

Polychlorinated Biphenyl
(PCB)

Removal from the Kenai National Wildlife Refuge, Alaska
October 1984 and 1988

by
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Presented: National Meeting of Environmental Contaminants Activity
Portland, Oregon
March 1988

Swan River Field PCB Remediation

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INTRODUCTION

Atlantic Richfield Company currently operates oil and gas production facilities at the Swanson River Field, which occupies 14 square miles on federal leases in the Kenai National Wildlife Refuge. The lease is administered by the Bureau of Land Management, which is responsible for overseeing all drilling and production activities. The U.S. Fish and Wildlife Service (Service) administers the use, conservation, and protection of the land and the environmental and biological resources within the Refuge.

History of Swanson River Field

The Swanson River Oil Field, located in the Kenai National Wildlife Refuge about 50 miles southwest of Anchorage, was operated by Chevron USA Incorporated. Chevron Incorporated opened the field in 1957 and have operated through October 1986. The Atlantic Richfield Company has operated the oil field since 1987.

The Swanson River Field includes an administration office and shop buildings, a compressor plant complex, 32 producing oil wells, 7 tank settings for oil and gas collection and transfer operations, pipelines, gas injection facilities, water wells, sand and gravel borrow areas, employee residences, and approximately 25 miles of unpaved roads.

Public vehicular entry to the Swanson River Field is restricted. Public access by foot within the lease boundaries is authorized but use of the roads for foot access is prohibited. Workers on the facility have free access to all areas within the unit boundary.

Summary of Existing Analytical Data

The Service on July 22, 1984, collected a series of preliminary soil samples. Analysis in late December 1984 disclosed polychlorinated biphenyls, certain trace or heavy metals, and DDT. Subsequent sampling and analyses by the Environmental Protection Agency and Chevron confirmed the presence of polychlorinated biphenyls. DDT analysis, however, was inconclusive.

Background of Polychlorinated Biphenyl Contamination

Long before their hazards were known, polychlorinated biphenyls have been used at the Swanson River Field as a component of electrical transformer fluids and as a heat transfer fluid medium in the propane recovery system, which is located at the compressor plant.

Beginning in 1962, an Aroclor 1248 heat transfer oil medium was used in the propane recovery unit's process heat system. A January 1972 explosion at the compressor plant resulted in a release of an undetermined quantity of heat transfer oil. Because the ground around the plant was frozen and snow-covered at the time of the explosion, it is believed that if there was release, most of the oil discharged was contained in snow and surface soils near the scene. Based upon a review of the operational procedures at the time, it is believed that the contaminated snow and soil was deposited into the SCU 14-3 sump.

When the process heat transfer system was brought back into service following the explosion, Therminol FR-1 (Aroclor 1242) was used. In 1976 or 1977, this fluid was replaced with Therminol 66, which does not contain polychlorinated biphenyl. After testing in 1982 identified residual contamination of 381 ppm Aroclor 1242 in the Therminol 66, the system was drained and flushed. The drained fluids from this change-out were shipped to a designated polychlorinated biphenyl disposal site at Arlington, Oregon, and present less than 1 ppm polychlorinated biphenyl is in the system.

During 1971, a sump was established at SCU 14-3 to serve as a central receiving site for oil-contaminated soils from routine production activities. This sump is located approximately one mile from the compressor plant. It is thus likely that polychlorinated biphenyl contamination at SCU 14-3 resulted from the cleanup of contaminated snow and gravel from the 1972 compressor plant explosion. This conclusion is further supported by the identification of Aroclor 1248 as the polychlorinated biphenyls mixture of concern in preliminary sample analyses. Aroclor 1248 was only used at the facility prior to the explosion at the compressor plant (1962-1972). It should be noted that polychlorinated biphenyls were not recognized as a hazardous substance until passage of the Toxic Substances Control Act in 1976.

During 1983 and 1984, oily sand and gravel from SCU 14-3 were used for dust suppression and road maintenance on approximately two miles of road within the Swanson River Field. Permits to use this material were obtained from the Alaska Department of Environmental Conservation for the year 1983 and 1984. The Service subsequently approved the use of the material for the road system. None of the principles associated with Chevron, the Service or the Alaska Department of Environmental Conservation had any knowledge that the material was contaminated with polychlorinated biphenyls.

At the request of the Regional Environmental Coordinator, soil samples were collected in July 1984 and subsequently analyzed at the Service's Patuxent laboratory in Maryland. As soon as the results became known in February 1985, the Regional notified the oil industry, Environmental Protection Agency, Bureau of Land Management and the Alaska Department of Environmental Conservation. Chevron (the oil field operator at the time) and the Environmental Protection Agency each collected and split samples from the areas previously sampled. Analysis results corroborated the Service's earlier findings. Since these initial preliminary findings, polychlorinated biphenyls have been found.

