reservoir becomes depleted, however, the amount of formation water extracted generally increases. Constituents found in produced water are iron, calcium, magnesium, sodium, bicarbonate, sulfates, and chloride. Produced water can also contain entrained petroleum hydrocarbons and measurable trace metal concentrations. Relative to ambient water, produced water contains increased organic salts and trace metals, decreased dissolved oxygen, and is higher in temperature. These same properties may adversely affect the marine environment (USDOI/MMS, 1996).

Produced water from the proposed project will be discharged in accordance with the existing general NPDES permit. The current NPDES permit contains limits on allowable concentrations of produced water constituents determined through a study of the effects of discharge elements on marine organisms. The limits, which are shown in Table 2.5, provide adequate protection for the marine environment. The maximum discharge of produced water from the combined Rocky Point and Point Arguello Units is estimated at 61,000 bbls per day. The maximum discharge of produced water from the Point Arguello Unit is estimated to be 51,800 bbls per day. In the Point Arguello Field DP EIR/EIS, the maximum daily discharge was estimated at 96,900 bbls per day. The USDOI/MMS (1983) estimated a 1000:1 dilution of formation waters within 100 m of the platform discharge. On this basis, because of rapid initial dilution, adverse impacts to marine biota in the region are not expected to occur. However, because of concern that produced water may adversely impact fishes residing beneath Platforms Hidalgo, Harvest, and Hermosa, Brandsma (2001) performed modeling studies to delineate plumes generated by discharges beneath each of the three platforms.

The maximum centerline concentrations of produced water constituents calculated from the Brandsma modeling results are provided in Tables 4.12 for Platforms Hermosa, Harvest and Hidalgo. In the table, maximum centerline constituent concentrations are computed at distances of 20, 40, 60, 80, and 100 m from the point of discharge. The concentrations in the tables are worse-case values that are calculated at the plume centerline from the maximum discharge scenario for each of the three platforms. It should be noted that these centerline concentrations

Table 4.12 Maximum Centerline Concentrations of Produced Water Constituents (mg/L) at 20, 40, 60, 80, and 100 m from the Point of Discharge for Platforms Harvest, Hermosa and Hidalgo (calculated from Brandsma (2001))

Constituent	Platform Harvest					Platform Hermosa				
	20 m	40 m	60 m	80 m	100 m	20 m	40 m	60 m	80m	100 m
Ammonia	1.5E+00	6.9E-01	5.7E-01	5.6E-01	5.5E-01	1.4E+00	6.9E-01	5.9E-01	5.6E-01	5.5E-01
Arsenic	6.5E-02	3.0E-02	2.5E-02	2.5E-02	2.4E-02	6.0E-02	3.0E-02	2.6E-02	2.5E-02	2.4E-02
Cadmium	2.2E-05	1.0E-05	8.4E-06	8.2E-06	8.0E-06	2.0E-05	1.0E-05	8.6E-06	8.2E-06	8.0E-06
Copper	4.6E-02	2.1E-02	1.8E-02	1.8E-02	1.7E-02	4.3E-02	2.1E-02	1.8E-02	1.8E-02	1.7E-02
Cyanide	3.2E-04	1.5E-04	1.3E-04	1.2E-04	1.2E-04	3.0E-04	1.5E-04	1.3E-04	1.2E-04	1.2E-04
Lead	8.6E-05	4.0E-05	3.4E-05	3.3E-05	3.2E-05	8.0E-05	4.0E-05	3.4E-05	3.3E-05	3.2E-05
Mercury	1.3E-03	6.0E-04	5.0E-04	4.9E-04	4.8E-04	1.2E-03	6.0E-04	5.2E-04	4.9E-04	4.8E-04
Nickel	8.4E-04	3.9E-04	3.3E-04	3.2E-04	3.1E-04	7.8E-04	3.9E-04	3.4E-04	3.2E-04	3.1E-04
Silver	3.5E-03	1.6E-03	1.4E-03	1.3E-03	1.3E-03	3.2E-03	1.6E-03	1.4E-03	1.3E-03	1.3E-03
Zinc	1.7E-01	8.0E-02	6.7E-02	6.6E-02	6.4E-02	1.6E-01	8.0E-02	6.9E-02	6.6E-02	6.4E-02
Benzene	1.8E-02	8.3E-03	7.0E-03	6.8E-03	6.6E-03	1.7E-02	8.3E-03	7.1E-03	6.8E-03	6.6E-03
Benzo(a)anthracene	5.3E-05	2.5E-05	2.1E-05	2.0E-05	2.0E-05	4.9E-05	2.5E-05	2.1E-05	2.0E-05	2.0E-05
Benzo(a)pyrene	5.3E-05	2.5E-05	2.1E-05	2.0E-05	2.0E-05	4.9E-05	2.5E-05	2.1E-05	2.0E-05	2.0E-05
Chrysene	1.1E-04	4.9E-05	4.1E-05	4.0E-05	3.9E-05	9.8E-05	4.9E-05	4.2E-05	4.0E-05	3.9E-05
Benzo(k)fluoranthene	1.1E-04	4.9E-05	4.1E-05	4.0E-05	3.9E-05	9.8E-05	4.9E-05	4.2E-05	4.0E-05	3.9E-05
Benzo(b)fluoranthene	1.1E-04	4.9E-05	4.1E-05	4.0E-05	3.9E-05	9.8E-05	4.9E-05	4.2E-05	4.0E-05	3.9E-05
Dibenzo(a,h)anthracene	1.1E-04	4.9E-05	4.1E-05	4.0E-05	3.9E-05	9.8E-05	4.9E-05	4.2E-05	4.0E-05	3.9E-05
Phenolic Compounds	7.0E-04	3.3E-04	2.7E-04	2.7E-04	2.6E-04	6.6E-04	3.3E-04	2.8E-04	2.7E-04	2.6E-04
Toluene	1.6E-02	7.4E-03	6.2E-03	6.0E-03	5.9E-03	1.5E-02	7.4E-03	6.3E-03	6.0E-03	5.9E-03
Ethylbenzene	2.8E-03	1.3E-03	1.1E-03	1.1E-03	1.1E-03	2.6E-03	1.3E-03	1.1E-03	1.1E-03	1.1E-03
Naphthalene	1.4E-03	6.4E-04	5.3E-04	5.2E-04	5.1E-04	1.3E-03	6.4E-04	5.5E-04	5.2E-04	5.1E-04
2,4-Dimethylphenol	3.2E-04	1.5E-04	1.2E-04	1.2E-04	1.2E-04	2.9E-04	1.5E-04	1.3E-04	1.2E-04	1.2E-04
Total Chromium	7.0E-05	3.3E-05	2.7E-05	2.7E-05	2.6E-05	6.6E-05	3.3E-05	2.8E-05	2.7E-05	2.6E-05

Table 4.12 Maximum Centerline Concentrations of Produced Water Constituents (mg/L) at 20, 40, 60, 80, and 100 m from the Point of Discharge for Platforms Harvest, Hermosa and Hidalgo (calculated from Brandsma (2001)) (continued)

Constituent	Platform Hildalgo				
	20m	40m	60m	80m	100m
Ammonia	1.3E-00	5.6E-01	4.9E-01	4.5E-01	4.3E-01
Arsenic	5.9E-02	2.5E-02	2.2E-02	2.0E-02	1.9E-02
Cadmium	1.9E-05	8.2E-06	7.2E-06	6.6E-06	6.4E-06
Copper	4.2E-02	1.8E-02	1.5E-02	1.4E-02	1.4E-02
Cyanide	2.9E-04	1.2E-04	1.1E-04	9.8E-05	9.5E-05
Lead	7.8E-05	3.3E-05	2.9E-05	2.6E-05	2.5E-05
Mercury	1.2E-03	4.9E-04	4.3E-04	3.9E-04	3.8E-04
Nickel	7.6E-04	3.2E-04	2.8E-04	2.6E-04	2.5E-04
Silver	3.1E-03	1.3E-03	1.2E-03	1.1E-03	1.0E-03
Zinc	1.6E-01	6.6E-02	5.7E-02	5.2E-02	5.1E-02
Benzene	1.6E-02	6.8E-03	6.0E-03	5.4E-03	5.3E-03
Benzo(a)anthracene	4.8E-05	2.0E-05	1.8E-05	1.6E-05	1.6E-05
Benzo(a)pyrene	4.8E-05	2.0E-05	1.8E-05	1.6E-05	1.6E-05
Chrysene	9.5E-05	4.0E-05	3.5E-05	3.2E-05	3.1E-05
Benzo(k)fluoranthene	9.5E-05	4.0E-05	3.5E-05	3.2E-05	3.1E-05
Benzo(b)fluoranthene	9.5E-05	4.0E-05	3.5E-05	3.2E-05	3.1E-05
Dibenzo(a,h)anthracene	9.5E-05	4.0E-05	3.5E-05	3.2E-05	3.1E-05
Phenolic Compounds	6.4E-04	2.7E-04	2.3E-04	2.1E-04	2.1E-04
Toluene	1.4E-02	6.0E-03	5.3E-03	4.8E-03	4.7E-03
Ethylbenzene	2.6E-03	1.1E-03	9.5E-04	8.6E-04	8.4E-04
Naphthalene	1.2E-03	5.2E-04	4.6E-04	4.2E-04	4.0E-04
2,4-Dimethylphenol	2.9E-04	1.2E-04	1.1E-04	9.6E-05	9.3E-05
Total Chromium	6.4E-05	2.7E-05	2.3E-05	2.1E-05	2.1E-05

only occur in a small area of the plume. These centerline concentrations make up the center zone of the plume, and represent the highest concentration, with rapidly decreasing concentrations as you move outward from the center of the plume to its lateral fringes. The transverse plots shown in Figures 2-3 through 2-5 show that at 20 meters downcurrent the effluent concentrations have dropped to 0.1 percent of the effluent or less within 10 meters of the centerline. At 0.1 percent of the effluent, the concentrations are below the current NPDES permit limits.

The modeling demonstrates that all constituent concentrations are far below the NPDES permit limits at distances well within the 100-m mixing zone. Most constituents regulated under the NPDES discharge permit are diluted below the permit limits at distances within 20 m of the discharge point for the maximum centerline concentration. The distance are less than 10 meters based upon average concentrations in the plume. However, for this analysis centerline concentrations have been used since they represent a "worst-case" scenario. The volume of the plume that would be above the current NPDES permit limits can be conservatively estimated assuming the plume is a cone that is 20 meters long with a radius of 10 meter at its widest point. This would give a volume of approximately 2,100 cubic meters. The water depths of Platform Harvest, Hermosa and Hidalgo are approximately 200, 180 and 130 meters, respectively. Therefore the fraction of the water around the discharge pipe affected by the plume at any one time would be less than one percent for Platforms Harvest and Hermosa and about 1.3 percent for Platform Hidalgo.

In the center of the plume 20 m from the discharge point, Arsenic, copper, mercury, silver, and zinc concentrations could exceed the NPDES limits established for receiving waters. However, ongoing initial dilution rapidly reduces these concentrations and all constituent concentrations are reduced to levels below the receiving-water limits at distances beyond 40 m of the discharge point. At Platform Hidalgo, the NPDES limits are met at distances greater than 20 m from the discharge point.

