DEC's Technical Project Team
Information Update on the Sulfolane Investigation

April 2011

This newsletter will be produced periodically to keep the North Pole community informed on the most current technical information regarding the investigation and remediation of the soil and groundwater contamination related to the North Pole refinery.

An aerial view of Flint Hills Resources' North Pole refinery from the south. Photo courtesy of Flint Hills Resources.

Technical Project Team Members

Dr. Dave Barnes: University of Alaska Fairbanks, Civil and Environmental Engineering professor and department chair

Bill Butler: City of North Pole, director of City Services

Cindy Christian: Alaska Department of Environmental Conservation Drinking Water, compliance program manager

Dennis Elliott: Williams, director of Environmental Health and Safety

Ann Farris: DEC Contaminated Sites Program, environmental engineer and TPT coordinator

Nim Ha: Alaska Department of Health and Social Services, Epidemiology Section, acting Environmental Public Health Program manager

Brian Jackson: DEC Prevention and Emergency Response Program, environmental program specialist

Lee Johnson: DEC Drinking Water Program, environmental engineer

Dr. Cassandra Kirk: DHSS, Epidemiology Section, public health assessor

Elizabeth Page: Flint Hills Resources Alaska, project manager

Brandon Perkins: U.S. Environmental Protection Agency, Region 10 Superfund Program

Jeanne Swartz: DEC Industry Preparedness Program, environmental program specialist

Plus more than 50 technical advisors and support personnel

The Alaska Department of Environmental Conservation's Contaminated Sites Program in March 2010 created a Technical Project Team to provide comprehensive and coordinated oversight for the investigation into the release of sulfolane at the Flint Hills refinery in North Pole. The team consists of experts in the fields of toxicology, engineering, hydrology, environmental chemistry and other relevant fields, and is working to ensure the protection of human health and the environment.

Progress to date in the sulfolane investigation and cleanup: The TPT at work

This first issue of the Alaska Department of Environmental Conservation's newsletter describes the work, accomplishments and next steps of the Technical Project Team (TPT) overseeing the investigation and cleanup of the refinery's contaminant releases.

The most important releases have been the historical releases of gasoline and sulfolane that have impacted North Pole residents downgradient of the refinery.

"The North Pole sulfolane issue is a top priority for DEC. The Technical Project Team members are well-qualified and are working hard to address the complexities of the situation."

– DEC Commissioner Larry Hartig, addressing the Fairbanks North Star Borough's Economic Development Commission on Dec. 14.

The TPT meets about every six weeks in Fairbanks. The team has met nine times since its formation in March 2010.

The TPT created specialized subgroups that meet more often to focus on specific questions having to do with sulfolane toxicology, site characterization and remediation, chemical analysis and data quality, drinking water treatment and communication. Some important TPT milestones so far:

- The federal Agency for Toxic Substances and Disease Registry (ATSDR) developed a protective set of action levels for sulfolane in drinking water.

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TPT Site Characterization and Remediation Subgroup Update

Goals: To ensure a thorough investigation of the sources and extent of contamination, and to oversee the control and cleanup of the contamination.

The Site Characterization and Remediation Subgroup is responsible for evaluating the current extent of contamination, migration or breakdown of that contamination, and technically feasible options for the appropriate control and cleanup of the contamination.

Specific site characterization activities completed in 2010:

- Researched sulfolane's physical, chemical and biological characteristics.
- Completed rigorous inspections of the refinery for potential ongoing sources.
- Worked with Flint Hills Resources' technical and legal staff to develop a site characterization work plan – essentially a road map required by regulation – to fully investigate the contamination, evaluate exposure and determine if there are feasible cleanup options beyond the existing pump and treat system on the refinery.
- Reviewed Flint Hills' interim cleanup plan to upgrade the existing remediation system on the refinery until a final cleanup plan can be determined. The TPT is continuing to oversee the implementation of the plan. Roughly 1,800 gallons of fuel were collected by the upgraded remediation system in 2010. An evaluation of the system's performance is underway.
- The subgroup is conducting a statistical evaluation on the groundwater data as the data come in, to determine if the plume is moving or growing. To date, the data suggest the plume is not growing, but investigation and evaluation must continue to be certain.

The Technical Project Team's Ann Farris of DEC (middle) meets with Flint Hills' Mark Gregory (left) and Mike Brose at the refinery in early fall 2009. Gregory is now with the company's Wichita, Kan., office; Brose is vice president of Alaska operations. DEC photo

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TPT Chemistry Subgroup Update

Goal: To ensure only high quality data are used for risk evaluation and cleanup.

The Chemistry Subgroup has been responsible for developing methods to further enhance the ability to detect sulfolane in water, soil and produce consistently and accurately.

The subgroup has developed data quality standards for analyzing sulfolane in water, vegetables and fuel, and is working on standards for soil.

The subgroup is also developing consistent laboratory methods so all laboratories analyzing for sulfolane are using the same methods and the results are accurate and comparable. As part of this method development, previously used laboratory methods for analyzing sulfolane are also being reviewed.

Activities the subgroup completed in 2010:

Continued on Page 8

TPT Drinking Water Subgroup Update

Goal: To ensure an alternate permanent drinking water supply for all impacted areas.

The Drinking Water Subgroup is responsible for making sure North Pole residents have a drinking water supply that meets state standards.

The subgroup is also responsible for evaluating potential in-home treatment systems for impacted well owners and for overseeing the City of North Pole public water system's routine testing.

Samples for the latter are sent to DEC's Environmental Health Laboratory in Anchorage for sulfolane analysis. Both the raw and treated water have been consistently below the 25 parts per billion sulfolane action level recommended by the federal Agency for Toxic Substances and Disease Registry.

