TAPS C-Plan Adjudicatory Hearing
Case No. OAH No. 07-496 DEC
Contingency Plan Amendment

Report of
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907-868-1918

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Basis of Opinions

I have been working professionally as a fisheries biologist in Alaska for the past 28 years. In 1983, I began working as a research and management biologist for the salmon and herring fisheries of the Prince William Sound and Copper River management areas. Since that time, I have had involvement in those fisheries in a variety of research, management, supervisory and regulatory capacities. In 1989, I was the Prince William Sound/Copper River area management biologist for the Alaska Department of Fish and Game. I was intimately involved with development of the Department's policies and biological response to the Exxon Valdez oil spill, including the drafting of the MOU between ADF&G and ADEC. I issued numerous emergency orders closing fisheries in response to oil impacts and observed clean up efforts.

Cascadia Wildlands Project asked me for my expert opinion concerning two topics relating to their adjudicatory hearing for the Trans Alaska Pipeline Contingency Plan (TAPS C-Plan). First, does the Copper River Watershed meet the criteria of an Environmentally sensitive area or area of public concern as defined in 18 AAC 75.990(35) and (5)? Secondly they have asked for my expert opinion in regard to the impacts to fisheries and other resources that would result from four Trans Alaska Pipeline oil spill scenarios. Cascadia Wildlands Project is compensating me at a rate of $150 per hour with a cap of $5,000 for completing this work.

Part I - ESA and APC Classification

Does the Copper River Watershed meet any of the criteria of an "environmentally sensitive area" or "area of public concern" as defined in 18 AAC 75.990 (35) and (5)?

For the purposes of the TAPS C-Plan, it is my opinion that the Copper River watershed in its entirety should be classified as both an "area of public concern" and an "environmentally sensitive area" as defined under 18 AAC 75.990 (5) and (35) respectively. This area should include all tributaries and water bodies of the Copper River drainage and incorporate the estuaries and coastal habitat of the Copper River Critical Habitat Area as defined in AS 16.20.600, down to and including the Copper River and Bering River fishing districts as defined in 5 AAC 24.200. (a) and (b).

Area of Public Concern

<u>Criteria A. Area of unique cultural value, historical significance or scenic importance.</u>

Salmon and salmon harvesting have been critical to the cultural and economic survival of the Ahtna people that inhabit the Copper River basin for at least 1,000 years. (Simeone & Kari, 2002) In their paper, Simeone and Kari, through first person oral histories from Ahtna elders, describe in detail the extensive Ahtna culture which centers around the river and its salmon resources. Prior to the construction of highways, Ahtna people

congregated along the length of the river above Wood Canyon. The Ahtna have a mythology that incorporates the river and its resources, developed management concepts and had an entire lexicon in their language to describe the various stocks of salmon in the river. A similar culture exists for the Eyak who inhabit the lower portions of the Copper River and currently reside in the community of Cordova.

The Copper River has a unique and diverse history dating back a 1,000 years numerous archeological sites in the watershed. The now long abandon Athabascan community at Taral and others along the river were described by U. S. Army Explorer, Lt. Henry T. Allen who was likely the first westerner to encountered Ahtna natives in 1885. Following discovery of rich copper deposits at Kennicott in 1899 and 1901 a mammoth effort started to construct a transportation corridor along the Copper River to transport the rich ore to sea. Steamboats operated on the river and ultimately the Copper River rail road was completed connecting the port town of Cordova to the copper mines. In "The Copper Spike", Lone Janson describes in detail this fascinating history. With the copper mined out, much of the rail was removed to assist in the war effort during World War II. The "Million Dollar Bridge" spanning the Copper River below Miles Lake, remains a historic monument. In fact, the "Million Dollar Bridge" is on the National Register of Historic Places along with some 24 other sites within the Copper River watershed.

The scenic significance of the Copper River watershed is, in my opinion, undebatable. I base this opinion not only on my many personal experiences but also on the importance placed on this area by BLM, the U.S. Forest Service and the National Park Service. I have personally floated the Gulkana River from Paxson Lake to Sourdough, a stretch that is classified as a wild and scenic river by BLM (BLM, 2006). Similarly, I have floated the section of the Copper River from above Wood Canyon at Chitina to the 27 Mile bridge. Both of these river stretches are world class for their scenic significance. I do not need to elaborate on the beauty of Wood Canyon, the unsurpassed beauty of the Copper River as it cuts through the Chugach Mountains or the stupendous beauty of the Miles and Childs Glaciers. All are eloquently described by others and are photographic icons found on calendars, magazines and coffee table photo books. The Copper River delta has a unique natural beauty of its own. I personally have helped organize field trips for the Alaska Society of Outdoor and Nature Photographers to the delta, and it continues to be a popular destination for this organization. The city of Cordova caters to tourists that come to see the scenic beauty and wildlife of the delta. The Forest Service, BLM and the Alaska Department of Fish and Game have constructed numerous interpretive signs catering to the tourism and interest in the area's scenic qualities. What other locations in Alaska can you drive to a spot where you can gaze across a world class salmon river at the 300 foot vertical face of a glacier?