Although maximum contaminant concentrations beyond the 100-m mixing zone will be well within NPDES permit limits, concerns remain regarding the toxicity and the bioaccumulation potential of produced water discharges to the fish populations that reside within the mixing zone beneath the platforms. Love *et al.* (1999) surveyed rockfish aggregations at mid-water and bottom levels beneath each of the three platforms. The buoyant produced-water plume is discharged at mid-water depths and will not impinge upon bottom waters (Brandsma, 2001). Consequently, only the mid-water fish population is of potential concern. Generally, Love *et al.* (1999) found that mid-water depths (>20-30 m) were dominated by young-of-the-year (YOY) and juvenile (<10 cm) rockfishes. Rockfishes larger than 20 cm were rarely seen in the mid-water. For the seven platforms surveyed, a total of 33 fish species were identified at mid-water depths. At Platforms Hidalgo, Harvest, and Hermosa, rockfish YOY dominated at mid-water depths. Other dominant species included the widow rockfish, painted greenling, bocaccio, chillipper rockfish, blue rockfish, and Pacific hake.

For the most part, the effects of produced water on marine biota, especially Pacific coast fish, have not been studied. However, studies conducted on Gulf of Mexico species provide insights to possible impacts to the biota in the project area (Neff, 1997). In bioassay studies conducted on brown and white shrimp, barnacles, and crested blennies exposed to formation water from the

Buccaneer Field in Texas, the blennies were the least sensitive species and the white shrimp the most sensitive with an LC50 value of 37,000 – 92,000 ppm (Rose and Ward, 1981). In an earlier study conducted by Zein-Elden and Keney (1978) using produced water treated with biocides, the LC50 values (96 hr) for juvenile white shrimp ranged from 1,750 – 6,500 ppm. Because the produced water was treated with biocides, these values represent a conservative estimate of the toxicity to the juvenile white shrimp.

Studies conducted by Anderson *et al.* (1974) and Rice *et al.* (1976, 1979, 1981) examined the effects of the water soluble fractions of oil and treated ballast water on marine organisms. Although not produced water, these studies provide insight into the acute lethal toxicity of produced water. Rice *et al.* (1979) using the water soluble fractions of Cook Inlet crude oil on Alaskan species, found that the sensitivity increased from lower to higher invertebrates and then to fish. LC50 values for pelagic fish and shrimp were 1-3 ppm. Benthic fish, crabs, and scallops had LC50 (96 hr) values of 3-8 ppm for total aromatic hydrocarbons. Using ballast water toxicity tests with shrimp and fish, Rice *et al.* (1981) reported an LC50 range of 0.8-3.2 ppm for total aromatic hydrocarbons.

In studies on the accumulation of hydrocarbons in the water column on sediments, fish, benthos, plankton and the fouling community in the Buccaneer Field in Texas, Middleditch (1981) found that measurable quantities of hydrocarbons occur only very near to the platform. No concentration gradient was detected. There was no evidence of hydrocarbon accumulation in the biota except for the platform fouling community.

Based on the dilution modeling performed by Brandsma (2001), produced-water concentrations that approach these toxicity levels will only occur within 20 m of the discharge point, if at all. Moreover, elevated constituent concentrations will occur only within the limited volume of water occupied by the discharge plume. The cross-sectional dimension of the plume 20 m from the discharge point is on the order of 30 m or less, and at a cross-sectional distance of 10m, the concentrations are all less than the current NPDES discharge limits. Due to the very limited water volume occupied by the plume and mobile nature of fish, it is highly unlikely that fish will remain stationary within the effluent plume for considerable periods of time. Hence, toxicological effects on these fish species are not expected to occur.

Neff (1997), in his review of produced water in the Santa Barbara Channel, summarized the potential effects of arsenic, barium, cadmium, mercury, phenols, and BTEX and PAH compounds to marine organisms. His conclusions were as follows:

Arsenic concentrations in produced water are low. In some cases, concentrations can be 30 times higher than that found in seawater. However, a five-fold dilution would decrease the concentration in the receiving water to less than the marine chronic water quality criterion. Two studies of arsenic bioaccumulation in bivalves and fish in the Gulf of Mexico indicated that arsenic is not accumulated above background concentration ranges.

Barium concentrations in produced water are high relative to seawater (>1,000 times). However, mixing with sulfate-rich seawater rapidly dilutes high barium concentrations and result in precipitation of dissolved barium as barite that has low solubility in seawater (ca. 50 ug/L). The solubility of remaining dissolved barium sulfate of 1.05×10^{-10} is below the threshold of toxic effects for marine organisms. Tissue concentrations of barium in soft tissues in fish and bivalves located adjacent to produced water discharges in the Gulf of Mexico were not different from reference samples.

Cadmium concentrations from offshore California produced water can range from below the detection limit to 15 ug/L. Although the levels can be higher than background levels of 0.02 ug/L, rapid dilution lower these concentrations to background concentrations. Cadmium levels in produced water are always below the acute water quality criterion of 43 ug/L and usually below the chronic criterion of 9 ug/L. There was no evidence from bioaccumulation studies in the Gulf of Mexico that organisms exposed to produced water with these cadmium concentrations would accumulate cadmium above background levels.

Mercury, predominately in the inorganic form, occurs in produced waters from offshore California in very low concentrations. In some cases, they may be 20-50 times higher than that found in seawater. However, it is expected to dilute rapidly in receiving water. There was no evidence in studies conducted in the Gulf of Mexico that mercury would bioaccumulate in marine organisms over background levels.

The phenols and alkylated homologues present in produced waters dilutes rapidly after discharge. A combination of photolysis and microbial degradation remove these compounds from the water column at a rate as high as 5 percent an hour. In Gulf of Mexico studies, there was no indication that phenol was bioaccumulated from produced waters.

Although BTEX compounds may attain high concentrations in produced waters, these compounds are known to dilute so rapidly that instances of exceeding water quality criteria for these compounds near produced water discharges are rare. There are also no documented cases that confirm that contamination levels in marine organism tissue represent a risk to human health.

There is limited PAH concentration data for produced water from offshore California. However, levels up to 25 ug/L have been observed. This concentration is on the low end of produced waters observed in the Gulf of Mexico. PAHs are efficiently bioaccumulated by marine organisms and while there is evidence of accumulation in organisms exposed to produced waters in the Gulf of Mexico, there is no indication of deleterious impacts to receptor organisms or for biomagnification in the food chain to harmful levels.

The rates of dilution and dispersion of chemicals in produced water following discharge to the ocean are influenced by the density of the produced water relative to that of the receiving water, discharge depth, vertical stratification of the water column, and current speed and direction. Produced waters from offshore the Pt. Arguello Field have salinities lower than ambient seawater. Hence, produced water will be slightly buoyant and dilute rapidly within a short distance from point of discharge (Neff, 1997). Also, surface and near-surface current velocities are generally more than 10 cm/sec and often exceed 30 cm/sec, ensuring rapid and mixing of produced water plumes with ambient sea water. At Platforms Hidalgo, Harvest, and Hermosa, 100-fold dilution will occur within 20 m to several thousand-fold dilution within 100 m from the point of discharge. Hence, fish residing beneath the platforms are not expected to bioaccumulate the chemical constituents found in produced water.

4.1.3.2 Mitigation Measures

Impact No. 1. Impact of drilling mud and drill cutting discharges on hard-bottom communities and implication of discharges to the Monterey Bay National Marine Sanctuary.
Mitigating Measure: Maintain shunt depth for discharge of drilling mud and drill cuttings at 113 m above bottom for Platform Harvest and 97 m above bottom for Platforms Hermosa and Hidalgo. The implemented shunt depths have minimized drilling mud and drill cuttings dispersal and regional impacts to hard-bottom biota have not been identified.

Impact No. 2. Oil spill impacts to sea otters and the marine environment.
Mitigating Measure: Maintain immediate oil spill response and cleanup capability at the Point Arguello Field platforms. Initiate immediate capture of fouled wildlife for care and cleanup at local rehabilitation centers in accordance with established protocols by trained personnel.

Impact No. 3. Project generated sounds, noise, or traffic impacts to marine organisms.
Mitigating Measure: Mitigation measures are not needed.

Impact No. 4. Produced water impacts to marine biological communities.
Mitigating Measure: All produced water discharge should occur in accordance with the guidelines provided in the general NPDES permit.

4.2 Air Quality

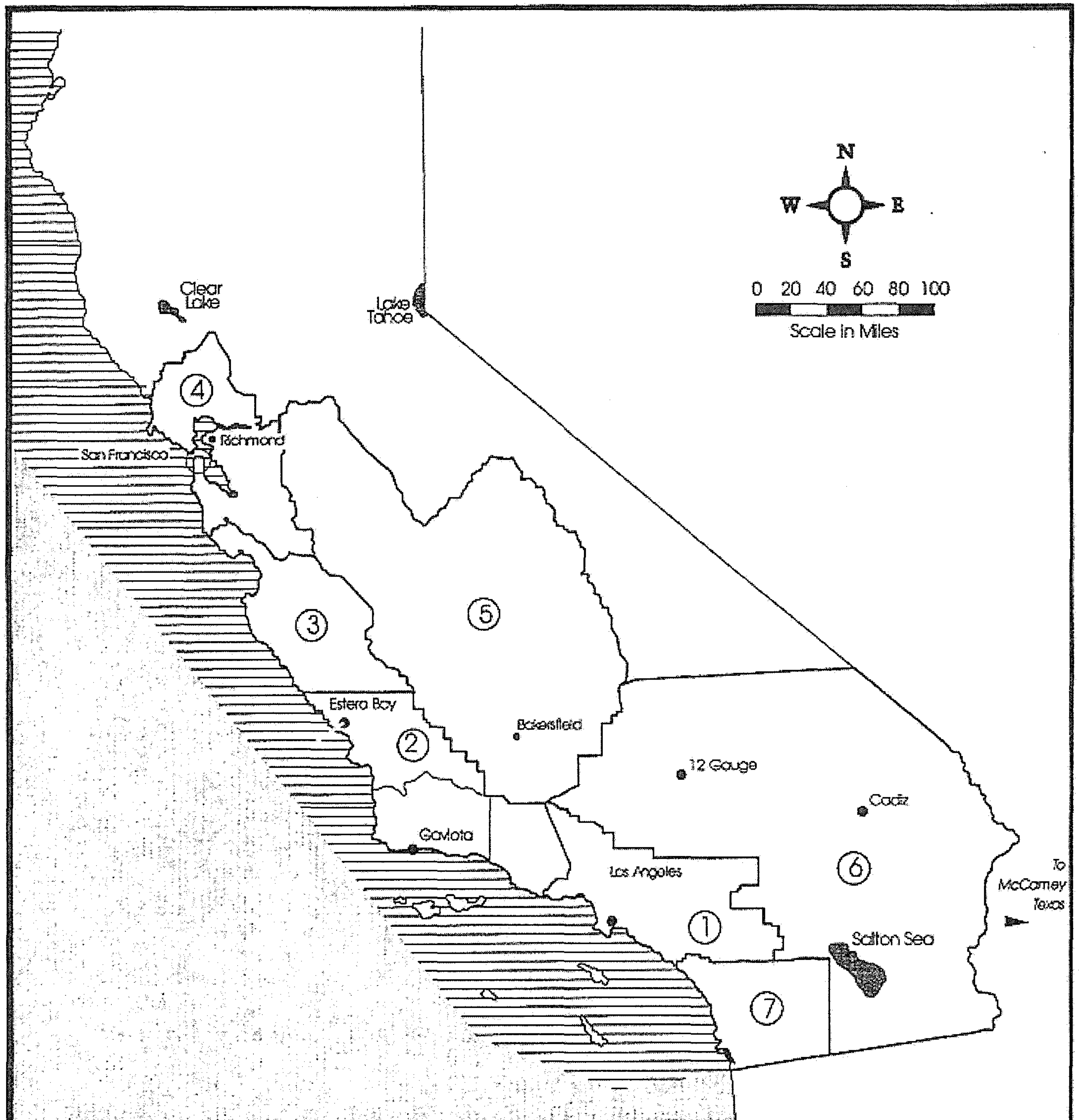
This section addresses air quality. The first part covers the environmental setting. The second part discusses the incremental air quality impacts and mitigation measures associated with the Rocky Point Unit development project.