Activities the subgroup completed in 2010:

- Approved the drilling and development of the City of North Pole's two new public drinking water system wells.
- Analyzed the data from the more than 400 private drinking water wells, commercial wells and the two municipal wells that have been tested to understand the extent of contamination and risk to human health. This work will continue as more samples are taken.
- The subgroup is actively reviewing Flint Hills' research and development of in-home treatment system options. The current carbon filtration treatment system looks promising, and Flint Hills presented verification data from pilot-scale systems at the March 30 TPT meeting. DEC engineers are currently reviewing the verification data and the final configuration of the treatment system.

The Water Quality Association, a nonprofit international trade association, is also undergoing review of the system for an independent third-party verification. The association's review is a three-month process. The final DEC engineering review will take place when DEC receives the final Water Quality Association report.

Shannon & Wilson Inc.'s Mark Lockwood collects a sample for the new City of North Pole distribution wells last October. Shannon & Wilson is a Flint Hills contractor. Photo courtesy of Shannon & Wilson.

A Timeline: Technical Project Team Activities

October 2009

- Flint Hills discovers sulfolane in drinking water wells north of the refinery property.

October 2009 to February 2010

Interim actions taken:

- Flint Hills completes a comprehensive drinking-water well search and sampling effort.
- Bottled water is provided to those impacted.
- DEC and health agencies evaluate the human health risk from sulfolane, a previously unregulated chemical.
- Tests of City of North Pole municipal wells are conducted weekly.

February 2010

- The federal Agency for Toxic Substances and Disease Registry publishes its health consultation recommending a public health action level of 25 parts per billion in drinking water.
- DEC adopts that recommendation as an interim cleanup level for the site, requiring Flint Hills to complete a full site investigation on and off the refinery, as well as revise its corrective action plan to include sulfolane.

March 2010

- DEC forms the Technical Project Team (TPT).
- Flint Hills submits its Draft Site Characterization Work Plan.

April 2010

- The TPT holds its first meeting April 15. Subgroups and objectives are defined for each technical aspect of the project.
- The TPT reviews and provides comprehensive comments on the Site Characterization Work Plan.
- DEC requires an interim plan for remediation system upgrades from Flint Hills.
- DEC briefs North Pole and Fairbanks area legislators and the City of North Pole.
- The scope of the garden sampling project is defined.
- Flint Hills chooses to install new City of North Pole wells that don't have a capture zone that includes the refinery, despite concentrations of sulfolane being consistently below 10 parts per billion. DEC reviews the engineering plans for the new wells.
- Procedures are established for DEC to receive all data on a continuous, as collected, electronic basis to place into a mapping system that allows for better oversight of the investigation.

May 2010

- The TPT meets May 5.
- The TPT holds an open house May 6 at the North Pole Plaza Mall.
- The Toxicology Subgroup reviews the objectives and methodology of a garden sampling project.
- The TPT establishes all possible routes for humans to come in contact with sulfolane through a conceptual site model, to verify that the upcoming summer's sampling will address those pathways. The Site Characterization Work Plan is modified accordingly.
- The TPT reviews Flint Hills' Sampling and Analysis Plan that describes how all environmental samples will be collected and analyzed on site. The Sampling and Analysis Plan is critical because sulfolane doesn't have a standard methodology.

- The TPT begins its in-depth review of the groundwater fate and transport model. The review involves research into the way sulfolane breaks down in the cold, low-oxygen subsurface environment beneath North Pole.
- DEC briefs North Pole and Fairbanks area legislators and mayors.

June 2010

- The TPT meets June 16.
- The U.S. Environmental Protection Agency receives a request to complete a preliminary assessment and hazard ranking of the refinery under the Comprehensive Environmental Response, Compensation and Liability Act (Superfund). The EPA begins an evaluation of the value of doing a preliminary assessment on a site already being actively investigated under the oversight of the TPT, which the EPA is already a part of, and involving a chemical without a federal cleanup level. To date, the EPA hasn't completed the preliminary assessment.
- DEC reviews Flint Hills' Spill Contingency Plan for weaknesses that can be addressed so future leaks and spills on the refinery property are avoided. Any issues found out of compliance are remedied.
- Flint Hills and its engineering contractor investigate historical leakage rates, estimated volume of spilled contaminants and potential chemicals of concern as part of the site characterization.
- DEC Drinking Water engineers review and approve the results of the City of North Pole water system wells, design specifications and engineering plan for the extension of city water to 27 residents (29 connections), primarily in the Ford subdivision, but also in the Highway Park subdivision and on Andrea Drive. The connections begin immediately.
- Flint Hills provides updates and revisions to the TPT on the Site Characterization Work Plan as the field investigation continues. The TPT provides technical direction based on an ongoing review of data.
- The Toxicology Subgroup discusses the sampling, scheduling and analysis for the garden sampling project, as well as the scope and objectives for a greenhouse study.

July 2010

- The TPT meets July 14.
- Flint Hills submits its Revised Draft Final Site Characterization Work Plan to DEC based on the TPT's comments.
- The first round of the garden sampling project is completed. Sulfolane is detected in plants, but below health action levels.

August 2010

- The Alaska Department of Health and Social Services issues a press release and fact sheet on the early results of the garden sampling project.
- DEC gives preliminary approval to the Site Characterization Work Plan so field investigation can continue.
- A Flint Hills contractor on Aug. 5 begins installing the water transmission lines from the City of North Pole's water treatment plant to the city's new well site. Another Flint Hills contractor begins drilling the first of two wells Aug. 26 and concludes drilling the second on Oct. 21.

September 2010

- DEC briefs North Pole and Fairbanks area legislators and mayors.
- The TPT meets Sept. 14.
- The TPT establishes the Chemistry Subgroup to refine the methodology for analyzing for sulfolane in the water, soil and plants so the analysis is more precise.
- Flint Hills presents an overview of the in-home treatment system as an alternative source of water for impacted residents based on laboratory tests of the system. The TPT reviews the laboratory data and describes the additional data required to proof the technology.

October 2010

- The TPT holds an open house Oct. 5 at the North Pole Plaza Mall.

