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February 20, 2017

Geoff Merrell
State On Scene Coordinator
Alaska Department of Environmental Conservation
555 Cordova Street
Anchorage, AK 99501

Re: Natural Gas Leak From 8-inch Pipeline
ADEC Spill No. 17239903801

Dear Mr. Merrell:

We are responding to your letter of February 10, 2017, regarding the natural gas leak from an 8" fuel gas line ("Pipeline") serving platforms in Cook Inlet's Middle Ground Shoal ("MGS") region, which Hilcorp Alaska, LLC ("Hilcorp") discovered and reported to the National Response Center, the Department of Environmental Conservation ("Department"), and others, on February 7, 2017.

During our meeting on Friday, February 17, 2017, we all agreed that we would prefer to be able to either immediately repair the Pipeline, or, if unable to make repairs, to shut in the Pipeline if there were no adverse impacts of taking that action. Neither is possible at this time.

With respect to repair, the conditions in Cook Inlet – the broken ice, exacerbated by high tidal flows and limited daylight – prevent the immediate dispatch of divers to inspect and contain the leak in the Pipeline. Given the typical weather patterns affecting ice formation and dissipation in Cook Inlet, we currently anticipate that the earliest that conditions will allow diving will be in mid-to-late March.

Shutting in the Pipeline is complicated by the likely after-effects of the shut-in. The Pipeline was in service carrying crude oil from the platforms to the shore until 2005, when it was converted by the previous operator to fuel gas service from the shore to the platforms. The Pipeline has residual crude oil in it from its use in crude oil service. If the gas supply were shut in, seawater would enter the depressurized Pipeline through the leak displacing the remaining gas. That could displace and mobilize residual oil, causing an unknown quantity of oil to be released through the leak. The gas fuels heat, light and power for the platforms, loss of which could put the health and safety of platform operators at risk, eliminate navigational aid lighting, as well as cathodic protection, and could lead to damage to the platforms and other infrastructure. Some services probably could be maintained by delivering diesel to the platforms. In addition, because the oil production from the platforms contains a high percentage of water, the crude oil line laying next to the Pipeline could potentially freeze at the point where the pipeline emerges from the ocean in the intertidal area and above on the shore, although we would seek

to ameliorate this risk. If the production line were to freeze, that would have the potential to create another source for an oil spill when the crude oil line thaws in the spring.

Thus, it is not simply a matter of whether the methane leak continues until the Pipeline can be repaired. Rather, the choice is between the current methane release – which as discussed below has been reduced by curtailing a range of platform operations – and one or more oil spills, along with other potential damage and additional risks.

It is with these considerations in mind that Hilcorp is diligently evaluating alternatives for repairing the leak, as well as alternative responses to the leak and the risks posed by each of those alternatives. We provided an analysis of the alternatives we have developed at the meeting, and will restate them in this letter. We also have been conducting a preliminary assessment of potential environmental impacts from the ongoing leak. Hilcorp has drawn upon those efforts to provide the best information currently available to the company in response to the five questions presented by your February 10 letter.[1]

Hilcorp will continue to provide status reports and to coordinate its response with you as the State On Scene Coordinator and with PHMSA, the USCG and other federal, state and local agencies and partners. Hilcorp also voluntarily provides the following information, as requested by your February 10 letter:

1&2. Availability of Alternatives and Associated Risk to the Environment, the Public, and Personnel

We have already undertaken several steps to reduce the volume and pressure of gas flowing through the Pipeline. Pursuant to authorization from the Alaska Oil and Gas Conservation Commission ("AOGCC"), we operate a water flood process which pumps treated seawater into the oil producing formations thousands of feet below the MGS platforms. We have now shut in the water flood process.[2] In addition to shutting in the water flood process we have reduced other non-essential activities which have lowered the need for fuel gas. As of the date of this letter we have successfully reduced the Pipeline pressure to 165 psig.[3] We will continue to assess our ability to further reduce the Pipeline pressure commensurate with the safety of our personnel and the environment.

In addition, Hilcorp has evaluated the following alternatives:

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1 The leak does not constitute a release of a "hazardous substance" as that term is defined in state law. The leak consists of methane gas, which is not a listed hazardous substance under state or federal law. The leak also, for reasons discussed below, does not rise to the level of an "imminent and substantial danger" to public health or welfare; or to fish, other aquatic species, or their habitat.

2 Over the course of time, the water flood shut down will impact the rate of oil production and may reduce the recoverable reserves from the field.