4.2.1 Air Quality Setting

The proposed Rocky Point Unit development project would be on the three Point Arguello platforms which are located offshore the South Central Coast Air Basin (SCCAB) (Figure 4-5). Emissions that would result from this project are subject to the rules and regulations of the Santa Barbara County Air Pollution Control District (SBCAPCD). Rules and Regulations of the SBCAPCD are designed to achieve air quality standards defined to protect public health. To that purpose they limit the emissions and the permissible impacts from projects, and they specify emission controls and control technologies for each type of emitting source in order to ultimately achieve the air quality standards.

This section describes the climate and meteorology of the study area, the existing ambient air quality, and the regulatory framework for impact evaluation.

Figure 4-5 Location of Affected South Central Coast Air Basin



Air Basins

1. South Coast
2. South Central Coast
3. North Central Coast
4. San Francisco Bay Area
5. San Joaquin Valley
6. Southeast Desert
7. San Diego

Key

California Coastal Waters

A. Climate and Meteorology of the Study Region

Santa Barbara County has a Mediterranean climate characterized by mild winters when most rainfall occurs and warm, dry summers. The regional climate is dominated by a strong and persistent high pressure system that frequently lies off the Pacific coast (generally referred to as the Pacific High). The Pacific High shifts northward or southward in response to seasonal changes or the presence of cyclonic storms. In its usual position to the west of Santa Barbara County, the High produces an elevated temperature inversion. Coastal areas are characterized by early morning southeast winds, which generally shift to northwest later in the day. Transport of cool, humid marine air onshore by these northwest winds causes frequent fog and low clouds near the coast, particularly during night and morning hours in the late spring and early summer months. Figure 4-6 displays typical prevailing afternoon wind flow during summer months (Aspen, 1992).

Temperature Inversion. Atmospheric stability is a primary factor that affects air quality in the study region. Atmospheric stability regulates the amount of air exchange (referred to as mixing), both horizontally and vertically. Restricted mixing (that is, a high degree of stability) and low wind speeds are generally associated with higher pollutant concentrations. These conditions are typically related to temperature inversions that cap the pollutants emitted below or within them. An inversion is characterized by a layer of warmer air above cooler air near the ground surface. Normally, air temperature decreases with altitude. In an inversion, the temperature of a layer of air increases with altitude. The inversion acts like a lid on the cooler air mass near the ground, preventing pollutants in the lower air mass from dispersing upward beyond the inversion "lid." This results in higher concentrations of pollutants trapped below the inversion.

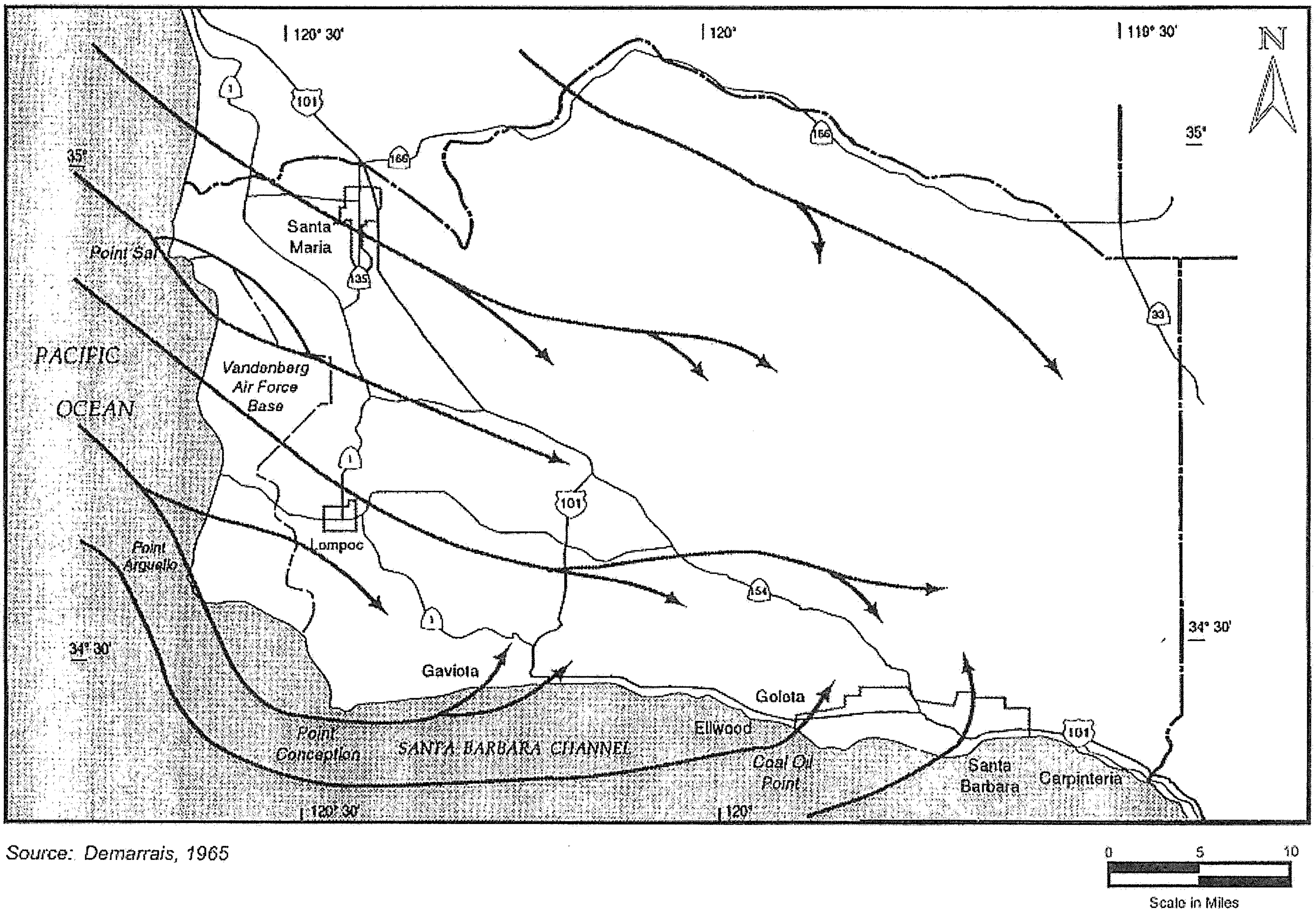
Because of its coastal location and the adjacent mountains and inland valleys, the coastal strip (south of the Santa Ynez Mountains) is susceptible to sea-land temperature variations and compressional heating that are often associated with inversion conditions. The Southern California coastal region has some of the lowest daytime and nighttime mixing heights in the United States (Holzworth, 1972).

Wind Speed And Direction. The airflow around the County plays an important role in the movement of pollutants. Wind speeds typical of the region are generally light, another factor that tends to cause higher levels of pollution since low wind speeds minimize dispersion of pollutants. The sea breeze is typically northwesterly throughout the year; however, local topography causes variations. During summer months, these northwesterly winds are stronger and persist later into the night, as illustrated in Figure 4-6.

Upper level air flow also affects air quality. The winds at 1,000 feet and 3,000 feet are generally from the north or northwest. Southerly and easterly winds occur frequently in winter and occasionally in the summer. As with surface winds, upper level winds can transport pollutants to or from other regions or air basins.

During the fall and winter months, the County is subject to Santa Ana winds, the warm, dry, strong, and gusty winds that blow northeasterly from the inland desert basins through the mountain valleys and out to sea. Wind speeds associated with Santa Anas are generally 15 to 20

Figure 4-6 Surface Wind Streamlines [typical July afternoon(1200 to 1800 PST)]



Source: Demarrais, 1965

mph, though they can reach speeds in excess of 60 mph. During Santa Ana conditions, pollutants emitted in Santa Barbara, Ventura County, and the South Coast Air Basin (SCAB, which includes the Los Angeles region) are moved out to sea. These pollutants can then move back onshore into Santa Barbara County in what is called a "post Santa Ana condition."

"Sundowner" winds are a local phenomenon on the coastal strip below the canyons. Similar to Santa Ana conditions, warm, gusty winds blow sometimes with great intensity down canyons toward the sea. However in contrast, these winds are local and caused by land-sea and diurnal temperature variations.

Topography. Topography plays a significant role in direction and speed of winds throughout the County. During the day, the sea breeze (from sea to land) is normally dominant. Winds reverse in the evening as the air mass over land cools, gets heavier, and flows down the coastal mountains and mountain valleys back towards the ocean as land breezes (from land to sea). This diurnal "sloshing" effect can further aggravate pollution by continually recycling an air mass over pollution sources. This effect is exacerbated during periods when wind speeds are low.

Topography also plays another role in the pattern of winds in the County. The terrain around Point Conception, combined with the change in orientation of the coastline from north-south to east-west, can cause counterclockwise circulation's (eddies) to form east of the Point Conception. These eddies fluctuate from time to time and from place to place, leading to highly variable winds along the southern coastal strip. Point Conception also marks the change in the prevailing surface winds from northwesterly to southwesterly, as illustrated in Figure 4-6.

Sunlight. Sunlight is also prevalent in the County. Although fog occurs along the coast and in inland valleys in the late spring to mid-summer period, and cloudy conditions occur during winter storms, there is frequent sunlight. The prevalence of sunlight is yet another contributor to photochemical smog, as it drives the photochemical reactions that produce ozone.

B. Air Quality

Air quality is determined by measuring ambient concentrations of pollutants that are known to have deleterious effects. The degree of air quality degradation is then compared to health-based standards. The current California and National Ambient Air Quality Standard (CAAQS and NAAQS) are listed in Table 4.13. A summary of the attainment status of all the air basin affected by the Proposed Project is provided in Table 4.14. Ambient air quality in Santa Barbara County is generally good (i.e., within applicable ambient air quality standards), with the exception of ozone (0_3) fine particulates (PM_{10}).

Photochemical Pollutants. Ozone is formed in the atmosphere through a series of complex photochemical reactions involving oxides of nitrogen (NO_x), reactive organic compounds (ROC), and sunlight occurring over a period of several hours. Since ozone is not emitted directly into the atmosphere but is formed as a result of photochemical reactions, it is classified as a secondary or regional pollutant. Because these ozone-forming reactions take time, peak ozone levels are often found downwind of major source areas.