November 2010

- The TPT meets Nov. 3.
- DEC improves the North Pole sulfolane public interface Web site and communication resources.
- Flint Hills completes a ground-penetrating radar investigation to gather information on soil lithology and provides the results to the TPT.
- The TPT completes the final quality assurance validation of the June vegetable samples. The process is exhaustive, involving six chemistry experts and two toxicologists.
- Flint Hills submits to DEC a final report on the inspections of the refinery's sumps.
- DEC briefs the Fairbanks North Star Borough Mayor's Office.

December 2010

- The TPT meets Dec. 14.
- DEC meets with the Fairbanks North Star Borough's Economic Development Commission and Mayor's Office.
- Flint Hills and DEC continue to review the in-home treatment system and Flint Hills continues data collection to show the technology can be effective.
- The TPT defines the objectives and methodology of an adsorption study that's required to explain why carbon filtration is effective for sulfolane, despite previous research indicating that sulfolane doesn't adsorb to soil.

January 2011

- DEC meets with the EPA and ATSDR to discuss the process for developing a federal toxicity value for sulfolane.
- The final validation of all garden data is completed.
- DEC issues key criteria for the groundwater analysis of sulfolane. These criteria create specific uniform standards that all laboratories analyzing water for sulfolane must meet. This is the best methodology based on a review of the data collected during 2010. It's designed to reduce the variability in results between laboratories and increase confidence in all data.
- The Water Quality Association, a nonprofit international trade association that does laboratory product-testing, among other things, is brought in as an independent third party to verify the in-home treatment technology along with DEC's review. The Water Quality Association's review is a three-month process.
- Flint Hills begins discussing options with all homeowners impacted by sulfolane and offers settlement agreements.

February 2011

- The TPT meets Feb. 16.
- DEC briefs North Pole and Fairbanks area legislators.
- The TPT identifies the need for additional monitoring wells to investigate the extent of the contamination and to better understand the fate of sulfolane in the aquifer.
- The City of North Pole supplies residents with water from the two new wells beginning Feb. 14.

March 2011

- DEC issues key criteria for the soil analysis of sulfolane.
- The City of North Pole accepts ownership of the two new wells March 21.
- The TPT meets March 30.
- The redesign of DEC's sulfolane Web site is completed.

TPT Toxicology Subgroup Update

Goal: To evaluate the potential risk of adverse health effects caused from the exposure to contaminants from the North Pole refinery's history of spills.

The Toxicology Subgroup is evaluating the toxicity and risk from exposure to sulfolane in drinking water and garden plants, and is identifying other ways people and animals may be exposed to sulfolane and other contaminants released to the environment at the North Pole refinery.

The subgroup's activities in 2010:

- Developed and conducted a garden sampling project to determine the amount of sulfolane present in fruits and vegetables grown with sulfolane-impacted well water in North Pole gardens. DEC and the Alaska Department of Health and Social Services released early results of the project in August; results of the full project were released in January.
- Continued work with the U.S. Environmental Protection Agency, federal Agency of Toxic Substances and Disease Registry, and University of Alaska Fairbanks to evaluate the toxicity of sulfolane and set regulatory levels.
- Continued work with the federal and state agencies to determine the need for and the scope of a toxicity study that would evaluate the effects from long-term exposure to sulfolane.
- Identified the need for additional plant uptake studies to identify the method for which plants take in sulfolane from groundwater. That information could be used to estimate the amount of sulfolane in garden fruits and vegetables that haven't been sampled and to estimate sulfolane concentrations in fruits and vegetables grown in future growing seasons.

Homestead Drilling workers, shown in November, set up a drilling rig to install Monitoring Well No. 188, which is outside the plume and the farthest northwest of the refinery. It's just over 2½ miles northwest of MW No. 166, at Bradway Road and Luckies Lane. To date, it's been nondetect for sulfolane. Photo courtesy of Shannon & Wilson.

TPT Communication Subgroup Update

Goals: To maintain lines of communication among TPT members and to ensure all stakeholders are informed on the project status.

The initial DEC Emergency Response Communication Plan was put in place at the outset of this project, in October 2009.

A year later, the Communication Subgroup expanded the DEC Communication Plan to facilitate a sustainable, interactive plan that both ascertains the concerns of the public and addresses the public's informational needs.

The subgroup has worked collaboratively with all involved state and federal agencies, and all other project stakeholders.

A synopsis of the subgroup's activities in 2010 that will continue in 2011:

- Maintained a sulfolane Web site (dec.alaska.gov/spar/csp/sites/north-pole-refinery) to provide as much up-to-date information as possible to the public.
- Held community open houses and community workshops to answer community questions in person.
- Sent out updates on the sulfolane investigation, summaries of the TPT meetings and other information to

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Progress to date

From Page 1

- When sulfolane was discovered in the groundwater off the refinery property, Flint Hills immediately interrupted exposure to sulfolane through drinking water by distributing bottled water to residents in the impacted area.

- A DEC contractor, the Alaska Department of Health and Social Services, and Flint Hills in early 2010 completed a comprehensive search of all literature and case studies related to sulfolane. They found unpublished material that was previously unavailable and had Chinese studies of the toxicity of sulfolane translated.

- DEC and DHSS, with input from the TPT and field sampling by contractor Shannon & Wilson, completed a garden sampling project involving seven local gardeners. DHSS issued a fact sheet with the final results in January.

- Seventy-eight delineation wells have been installed and more than 400 private wells sampled to understand the extent of the sulfolane groundwater plume. The horizontal extent is now well understood. More wells are now being drilled to fully understand the vertical extent of the contamination. Up-to-date maps of the plume can be found on DEC's North Pole sulfolane Web site.

- Trends in the groundwater data on and off the refinery indicate a stable or decreasing plume, but additional wells must be installed and monitoring must continue to be certain we completely understand the fate of sulfolane in the aquifer.

- Inspections of the infrastructure on the refinery indicated six areas of potential leaks. Those are being addressed and the inspection frequency has been increased. Additionally, DEC's Prevention and Emergency Response Program now conducts a site inspection every time there's a spill on the refinery, even if it's to an enclosed containment area, to ensure handling processes are improved.

