

STATE OF ALASKA
ALASKA OIL AND GAS CONSERVATION COMMISSION
333 West 7th Avenue, Suite 100
Anchorage, Alaska 99501

Re: THE REQUEST OF UNION OIL) Aquifer Exemption Order No. 11
COMPANY of CALIFORNIA for an)
Aquifer Exemption Order for portions of) Sterling and Beluga Formations
the Deep Creek Unit in Township 2) Deep Creek Unit
South, Range 13 West, Seward Meridian,)
Kenai Peninsula.) December 7, 2004

IT APPEARING THAT:

1. Union Oil Company of California (“UNOCAL”) submitted an application for aquifer exemption order dated August 4, 2004, for portions of 15 governmental sections within the Deep Creek Unit (“DCU”) on the Kenai Peninsula (within Township 2S, Range 13W, Seward Meridian);
2. The Alaska Oil and Gas Conservation Commission (“Commission”) published a public hearing notice in the Anchorage Daily News on August 6, 2004, with a tentative hearing date of September 16, 2004;
3. Cook Inlet Keeper, a membership based watershed protection organization, requested a public hearing and a one-week extension of the date to file comments by letter dated August 14, 2004, which request was granted;
4. The September 16, 2004 public hearing was continued to September 30, 2004;
5. At the September 30, 2004 hearing, Unocal provided sworn testimony addressing engineering and geologic considerations in support of the DCU aquifer exemption order application; Cook Inlet Keeper provided public comment at the hearing; and following the hearing the record was held open to allow Unocal and Cook Inlet Keeper to provide certain additional information and clarifications requested by the Commission;
6. On October 5, 2004 Unocal amended its request for an aquifer exemption, contracting the proposed aquifer exemption area within Township 2S, Range 13W of the Seward Meridian to:
 - A one quarter mile radius around the NNA #1 well in Section 11;
 - All of Section 22 which includes the existing Happy Valley development drillsite and associated wells;
 - The southeast one-quarter of Section 15; and
 - All of Section 21;

7. Cook Inlet Keeper provided technical and process questions by letter dated October 7, 2004, and included as an attachment a letter from the Ninilchik Traditional Council concerning protection of ground water resources in the vicinity of DCU and depth of drinking water wells;
8. The Commission has jurisdiction in this matter under AS 31.05.030(h), 20 AAC 25.440, and 40 CFR 147, Subpart C – Alaska;
9. The Commission submitted a copy of Unocal’s Aquifer Exemption application and related documents to the U.S. Environmental Protection Agency, Region 10, (“EPA Region 10”) on October 15, 2004 and a draft of this aquifer exemption order was sent to EPA Region 10 on October 26, 2004;
10. In correspondence dated November 19, 2004, EPA Region 10 concurred with the proposed aquifer exemption order for the DCU; and
11. Unocal also submitted a Disposal Injection Order (“DIO”) application for converting the near vertical well NNA No. 1 to disposal service within the DCU. This application was received October 4, 2004 and public review was initiated October 8, 2004.

FINDINGS:

1. Extent of Aquifer Exemption Area.¹

The Deep Creek Unit (“DCU”) is located on the Kenai Peninsula approximately six miles southeast of the city of Ninilchik, Alaska. Development operations are underway to begin regular gas production from the Happy Valley drillsite by the end of 2004. There are two plugged and abandoned oil exploratory wells, one shut in gas exploratory well, and ten delineation and production gas wells that have been drilled in the DCU. As noted in the DIO application, the Unocal NNA No.1 well located on a pad approximately two miles north of the Happy Valley gas production pad is proposed for conversion to disposal injection service. Supporting data have been provided in the record for an aquifer exemption covering an area within Township 2S, Range 13W, Seward Meridian, specifically described as:

- A one quarter mile radius around the NNA #1 well in Section 11;
- All of Section 22 which includes the existing Happy Valley development drillsite and associated wells;
- The southeast one-quarter of Section 15; and
- All of Section 21.

¹ All depths noted in this Order are true vertical depth (“TVD”) below ground level.

2. Geology and Groundwater Hydrology.

The stratigraphic column on the Kenai Peninsula includes clastic rocks of Quaternary through Tertiary age that lie unconformably on top of Mesozoic Age basement rocks. Glacial Pleistocene shallow sand and gravel reservoirs serve as underground sources of drinking water for much of the Kenai Peninsula and are locally over 800 feet thick. Current control from oil and gas wells within the DCU indicates these fresh water aquifers may range to a depth of 1,000 feet in the vicinity of the NNA No. 1 and Happy Valley drill sites. Gravel rich deposits with very desirable aquifer properties range to 300 feet deep in this area. The value of this aquifer system has long been recognized and hydrocarbon exploration and production wells on the Kenai Peninsula have been cased and cemented across this freshwater zone during drilling operations to avoid any possibility of contamination.