Table 4.13 National and California Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards [1] [3]	National Standards [2] Primary [4]	National Standards [2] Secondary [3,5]
Ozone (O_3)	1 hour 8 Hour	0.09 ppm (180 ug/m^3)	0.12 ppm (235 ug/m^3) 0.08 ppm (157 ug/m^3)	0.12 ppm (235 ug/m^3) 0.08 ppm (157 ug/m^3)
Carbon Monoxide (CO)	8 hour 1 hour	9.0 ppm (10 mg/m^3) 20.0 ppm (23 mg/m)	9.0 ppm (10 mg/m^3) 35 ppm (40 mg/m^3)	NS[6] NS
Nitrogen Dioxide (NO_2)	Annual Avg. 1 hour	NS 0.25 ppm (470 ug/m^3)	0.053 ppm (100 ug/m^3) NS	0.053 ppm (100 ug/m^3) NS
Sulfur Dioxide (SO_2)	Annual Avg. 24 hour 3 hour 1 hour	NS 0.04 ppm [7] (105 ug/m^3) NS 0.25 ppm (655 ug/m^3)	80 ug/m^3 (0.03 ppm) 365 ug/m^3 (0.14 ppm) NS NS	NS NS 1300 ug/m^3 (0.5 ppm) NS
Suspended Particulate Matter (PM_{10})	Ann.Geo.Mean Ann.Arith.Mean 24 hour	30 ug/m^3 NS 50 ug/m^3	NS 50 ug/m^3 150 ug/m^3	NS 50 ug/m^3 150 ug/m^3
Fine Particulate Matter ($PM_{2.5}$)	24 hour Annual Mean	No Separate Standard	65 ug/m^3 15 ug/m^3	65 ug/m^3 15 ug/m^3
Sulfates (SO_4)	24 hour	25 ug/m^3	NS	NS
Lead (Pb)	30-day Avg. Calendar Qtr.	1.5 ug/m^3 NS	NS 1.5 ug/m^3	NS 1.5 ug/m^3
Hydrogen Sulfide (H_2S)	1 hour	0.03 ppm (42 ug/m^3)	NS	NS
Visibility Reducing Particles	8 hour (10 am to 6 pm, PST)	Insufficient amount to reduce the prevailing visibility [8] to less than 10 miles when the relative humidity is less than 70 percent (CA only)		

Note: Based on California ARB 1/25/99 Ambient Air Quality Standards, ug/m^3 = Microgram/cubic meter

1. California standards for ozone, carbon monoxide (except Lake Tahoe), sulfur dioxide (1 and 24 hour), nitrogen dioxide, suspended particulate matter—PM10 , and visibility reducing particles, are values that are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations. In addition, Section 70200.5 lists vinyl chloride (chloroethene) under "Ambient Air Quality Standards for Hazardous Substances." In 1978, the California Air Resources Board (ARB) adopted the vinyl chloride standard of 0.010 ppm (26 mg/m^3) averaged over a 24-hour period and measured by gas chromatography. The standard notes that vinyl chloride is a "known human and animal carcinogen" and that "low-level effects are undefined, but are potentially serious. Level is not a threshold level and does not necessarily protect against harm. Level specified is lowest level at which violation can be reliably detected by the method specified. Ambient concentrations at or above the standard constitute an endangerment to the health of the public." In 1990, the ARB identified vinyl chloride as a Toxic Air Contaminant and determined that there was not sufficient available scientific evidence to support the identification of a threshold exposure level. This action allows the implementation of health-protective control measures at levels below the 0.010 ppm ambient concentration specified in the 1978 standard.
2. National standards (other than ozone, PM, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest eight hour concentration in a year, averaged over three years, is equal to or less than the standard. For PM10, the 24 hour standard is attained when 99 percent of the daily concentrations, averaged over three years, are equal to or less than the standard. For PM2.5 , the 24 hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard. Contact U.S. EPA for further clarification and current federal policies.
3. Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 mm of mercury. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of mercury (1,013.2 millibar); ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.
4. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health.
5. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.
6. Reference method as described by the EPA. An "equivalent method" of measurement may be used but must have a "consistent relationship to the reference method" and must be approved by the EPA.
7. New federal 8-hour ozone and fine particulate matter standards were promulgated by U.S. EPA on July 18,1997. The federal 1-hour ozone standard continues to apply in areas that violated the standard. Contact U.S. EPA for further clarification and current federal policies.
8. Prevailing visibility is defined as the greatest visibility, which is attained or surpassed around at least half of the horizon circle, but not necessarily in continuous sectors.

Table 4.14 Attainment Status of Affected Air Basins

Air Basin	O_3		CO		NO_2		SO_2		PM_{10}	
	State	*Fed*	*State*	*Fed*	*State*	*Fed*	*State*	*Fed*	*State*	*Fed*
Santa Barbara County	N	A	A	U/A	A	U/A	A	U/A	N	U
San Luis Obispo County	N	U/A	A	U/A	A	U/A	A	U/A	N	U
Ventura County	N	N	A	U/A	A	U/A	A	U/A	N	U

Source: ARB web page, 2000
Notes
A = Attainment of Standards
N = Non-Attainment
U = Unclassified
U/A = Unclassified/Attainment
P = Partial Attainment

The CAAQS have been violated in South and North County in recent years. The South Coast Central Air Basin is composed of San Luis Obispo, Santa Barbara and Ventura Counties. Currently, Santa Barbara, and Ventura Counties are designated non-attainment for the State ozone standard. San Luis Obispo County is in attainment for the state ozone standard.

Inert Pollutants. Carbon monoxide is formed primarily by the incomplete combustion of organic fuels. Santa Barbara County is in attainment of the California and National one-hour carbon monoxide (CO) standards. High values are generally measured during winter when dispersion is limited by morning surface inversions. Summer values are much lower due to increased mixing. The County is in attainment of the California and National 8-hour CO standard, the last recorded violation having occurred in 1985.

Nitric oxide (NO) is a colorless gas formed during combustion processes which rapidly oxidizes (within minutes) to form nitrogen dioxide (NO_2), a brownish gas. Santa Barbara County is in attainment for all the California and National nitrogen dioxide standards. The highest nitrogen dioxide values are generally measured in urbanized areas with heavy traffic. Downtown measurements are well below the California and National standards.

Sulfur dioxide (SO_2) is a gas produced primarily from the combustion of sulfurous fuels by stationary sources and by mobile sources. Santa Barbara County has been in attainment of the California and National 1-hour, 3-hour, 24-hour and annual sulfur dioxide standards over the past 10 years.

PM_{10} is particulate matter with an aerodynamic diameter of ten microns or less. The largest PM_{10} emissions in the County appears to originate from soils (via roads, construction, agriculture, and natural windblown dust). Other sources of PM_{10} include sea salt, particulate matter released during combustion processes such as those in gasoline and diesel vehicles, and woodburning. Also, nitrogen oxides (NO_x) and sulfur oxides (SO_x) are precursors in the formation of secondary PM_{10}.

While the County is in attainment for the National annual PM_{10} standard, both the California 24 hour and annual PM_{10} standards are exceeded in the County.

Lead is a heavy metal that in ambient air occurs as a lead oxide aerosol or dust. Primary sources of this pollutant are automotive emissions, lead processing, and the manufacturing of lead products. There are few lead emissions in Santa Barbara and, as a result, the County is in attainment for the California and National lead standards.

Sulfates are aerosols (i.e., wet particulates) that are formed by sulfur oxides in moist environments. They exist in the atmosphere as sulfuric acid and sulfate salts. The primary source of sulfate is sulfur oxide precursors from the combustion of sulfurous fuels. Santa Barbara County is in attainment for the California sulfate standard, and there has been a steady decrease since the last violation in 1984.

Hydrogen sulfide (H_2S) is an odorous, toxic, gaseous compound that can be detected by humans at low concentrations. The gas is produced during the decay of organic material and is also found naturally in petroleum. The County is in attainment of the H_2S standard.

Toxic Air Contaminants. Toxic air contaminants (TAC) are hazardous air pollutants that are known or suspected to cause cancer, genetic mutations, birth defects, or other serious illness to people. TACs come from three basic types of sources: industrial facilities, internal combustion engines (stationary and mobile), and small "area sources" (such as solvent use).

Generally, TACs behave in the atmosphere in the same way as inert pollutants (those that do not react chemically, but preserve the same chemical composition from point of emission to point of impact). The concentrations of inert and toxic pollutants are therefore determined by the concentrations emitted at the source and the meteorological conditions encountered as those pollutants are transported away from the source. Thus, impacts from toxic pollutant emissions tend to be site-specific and their intensity is subject to constantly changing meteorological conditions. The worst meteorological conditions that affect short-term impacts (low wind speeds, highly stable air mass, and constant wind direction) occur relatively infrequently.

C. Applicable Regulations, Plans, and Standards

National and State Regulations. National, state, and regional agencies have established standards and regulations that affect the Proposed Project. The following National and State regulatory considerations apply to the project and to all alternatives:

- Federal Clean Air Act of 1970 directs the attainment and maintenance of National Ambient Air Quality Standards (NAAQS). The 1990 Amendments to this Act affect attainment and maintenance of NAAQS (Title I), motor vehicles and fuel reformulation (Title II), hazardous air pollutants (Title III), acid deposition (Title IV), facility operating permits (Title V), stratospheric ozone protection (Title VI), and enforcement (Title VII).

- The U.S. Environmental Protection Agency (EPA) implements the Federal Clean Air Act and established the NAAQS for criteria pollutants.

- California Air Resources Board (CARB) has established the California Ambient Air Quality Standard (CAAQS), which determine State attainment status for criteria pollutants.

- The California Clean Air Act (CCAA) went into effect on January 1, 1989 and was amended in 1992. The CCAA mandates achieving the health-based CAAQS at the earliest practicable date.

- Air Toxics "Hot Spots" Information and Assessment Act of 1987 (AB 2588) requires an inventory of air toxics emissions from individual facilities, an assessment of health risk, and a notification of potential significant health risk.

- The Calderon Bill (SB 1731) alters AB 2588. The bill sets forth changes in the following four areas: providing guidelines to identify a more realistic health risk, requiring high risk facilities to submit an air toxic emission reduction plan, holding air pollution control districts accountable for ensuring that the plans will achieve their objectives, and requiring high risk facilities to achieve their planned emissions reduction.

- The new Tanner Bill (AB 2728) amends the existing Tanner Bill (AB 1807) by setting forth provisions to implement the National program for hazardous air pollutants.

- Toxic Emissions Near Schools (AB 3205). This bill requires new or modified sources of air contaminants located within 1,000 feet from the outer boundary of a school to give public notice to the parents of school children before an air pollution permit is granted.

- Section 21151.4 of the California Environmental Quality Act discusses Hazardous Air Pollutant releases within one-fourth mile of a school site.

Santa Barbara County APCD Rules and Regulations. The SBCAPCD has jurisdiction over air quality attainment in the Santa Barbara County portion of the SCCAB. The SBCAPCD was the principal author of the 1991 Air Quality Attainment Plan (AQAP), the 1993 Rate of Progress Plan (ROP), and the 1994 Clean Air Plan (CAP) which contains strategies for locally attaining State and National ozone standards.

The 1991 AQAP was written to conform with requirements set forth in the 1988 California Clean Air Act. The SBCAPCD, through the 1991 AQAP, has adopted an extensive list of emission control measures to demonstrate that the California ozone standard will be attained at the earliest feasible time. These measures include both ROC and NO_x controls for stationary sources, and methods called Transportation Control Measures (TCMs), to reduce emissions from motor vehicles.

The SBCAPCD (District) has 11 regulations, each of which includes a number of rules. District permit requirements are given in Regulation II. Persons constructing or modifying sources of air contaminants are required to obtain (1) an Authority to Construct permit (ATC) before initiating construction or modification of a source and (2) a Permit to Operate (PTO) prior to beginning operations. See Table 4.15 for Best Available Control Technology (BACT), Air Quality Impact Analysis (AQIA), and offset threshold requirements.

Table 4.15 BACT, AQIA, and Offset Requirements

BACT Requirements	$\geq$25 lbs/day for any non-attainment pollutant (except CO) $\geq$ 150 lbs/day for CO
AQIA Requirements	$\geq$ 120 lbs/day for any non-attainment pollutant (except CO and PM_{10}) $\geq$ 550 lbs/day for CO; $\geq$ 80 lbs/day for PM_{10}
Offsets Requirements	$\geq$55 lbs/day or $\geq$10 tons/yr for any non-attainment pollutant (except CO and PM_{10}) $\geq$ 150 lbs/day or $\geq$25 tons/yr for CO; $\geq$ 80 lbs/day or $\geq$10 tons/yr for PM_{10}

The SBCAPCD has adopted Rule 331 to control emissions of fugitive hydrocarbons from oil extraction, processing, and pipeline facilities. Operators must make visual inspections of pumps and compressors every eight hours of operation. Quarterly inspections of all components, including flanges, fittings, and valves, are also required. Inspection of these components is intended to reduce fugitive ROC emissions that result from oil and gas leakage.