- The design and construction of the two new municipal wells have been completed and they went online Feb. 14.

- The TPT has also developed a standard procedure for analyzing sulfolane in water to increase the comparability of results from different Alaska laboratories and to lower the detection limit in water from 10 parts per billion to 5. Because the U.S. Environmental Protection Agency doesn't regulate sulfolane, there was no set of standard operating procedures that all laboratories had to follow.

  Therefore, although all the laboratories used the widely accepted EPA8270 method for analysis, there were minor variations in their use of surrogates and quantification techniques that led to variability in results from different laboratories. This variability will be minimized with the new procedures.

- An in-home water treatment system has been developed and is undergoing accelerated pilot-testing. Flint Hills is offering this treatment option to homeowners who wish to continue to use their wells. Other options that Flint Hills is offering are bottled water, bulk-water tanks, and holding tanks for water for gardening.

- New treatment equipment and a new pumping well have been installed at the refinery to more aggressively clean up the source area.

- A robust and interactive communication plan has been developed to provide the most current information to all stakeholders.

Chemistry

From Page 2

- Developed a laboratory method to accurately assess the amount of sulfolane in fruits and vegetables as part of the garden sampling project.

- Reviewed all garden sampling project laboratory data to ensure all results were accurate and identified any necessary adjustments to the laboratory methods for analyzing sulfolane in garden produce.

- Identified all necessary quality control measures to ensure laboratories analyzing for sulfolane are doing so accurately and consistently between laboratories.

- Adjusted current water laboratory methods to develop a statewide standard method to accurately identify the amount of sulfolane in water samples.

- Determined standard requirements for all data submitted to the state and the public.

- The final laboratory data quality standards and DEC-approved laboratory standard operating procedures for analyzing for sulfolane are expected by the end of April.

Communication

From Page 7

sulfolane-impacted well owners, North Pole residents, public officials and others who signed up for a sulfolane mailing list. The information was also posted on the sulfolane Web site.

- Provided regular updates to state and local officials.

The Next Steps

Steps taken in February 2011:

- The two new City of North Pole drinking water wells were brought online Feb. 14 to serve as the municipal water source. They were installed outside the plume with a capture zone that doesn't include the refinery.
- DEC and the City of North Pole are continuing to work together sampling and analyzing the municipal water supply for sulfolane as well as for other regulated chemicals. The results will be available from DEC's Drinking Water Program and will be posted on DEC's sulfolane Web site.
- Flint Hills is contacting homeowners to discuss the options for permanent alternative water supplies and holding tanks for their gardens.

March 2011:

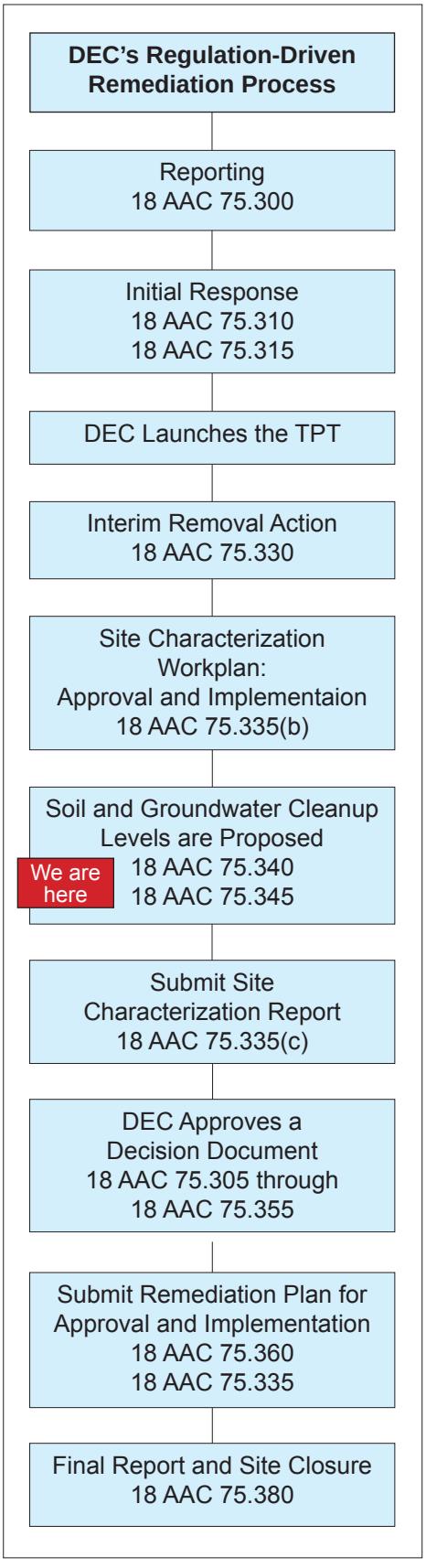
- The TPT developed requirements for standard operating procedures for laboratories analyzing sulfolane in water or soil at the Flint Hills site. Individual laboratory procedures will be reviewed by the TPT to ensure accurate analysis. Additional water and soil sampling will be conducted in 2011.
- The TPT Toxicity Subgroup met with and will continue to meet with the U.S. Environmental Protection Agency and the federal Agency for Toxic Substances and Disease Registry to monitor the status of setting a federal action level for sulfolane and the release of a nationally peer-reviewed health consultation.

This month:

- Flint Hills and the TPT are working on the full characterization of the vertical delineation of the sulfolane plume – essentially, the determination of how deep the plume is by drilling more monitoring wells. The full characterization is expected to be completed by the end of summer.
- The TPT Site Characterization Subgroup will meet to discuss the numerical fate and transport modeling to determine the status of Flint Hills' efforts on understanding the historical movement of sulfolane from the refinery and the length of time to clean up the contamination.
- DEC and the TPT are continuing their engineering review of Flint Hills' proposed treatment system for individual drinking water wells; Flint Hills presented verification data from pilot-scale systems at the March 30 TPT meeting. The final DEC and TPT review will take place when DEC receives a final Water Quality Association report – an independent third-party verification that takes three months. The results of the reviews will be published on DEC's sulfolane Web site.