1. Material at Sump SCU 14-3

Samples collected from the material stockpiled at SCU 14-3 range from 10 to 34 ppm polychlorinated biphenyl. Available information indicates that polychlorinated biphenyl-contaminated material from the 1972 incident was most likely deposited here.

2. Parking Lot West of Compressor Building

One split sample collected by the Environmental Protection Agency in the parking lot west of the compressor building and analyzed for Chevron was reported to contain near 5,800 ppm polychlorinated biphenyls.

3. Roads and Other Parking Areas

A soil sample collected near the junction of the compressor station access road with the main road to the compressor ranged above 57 ppm polychlorinated biphenyl. Chevron subsequently sampled a number of road areas, collecting surface and subsurface (3 to 4 inch depth) samples in each location. The analytical results showed that levels of polychlorinated biphenyls in the surface samples were consistently deeper than 4 inches. Average depth of polychlorinated biphenyls has been found to be 12 inches. Soil contamination on some portions of the road range near two feet.

4. Pipeyard

Polychlorinated biphenyl soils in the pipeyard have been found to be near 220,000 ppm.

ORDER BY CONSENT

On August 6, 1985, Chevron became a signatory to an Order by Consent administered by the Service in coordination with the Bureau of Land Management and the Alaska Department of Environmental Conservation and in consultation with the Environmental Protection Agency. Its provisions include a requirement to submit an Interim Mitigation Plan for approval by the Service and the Alaska Department of Environmental Conservation by September 5, 1985, see attachment A.

According to the Order, primary objectives of the Interim Mitigation Plan include:

- o Stabilizing and containing those areas presently known to contain over 12 ppm polychlorinated biphenyl, including the SCU 14-3 sump and stockpile; and

- o Preventing contaminants from migrating into surrounding soil or coming into contact with surface or groundwaters.

Measures identified to achieve these objectives were to be implemented no later than December 31, 1985.

Additional objectives addressed in this Interim Mitigation Plan include:

- o Limiting potential for the public and for wildlife to come into direct contact with the contaminated area (In addition to fencing already in place at SCU d14-3 sump and stockpile area);
- o Implementing interim measures that will be technically feasible and environmentally compatible with final mitigation and restoration activities; and
- o Selecting interim mitigation options that could be implemented within the time constraints imposed under the Order of Consent as well as those posed by seasonal limitations.

SITE IDENTIFICATION

Geology

The lowlands are formed by a tertiary rock formation covered by glacial deposits. The glacial moraine and outwash material covering the bedrock is thick and unconsolidated. The tertiary formation, collectively known as the Kenai Group, is mostly siltstone, fine sandstone and shale, with some petroleum-bearing sandstone and conglomerate and locally abundant coal beds.

Climate

The climate on the Kenai Peninsula is characterized as subarctic, with temperatures rarely rising above 80°F or falling below -30°F. The average annual temperature on the Refuge is 33.2°F. Annual precipitation is approximately 19 inches. The largest amount fall in late summer and autumn, the smallest in February and March.

Water Resources

The Kenai National Wildlife Refuge contains a large number of streams and lakes. The shallower lakes (less than 15 feet deep) are frozen from November to May and are generally unsuitable for sustaining a fish population because they are depleted of oxygen by the end of winter. During the summer, the oxygen content of both lakes and streams is generally high, with water temperatures rarely exceeding 68°F. The dissolved mineral content of these waters is generally low, with a pH that is neutral to slightly acidic. Organic tannins leaching from decomposing vegetation stain some surface water bodies.

Lake and stream beds are usually composed of sands and gravels. The principal drainageway in the field is the Swanson River, which meanders westward across the site, to Cook Inlet. The largest lake, Hungry Lake, lies close (several hundred feet) southwest of the contaminated road system proximate to the "administrative site."

Little information is available concerning groundwater resources in the Swanson River Field. Water well drilling logs indicate that groundwater is generally found at depths of 30 to 40 feet. However, water used for industrial and domestic purpose is withdrawn from deeper aquifers.

Vegetation

The Swanson River Field is dominated by ponds, lakes, peatlands and bogs. A large fire in 1969 was followed by growth of dense thickets of aspen, alder, willow and birch throughout much of the field. Wetlands in the field can be characterized as three principal types:

- o Seasonally-flooded, persistent, emergent marshes usually occurring on the floodplain of small streams and creeks of the area. Standing water from stream overflow is present for one month during growing season. Dominant plants include sedges and bluejoint.
- o Seasonally flooded areas on floodplains and in drainageways that are a mixture of scrub black spruce and emergent covertypes. Emergent vegetation occurs in areas corresponding to historic river channels.
- o Continuously saturated bog with 30 percent or more of the canopy consisting of broad-leaved deciduous shrubs. Dominant shrubs include dwarf birch, bog blueberry, mountain cranberry, Labrador tea, leatherleaf, cloudberry, cranberry, bog rosemary, and sweet gale.