D. Point Arguello Project Emissions

The Point Arguello Project is an existing emission source within Santa Barbara County, and the emissions are reflected in the ambient air quality. Table 4.16 provides a summary of the current permitted emissions associated with the Point Arguello platforms and supply boats.

Table 4.16 Permitted Emissions for Point Arguello Platforms and Supply Boats (tons/yr)

Pollutant	Platform Harvest	Platform Hermosa	Platform Hidalgo	Supply Boats
NO_x	341.64	109.35	111.19	76.24
ROC	78.38	69.00	50.35	3.99
CO	180.33	90.46	69.76	16.67
SO_x	46.34	40.04	31.32	8.18
PM	18.02	9.42	9.31	6.79
PM_{10}	17.90	9.23	9.16	6.51

1. Platform emissions do not include supply, crew and emergency response vessel emissions.
2. Supply boats are for all three platforms and cover emissions from the SB County line to the platforms, consistent with the PTO.
3. Data from SBCAPCD PTOs 9103, 9104, and 9015 (April 19, 2001).

The actual year 2000 emissions for the Point Arguello platforms and the supply boats (Table 4.17) are considerablely less than the permitted values from the April 19, 2001 PTOs issued by the SBCAPCD.

Table 4.17 2000 Actual Emissions from Point Arguello Platforms and Supply Boats (tons/yr)

Pollutant	Harvest	Hidalgo	Hermosa	Supply Boats
NO_x	125.14	52.99	52.57	21.85
ROC	49.58	27.41	40.11	1.32
CO	72.71	35.37	41.20	5.25
SO_x	38.29	26.35	23.84	2.49
PM	3.34	5.14	4.02	2.16
PM_{10}	3.31	5.10	3.97	2.04

1. Platform emissions do not include supply, crew and emergency response vessel emissions.
2. Supply boats are for all three platforms and cover emissions from the SB County line to the platforms, consistent with PTO.
3. Data from Arguello Inc. 2000 Annual Emission Report.

These emission levels are considerably less than what was analyzed in the Point Arguello Field EIR/EIS and less than the allowable emissions.

4.2.2 Project-Specific Impacts and Mitigation Measures

The sections below present the incremental marine resource impacts associated with the Rocky Point Unit development and mitigation measures.

4.2.2.1 Project Impacts

Impacts described in the Development Plan EIR/EIS for the Point Arguello Field and Gaviota Process Facility were evaluated with respect to their applicability to the proposed Rocky Point Unit project. The category of impacts described in the Point Arguello DP EIR/EIS and those anticipated from Rocky Point are compared in Table 4.18. Activities that are proposed for Rocky Point have essentially been analyzed in the Point Arguello Field DP.

Table 4.18 Comparison of Impacts Contained in the Arguello Project DP EIR/S and Additional Impacts Potentially Caused by the Proposed Rocky Point Project

Impact/Issue	Addressed in Arguello Project DP EIR/S	Additional Impact Caused by Rocky Point
NO_x and ROC emissions from offshore platforms and support activities may contribute to violations of the ozone standard and hinder reasonable further progress of attaining the ozone standard.	Yes	During drilling operations there will be an increased load placed on the offshore turbines which will result in an increase in emissions. There will also be an increase in emissions from internal combustion engines that are used to support the drilling operations. During drilling there will be an increase in the number of supply boat trips that will be needed for servicing the platforms. Drilling will last between four and six years. The 1984 EIR/EIS assumed 13 supply boat trips per week for drilling and 4.5 per week for production. For Rocky Point it is estimated that 2 supply boat trips will be needed per

Impact/Issue	Addressed in Arguello Project DP EIR/S	Additional Impact Caused by Rocky Point
		week. When this is added to the current supply boat trips of approximately one per week, the total would be around three per week, which is less then the level estimated for production in the 1984 EIR/EIS. During the production phase there will be an increase in emissions associated with the Rocky Point Unit development project due to fugitive emissions from the well heads.

Impact No. 1. NO_x and ROC emissions from offshore platforms and support activities may contribute to violations of the ozone standard.

During the drilling phase of the project there will be an increased load placed on the offshore turbines due to the drill rig and mud handling equipment. This increased load will be approximately 6,000 Hp at the maximum rated capacity. The estimated emissions associated with this increase load are presented in Table 4.19.

Table 4.19 Estimated Turbine Emission Increase from Rocky Point Drilling Operations

Rocky Point Drilling Emissions	NO_X	ROC	CO	SO_X	PM	PM_{10}
Platform Harvest						
lbs./hr	6.52	0.12	1.74	0.21	0.07	0.07
lbs./day	156.43	2.98	41.65	5.02	1.76	1.76
tons/qr.	7.14	0.14	1.90	0.23	0.08	0.08
tons/yr	28.55	0.54	7.60	0.92	0.32	0.32
Platform Hermosa						
lbs./hr	5.14	0.54	3.39	0.21	0.07	0.07
lbs./day	123.36	12.89	81.28	5.01	1.79	1.79
tons/qr.	5.63	0.59	3.71	0.23	0.08	0.08
tons/yr	22.51	2.35	14.83	0.91	0.33	0.33
Platform Hidalgo						
lbs./hr	5.14	0.54	3.39	0.21	0.07	0.07
lbs./day	123.36	12.89	81.28	5.01	1.79	1.79
tons/qr.	5.63	0.59	3.71	0.23	0.08	0.08
tons/yr	22.51	2.35	14.83	0.91	0.33	0.33
Total Drilling Emissions (tons)						
Phase 1	69.18	5.81	39.05	2.67	0.95	0.95
Phase 2	28.03	2.22	15.20	1.07	0.38	0.38
Phase 3	46.44	2.01	17.52	1.60	0.57	0.57
Total All Phases	***143.65***	***10.03***	***71.77***	***5.34***	***1.90***	***1.90***

1. Phase 1 is 10 wells, Phase 2 is 4 wells and Phase 3 is 6 wells.
2. See Attachment D for the detailed emission calculations and assumptions.

All of these emissions are already permitted and offset per SBCAPCD rules, since the offshore turbines are a permitted source for the Point Arguello Field. It appears that the turbines have sufficient capacity to provide the power requirements for the Rocky Point drilling program. However, the exact electrical load for the drilling program will not be known until a rig is chosen.

All of the drilling equipment will be electrically driven with the exception of the well logging unit, the cement pump, the acidizing pump, and an emergency generator. The emergency generator will only be used if power is lost on the platform to assure a safe shut down of the drilling equipment. Attachment D contains detailed emission calculations for the additional drilling operations equipment, and includes emission factors, usage factors, hourly, daily, quarterly and annual emission estimates. Table 4.20 provides an estimate of the emissions associated with these support engines.

Included in Table 4.20 is a slurry pump that would only be needed if the oil/synthetic based cuttings were injected into the formation. This is a possible option that could be used to eliminate the need to take the cuttings ashore via supply boat for onshore disposal. With this option, there could be a reduction in the number of supply boat trips, which could reduce boat emissions.

No new air permitting should be needed to operate the drill rig since emissions associated with drilling operations are exempt if the total NO_x emissions are less then 25 tons per year (Rule202.F6).

Table 4.21 provides an estimate of the hydrocarbon emissions that would be expected from the mud handling system. The bases for these estimates is provided in Attachment D. Hydrocarbon emissions can be emitted from the drilling muds and cuttings only while drilling through an interval that contains gas. The majority of the entrained gas will be removed in the mud-gas separator, and mud degasser (98%). The remaining hydrocarbon vapors will be released as fugitive emissions from the mud pits. For this analysis it has been estimated that drilling through intervals that contain gas will occur for 20 days for each well. During this time a total of 85,000 scf of gas will be absorbed into the muds and cuttings. Based upon the current Point Arguello produced gas composition the gas would contain 20% reactive organic compounds (ROCs). The hydrocarbon emissions from the mud system are released from a vent at the top of the derrick, which is the process that was used for drilling all of the Point Arguello wells.

In addition, supply boat trips during the drilling phase would increase. For this analysis it has been assumed that an additional two trips per week would be needed over the entire drilling period. Table 4.22 provides an estimate of the increased air emissions for the supply boat trips.

The boats that will be used are all permitted with the SBCAPCD, and are currently available for use in the Point Arguello project. Transporting of the drill rig will take approximately 20 supply boat round trips. The rig will be moved from Port Hueneme to Platform Hidalgo. Once the wells have been drilled at Hidalgo, the drill rig will be moved to Platform Harvest and then to Platform Hermosa. This will take approximately 20 round trips between each of the platforms. Once all

Table 4.20 Estimated Emission from Rocky Point Drilling Operation Support Equipment Engines

Rocky Point Drilling Emissions	NO_X	ROC	CO	SO_X	PM	PM_{10}
		lbs/hr				
Well Logging Unit	1.85	0.25	0.67	0.05	0.22	0.22
Acidizing Pump	1.85	0.25	0.67	0.05	0.22	0.22
Emergency Generator	25.00	3.39	9.02	0.63	2.98	2.98
Cement Pump	3.70	0.50	1.34	0.09	0.44	0.44
Slurry Pump	18.52	2.51	6.68	0.46	2.20	2.20
Total Hourly Emissions	***50.93***	***6.91***	***18.37***	***1.27***	***6.06***	***6.06***
		lbs/day				
Well Logging Unit	44.45	6.03	16.03	1.11	5.29	5.29
Acidizing Pump	14.82	2.01	5.34	0.37	1.76	1.76
Emergency Generator	50.00	6.79	18.04	1.25	5.95	5.95
Cement Pump	29.63	4.02	10.69	0.74	3.53	3.53
Slurry Pump	148.15	20.11	53.44	3.70	17.64	17.64
Total Daily Emissions	***287.04***	***38.96***	***103.54***	***7.18***	***34.17***	***34.17***
		tons/qr				
Well Logging Unit	0.67	0.09	0.24	0.02	0.08	0.08
Acidizing Pump	0.04	0.01	0.01	0.00	0.00	0.00
Emergency Generator	0.08	0.01	0.03	0.00	0.01	0.01
Cement Pump	0.09	0.01	0.03	0.00	0.01	0.01
Slurry Pump	5.19	0.70	1.87	0.13	0.62	0.62
Total Quarterly Emissions	***6.05***	***0.82***	***2.18***	***0.15***	***0.72***	***0.72***
		tons/yr				
Well Logging Unit	2.67	0.36	0.96	0.07	0.32	0.32
Acidizing Pump	0.15	0.02	0.05	0.00	0.02	0.02
Emergency Generator	0.30	0.04	0.11	0.01	0.04	0.04
Cement Pump	0.36	0.05	0.13	0.01	0.04	0.04
Slurry Pump	20.74	2.81	7.48	0.52	2.47	2.47
Total Annual Emissions	***24.21***	***3.29***	***8.73***	***0.61***	***2.88***	***2.88***
		Total Drilling Emissions (tons)				
Phase 1	70.62	9.58	25.47	1.77	8.41	8.41
Phase 2	28.25	3.83	10.19	0.71	3.36	3.36
Phase 3	42.37	5.75	15.28	1.06	5.04	5.04
Total All Phases	***141.23***	***19.17***	***50.95***	***3.53***	***16.81***	***16.81***

Notes: Assumes seven wells drilled at Harvest, seven drilled at Hermosa, and six drilled at Hidalgo.
Assumes each well takes 3.5 months to complete.
See Attachment D for detailed emission calculations.
Number may not add up due to rounding.
Slurry pump would only be needed if the oil/synthetic based cuttings were injected at the platforms.