May 2011:

- The TPT is holding a community workshop on sulfolane May 16 from 7 p.m. to 9 p.m. at The Grange in North Pole, Mile 3.5 Grange Road. The topics will include what we know and don't know about sulfolane, and a review of the Alaska Department of Health and Social Services health consultation that talks about the different ways people can be exposed to the solvent. TPT members will be available to answer questions. For more information, call the DEC's Susan Erben at (907) 465-5206.
- A TPT meeting will be held May 17.
- The Draft Site Characterization Report is due from Flint Hills by May 30. The report will summarize the data collected and work completed since late 2009 related to the sulfolane investigation and cleanup.



Technical Project Team Subgroups

Chemistry
Stephanie Pingree Buss

Goal:
To ensure only high quality data are used for risk evaluation and cleanup.

Members
1. Stephanie Pingree Buss (SPB Consulting)
2. Dave Verbrugge (DHSS-DPH)
3. Earl Crapps (DEC-CSP)
4. Meg Mitchell (Environmental Standards)
5. Rock Vitale (Environmental Standards)
6. Jon Lindstrom (Shannon & Wilson)
7. Kristen Freiburger (Shannon & Wilson)
8. Liz Page (FHR)
9. Ann Farris (DEC-CSP)

Communication
JoAnn Grady

Goals:
To maintain lines of communication among TPT members, and to ensure all stakeholders are informed on the project status.

Members
1. JoAnn Grady (Grady and Assoc.)
2. Nim Ha (DHSS-Epidemiology)
3. Susan Erben (DEC-CSP)
4. Marisa Sharrah (FHR)
5. Jeff Cook (FHR)
6. Eric Zentner (Oasis Environmental)

Drinking Water
Cindy Christian

Goal:
To ensure an alternate permanent drinking water supply for all impacted areas.

Members
1. Cindy Christian (DEC-DW)
2. Audrey Lammers (DEC-DW)
3. Denise Elston (DEC-CSP)
4. Lee Johnson (DEC-DW)
5. Johnny Mendez (DEC-DW)
6. Shannon Price (FHR)

Key to Agencies and Companies
DHSS = Alaska Department of Health and Social Services
DPH = Division of Public Health
CSP = Contaminated Sites Program
FHR = Flint Hills Resources
DW = Drinking Water
PERP = Prevention and Emergency Response Program
IPP = Industry Preparedness Program

Characterization and Remediation
Ann Farris

Goals:
To ensure a thorough investigation of the sources and extent of contamination, and to oversee the control and cleanup of the contamination.

Members
1. Ann Farris (DEC-CSP)
2. Denise Elston (DEC-CSP)
3. Lisa Minnear (Oasis Environmental)
4. Dave Barnes (UAF)
5. Liz Page (FHR)
6. Brian Jackson (DEC-PERP)
7. Bob Tisserand (DEC-IPP)
8. Rebecca Andresen (Arcadis)
9. Cody Black (Oasis Environmental)

Toxicology
Stephanie Pingree Buss

Goal:
To evaluate the potential risk of adverse health effects caused from the exposure to contaminants from the North Pole refinery's history of spills.

Members
1. Stephanie Pingree Buss (SPB Consulting)
2. Marty Brewer (DEC-CSP)
3. Nim Ha (DHSS-Epidemiology)
4. Cassie Kirk (DHSS-Epidemiology)
5. Laurie Haws (Tox Strategies)
6. Rock Vitale (Environmental Standards)
7. Rebecca Andresen (Arcadis)
8. Brian Jackson (DEC-PERP)
9. Ann Farris (DEC-CS)