<u>Criteria B. Area of substantial residential or public recreational value or opportunity.</u>

The Copper River watershed meets this criteria due to its abundant natural resources that are used by both basin residents and visitors from outlying areas. Primary of these resources are fisheries. The Gulkana River sport fishery, Glennallen and Chitina Sub district subsistence and personal use fisheries, and the Copper River commercial fisheries

are discussed elsewhere in this document. The Gulkana, Tazlina, Klutina, Bremner, and Copper are all popular rivers for boaters (Embick, 1994).and (Jettmar. 1993).

Criteria C. Area where fish hatcheries or other facilities primarily depend upon the use of potentially affected water.

The Gulkana Hatchery, a facility that produces from 200,000 – 500,000 sockeye salmon annually, is located near Paxson. Hatchery produced fry rear in Paxson and Summit Lakes, waters that are vulnerable to a TAPS spill.

Criteria D. Area significantly used for commercial, sport or subsistence hunting, fishing and gathering.

In 2007, the commercial salmon fishery in the Copper River harvested 1.9 million sockeye salmon, 40,000 Chinook salmon and 117,000 coho salmon. (Hallowell el.al., 2007a). Economic data are not yet available for 2007, however in 2005, a year with a slightly smaller harvest, the value paid to commercial fishermen for their harvest was around $20 million. The upper Copper River is home to traditional subsistence fisheries for the Ahtna, as well as other subsistence harvesters from within and outside of the watershed. The personal use dip net fishery at Chitina has over 8,000 participants annually (Sommerville & Taube, 2005). The Gulkana is an extremely popular sport fishing river. All of these fisheries would be impacted by an oil spill.

Criteria E. Area where concentrations of terrestrial or marine mammals or bird populations primarily depend on the marine environment are located.

The Copper River Critical Habitat Area, located at the mouth of the river, was created by the state for just this purpose. Each spring an estimated 12 million shorebirds, the largest gathering of shorebirds in the western hemisphere, stop along the shores of the Copper River delta on their way to nesting grounds (ADF&G, 200?). The delta is a major nesting grounds for waterfowl, including a large portion of the world's population of Dusky Canada Geese. Harbor seals haul out and pup on the barrier islands (sand bars) in the delta. The marine waters of the critical habitat area are used by sea lions, porpoise, as well as grey, minke, humpback and killer whales. All of these areas and resources are especially vulnerable to an oil spill into the Copper River.

Environmentally Sensitive Area – area that is especially sensate to change or alteration

It is my opinion that the Copper River Watershed, as I have described above, meets the criteria of an "Environmentally Sensitive Area" as defined in 18 AAC 75.990(35). I base this on the following: (Paragraph headings correspond to the letter heading under 18 AAC 75.990(35)).

A. This area is characterized as having unique and fragile natural habitat, as evidenced by the state's classification of the Copper River delta as a critical habitat area under AS 16.20.600. This productive estuary and adjacent wetlands

are critical habitat to Dusky Canada Geese, in addition to a host of other waterfowl and shore birds. This habitat area lies directly in the path of any oil spilled into the Copper River.

B. The abundant sockeye and Chinook salmon resources of the Copper River speak to the area's high natural productivity. Rainbow trout that abundantly inhabit the Gulkana River drainage are the farthest north natural population for this species.

C. The Copper River delta is of unique geologic significance owing to the six foot uplift of this area that resulted from the 1964 earthquake. It is also topographically significant owing to its unique barrier islands and productive estuary and adjacent uplands. The barrio islands make this unique habitat especially vulnerable to a slip from oil that would be transported into the area by the Copper River.

D. The importance of the Copper River delta's offshore sandbars have been previously discussed.

E. The Copper River delta is classified as a critical habitat area under AS 16.20.600.

F. My review of current regulations indicated that 6 AAC 80.170, "area that merits special attention", has been repealed.