3 Hilcorp ordinarily operates the Pipeline at 195 psig. After the leak started, we lowered pressure in three steps to 185 psig, then to 170 psig, and then to 165 psig. See Alternative 2, Description of Alternative.

Alternative 1 – No Action

Description of Alternative: Hilcorp operations would continue as normal. Hilcorp did not evaluate this alternative, but rather implemented Alternative 2.

Alternative 2 – Reduced Operational Throughput in Pipeline

This alternative describes the actions Hilcorp has taken to date and its current path forward.

Description of Alternative: Hilcorp would continue to reduce operations to minimal activities and operate at lower specifically selected operating pressures. Normal operating pressure on the Pipeline is 195 psig with a minimum normal in the range of 185 psig. We initially lowered the pressure to 185 psig, and then further lowered it to 170 psig, and then lowered it to the current pressure of 165 psig. Continuous monitoring of the Pipeline and all associated equipment would occur to ensure that the system remains stable. Operations has already shut down Platforms A and C water flood operations and the Saturn Generator (power generator for the platform) on Platform A.

Environmental Risk: Current environmental impacts include potential displacement of oxygen in the water and methane release to the air. As discussed below, the concentrations of dissolved methane in the bubble plume are likely to be low and to be diluted by tidal action with distance from the release point. Further, dissolved methane is not toxic to aquatic organisms. Review of available literature indicates that, with the exception of beluga whales, likely low populations of potentially effected aquatic species in the vicinity of the leak at this time of year. While belugas may be in the MGS area this time of year, they also avoid ice cover. The reductions we have made to the pressure in the Pipeline have resulted in less methane being released through the leak.

Public and Personnel Risk: This alternative would not create any additional risk to the public as there is no occupancy within the immediate area. Flow of methane gas in the water could potentially create a hazard to boats in the area; however the area where the leak is occurring is not a main navigational route and the Coast Guard has put out a notice to mariners in the area (see page 6, Section 3, below).

A thorough review of the risk to the platform personnel based on reducing throughput in the gas line has been conducted and no increased risk has been identified.

Alternative 3 – Line Repair Considerations

This alternative contains multiple options for how line repair would be conducted.

3A. Description of Alternatives –

1. **Line Repair from Surface**: Hilcorp would access and contain the leak from the surface (i.e., without putting divers in the water). Hilcorp does not believe the technology to perform this type of a repair currently exists. The technology would have to be developed – a difficult and

perhaps unmanageable task, given the ice and tidal conditions in Cook Inlet, and one unlikely to be completed before more conventional methods could be applied.

2. **Line Repair by Coil Tubing:** Hilcorp also reviewed the option of using coil tubing as a means to repair the line or as an alternative for gas delivery to the platforms. A preliminary investigation of this option brought to light that coil tubing in a horizontal lateral could not reach further than approximately 6000 ft. Using coil tubing to repair the Pipeline would require the tubing to be sent approximately five miles (over 26,000 feet) from start to finish, making this alternative infeasible. In addition, fluid would need to be used to clean and lubricate prior to insertion of the coil tubing. If attempted prior to repair of the leak this would allow the fluid, residual oil, and additional elements that are currently contained in the pipeline to be introduced into the Cook Inlet through the leak which could pose a greater risk to the environment.

3. **Line Repair by ROV:** Hilcorp has also reviewed the option of using remote operated vehicles (ROVs) to observe and repair the leak. We have not found a company willing to place its ROVs in Cook Inlet waters even without ice coverage. ROVs typically use visual spectrum cameras to navigate and observe repair targets. Even those ROVs guided by telemetry would be useful only to the extent they could either visualize and/or repair the Pipeline. At the latitude of the Pipeline, Cook Inlet carries large volumes of glacier silt, preventing the effective use of a visual spectrum camera.[4]

Public and Personnel Risk: Not applicable. Until the technology to contain the leak from the surface is developed, it is impossible to assess the risk to personnel and public. The use of coil tubing and ROVs is infeasible, eliminating the need to assess the risk to personnel and public.

3B. Description of Alternative – Line Repair with Divers: Hilcorp would place divers in the water at the location to repair the leak, once ice conditions allow.

Public and Personnel Risk: This would not create any additional risk to the public as there is no occupancy within the immediate area. Flow of methane gas in the water could potentially create a hazard to boats in the area; however this is not a main navigational route and the Coast Guard has put out a notice to mariners in the area (see below). The risk to the dive boat, divers, and support personnel is manageable without ice coverage because the location of the methane column can be identified, monitored and avoided during dive operations.