Emerging Contaminants
Denise Elston

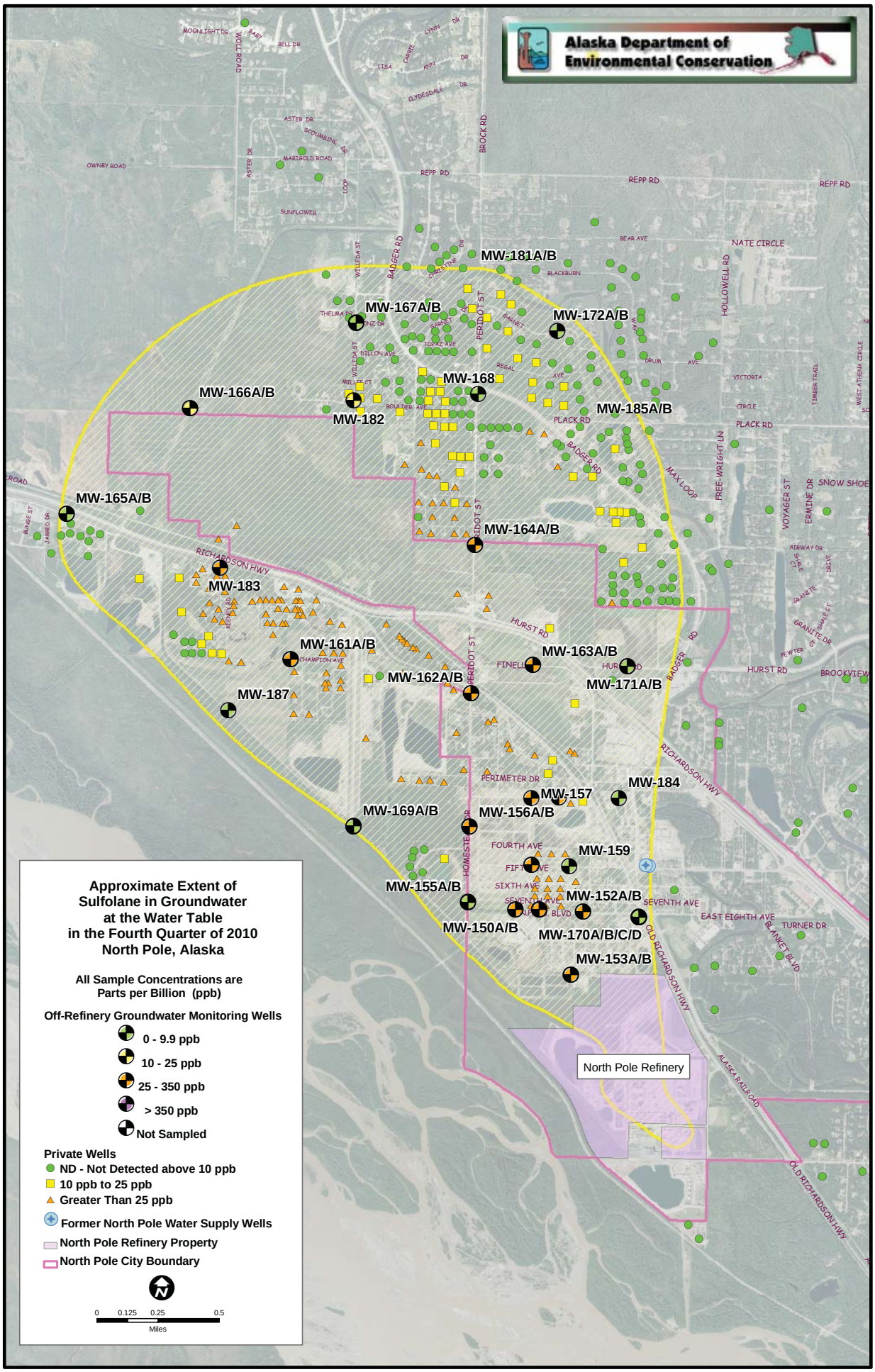
Goals:
To understand the physical, chemical and biological characteristics of sulfolane; to determine if sulfolane is a contaminant of concern at other facilities or contaminated sites in Alaska; and to evaluate the need for regulatory change.

Members
1. Denise Elston (DEC-CSP)
2. Tamara Cardona-Marek (DEC-CSP)
3. Marty Brewer (DEC-CSP)
4. Janice Wiegers (DEC-CSP)
5. Lisa Minnear (Oasis Environmental)

Source Control
Tom DeRuyter

Goals:
To ensure that no ongoing releases are occurring and to aggressively address any new spills.

Members
1. Tom DeRuyter (DEC-PERP)
2. Brian Jackson (DEC-PERP)
3. Jeanne Swartz (DEC-IPP)
4. Sam Saengsudham (DEC-IPP)
5. Daren Knowles (FHR)
6. Wes Harvey (DEC-Wastewater)
7. Bill Smyth (DEC-Wastewater)
8. Renee Evans (DEC-Wastewater)
9. Kim Speckman (DEC-Compliance)


Alaska Department of Environmental Conservation
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MW-164A/B
MW-183
MW-161A/B
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MW-162A/B
MW-171A/B
MW-187
MW-184
MW-157
MW-169A/B
MW-156A/B
MW-159
MW-155A/B
MW-152A/B
MW-150A/B
MW-170A/B/C/D
MW-153A/B
North Pole Refinery
Approximate Extent of Sulfolane in Groundwater at the Water Table in the Fourth Quarter of 2010 North Pole, Alaska
All Sample Concentrations are Parts per Billion (ppb)
Off-Refinery Groundwater Monitoring Wells
0 - 9.9 ppb
10 - 25 ppb
25 - 350 ppb
> 350 ppb
Not Sampled
Private Wells
ND - Not Detected above 10 ppb
10 ppb to 25 ppb
Greater Than 25 ppb
Former North Pole Water Supply Wells
North Pole Refinery Property
North Pole City Boundary
0 0.125 0.25 0.5
Miles

Glossary

Adsorption – Removal of a pollutant from air or water by collecting the pollutant on the surface of a solid material; e.g., an advanced method of treating waste in which activated carbon removes organic matter from wastewater.[1]

Attenuation – The process by which a compound is reduced in concentration over time, through absorption, adsorption, degradation, dilution, and/or transformation. Can also be the decrease with distance of sight caused by attenuation of light by particulate pollution.[1]

Aquifer – An underground geologic formation composed of materials such as rock, sand, soil or gravel that can store and supply groundwater to wells and springs. Aquifers in Alaska can be as little as a few feet below ground surface to more than 200 feet below ground surface. A groundwater supply is usually considered an aquifer if it contains enough water to supply the water needs for a community. An unconfined aquifer is open to receive water from the surface, and whose water table surface is free to fluctuate up and down, depending on the recharge/discharge rate. There are no overlying "confining beds" of low permeability to physically isolate the groundwater system.[2]

ATSDR – The acronym stands for the Agency for Toxic Substances and Disease Registry, which is in the U.S. Department of Health and Human Services. It's a federal public health agency that evaluates the human health effects of exposure to hazardous substances. It's an independent operating division within DHHS, but the Centers for Disease Control (also within DHHS) performs many of its administrative functions. DEC's interim cleanup level for sulfolane at Flint Hills is 25 parts per billion, which is based on ATSDR's lowest recommended action level for sulfolane in drinking water.

Bioremediation – A technique that uses bacteria or other organisms to clean up contamination. Bacteria generally break down the contamination into less harmful components, such as carbon dioxide and water. Bioremediation can be used to clean up soil or water. Water and nutrients, such as fertilizer and oxygen, may be added to the contaminated

Continued next page

The Flint Hills Resources refinery in North Pole at sunset. Photo courtesy of Flint Hills Resources.