Part II – Spill Scenarios

Scenario No. 1. Gulkana Scenario – 1,600 BBL, (67,200 gal), at or adjacent to the River crossing at PLMP 654.4.

I was asked to predict the consequences of an oil spill at or adjacent to the TAPS crossing of the Gulkana River near Sourdough at PLMP 654.4 in an amount of 1,600 bbl. This is similar to the Gulkana River "bullet hole" Scenario 12, contained in the Volume 2 of the C-Plan. In the published scenario, the spill occurs in August, during optimal weather conditions and low water velocities in the Gulkana River. In this scenario, all oil is contained and accounted for within 72 hours of the discovery of the spill, and none of the spilled oil makes it into the Copper River.

First I will comment on the likely consequences if the spill and the recovery occurred exactly as published in the C-Plan. The August timing of the spill would be after the peak timing migrating for adult Chinook salmon returning to the Gulkana at the spill site, but still into the heart of the sockeye migration. Under the scenario, 300 bbl of oil remain trapped in soils and tundra mats, while 200 bbl are trapped along Gulkana River shorelines. This 500 bbl of oil would prove problematic for the Gulkana River. As a popular recreational river, recreational boat traffic would compound concerns for shoreline oil. First, boat wakes would tend to wash oil up into the riparian zone where it would be more difficult to recover and would tend to slowly leach back into the river. Secondly boat wakes would tend to emulsify part of the oil into the water column, making it easier to ingest for resident and migratory fish species. Third, boats passing through oiled areas would provide a transport mechanism for oil to move upstream. Consequently, a closure of the Gulkana River to all recreational boat traffic would be required. Depending on how successful oil recovery activities are, the contaminated riparian areas of the river may continue to leach oil sheens into the river into the summer following the spill. Further damage to riparian areas from cleanup activities may leave them especially delicate. Consequently, the power boat closure would need to be reevaluated and possible extended into the following summer. As part of the response activities, a boat cleaning station should be established.

Impacts to wildlife would include impairment due to direct contact with oil and the ingestion of oil. Waterfowl that inhabit or migrate through the spill area would be especially vulnerable to oiling. Oil floating on the water surface would be picked up by the feathers of waterfowl. Also, waterfowl would be likely to ingest oil while feeding in riparian areas or dabbling in contaminated areas. Mammals that occupy the riparian zones of the Gulkana River, such as mink, ermine, martin and river otter would be vulnerable to oiling their fur as they pass through oiled zones. Oiling may reduce insulating characteristics of their coats. These mammals are also likely to ingest contaminated prey taken in the riparian zones. Raptors, similarly, would be vulnerable to ingestion of contaminated prey, and may also pick up oil on their feathers while

scavenging in the riparian zones. Resident fish would pick up oil toxins through their gills and through ingestion of contaminated insects and other prey species.

Due to its accessibility and abundant fishery resources, the Gulkana River is second only to the Kenai in its popularity as a sport fishing destination. In addition to world class Chinook salmon fishing, anglers also target sockeye salmon, coho salmon, rainbow trout and grayling. The Gulkana River contains the most northern native population of Rainbow trout in North America. Over the past decade there has been a significant increase in the number of fishing guide operations on the Gulkana River. In 2005, fourteen guides were registered with BLM to operate within the Gulkana "Wild River" corridor (Somerville, 2007). Over the past decade annual sport fishing effort on the Gulkana River has averaged 29,600 angler days.

With a spill as described in the C-Plan Gulkana Scenario, an immediate closure of the sport fishery in the Gulkana River would be called for. This would be justified first as a precautionary measure to mitigate the potential toxic impacts to fishery and ecosystem resources. Secondly, the closure would be warranted due to health concerns from contaminated fish. Finally, the closure would minimize further damage to riparian areas and introduction of oil to the river resulting from anglers trafficking through oiled river bank zones. The following fishing season, one year after the spill, the river would need to be closely surveyed for lingering oil in river bank areas. Closures for this season would likely be reduced in size, dependant upon the extent of the areas affected by the spill.

The subsistence fishery operating in the Glennallen District, in the main stem of the Copper River downstream of the mouth of the Gulkana River, would be vulnerable to the trajectory of this spill scenario. Even though the hypothetical scenario claims that all oil would be contained prior to entering the Copper River (Glennallen Subdistrict), subsistence harvesters would be very suspect of fishery resources harvested in the river. Following the Exxon Valdez Oil spill, subsistence harvests declined by as much as 77% in the 10 villages of Prince William Sound, lower Cook Inlet and Kodiak Island. (Fall, 1999). An Ouzinkie subsistence harvester was quoted as saying, "No one's eating anything out of the ocean any more." This reduction was largely due to the fear that oil contamination had rendered resources unsafe to eat. Copper River subsistence users would experience similar fears, resulting in reduced subsistence fishery harvests in the villages of Gakona, Glennallen, Copper Center and Chitina. Personal use dip net harvesters at Chitina would experience similar concerns. These concerns would likely continue through the next fishing season following the spill.