Due to the current ice coverage on the Cook Inlet, the divers' ongoing assessment of conditions continues to deem the area unsafe for dive operations. Conducting diving operations amongst ice floes would place personnel in danger. Ice floes also have the potential to sink vessels and damage dive equipment, delaying operations until replacement equipment can be obtained.

4 Divers use clear plastic bags filled with fresh water to make visual observations underwater in Cook Inlet. A diver presses the bag against the object to be viewed, and then presses his face mask to the bag in order to view the object through the fresh water. Divers also use their sense of touch to observe and assess objects.

Alternative 4 – Shutdown of the Pipeline

Description of Alternative: Hilcorp would shut down the Pipeline and all four platforms that it feeds: Baker Platform, "A" Platform, "C" Platform and Dillon Platform. This would allow for water to enter the Pipeline as the positive pressure is removed from the line, which would introduce new environmental impacts.

Environmental Risk: Shutdown of the Pipeline would reduce potential environmental impacts from possible lowered oxygen in the water column. However, it would increase environmental risks because it would instead introduce the possibility of an oil release. Maintaining a minimum positive pressure is necessary to prevent water intrusion through the leak, which would fill the line and potentially allow for the escape of residual crude oil, as this line was previously used as a crude oil pipeline. In addition, the crude oil line next to the Pipeline may freeze at the point where the pipeline emerges from the ocean in the intertidal area and above on the shore, creating the potential to create another source for an oil spill when the crude oil line thaws in the spring.

Public and Personnel Risk: Shutting down the Pipeline presents safety risks for Hilcorp personnel, the environment and has the potential to further damage offshore infrastructure. Shut down would require the use of diesel generation to maintain aids to navigation on the platforms, requiring transportation of diesel to each platform. This alternative would also create an increase in risk to those who would be responding to an oil spill, due to many factors including but not limited to darkness, ice, cold, water currents, and increased complexity of a spill response.

Alternative 5 – Pipeline Inspection

This alternative contains multiple options for how pipeline inspection would be conducted.

5A. Description of Alternative – Pigging: Hilcorp would pig the Pipeline prior to repair of the leak

Environmental Risk: Pigging of this line prior to repair of the leak would allow for scale, residual oil, and additional elements that are currently contained in the pipeline to be introduced into the environment through the leak.

Public and Personnel Risk: Not applicable.

5B. Description of Alternative – ROV: Hilcorp would send a Remotely Operated Vehicle (ROV) down to inspect the pipeline. As noted above, due to tides, ice, and water clarity, Hilcorp has been unable to locate a contractor that will allow their equipment to be placed into current water conditions.

Public and Personnel Risk: Not applicable.

3. Monitoring Environmental Impacts While Leak is Ongoing

As part of current environmental monitoring activities in response to the Pipeline leak, Hilcorp is conducting aerial over flights daily as weather conditions permit to detect if an escalation of the leak has occurred. We are also monitoring all pressures and flows on the Pipeline to ensure that the process remains stable. Ice conditions on Cook Inlet at the site of the leak are also being monitored closely so that Hilcorp is prepared for ice movement that would allow for divers to be sent out. Divers have been identified, engaged, briefed, and are prepared to dive as soon as conditions allow.

Environmental scientists within Hilcorp are reviewing in depth all literature on current species in the area that may be impacted. Hilcorp also has conducted a preliminary evaluation of potential environmental impacts from the release of natural gas to the water column. The following reflects the preliminary results of that work.

The primary component of natural gas is methane, a colorless, odorless, and tasteless gas. Based upon discussions to date with biologists and other scientists, a literature review, and a review of relevant regulatory requirements, Hilcorp's understanding is that methane may present a physical hazard (asphyxiation), but not a chemical hazard (toxicity). We have been provided with a citation to an online article as support for the statements in your February 10 letter that methane is "known to be detrimental to several aquatic species" and that it is "lethal to fish at concentrations over 1 mg methane/L of water." The article contains no citations to scientific studies, does not appear to have been peer reviewed, and seems to have been posted by an advocacy group. Hilcorp and its consultants are as yet unaware of any peer-reviewed studies that would support the assertions in this article or of any other studies in the available literature reporting toxic effects on aquatic species from exposure to methane bubbling through seawater in an active tidal environment like Cook Inlet.