Special Values

At least 199 species of amphibians, birds, and mammals are permanent or seasonally residents or casual visitors on the Refuge. No threatened or endangered species are present. The stream and lake habitats with their populations of salmon, trout, and char are considered very important resources of the Refuge. Because of its genetic vigor, a strain of rainbow trout that originates in the Swanson River is used for statewide stocking by the Alaska Department of Fish and Game. The Swanson River Field is part of the natural breeding and feeding range of the Kenai moose.

SAMPLING PLAN OBJECTIVES AND GUIDELINES

As stated in the Order by Consent, the Sampling Plan must meet the following objectives:

- o Identify those areas within the Swanson River Field where remedial action is required; and
- o Assess the impact, if any, that the contaminants of concern have had on fish or wildlife in the Refuge.

Field quality assurance/quality control procedures include the following:

- o Duplicate, split, background and blank sample collection;
- o Sample container quality control;

- o Sample preservation, packaging and shipment;
- o Sampling equipment decontamination;
- o Field documentation protocols, including the Environmental Protection Agency approved chain-of-custody during collection, packaging, shipment, and storage of all samples; and
- o Archiving of soil, sediment and water sample splits by Chevron to provide backup in case of breakage or loss.

To assure that acceptable internal quality assurance/quality control standards were followed, only Service approved labs were chosen to perform the analyses. For biological tissue samples, only labs under contract to the Service were used. The Environmental Protection Agency Laboratory Program, with performance criteria designed to provide defensible data for Environmental Protection Agency enforcement activities, were utilized for analyses of soil, sediment and water samples. In addition, all data was reviewed by the Service chemist and the Ecology and Environment Inc., chemists (contracted by Chevron USA).

CONTAMINANTS OF CONCERN

The Order specified sampling of soil, sediment, water and biota for both on-site and background locations on the Refuge be collected and analyzed. The Swanson River Field was divided into 12 areas for the purpose of managing sample collection activities. In addition, a background location was identified by the Service.

Polychlorinated Biphenyls

Based on previous sampling results, polychlorinated biphenyls have been identified as the primary contaminant of concern at the Swanson River Field. Initial soil samples contained polychlorinated biphenyl concentrations ranging from 0-170 ppm. Aroclor 1248 and 1242 were identified as the polychlorinated biphenyl mixtures present.

DDT and Metabolites

Low levels of DDT were identified in the samples collected previously by the Service on July 22, 1984. Metabolites expected to be found in association with DDT, however, were not detected in the Service samples. The absence of these compounds (i.e., DDD and DDE) indicates that the presence of DDT at levels above background were questionable. Samples collected at the same location and analyzed by the Environmental Protection Agency and Chevron yielded inconclusive results for DDT. Concentrations of DDT measured in preliminary samples range from 0-700 ppb.

Metals

The Order by Consent specifies the following metals be analyzed:

- | | |
|------------|-----------|
| o Arsenic | o Cadmium |
| o Chromium | o Copper |
| o Lead | o Mercury |
| o Nickel | o Zinc |

DIOXIN

The inclusion of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) and 2,3,6,7-tetrachlorodibenzofuran (2,3,6,7-TCDF) as "Contaminants of Concern" was based on the Service's concern that during the explosion of the compressor plant in 1972, the Aroclor 1248 may have undergone a "rearrangement" resulting in the formation of 2,3,7,8-TCDD and 2,3,6,7-TCDF.

During the excavation activities around the foundations of the Therminox Heater Building and Compressor Plant Buildings A and B, a black residue was encountered in conjunction with high polychlorinated biphenyls concentrations. On August 10, 1987, excavation activities were stopped around the building foundations and soil samples were collected and analyzed for polychlorinated dibenzo-p-dioxin and polychlorinated dibenzofurans.

Analytical Results

The laboratory results confirmed the presence of polychlorinated dibenzofurans in concentrations ranging between 0.3 ppb and 1,020 ppb. These polychlorinated dibenzofurans include the 2, 3, 7, 8 isomer (which is included in the tetrachloro dibenzofuran group) in concentrations less than 144 ppb (one sample). No dioxins (polychlorinated dibenzo-p-dioxins) were detected in any of the samples. Polychlorinated biphenyls have been confirmed in concentrations ranging between 8,000 ppm and 220,000 ppm at these locations.