Table 4.21 Estimated Emission from the Mud Handling Equipment

Source	ROC Emissions						
	lbs/hr	lbs/day	lbs/well	lbs/yr	Phase 1 (lbs)	Phase 2 (lbs)	Phase 3 (lbs)
Mud-gas Separator/Mud Degasser Vent	0.041	0.980	19.590	68.099	198.622	79.449	119.173
Fugitives from Mud Tanks	0.001	0.020	0.400	1.390	4.054	1.621	2.432
Total Emissions	0.042	0.999	19.990	69.489	202.675	81.070	121.605

See Attachment D for detailed emission calculations.

Table 4.22 Estimated Emission Increase from Rocky Point Drilling Supply Boat Trips

Estimated Supply Boat Emissions	NO_X	ROC	CO	SO_X	PM	PM_{10}
Drill Rig Transport from Port Hueneme to the Platforms (round-trip) [a]						
lbs./hr[b]	127.18	5.20	19.79	9.13	7.79	7.48
lbs./day[c]	1,631.60	58.04	241.19	117.97	98.01	94.09
tons/qr[d].	11.09	0.58	2.41	1.18	0.98	0.94
tons/yr[d]	11.09	0.58	2.41	1.18	0.98	0.94
Drill Rig Transport Between Platforms (round-trip)[a]						
lbs./hr[b]	127.18	5.20	19.79	9.13	7.79	7.48
lbs./day[c]	288.34	13.17	46.90	20.58	17.97	17.25
tons/qr[d].	2.16	0.13	0.47	0.21	0.18	0.17
tons/yr[d]	2.16	0.13	0.47	0.21	0.18	0.17
Drilling Operations[e]						
lbs./hr[b]	127.18	5.20	19.79	9.13	7.79	7.48
lbs./day[c]	1,631.60	58.04	241.19	117.97	98.01	94.09
tons/qr[d].	14.42	0.75	3.14	1.53	1.27	1.22
tons/yr[d]	57.67	3.02	12.54	6.13	5.10	4.89

a. Drill rig transport based on 20 round trips total over one month, once per year.
b. lbs/hr maximum based on all engines running simultaneously, and assumes uncontrolled main engines.
c. Assumes one round trip per day, and assumes uncontrolled main engines.
d. Assumes that uncontrolled main engines are used 10% of the time. (Same assumption as PTOs 9103, 9104, and 9105.)
e. Supply boat trips for operations assume 2 round trips per week for 52 weeks per year.
See Attachment D for the basis and detailed emission calculations.

the wells are completed, the drill rig will be disassembled and taken back to Port Hueneme. This will require approximately 20 round trips.

The SBCAPCD regulates the fuel use, hp limit on the main and auxiliary engines and the emission factors for the engines. The Point Arguello Project is permitted to consume 90,269 gallons per quarter of fuel on supply boat main engines within Santa Barbara County. In the fourth quarter of 1999, the actual fuel use for supply boat main engines was 28,000 gallons in the County. The estimated main engine fuel use per quarter for drill rig transportation and drilling operations are 39,325 gallons and 51,122 gallons, respectively. Even with these additional supply boat trips, the quarterly fuel use should be below the permitted levels. The SBCAPCD also limits the daily fuel use by the supply boat main engines to 1,967 gallons. This represents one round trip per day. With the development of Rocky Point, it is not expected that more than one supply boat will service the platforms in any one day. Therefore, it does not appear that any new permitting will be required for the supply boat trips associated with the Rocky Point Unit development.

Once the wells are brought into production, there will be fugitive emissions associated with the components on each of the wells. For this analysis it has been assumed that 20 wells will be drilled and that each well has 250 leak-paths. Table 4.23 provides an estimate of the fugitive emissions associated with the producing wells.

Table 4.23 Estimated Fugitive Emission Increase from Rocky Point Production Wells

Component Type	Quantity	Emission Factor (lbs/day-clp)	ROC Emissions lbs/hr	lbs/day	tons/qr	tons/yr
		Phase 1				
Oil - controlled	1250	0.0009	0.047	1.125	0.051	0.205
Oil - unsafe	0	0.0044	0.000	0.000	0.000	0.000
Gas - controlled	1250	0.0147	0.766	18.375	0.838	3.353
Gas - unsafe	0	0.0736	0.000	0.000	0.000	0.000
Total Phase 1	***2500***		***0.813***	***19.500***	***0.890***	***3.559***
		Phase 2				
Oil - controlled	500	0.0009	0.019	0.450	0.021	0.082
Oil - unsafe	0	0.0044	0.000	0.000	0.000	0.000
Gas - controlled	500	0.0147	0.306	7.350	0.335	1.341
Gas - unsafe	0	0.0736	0.000	0.000	0.000	0.000
Total Phase 2	***1000***		***0.325***	***7.800***	***0.356***	***1.424***
		Phase 3				
Oil - controlled	750	0.0009	0.028	0.675	0.031	0.123
Oil - unsafe	0	0.0044	0.000	0.000	0.000	0.000
Gas - controlled	750	0.0147	0.459	11.025	0.503	2.012
Gas - unsafe	0	0.0736	0.000	0.000	0.000	0.000
Total Phase 3	***1500***		***0.488***	***11.700***	***0.534***	***2.135***
Total All Phases	***5000***		***1.625***	***39.000***	***1.779***	***7.118***

1. Emission Factors from SBCAPCD PTOs 9103, 9104, and 9105.
2. Component counts are estimates only. Actual counts will be developed when wells are installed.
3. Numbers may not add up due to rounding.
4. See Attachment D for the basis and detailed emission calculations.

The fugitive emissions are relatively small when compared with the entire project ROC emissions. For the Phase 1 wells the daily ROC emission are estimated to be 19.5 lbs, which is below the deminimus level of 24 lbs/day. Therefore, these wells will not have to be offset assuming that the total deminimus ROC emissions for the Point Arguello Facilities are below 24 lbs/day. In addition, the Phase 1 well should not need BACT since the total ROC emissions are below 25 lbs/day. With the addition of the Phase 2 and 3 wells, it may be necessary to provide offsets and meet BACT requirements if all the Phase 1, 2 and 3 wells use new well heads.

However, it is possible that some of these wells could use existing well heads from Point Arguello Field wells that have reached the end of their productive life. If the new Rocky Point wells plus the other Point Arguello Field deminimus emissions result in fugitive ROC emissions of 24 lbs/day or greater, then offset would be required. In addition, if the Rocky Point wells result in new fugitive ROC emissions of 25 lbs/day or greater, then BACT requirements would have to be met.

Each well is expected to have a life of approximately seven years. Therefore, after the first seven years of production the fugitive emissions will begin to decline as wells are taken out of service.

Table 4.24 provides and estimate of the peak annual Rocky Point Unit emissions for each of the platform and the supply boats. This table also shows the annual permitted emission levels and the 2000 actual emissions for each Point Arguello platform and the supply boat. When the peak annual Rocky Point emissions are combined with the 2000 actual emissions they do not exceed any of the permitted level, specified in the SBCAPCD PTOs 9103, 9104, and 9105 for the Point Arguello platforms.

Table 4.24 Comparison of Peak Annual Rocky Point Emission to Total Permitted Facility Emissions

Platform/Emission Category	NO_X	ROC	CO	SO_X	PM	PM_{10}
Platform Harvest[a]						
Total Permitted Emissions (tons/yr) [PTO 9103]	341.64	78.38	180.33	46.34	18.02	17.90
2000 Actual Emissions (tons/yr)	125.14	49.58	72.71	38.29	3.34	3.31
Estimated Peak Rocky Point Emissions (tons/yr)[b]	52.76	3.87	16.33	1.52	3.20	3.20
Excess Permitted Emissions (tons/yr)[c]	163.74	24.93	91.28	6.53	11.48	11.38
Platform Hermosa[a]						
Total Permitted Emissions (tons/yr) [PTO 9104]	109.35	69.00	90.46	40.04	9.42	9.23
2000 Actual Emissions (tons/yr)	52.57	40.11	41.20	23.84	4.02	3.97
Estimated Peak Rocky Point Emissions (tons/yr)[b]	46.72	5.67	23.57	1.52	3.21	3.21
Excess Permitted Emissions (tons/yr)[c]	10.05	23.21	25.69	14.68	2.19	2.05
Platform Hidalgo[a]						
Total Permitted Emissions (tons/yr) [PTO 9105]	111.19	50.35	69.76	31.32	9.31	9.16
2000 Actual Emissions (tons/yr)	52.99	27.41	35.37	26.35	5.14	5.10
Estimated Peak Rocky Point Emissions (tons/yr)[b]	46.72	5.67	23.57	1.52	3.21	3.21
Excess Permitted Emissions (tons/yr)[c]	11.48	17.27	10.82	3.45	0.96	0.85
Supply Boats						
Total Permitted Emissions (tons/yr) [PTOs 9103, 9104, 9105]	76.24	3.99	16.67	8.18	6.79	6.51
2000 Actual Emissions (tons/yr)	21.85	1.32	5.25	2.49	2.16	2.04
Estimated Peak Rocky Point Emissions (tons/yr)[d,e]	44.18	2.32	9.61	4.68	3.90	3.74
Excess Permitted Emissions (tons/yr)[c]	10.21	0.35	1.81	1.00	0.73	0.73

a. Supply, Crew and Emergency Response vessel emissions not included.
b. Assumes drilling for 12 months and that muds are injected at the platform.
c. The excess permitted emissions = total permitted emissions-2000 actual emissions-estimated peak Rocky Point emissions. For Platform Harvest and Hidalgo, the peak Rocky Point emissions occur well in the future when the actual Point Arguello emissions should be lower. Therefore, the excess permitted emissions will most likely be greater for these two platforms.
d. Boat emissions are from SB County line to the platforms, consistent with Total Permitted Emissions from the PTOs.
e. Assumes 2 supply boat trips per week in addition to what is currently occurring for the Point Arguello Field operations. It is likely that supply boat trips would be shared between the two projects. This would serve to reduce the estimated Rocky Point emissions.

4.2.2.2 Mitigation Measures

Impact No. 1. NO_x and ROC emissions from offshore platforms and support activities may contribute to violations of the ozone standard.

Mitigating Measure: The existing Point Arguello Project provides emission offsets for the maximum allowable project emissions. The increase in emissions due to the drilling rig operations for Rocky Point would be covered by the existing emission offsets in place for the offshore turbines on the Point Arguello platforms. No additional emission offsets should be needed for these incremental emissions. It also appears that the increased supply boat trip emissions can be covered by the existing offsets that are in place for the supply boats. Additional offsets and BACT may be needed for the fugitive emissions associated with some of the 20 new production wells.

4.3 Public Safety

The public safety impacts are related to the injection of the produced gas at the platforms. For this analysis it has been assumed that a portion of the Rocky Point gas will be injected at Platform Harvest or Hidalgo. The portion the will be injected will the that in excess of what is needed for platform fuel use and sales gas to shore.

4.3.1 Public Safety Setting

The Point Arguello Project is currently injecting all of the produced gas back into the reservoir. As part of the Reconfiguration 1 project a detailed risk assessment was conducted to address the public safety impacts associated with gas injection. Based upon current and projected oil and gas production rates, it has become feasible to process oil offshore and inject gas back into the reservoir at Platforms Harvest and Hidalgo.

In 1994, Chevron conducted a gas re-injection study for the Point Arguello Field. This study was required as part of the Tri-Party Agreement between Chevron, the Minerals Management Service and the County of Santa Barbara. This study showed that, for the full gas re-injection case, there was a significant safety impact associated with a possible fitting break on the gas re-injection wellhead system (Scenario FGR-2).