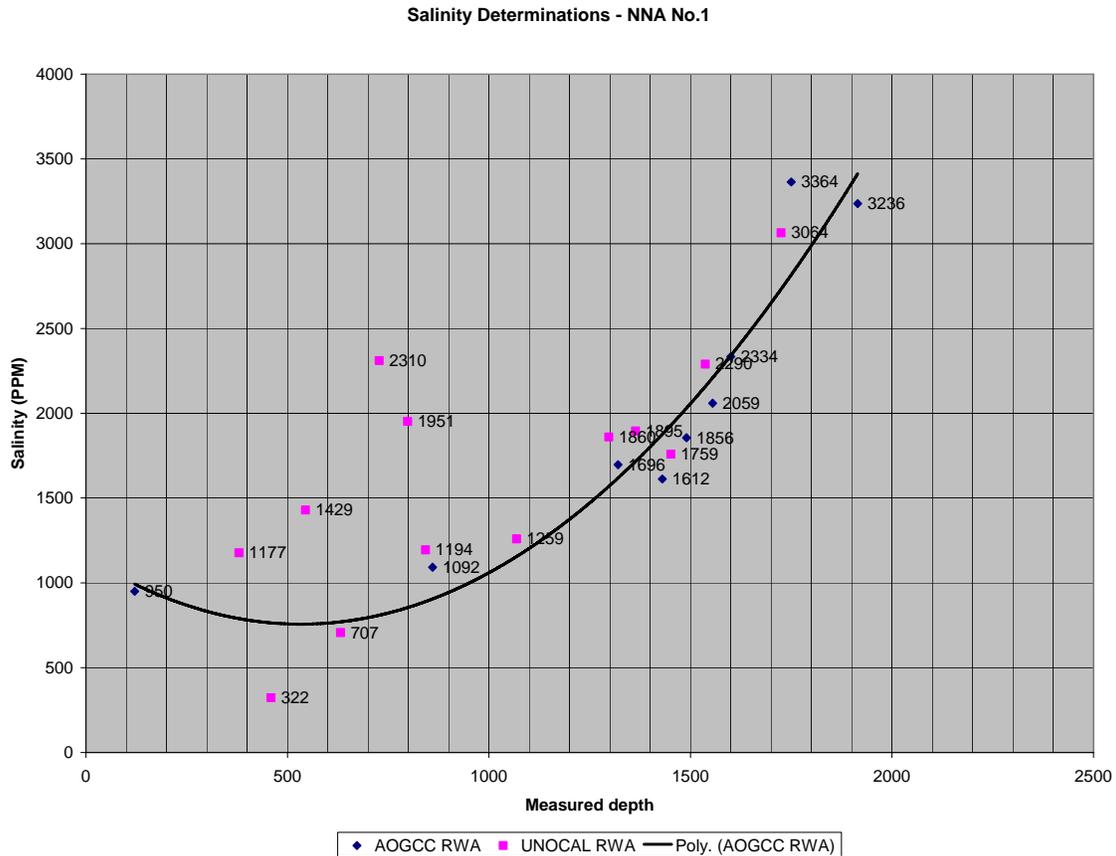
Below this freshwater zone lies the Kenai Group that includes the Beluga and Tyonek formations, mainly consisting of a series of reservoir and non-reservoir lacustrine and fluvial-derived rocks.

The Beluga Formation is several thousand feet thick and occurs at depths greater than 2,000 feet in the DCU. This formation is comprised of thinly laminated sandstones, siltstones, shales and coals. Individual sandstone beds within the Beluga Formation are generally less than 30 feet thick, resulting in a heterogeneous sequence of rocks with very poor or no vertical connectivity or permeability. In the area considered for aquifer exemption, the top of the Beluga Formation is at a depth of approximately 2,400 feet and marked by locally continuous, 75-foot thick shale. The entire Beluga Formation interval can be expected to act as a confining zone for the underlying Tyonek Formation.

3. Formation Water Salinity.

Well logs from two DCU wells provide data for formation water salinity calculations: the Deep Creek No.1 (drilled 1958 within Section 15) and the NNA No.1 (drilled 2001 within Section 11). Formation water salinities calculated by a third party contract petrophysicist working for Unocal used estimation techniques described in EPA guidance document "Survey of Methods to Determine Total Dissolved Solids Concentrations", (KEDA Project No. 30-956). A comparison with a produced water sample from the Tyonek Formation in the Unocal NNA No. 1 well showed good agreement with the log derived values. The results of this work indicate formation water salinities in the DCU are greater than 3,000 ppm and less than 10,000 ppm at depths greater than 1,800 feet.

The Commission independently verified Unocal's analysis using data from the NNA No. 1 well, chosen because of its good data quality. The Commission analysis also utilized the EPA methodology. Comparing the results of Unocal and Commission analyses demonstrates good agreement (see graph "Salinity Determinations – NNA No.1; the correlation line in the graph is a second order polynomial fit to the Commission salinity calculations.)