While not toxic, in high enough concentrations methane can physically displace oxygen and become an asphyxiant. However, here the volume of gas being released to the atmosphere is too small and dispersed to pose that risk to humans. Further, the atmospheric concentration is too low to pose an explosion risk. Any potential physical hazard the bubbling gas may pose to vessels has already been addressed by the U.S. Coast Guard through a Notice to Mariners ("NOTAM"). The NOTAM dated February 15, 2017, provides:

> 353 ALASKA – SOUTHCENTRAL – COOK INLET
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> A natural gas leak has been reported from an 8 inch pipeline between platform a (Middle Ground Shoal) and the shore, in approximate position 60°46.816'N, 151°26.342'W. Due to the current level of ice in lower Cook Inlet, natural gas may be accumulating under the ice and unable to be dissipate safely into the atmosphere. Mariners are requested to stay outside of a 1000-yard radius of the location and transit the area with caution.[5]

To get a better understanding of possible worst-case impacts on methane levels in the water column above the leak, Hilcorp asked an environmental consultant, SLR International, to adapt an EPA-developed plume modeling program to roughly estimate potential methane concentrations at the surface

5 See https://www.navcen.uscg.gov/pdf/lnms/lnm17072017.pdf accessed February 17, 2017.

within the bubble field and the dilution that would occur as the tides move water away from the bubble column. SLR also performed a different worst-case mass balancing analysis that estimates the change in methane concentrations that would occur in Cook Inlet water if all of the methane being released were to dissolve into the water column (which clearly is not occurring, as demonstrated by the release of bubbles to the atmosphere).

To model dispersion of methane as water moves away from the plume, the size of the release was exaggerated to account for the differences between the mixing behavior of a gas and the behavior of a typical liquid plume for which the model was designed. In addition, a simplified mass flux model, again using conservative assumptions, estimated that 17% of the released methane would be dissolved into the water column and 83% would be released to the atmosphere. The preliminary results of this exercise provided an estimate of 0.05 mg/L as an initial methane concentration at the surface (within the bubble field). We would note that this is less than 1/500th of the level your February 10 letter indicates may be harmful to fish and approximates the minimum threshold for detection by fish hypothesized in the article that was the source for your information. The model also indicates that, even without accounting for transformations (volatilization, degradation, etc.), concentrations would be reduced by half in about 5,000 meters.

SLR's second approach was to evaluate the possible concentration of methane in Cook Inlet water as if (a) the methane release continued indefinitely, and (b) all of the gas being released were to be dissolved and retained in the water column (even though the mass flux model conservatively projected 83% is escaping to the atmosphere). This analysis showed that even with these worst-case assumptions, due to tidal mixing the methane concentrations would reach a steady state, depending on the considerations given to tidal characteristics, of between 0.002 and 0.0005 mg/L. While these analyses are rough estimates and the results are preliminary (given the very short time SLR had to prepare them), they demonstrate the relatively small impact that the release is likely to have on methane concentrations in the water column near the plume.

Hilcorp's consultants also have located prior environmental reviews that considered the potential impact of methane gas releases on ocean waters, including a recent study that evaluated potential impacts in Cook Inlet, which projected low levels of impacts in line with the implications of SLR's work. The Georgia Strait Crossing Project Final EIS (FERC, 2001) noted that methane gas is a non-toxic natural and common molecular component of seawater and is produced by benthic organisms in the marine environment. The FERC EIS provides an analysis of a major gas pipeline rupture and concludes that minimal incremental changes would occur to water chemistry and quality. The document concludes that mobile marine wildlife would be able to avoid the gas bubble stream in the water column from a minor to major rupture and would not be harmed.

The Cook Inlet Lease Sale 244 Final EIS (BOEM, 2016) considered the potential impacts of a one-day natural gas release of 8 MMcf/day (million cubic feet per day), which is 25 to 30 times the release rate from the Pipeline. BOEM concluded that the methane would rise through the water column, with subsurface water quality altered temporarily in colder deep waters. Upon reaching the surface, the gaseous methane would react with air to form water and carbon dioxide near the surface. While methane and carbon dioxide both will tend to disperse to the atmosphere, near surface waters would

have higher concentrations of carbon dioxide. Methane and carbon dioxide in solution could locally deplete the available dissolved oxygen.

The BOEM EIS concluded that no large-scale effects on marine mammals would occur from a gas release of this size and that it would have negligible to minor effects overall on marine mammals. The FERC EIS concluded that mobile marine wildlife would be able to avoid the gas bubble stream in the water column from a minor to major rupture and would be not be harmed.
Localized depletion of dissolved oxygen could have an impact on small and larval fishes which are not readily able to avoid those waters. However, in addition, neither pelagic nor groundfish are likely to be present in significant numbers in the waters around MGS at this time of year.