The Copper River commercial salmon fishery is renowned in fish markets both nationally and internationally. Copper River salmon are unique and highly prized in the market due to their early run timing, their rich flavor and high omega-3 oil content. Copper River commercial fishermen have invested a good deal of effort to make their salmon so well recognized through special handling of their catch, timely processing and transport and wide scale marketing efforts. Other salmon fisheries in Alaska have modeled similar programs in competitive effort to elevate their market share. Any perception of contamination from a TAPS oil spill would have impacts on the markets for Copper

River salmon. Many of the commercial fishermen from Cordova experienced the Exxon Valdez spill, and consequently do not trust the oil industry. Even if the published Gulkana scenario were in fact true that 100% of the spilled oil was contained before entering the Copper River, it would not diminish their suspicions.

It is my opinion that impacts resulting from a 1,600 bbl Gulkana "bullet hole" spill scenario in August would be significantly greater than published in the C-Plan. It is very unlikely even given the best of conditions that 100% of the spilled oil would be contained before reaching the Copper River. Based upon my experiences observing booming operations in Prince William Sound following the Exxon Valdez spill, I do not believe that diversion booms could collect all oil on the water. Given that the oil has traveled for 50 miles on the Gulkana prior to reaching the CS10-16 containment site, it would be well distributed across the river. Booming operations in moving water are inefficient at best. The water velocity and riffles at this containment site add to the challenge and some portion of the spilled oil would undoubtedly enter the Copper River. If weather were not optimal, this portion would be greater. If the response time was compromised in some unforeseen way, still more oil would reach the Copper River. If the water levels were high due to recent rain storms, or due to the spill occurring earlier in the summer, again more oil would enter the Copper River. The net result would be to compound the down-stream impacts described above. Rather than fearing that there is oil contaminating their catch, subsistence fishers would see oil on the water and oil fouling their fish wheels or dip nets. Personal Use dip net fishers at Chitina would also see evidence of the spill.

In response to the 1989 Exxon Valdez spill, a memorandum of understanding (MOU) was signed by the commissioners of the Alaska Department of Fish & Game and the Alaska Department of Environmental Conservation governing the conduct of fisheries within the spill affected area. (Brady, 1991a). Popularly known as the "Zero Tolerance Policy", this MOU directed that ADF&G would close or not open fisheries if:

> "*there is an indication of oil in any quantity in the area or proximity of the area (including beaches), such that there is an appreciable likelihood that gear will be fouled, fish harvest adulterated, or such that the conduct of an orderly fishery could not take place."*

Detailed and ongoing assessment of the Copper River below the Gulkana River confluence and extending down to the Copper River delta and commercial fishing district would be required. Dependant upon the degree that oil is detected; adoption of a policy similar to the "Zero Tolerance Policy" referenced above would be warranted. Commercial fishermen would be particularly concerned, expressing the need by the state agencies to provide some assurance to their buyers that not one contaminated fish will make it to market. If oil presence is detected, fishery closures would be warranted in the Glennallen Subdistrict, the Chitina Subdistrict and the Copper River District, respectively.

Scenario No. 2. Gulkana Contingency Area – spill of 18, 657 BBL, (783,594 gal), at or adjacent to the River crossing at PLMP 654.4.

This spill scenario is similar to the spill Scenario No. 1 above in location, but differs significantly due to the substantially larger volume of oil spilled. In this scenario, the volume of spilled oil is 18,657 bbl, an order of magnitude greater than in the first scenario. This spill volume is approximately 7% of the volume spilled by the Exxon Valdez.

Fate of the Spilled Oil.

In this scenario the impacts to natural resources mentioned above would be significantly exaggerated. In the most optimal response situation for a 1,600 bbl spill, I still predicted that oil would reach the Copper River. With a spill of 18,657 bbl, there is no question, even in the most optimal circumstances, that a significant amount of oil would enter the Copper River. The actual amount would be dependant upon a number of factors such as weather conditions, water levels, time of year, and the response assets available at the time of the spill. For the purposes of this analysis, I predict that 50% (more that 9,000 bbl) of the spilled oil would reach the main Copper River, which I feel is a median figure for a spill volume of this magnitude.