Glossary *From Page 12*

soils to speed up the breakdown process. Some chemicals, such as gasoline, are easily bioremediated while others, such as pesticides, cannot be effectively treated using bioremediation. The contamination can be treated in place (in situ) or the material can be excavated and treated above ground in a different location (ex situ). Types of soil bioremediation methods include landfarming, composting, land spreading, biotreatment and biopiles. Types of water bioremediation include natural attenuation and engineered wetlands.[2]

Carbon adsorption/carbon filtration – A treatment system for contaminated water or air, where the contaminated media is forced through tanks containing activated carbon. Activated carbon attracts, or adsorbs, the contaminants. This treatment is usually combined with other forms of treatment such as air stripping or an oil/water separator. Spent carbon must be treated or properly disposed of.[2]

Cleanup – Efforts to mitigate environmental damages or threat to human health, safety or welfare from hazardous substances or oil. It may include removal of a hazardous substance from the environment, including restoration, remediation and other measures that are necessary to mitigate or avoid further threat to public health, safety and welfare, or the environment. Cleanup is often used interchangeably with terms such as corrective action, remedial action, removal action or response action. It is often used broadly to describe various actions or phases of an action, such as the remedial investigation/feasibility study in the Superfund process.[2]

Conceptual Site Model – A summary of conditions at a site that identifies the type and location of all potential sources of contamination and how and where people, plants or animals may be exposed to the contamination.[2]

Exposure pathway – An exposure pathway refers to the way in which a person (or plants or animals) may come into contact with a hazardous substance. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing or touching); and a receptor population (people, or plants or animals, potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.[3]

Groundwater – Water found beneath the earth's surface that fills pores between sand, soil particles or gravel creating a saturated zone. In aquifers, groundwater is in sufficient quantities that it can be used for drinking water, irrigation or other purposes.[2]

Hazard Ranking System – The principal screening tool used by EPA to evaluate risks to public health and the environment associated with abandoned or uncontrolled hazardous waste sites. The HRS calculates a score based on the potential of hazardous substances spreading from the site through the air, surface water or groundwater, and on other factors such as density and proximity of human population. This score is the primary factor in deciding if the site should be on the National Priorities List and, if so, what ranking it should have compared to other sites on the list.[1]

Health consultation – A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical.[3]

Interim Remedial Action – An interim measure to remove or isolate contamination. This action can be taken any time during the process and is usually taken to protect people and the environment from high levels of contamination until the final remedial action can be taken.[2]

Monitoring wells – Wells drilled at specific locations where groundwater parameters (depth, flow direction, chemical nature and so forth) can be sampled to determine the types and amounts of contaminants present.[2]

Natural attenuation, or intrinsic remediation – The natural breakdown of hazardous substances in the environment. Many hazardous substances will slowly degrade or break down into non-hazardous substances through natural processes in the environment. Natural attenuation may be approved as a remedy for contamination, particularly if other efforts have been exhausted without achieving the applicable cleanup levels, and as long as there is little

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chance that the contamination will pose a threat to people, plants or animals. Regular monitoring of soil and groundwater may be required to ensure that natural attenuation is occurring.[2]

Parts per billion – For both soil and water, one part per billion (ppb) is when a microgram, or 1/1,000,000th of a gram, of a contaminant is present in one liter of water or one kilogram of soil. Here are some analogies to visualize one part per billion: One part per billion is one drop of water in an Olympic-size swimming pool, which holds about 130,000 gallons. One part per billion is 1/32 of a second of one year. One part per billion is one minute of 1,903 years. (For more information, see the DEC fact sheet entitled, *Contaminant Concentrations*, at dec.alaska.gov/spar/csp/guidance/cont_concentrations.pdf.)

Plume – A visible or measurable discharge or release of a contaminant as it moves water or air from a given point of origin. The plume of a contaminant in groundwater is the area of water which, as it moves underground, carries the contaminant with it. The shape is often like that of a skinny balloon. The portions of the plume close to the source will have higher concentrations than the portions farther away from the source. Natural physical, chemical and biological processes diminish the concentration levels as the water carries the contaminant away from the source.[2]

Public health assessment – An ATSDR document that examines hazardous substances, health outcomes and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The public health assessment also lists actions that need to be taken to protect public health.[3]

Stakeholder – A person, group or community who has an interest in activities at a hazardous waste site.[2]

Toxicology – The study of the harmful effects of substances on humans or animals.[2]

Work plan – A written plan that describes the planned actions, such as sampling and analysis, site investigation, site assessment or risk assessment. It includes the justification and instructions for conducting these activities. It also includes health and safety plans for the workers conducting these tasks.[2]

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[1] From the U.S. Environmental Protection Agency's Terms of Environment: Glossary, Abbreviations and Acronyms at www.epa.gov/OCEPAterms/.

[2] From the Alaska Department of Environmental Conservation's Spill Prevention and Response Division Glossary of Terms and Acronyms at dec.alaska.gov/spar/glossary.htm.

[3] From the Agency for Toxic Substances and Disease Registry's Glossary of Terms at http://www.atsdr.cdc.gov/glossary.html.

The following is an executive summary for a report that Oasis Environmental, an environmental consulting firm, did under contract for the Technical Project Team. The Alaska Department of Environmental Conservation posted the full report, along with this executive summary, in September on the department's North Pole sulfolane Web site at dec.alaska.gov/spar/csp/sites/north-pole-refinery/. Because this executive summary has a lot of good background information on sulfolane and readers might have missed it, we've reprinted it here.

Sulfolane Technical Assistance and Evaluation Report

Executive Summary

This report summarizes research of sulfolane's physical and chemical properties, industrial applications, corrosivity, breakdown and attenuation processes, and case histories involving sulfolane spills. The information included in this report is intended for readers to better understand how sulfolane is used in the oil and gas industry, its potential to cause corrosion in process equipment and piping, sulfolane regulations, and case histories of sulfolane spills and any cleanup that was completed.

Sulfolane is an organic compound that is readily soluble in water; it prefers to dissolve in water rather than stay in its pure form or attach to soil particles. It is also soluble, although to a lesser extent, in hydrocarbons (components of fuel). In its pure form, sulfolane is a clear, colorless liquid that is heavier than water. It does not readily evaporate like other solvents do, such as paint thinners or benzene.