Marine Mammals

Cook Inlet beluga whales are the marine mammal species most likely to be observed in the area of MGS at this time of year. Harbor porpoise are not present in upper Cook Inlet during ice conditions. Harbor seals, though common in upper Cook Inlet, would be associated with haulouts further north or onshore near rivers, near MGS. Orcas, Dall's porpoise, humpback whales (Hawaii DPS) and Steller sea lions (Western DPS) have also been observed in upper Cook Inlet but their occurrence is considered infrequent or rare, particularly while ice is in the area. Sea otters (southwest Alaska DPS) are found in lower Cook Inlet but are predominantly found in nearshore waters throughout much of the year.

The best available information on the distribution of Cook Inlet beluga whales indicates that they are likely to be found in the vicinity of MGS and could be encountered in the area around the gas leak through March. However, as noted above, prior environmental assessments have concluded that any beluga encountering the gas bubble stream is likely to avoid it. Further, belugas tend to avoid ice-covered areas. The location of Cook Inlet belugas in April is not well understood, but by May they are moving north out of the area, into upper Cook Inlet.

Pelagic Fish

Forage Fish – Forage fish (particularly Eulachon and Capelin) are well distributed in Cook Inlet waters and could be present in MGS waters near the leak, but they are not likely to be present in those waters in significant numbers. Sand lance are abundant in shallow, nearshore areas, ranging in depth to 100 meters, but are most common in depths less than 50 meters. Eulachon (Hooligan) are anadromous and as spawning season approaches they gather in large schools off the mouths of spawning streams and rivers. In central Alaska this generally takes place in May. Pacific herring generally spawn in the spring (April and May in Prince William Sound) and support a sac-roe fishery in Kamishak Bay, well away from the MGS area. Longfin smelt gather in large schools off the mouths of freshwater spawning streams and rivers, but have been observed returning to the Kenai River in late November through early December. Capelin populations are large and range extensively in Alaskan waters, and are a major forage fish in the Cook Inlet region.

Salmonids – None of the salmonid species are likely to be present in MGS waters at this time of year. Chinook salmon begin entering Cook Inlet waters and moving toward spawning rivers in May

and juvenile Chinook begin out-migrating during that same time. During the winter months, winter (feeder) Chinook are generally found in central and lower Cook Inlet, below Anchor Point. Coho salmon enter the area beginning in July. Pink salmon enter spawning streams beginning in June. Chum salmon enter the Cook Inlet region beginning in early July. Red salmon return to Cook Inlet waters beginning in late June.

Groundfish

At this time of year, few groundfish are likely to be present in MGS waters. Halibut are likely to be in lower Cook Inlet or further south; they usually spawn on the continental slope in December through February. Peak spawning season for Pacific cod extends approximately from January through May and also is likely to occur in deeper waters to the south. Pacific hake (whiting) may be found throughout the Cook Inlet region, though not in large numbers. Sablefish usually occur at greater depths, found outside of Cook Inlet. Other groundfish also may be found in waters near MGS, but as with several of the other species discussed, they are more common in lower Cook Inlet.

4. Evaluating Potential Impacts After Leak Is Repaired

Your fourth question assumes, or at least appears to assume, that detectable methane is likely to remain in the waters of Cook Inlet after the leak is repaired. That is unlikely, however, due to its physical properties. The potential fate of the released methane is (1) to rise in a bubble through the water column and directly enter atmosphere, or (2) dissolve in the surrounding water, then re-gasify from water and volatilize to atmosphere or biodegrade in the water. Nevertheless, Hilcorp is willing to discuss post-repair monitoring.

5. Other Options

Hilcorp has outlined the potential alternatives it has identified to date in its response to your first question, but is open to discussing any additional alternatives that the Department or other agencies may wish to suggest.

Supporting Information

This letter's discussion of potential environmental impacts from the gas leak is based upon the preliminary findings of several marine mammal and fishery biologists and other consultants. Hilcorp anticipates you will agree that their work is both informative and remarkably thorough in light of the very few days they had to assemble this information. Hilcorp plans to continue working with this team, and with the state and federal agencies, to improve its understanding of any potential environmental impacts that may result from the gas leak. At the same time, Hilcorp will remain focused on determining appropriate means to safely repair the fuel gas line and bring the leak under control.

If you have any questions or concerns regarding this letter please feel free to contact either myself or the appropriate Hilcorp staff member as we continue to work with you on our ongoing response to this event.

Sincerely,

David Wilkins

cc: Graham Wood, ADEC
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