The current gas injection differs significantly from the system originally proposed as part of Chevron's Gas Re-injection Feasibility Study. The changes result from lower than expected gas production rates, which have allowed for the utilization of existing compressors and piping on Platform Harvest. Table 4.25 provides a summary of the differences between the original gas injection project, evaluated in the Gas Re-Injection Study (1994), and the current gas injection program.

Table 4.25 Changes in Design Basis for Point Arguello Field Gas Re-Injection

Parameter	Gas Re-injection Study (1994)	Current Gas Injection
Gas Production Rates	60+ MMSCFD for remainder of field life.	Currently 10 to 20 mmscfd declining to 5 to 10 mmscfd.
New Injection Equipment Requirements	Power turbines, injection compressors, gas lift compression and flare tip.	None. Injection would utilize existing compressor and injection line.
Platform Injection Equipment Operating Conditions	3,500 psig	2,700 psig
Platform Injection Equipment Design	Pipe sizes ranging from 2 to 6 inches.	Utilizes existing 2-inch collection and injection piping.
Platform Injection Equipment Location	Wellhead level.	Below 70' Mezzanine level, protected by overhead grating and decking, and away from overhead levels.

MMSCFD = million standard cubic feet per day; psig = pounds per square inch absolute

Figure 4-7 shows the risk matrix for the offshore hazard scenarios that were evaluated in the 1994 Gas Re-Injection Study and the current gas injection. In Figure 4-7, the base case scenarios (i.e., no gas injection) are presented by code PFB, the 1994 full gas re-injection scenarios are presented by code FGR, and the current gas injection scenarios are presented by code RFR.

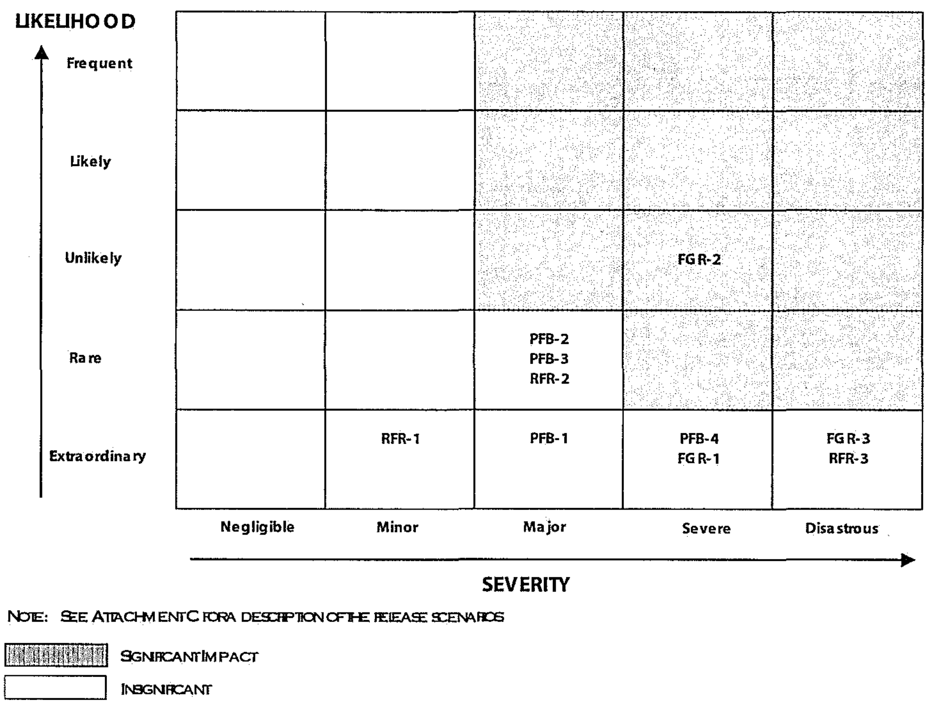
As Figure 4-7 shows, the base case (i.e., no gas injection) scenarios do not have an impacts that would be classified as significant, based upon the County of Santa Barbara risk matrix. The 1994 full gas re-injection alternative has one impact (FGR-2) that would be classified as significant. However, under the current gas injection project, this scenario would have a lower potential failure rate, as well as lower consequences. As a result, potential impacts associated with the current gas injection scenario (RFR-2) are less than significant.

The reductions in failure rates and consequences for injection scenario RFR-2 are a result of the following:

1. Lower gas injection pressures than previously required.
2. Lower gas injection volume than originally proposed.
3. Smaller and less piping required for gas injection.
4. The existing gas compressor is located below the mezzanine level, which is more remote from the location of the crew and other activities that could lead to a release and/or exposure.

The reader is referred to Attachment E for a complete copy of the risk assessment that was conducted for gas injection at the Point Arguello Unit.

Figure 4-7 Offshore Platform Hazard Scenario Risk Ranking Matrix



It is not anticipated that any new infrastructure will be needed to handle this volume of gas. The existing gas injection capacity for Point Arguello should be sufficient. Since the Rocky Point Unit development will not require any new infrastructure, the public safety impacts will not increase over what exists for the Point Arguello Project, which is considered part of the environmental baseline. Therefore, there will be no new public safety impacts associated with the Rocky Point Unit development.

Given there are no new public safety impacts associated with the Rocky Point Unit development, there are no mitigation measures required.

4.4 Oil Spill Risk

Oil spill risks described in the Development Plan EIR/EIS for the Point Arguello Field and Gaviota Process Facility were evaluated with respect to their applicability to the proposed Rocky Point Unit project. The category of impacts described in the Point Arguello Field DP EIR/EIS and those anticipated from Rocky Point are compared in Table 4.26. Activities that are proposed for Rocky Point have essentially been analyzed in the Point Arguello Field DP.

Table 4.26 Comparison of Oil Spill Risk Contained in the Arguello Project DP EIR/EIS and Additional Risks Potentially Caused by the Proposed Rocky Point Project

Impact/Issue	Addressed in Arguello Project DP EIR/EIS	Additional Impact Caused by Rocky Point
Potential for offshore oil spill from platform and offshore pipeline.	Yes	The Rocky Point Unit development will increase the likelihood of an oil spill over what is currently occurring for the Point Arguello Field due to the addition of up to 20 new wells. The 1984 EIR/EIS evaluated production rates of up to 250,000 bbls per day, and estimated a total production level of approximately 500 million barrels of oil. With the addition of the Rocky Point Unit, peak production levels will be around 30,000 bbls per day, and the total recovered reserves from the combined Rocky Point and Point Arguello will be some where around 170 million barrels. Therefore, the addition of the Rocky Point Unit is well within what was analyzed in the 1984 EIR/EIS for the Point Arguello Field. In addition, the 1984 EIR/EIS evaluated the drilling of 154 wells on the three Point Arguello platforms. With the Rocky Point Development the total number of wells drilled will be less than 100. Here again, the number of wells to be drilled for the combined Rocky Point/Point Arguello Units, is well under what was evaluated in the 1984 EIR/EIS.

The remainder of this section discusses the likelihood of an oil spill occurring, the expected range of spill volumes, and the probability of spilled oil impacting various land segments. The first part of this section presents the oil spill setting, which covers the existing Point Arguello platforms and pipeline. The second part discusses the incremental oil spill risks associated with the Rocky Point Unit development. The impacts from a spill are discussed in the Marine Resources Section.

4.4.1 Oil Spill Risk Setting

This section is broken down into two parts. The first part discusses the oil spill probability for the Point Arguello Field. The second part discusses the estimated worst-case oil spill volume for the Point Arguello Field.

4.4.1.1 Oil Spill Probability

The MMS has developed an approach for estimating the oil spill occurrence, normalized as a function of total oil handled (Anderson, *et al.*, 1994). This analysis is based upon the actual spills that have occurred for offshore platforms and pipelines for the period 1964-1992. Table 4.27 provides the OCS platform and pipeline spill rates for the period 1964-1992.

Table 4.27 OCS Platform and Pipeline Spill Rate, 1964-1992

US OCS Spills	Number of Spills	Median Spill Size (bbls)	Spill Rate (spills per 10^9 bbls)
Spills Greater than or Equal to 1,000 bbls			
Platforms	11	7,000	0.45
Pipelines	12	5,600	1.35
Spills Greater than or Equal to 10,000 bbls			
Platforms	4	41,500	0.16
Pipelines	4	17,700	0.44

Source: Comparative Occurrence Rate for Offshore Oil Spills, Anderson and La Belle, MMS.

Using the data provided in Table 4.27 estimated oil spill probabilities were generated for the Point Arguello Field. These spill probability estimates are shown in Table 4.28, and are based upon the remaining life of the Point Arguello Field (2000-2015). The Point Arguello Field is expected to continue production until 2015. From the beginning of the year 2000 until the end of the field productive life, it is expected to produce approximately 55 million barrels of oil.

Table 4.28 Oil Spill Probability Estimates for the Point Arguello Unit (2000-2015)

Location	Oil Spill Probability (chance of one or more spills)	
	Spills Greater than or Equal to 1,000 bbls	*Spills Greater than or Equal to 10,000 bbls*
Platforms	2.5%	0.9%
PAPCO Pipeline	7.2%	2.4%

See Attachment H for detailed calculations of oil spill probabilities.

These oil spill probability estimates are based upon historical data of oil spills from OCS facilities and the total production from these facilities. This data is combined to generate a spill rate as a function of total oil production. This method of estimating spill rates is useful to evaluate the likelihood of an oil spill in general from OCS facilities. However, when looking at a specific project, spill probabilities are typically generated based upon equipment failure rate, which allow one to account for variations in project-specific designs. For example, projects that have a large number of oil handling vessels on a platform would have a higher probability of an oil spill since there is more equipment that could fail. The 1984 EIR/EIS for the Point Arguello Field developed project-specific estimates of the frequency of an oil spill release greater than or equal to 1,000 barrel from the platform equipment. Using this data, the probability of an oil spill greater than or equal to 1,000 bbls would be 1.7% during the period of 2000 through 2015. This value is slightly lower than the 2.5% estimated using the MMS spill data, which is based upon total oil production.

The 1984 EIR/EIS for the Point Arguello Field developed a specific failure rate for the offshore portion of the PAPCO pipeline. The EIR/EIS estimated the failure rate for this pipeline at 4.8×10^{-3}/yr. This would give a probability of an oil spill greater than or equal to 1,000 bbls over the next 15 years (2000 through 2015) of 7.2% which is the same as estimated using the MMS spill data, which is based upon total oil production.

4.4.1.2 Worst-Case Oil Spill Volume

In estimating the worst-case oil spill from the Point Arguello platforms, the three spill categories described in 30 CFR 254.47 were used. These three categories include the following:

- The maximum capacity of all oil tanks and flow lines;
- The volume of oil from a break in a pipeline connected to the facility considering factors which may affect amount; and
- The daily production volume of oil that would flow from the highest capacity well at the facility.

Table 4.29 provides a summary of the worst-case oil spill volumes for the existing Point Arguello platforms. Attachment G contains the detailed calculations for these spill volume estimates.

Table 4.29 Point Arguello Platform Worst-Case Oil Spill Volumes – Point Arguello Unit Only

	Worst-Case Spill Volume (barrels of dry oil)		
Source	Platform Hermosa	Platform Harvest	Platform Hidalgo
Oil Vessels and Piping on the Platform	2,509	2,908	1,336
Well Blowout[1]	1,070	5,000	973
Offshore Pipelines	2,217	292	500
Maximum Oil Spill Volume	5,796	8,200	2,809

1. This represents the daily production volume of oil that would flow from the highest capacity well on each of the platforms (30 CFR 254.47).
2. Attachment G provides the detailed calculations for the worst-case oil spill volumes.