RISK ASSESSMENT

The purpose of the risk assessment was to identify an appropriate clean-up level for polychlorinated biphenyl contaminated at the Swanson River Field which would assure the continued integrity of wildlife populations present in the area. This clean-up level was based on an evaluation of the potential risks which would be posed to terrestrial and aquatic biological resources following mitigation activities at the site.

Biological Samples

Polychlorinated biphenyl concentrations in biological samples collected in November and December 1985 range from non-detectable to a maximum total concentration of 0.90 ppm of Aroclors 1248, 1254 and 1260 in a whole-body composite of shrews collected near the compressor plant.

A risk assessment was prepared by Ecology and Environment Inc., and the University of Arkansas in April 1986 to evaluate the potential risk to terrestrial and aquatic biological resources from the polychlorinated biphenyl contamination at the Swanson River Field. The properties and environmental fate of polychlorinated biphenyls on vertebrate species, including fish, mammals, birds and domestic animals.

The Service also concluded that the bioconcentration factor for plants; the dietary intake of small mammals in the wild; the habitat range for small mammals in the area; incidental soil ingestion as a percentage of daily food intake; and the oral bioavailability of polychlorinated biphenyls in soil and plants were major considerations for cleaning of polychlorinated biphenyls from the affected area. By a series of calculations, the Service determined the level of polychlorinated biphenyls necessary to effect the red-back vole was between 3.8 and 11.9 ppm. A level of 12 ppm was found acceptable by industry.

CLEANUP FEASIBILITY STUDY

A preliminary Feasibility Study was prepared by the oil industry to evaluate numerous remedial alternatives potentially applicable to the polychlorinated biphenyl cleanup at Swanson River Field. Of 70 technologies initially identified, 11 were selected for additional evaluation based on technical feasibility. Additional evaluation criteria applied to these 11 alternatives included permitting and policy issues, environmental protection, future liability, scheduling concerns, and cost. Based on this screening process, six remedial alternatives were selected for further consideration. Five of these options involved various on-site thermal treatment technologies while the sixth alternative identified was off-site landfilling in a permitted facility. No permitted hazardous substance waste disposal site exists in Alaska.

In order for a polychlorinated biphenyl treatment unit to function at the site, the following criteria must exist:

1. mobile,
2. treat the soil on-site,
3. permitted by the Environmental Protection Agency.
4. handle large quantities (cubic yards) of sand material including capability to reduce stones to treatment size, and
5. fit in an established layout work area.

Mitigation

An extension of one year to the original deadline of December 31, 1986, as established in the Order by Consent for the mitigation of polychlorinated biphenyls contamination exceeding 12 ppm, was granted July 25, 1986. This extension was necessary to allow Chevron and now Atlantic Richfield Company time to permit, construct, and mobilize an on-site soil treatment facility. Due to the greater amount of soil removed (nearly three times initial calculations) and stockpiled, a second extension was granted industry November 13, 1987, for an additional year or until December 31, 1988, to remove and treat the contaminated soils.

Present Status

The Service is currently waiting for Atlantic Richfield to notify them of the selected treatment process and the time schedule for work in 1988.



United States Department of the Interior

FISH AND WILDLIFE SERVICE
1011 E. TUDOR RD.
ANCHORAGE, ALASKA 99503

IN REPLY REFER TO:

ORDER BY CONSENT - MITIGATION PLAN - SWANSON RIVER OIL FIELD KENAI NATIONAL WILDLIFE REFUGE

Chevron USA Inc., Swanson River Field Unit Operator, here and after referred to as the Respondent, hereby agrees to fully comply with and execute this ORDER BY CONSENT.

The U.S. Fish and Wildlife Service will administer this ORDER in coordination with the Bureau of Land Management and the Alaska Department of Environmental Conservation, and in consultation with the Environmental Protection Agency, pursuant to:

1. Pertinent regulations of the United States Fish and Wildlife Service (FWS) and Bureau of Land Management (BLM) (43 CFR parts 3100 through 3160), the Unit Agreement for the Development and Operation of the Swanson River Unit Area No. 14-08-001-2969 (1956), lease terms and conditions, Special Use Permits, and the authorities thereunder;
2. State of Alaska Department of Environmental Conservation (ADEC), Alaska Administrative Code (AAC), 18 AAC 75.010(a), and the Alaska Statutes AS 46.03.100, AS 46.03.302, AS 46.03.710, AS 46.03.740, and AS 46.03.850;
3. Public Law 96-487 Alaska National Interest Lands Conservation Act (ANILCA) Title III - National Wildlife Refuge System, Section 303(4)(A)(B) and Title VII - National Wilderness Preservation System, Section 702(7);
4. Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA);
5. Federal Water Pollution Control Act (FWPCA), as amended; and
6. All other applicable State and Federal laws.

*REST OF
CONSENT ORDER
NOT INCLUDED
IN FAX*