The high solubility of sulfolane in water means that when it is released into the environment, it tends to move toward groundwater. Once in groundwater, it spreads out and becomes diluted as it travels with the groundwater flow.

Sulfolane is a man-made industrial solvent used in a wide variety of applications including oil refining, natural gas production, the production of insecticides, herbicides, and fungicides, lithium batteries, pharmaceuticals, printer ink, circuit board cleaning solutions, semiconductors and soap.

At Flint Hills, sulfolane is used as the primary solvent in a sulfolane extraction unit that removes the aromatics such as benzene, toluene and xylenes from refined oil so that they can later be added at very specific concentrations for each type of gasoline produced at the refinery. Sulfolane extraction units are closed-loop systems so pure sulfolane does not typically go down drains; however, some residual sulfolane can remain in the final gasoline product and in the wastewater from the units because of some mixing of these fluids during the extraction process. Flint Hills' wastewater stream goes through the company's wastewater treatment plant and is regulated through its wastewater discharge permit.

Corrosion is a concern in sulfolane extraction units, yet – based on research internationally, and responses from companies and regulatory agencies – corrosion has never become severe enough to cause a sulfolane leak or spill. That is because corrosion causes inefficiencies in the system, so any instances of corrosion were discovered long before they could cause leaks or spills.

Sulfolane extraction units, including the piping, are made of steel. Sulfolane itself does not corrode steel; instead, sulfolane's acidic by-products cause the corrosion. Those by-products occur when sulfolane degrades – from high temperatures or if oxygen or other impurities get into extraction units through leaks. (Most sulfolane extraction units have sulfolane recycling systems, where the by-products are removed before the sulfolane is used again. The sulfolane is usually recycled as much as possible.)

The research done for this report indicated that there is sparse government regulation of sulfolane. The U.S. Environmental Protection Agency does not regulate sulfolane. The transportation of sulfolane is also not regulated in the United States as a hazardous material or a dangerous good. Texas is the only state that has established statewide cleanup levels for sulfolane.

Internationally, Environment Canada, Canada's equivalent to the U.S. Environmental Protection Agency, is the most progressive regulatory authority in establishing environmental quality guidelines for sulfolane-contaminated soil and groundwater. Its level for drinking water is 90 parts per billion. Sulfolane-contaminated sites exist in Canada near sour-gas processing complexes that use sulfolane in the natural-gas sweetening process. (Natural gas that has carbon dioxide and other compounds is called "sour gas"; when sulfolane is used to remove those compounds, it is called a "sweetening" process.)

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Sulfolane research *From Page 15*

In the early 1980s, responding to the increased use of sulfolane in both the oil and natural gas industries, Shell Oil Company researchers performed the foundational work on remediating sulfolane from spills at natual gas processing facilities. Since Shell's work, independent contractors and university researchers worldwide, as well as the Canadian government, have worked to develop regulatory cleanup levels and design remediation systems for sulfolane-contaminated sites.

Findings from the research on sulfolane remediation processes indicate that the primary attenuation mechanism – the ability to break down the contamination into non-hazardous components – is biodegradation in an aerobic environment, where the sulfolane is broken down by bacteria in soil or water, in contact with the air.

Case studies in Canada show that an effective remediation option for sulfolane-contaminated groundwater is through biological wastewater treatment processes. Those systems are functional in Alberta and have proven to reduce sulfolane concentrations in groundwater to well-below the established cleanup levels.

Overall, there are more than 150 sulfolane extraction units licensed throughout the world. Despite that number, only a few countries have established cleanup levels for sulfolane in the environment.

Since sulfolane is generally not considered by governments to be highly toxic and is often not regulated as a water or soil contaminant, limited case studies of sulfolane spills and their remediation have been reported in the United States and internationally. The findings from the research contained in this report will provide a better understanding of the chemical and its background for addressing sulfolane contamination in the environment.

For the full report, on the Web go to dec.alaska.gov/spar/csp/sites/north-pole-refinery/documents.htm#sulfo.

For More Information

Visit the Alaska Department of Environmental Conservation's North Pole sulfolane Web site at dec.alaska.gov/spar/csp/sites/north-pole-refinery/.

Join DEC's suloflane Listserv, an email subscription list, by going to the sulfolane Web site or by going to dec.alaska.gov/spar/csp/sites/north-pole-refinery/email_sulfo.htm. If you'd rather receive hard copies of our mail outs, contact the Contaminated Sites Program's Susan Erben or Denise Elston below.

Still have questions? Here are some people to contact on various topics:

Contaminated Sites – Contact DEC, Spill Prevention and Response Division, Contaminated Sites Program:
Ann Farris, environmental engineer and TPT coordinator – (907) 451-2104, ann.farris@alaska.gov.
Denise Elston, environmental program specialist – (907) 465-5207, denise.elston@alaska.gov.
Susan Erben, public involvement coordinator – (907) 465-5206, susan.erben@alaska.gov.

Health-related information – Contact the Alaska Department of Health and Social Services, Division of Public Health, Epidemiology Section:
Nim Ha, acting Environmental Public Health Program manager – (907) 269-8028, nim.ha@alaska.gov.

Public water supplies – Contact DEC, Division of Environmental Health, Drinking Water Program:
Cindy Christian, compliance program manager – (907) 451-2138, cindy.christian@alaska.gov.
Lee Johnson, environmental engineer – (907) 451-2179, lee.johnson@alaska.gov.

Water testing, alternate water supplies, in-home water treatment systems, and other refinery issues – Contact Flint Hills Resources:
Marisa Sharrah, Public Affairs, Koch Companies Public Sector – (907) 488-5103, marisa.sharrah@kochps.com.
Jeff Cook, External Affairs, Koch Companies Public Sector – (907) 488-5104, jeff.cook@kochps.com.