The maximum oil spill volume from each platform including the offshore pipelines would be 5,796 bbls of dry oil for Hermosa, 8,200 bbls of dry oil for Harvest and 2,809 bbls of dry oil for Hidalgo.

The largest oil spill volume for the offshore pipelines would be associated with the PAPCO pipeline from Platform Hermosa to shore. This has an estimated spill volume of 2,217 bbls of dry oil. The 1984 EIR/EIS for the Point Arguello Field estimated the PAPCO worst-case spill volume at 7,600 bbls of dry oil. The estimated worst-case spill volume for the PAPCO pipeline has been reduced due to a number of factors.

- The 1984 EIR/EIS assumed a throughput for the PAPCO pipeline of 200,000 bbls per day of dry oil. The current maximum throughput is approximately 46,570 bbls per day of dry oil based upon the maximum capacity of one oil shipping pump at Platforms Hermosa and Harvest. This reduces the discharge rate from 139 bbls per minute to 32.3 bbls per minute of dry oil.

- The 1984 EIR/EIS assumed a 10-minute pumping time between when the pipeline rupture occurred and when the oil shipping pumps were shut down. The EIR/EIS analysis was based upon the assumption that operator intervention was required to shut down the oil shipping pumps in the event of a pipeline rupture. The actual PAPCO oil spill leak detection system will automatically shut down the oil shipping pumps and close the valves at the platforms, with no operator intervention, in the event of a pipeline rupture. This reduces the shut down time for the oil shipping pumps from 10 minutes to 5.75 minutes. This change reduces the pumping discharge volume from 1,390 bbls of dry oil to 186 bbls of dry oil, taking into account the lower pipeline throughput. The shut down time is based upon five minutes to detect the rupture, and 45 seconds to shut the pumps down and close the valves. It is a regulatory requirement that the pumps shut down and valves close within 45 seconds of being activated.

- The 1984 EIR/EIS assumed an operating pressure for the PAPCO pipeline of 1,480 psig. The current maximum operating pressure of the PAPCO pipeline is 1,300 psig. This change reduced the losses due to compressibility (i.e., density change) and pipeline diameter change. Another factor that affects compressibility is the amount of gas dissolved in the oil. The 1984 EIR/EIS assumed the oil has some level of dissolved gas, which increases the compressibility of the oil. However, today the oil is stabilized offshore before entering the PAPCO pipeline, which serves to reduce the amount of dissolved gas in the oil. The 1984 EIR/EIS estimated this value to be equal to the pumping losses (1,390 bbls of dry oil). For this analysis the oil losses due to compressibility and pipeline diameter were calculated to be 225 bbls of dry oil.

- The 1984 EIR/EIS estimated the perculation and hydrostatic head losses from the PAPCO pipeline due to density differences between the seawater and the oil to be 4,800 bbls of dry oil. This number was based upon a preliminary elevation profile of the pipeline and assumed a water cut in the oil of 20 percent. Based upon the actual elevation profile of the PAPCO pipeline and the actual water cut of approximately one percent, the perculation and hydrostatic head losses have been estimated to be 1,807 bbls of dry oil.

The MMS developed the Oil Spill Risk Analysis (OSRA) model in 1975 as a tool to evaluate offshore spill risks (Smith *et al.*, 1982). This model is used to develop probabilistic estimates of oil spill occurrences and contact with land. The OSRA model has recently been updated by the MMS and was used for this analysis. The results from the OSRA model show that an oil spill from the Point Arguello platforms or the PAPCO pipeline would most likely travel to the southeast or west, with lower probabilities of the oil going west or north. Attachment F provides the output from the OSRA model for each of the Point Arguello platforms and the PAPCO pipeline. This attachment presents 10 day and 30 day probabilities of shoreline impact. The results of the updated OSRA model agree with the trajectories presented in the Oil Spill Contingency and Emergency Response Plan for Point Arguello.

The oil spill risk analyses described in this evaluation were performed using the MMS numerical (OSRA) model for the SBC area. It calculates probabilities of shoreline impact after applying a drift equivalent to 3% of the prevailing wind velocity in its trajectory computations. Because of the heavy influence of southward-directed winds near Point Conception, the model results indicate that the probability of shoreline impacts along the Channel Islands to the south is far higher than at sites along the central coast to the north. The influence of southward directed winds in the model effectively overcomes the northwestward surface currents observed over much of the year in the field programs. This contrasts with SBC-SMB CCS drifters which tend to travel toward the south only about 31% of the time and only about 15% of these intersect the shoreline (Browne, 2000). In Browne's analysis, northward transport has a slight edge with 32% of the trajectories traveling to the north and contacting the coast about 23% of the time.

Clearly, the complexity of opposing winds and currents near the project area makes the reconciliation between OSRA model results and observations difficult. Because the applicability of the "*3% wind rule*" in complex coastal flow regimes has not been rigorously quantified, this environmental evaluation should entertain the possibility for spilled oil to travel from the project area toward the north and into the SMB.

Similarly, the environmental evaluation for the proposed project should not rely solely on shoreline impact probabilities determined exclusively from available drifter trajectories. Drifters, with their measurable mass and finite vertical profile below the sea surface, cannot capture the behavior of an oil slick that is typically only a few millimeters thick (Reed *et al.*, 1988). Furthermore, dispersion and weathering affects the spread of oil on the sea surface, and buoys cannot capture the changing slick dynamics across a wide range of winds, waves, and currents. Goodman *et al.* (1995) and Simecek-Beatty (1994) tested the oil-tracking ability of several drifter designs, including the Davis *et al.* (1982) design used in the SBC-SMB CCS study. They found that Davis-type drifters lagged behind simulated oil slicks presumably because they are optimized to track surface currents with minimal influence by winds and waves. In cases where winds opposed surface currents, the Davis-type drifters moved into the prevailing wind and in a direction opposite of the simulated oil slicks made from wood chips. This is similar to the case in the project area where the northward-flowing Davidson current often opposes the prevailing southward-directed winds.

Since the Point Arguello Project is an existing operation, these oil spill risks are considered to be part of the baseline.

4.4.2 Project Oil Spill Risk

This section of the document discusses the oil spill probability and worst-case oil spill volumes associated with the Rocky Point Unit development. The impacts associated with these spills and any associated mitigation measures are discussed in the Marine Resource section of the document.

4.4.2.1 Oil Spill Probability

Using the data provided in Table 4.27 estimated oil spill probabilities were generated for the Rocky Point Unit Development. These spill probability estimates are shown in Table 4.30 and are based upon a 12 year life for the Rocky Point Unit.

Table 4.30 Oil Spill Probability Estimates for the Rocky Point Unit (2001-2012)

Location	Oil Spill Probability (chance of one or more spills)	
	Spills Greater than or Equal to 1,000 bbls	*Spills Greater than or Equal to 10,000 bbls*
Platforms	1.5%-2.2%	0.6%-0.8%
PAPCO Pipeline	4.6%-6.5%	1.5%-2.2%

Low value of the range is for a total oil production from Rocky Point of 35 million barrels. The high value of the range is for a total oil production of 50 million barrels.
See Attachment H for detailed calculations of oil spill probabilities.

The Rocky Point Unit development will increase the likelihood of an oil spill over what is currently occurring for the Point Arguello Field due to the addition of 20 new wells and the increase production volume that will be handled by the three Point Arguello platforms , as well as the PAPCO pipeline. These represent a very minor increase in oil spill risk for the Point Arguello platforms and the PAPCO pipeline.

It is also questionable whether this increase in oil production would really increase the probability of an oil spill once the risk of a blowout is gone. As discussed above for the Point Arguello Field, failure rates for pipelines and equipment is typically based upon failures per year, which for the most part are independent of throughput. If one used the failure rate analysis contained in the 1984 EIR/EIS for the Point Arguello Field to estimate the probability of an oil spill from the Rocky Point Unit development, the only increase would be to a well blowout. All other platform equipment and pipeline failure rates are independent of throughput.

The 1984 EIR/EIS estimated that a well blowout during drilling, which led to an oil spill, would occur at a rate of 1 per 1,162 wells drilled (1 blowout per 200 wells drilled, with 17.2% of blowouts leading to an oil spill). This would translate into a probability of blowout that leads to an oil spill during drilling of 1.2% for the Rocky Point Unit. For well blowouts that lead to an oil spill during production, the 1984 EIR/EIS used an estimated value of 1 per 11,628 well-years (1 blowout per 2,000 well-years, with 17.2% of blowouts leading to an oil spill). This would give a probability of a blowout that leads to an oil spill during production of 0.6% for the Rocky Point Unit. Using the 1984 Point Arguello Field EIR/EIS failure rates, the increase in probability of an oil spill due to the Rocky Point Unit development would be 1.8% during the first five years of production. (This includes the four years of drilling and the first five years of production when the wells are expected to flow under natural pressure.) After the first five years of production, the Rocky Point Unit development would not be expected to increase the oil spill risk for the Point Arguello facilities.

4.4.2.2 Worst-Case Oil Spill Volume

Using the same methodology discussed above for the Point Arguello platforms, the new worst-case oil spill volumes that could be generated from the Rocky Point Unit development are associated with a well blowout during the first five years when the wells are flowing under natural pressure. It has been estimated that wells from the Rocky Point Unit development will have a maximum flowrate of 2,500 bbls per day of dry oil. 30 CFR 254.47 states that the maximum spill volume from a well is based upon the daily production from the highest flowing well. Table 4.31 provides a summary of the worst-case oil spill volumes for the existing Point Arguello platforms with both the Point Arguello and Rocky Point Units. Attachment G contains the detailed calculations for these spill volume estimates.

Table 4.31 Point Arguello Platform Worst-Case Oil Spill Volumes – Point Arguello and Rocky Point Units

	Worst-Case Spill Volume (barrels of dry oil)		
Source	**Platform Hermosa**	**Platform Harvest**	**Platform Hidalgo**
Oil Vessels and Piping on the Platform	2,509	2,908	1,336
Well Blowout[1]	2,500	5,000	2,500
Offshore Pipelines	2,217	292	500
Maximum Oil Spill Volume	7,226	8,200	4,336

3. This represents the daily production volume of oil that would flow from the highest capacity well on each of the platforms (30 CFR 254.47).
4. Attachment G provides the detailed calculations for the worst-case oil spill volumes.

The Rocky Point Unit development would increase the maximum oil spill volume of Platforms Hermosa and Hidalgo. Platform Hermosa would increase from 5,796 bbls per day of dry oil to 7,226 bbls per day of dry oil. Platform Hidalgo would increase from 2,809 bbls per day of dry oil to 4,336 bbls per day of dry oil. This increase would only last for the first five years of Rocky Point production, when the wells are flowing under natural pressure. After the first five years, the maximum oil spill volume for Platforms Hermosa and Hidalgo would return to no more than their current values. The maximum oil spill volume for Platfrom Harvest would not increase with the Rocky Point Unit development because the current highest flowing well is greater than what is expected for Rocky Point wells (5,000 bbls/day vs 2,500 bbls/day).

The worst-case spill volume for the offshore portion of the PAPCO pipeline would remain the same with or without the Rocky Point Unit development. This is due to a number of factors.

- The worst-case oil spill from the PAPCO pipeline is based upon the maximum oil shipping pump discharge rate of 46,570 bbls per day of dry oil, which is greater than the combined production of Point Arguello and Rocky Point.

- All of the other elements that make-up the worst-case oil spill volume from the PAPCO pipeline are based upon the volume of the pipeline and the density of the oil, which will not change significantly as a result of the Rocky Point Unit development.

The oil spill trajectory analysis discussed above for the Point Arguello project would be the same with the Rocky Point Unit development since the release locations are the same (see Attachment F).

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