Findings from the Commission's analysis of DCU salinity data are as follows:

- a. Drinking water in the area comes largely from glacial sediments in this area.
- b. Below a depth of approximately 1,000 feet, water salinities increase uniformly to a value of approximately 3,000 ppm at 1,800 feet.
- c. The transition from consistently low salinities below 1,000 feet to continuously increasing salinities above 1,000 feet indicates a lack of hydraulic connectivity between the two formation water salinity regimes.
- d. The salinity trend shown in the graph conforms to known stratigraphic conditions in the DCU area, with low salinity formation waters occurring in Glacial Pleistocene and possibly minor portions of the Upper Sterling Formation sediments.

4. Suitability of DCU Sediments Below 1,800 feet as Drinking Water Aquifers.

Regulation 20 AAC 25.440 (a)(1)(B)“Freshwater Aquifer Exemption” provides that the Commission may grant a aquifer exemption regardless of salinity if the aquifer “is situated at a depth or location that makes recovery of water for drinking purposes economically or technologically impractical”. Unocal has presented three reasons in support of an aquifer exemption below 1,800 feet.

First, the area has plentiful groundwater available from the surface to a depth of approximately 1,000 feet with the most permeable and therefore desirable sediments within 300 feet of the surface. Using the NNA No.1 well as a geographic datum, information about water wells available from the Department of Natural Resources is summarized in the following table:

Water Well Depth		
Depth	Within 10-miles of NNA No. 1	Within approximately 2-miles of NNA No. 1
Average	88 ft	47 ft
Maximum	292 ft	50 ft
Minimum	0 ft	45 ft
No. of Wells	87	3*

* 3 water wells are slightly more than 2 miles from the NNA No. 1.

In a post hearing submittal, Mr. Bruce Oskolkoff, Environmental Program Director for the Ninilchik Traditional Council, has asserted that some water wells in the vicinity of the DCU exist to a depth of 800 feet.

Second, the groundwater below 1,800 feet depth is predominately between 3,000 and 10,000 ppm total dissolved solids. Given the demonstrated abundance of drinkable water at shallow depths, recovery of drinking water with such quality from below 1,800 feet is highly impractical due to drilling and treatment costs.

Third, mud logs from wells drilled to date in the DCU show that hydrocarbon gas, primarily methane, occurs in increasing quantities (non-commercial) throughout the Kenai Group below depths of 1,300 feet. The presence of gas below 1,300 feet in the DCU is due to trapping of the gas within the DCU anticlinal structure. This is demonstrated by wells that are high on the structure having greater methane concentrations than those on the flanks of the anticline.

CONCLUSIONS:

1. Those portions of freshwater aquifers occurring below approximately 1,000 feet within the DCU do not currently serve as a source of drinking water. All known and foreseeable ground water consumption from the DCU vicinity is consistent with usable ground water resources occurring above 1,000 feet;

2. Those portions of freshwater aquifers occurring below 1,800 feet within the DCU contain salinities and hydrocarbon gases, and are situated at depths that make recovery of these waters for drinking water purposes economically impractical;
3. Those portions of aquifers occurring below 1,800 feet within the DCU cannot reasonably be expected to serve as underground sources of drinking water; and
4. Those portions of aquifers occurring within a ¼ mile radius around the NNA No. 1 wellbore in section 11, the S.E. 1/4 of Section 15, all of Section 21 and all of Section 22 in T2S, R13W, Seward Meridian and below 1,800 feet qualify as exempt freshwater aquifers under 20 AAC 25.440(a)(1)(A), 20 AAC 25.440(a)(1)(B), and 20 AAC 25.440(a)(2).

NOW, THEREFORE, IT IS ORDERED THAT the aquifers or portions of aquifers occurring below 1,800 feet TVD in the following areas within T2S, R13W, Seward Meridian, are exempt as provided by 20 AAC 25.440:

- A one quarter mile radius around the NNA No.1 well in Section 11;
- All of Section 22 which includes the existing Happy Valley development drillsite and associated wells;
- The southeast one-quarter of Section 15; and
- All of Section 21.

Note that this Order does not authorize the injection of any fluids within the exemption area; and, the Commission will require the applicant to demonstrate the existence of an adequate confining layer above the zone of proposed injection before authorizing any injection of fluids into the exempt area.

DONE at Anchorage, Alaska, and dated December 7, 2004.

John Norman, Chairman
Alaska Oil and Gas Conservation Commission

Daniel T. Seamount, Jr., Commissioner
Alaska Oil and Gas Conservation Commission

AS 31.05.080 provides that within 20 days after receipt of written notice of the entry of an order, a person affected by it may file with the Commission an application for rehearing. A request for rehearing must be received by 4:30 PM on the 23rd day following the date of the order, or next working day if a holiday or weekend, to be timely filed. The Commission shall grant or refuse the application in whole or in part within 10 days. The Commission can refuse an application by not acting on it within the 10-day period. An affected person has 30 days from the date the Commission refuses the application or mails (or otherwise distributes) an order upon rehearing, both being the final order of the Commission, to appeal the decision to Superior Court. Where a request for rehearing is denied by nonaction of the Commission, the 30-day period for appeal to Superior Court runs from the date on which the request is deemed denied (i.e., 10th day after the application for rehearing was filed).