Due to its immense size and velocity, once oil enters the Copper River, containment or diversion becomes exponentially harder if not impossible. The Gulkana River Contingency Area spill action plan does not discuss response deployments in the main stem of the Copper River below the Gulkana River confluence. An initial response would focus all available resources on the immediate spill site, and containment sites at CS10-17 and CS10-16. Once it was ascertained that this response was insufficient, the oil that had escaped the containment efforts at CS10-16 and entered the Copper River would likely pass Glennallen and/or Copper Center before any resources could be deployed there. With the Copper River running at an average gradient of 5 feet per mile between Chitina and Flag Point and with a normal flow volume between 50,000 and 150,000 cfs (Embick, 1994), the spilled oil would be on an express train to the Copper River delta. The Tazlina oil spill scenario modeled by the Ecotrust Copper River Project shows oil to be transported from Glennallen to the mouth of the Copper River in 39 hours. (Ecotrust, 2007).

The Exxon Valdez spill was approximately 250,000 bbl in volume. The spilled oil exited Prince William Sound and followed the Alaska Coastal Current westward impacting fisheries in Cook Inlet, on Kodiak Island and along the South Alaska Peninsula. Oil was not detected in quantities sufficient to disrupt fisheries west of the Shumigan Islands, roughly 650 miles from Bligh Reef where the Exxon Valdez grounded. As the Exxon Valdez oil traveled through the marine environment, portions of the original spilled volume were left on beaches, removed by recovery efforts and lost to evaporation of the volatile fraction of the oil. As a gross method to estimate the volume of oil that passed any point on the spill path, I assumed a constant linear rate of reduction. I then calculated

that a 30% reduction in the spilled volume for each 25 miles traveled would leave about 23 bbl of oil reaching the Shumigan Islands, Table 1.

Table 1. Estimates of the volume of oil passing points along the Exxon Valdez Oil spill trajectory between Bligh Reef and the Shumigan Islands using a constant rate of decay of 30% for each 25 miles of travel.

Miles From Spill	Landmarks on spill path	Spill Volume (bbl) reaching Point
0	Bligh Reef grounding	250,000
25	PWS	175,000
50	PWS	122,500
75	Exits PWS	85,750
100		60,025
125		42,018
150	Outer Kenai Coast	29,412
175		20,589
200		14,412
225	Cook Inlet – Kachemak Bay	10,088
250		7,062
275		4,943
300		3,460
325	Kodiak Island	2,422
350		1,696
375		1,187
400		831
425		582
450		407
475		285
500		199
525		140
550		98
575		68
600		48
625		34
650	Shumigan Islands	23

The Copper River is a broad, swift, glacial fed river. North slope crude oil would be quickly transported down stream impacting numerous gravel bars as it travels its course leaving a characteristic “bath tub ring” of contamination. Some significant portion of the 9,000 bbl volume would be retained by these gravel bar impacts, with the remainder moving into the Copper River delta. Using the EVOS decay rate of 30% per each 25 miles traveled, roughly 8,000 bbl would be left on the river bars of the Copper River and 1,000 bbl would enter into the Copper River delta, Table 2.

Table 2. Hypothetical estimates of the volume of oil passing mileage points and land marks along the oil spill trajectory for Scenario No. 2, a 18,657 bbl spill into the Gulkana River at PLMP 654.4 using a constant rate of decay of 30% for each 25 miles of travel.

Miles From Spill	Landmarks on spill path	Spill Volume reaching Point
0	PLMP 654.4	18,657
25		13,060
50	Mouth of Gulkana	9,142
75		6,399
100		4,480
125		3,136
150	Wood Canyon	2,195
175		1,536
200		1,076
225	CR Delta	753
250		527
275		369
300	Hinchenbrook Ent.	258
325	PWS	181
350		127
375	Exit PWS	89
400		62
425		43
450		30
475		21
500		15
525	Cook Inlet	10
550		7
575		
600		
625	Kodiak	

The delta has a broad intertidal area protected by a series of sand bars, Figure 1. The area is roughly 50 miles wide running from Softuk Bar in the east to Strawberry bar to the west. There are numerous channels that penetrate the bars, the most significant being Kokinhenik. A significant portion of the oil traveling down the river would be trapped by the bars and remain within the intertidal area of the delta. This oil would be "pumped" with each tide cycle up into the high estuary marshes of the delta, and on to the bars leaving a "bath tub ring" of oil at the high tide mark.

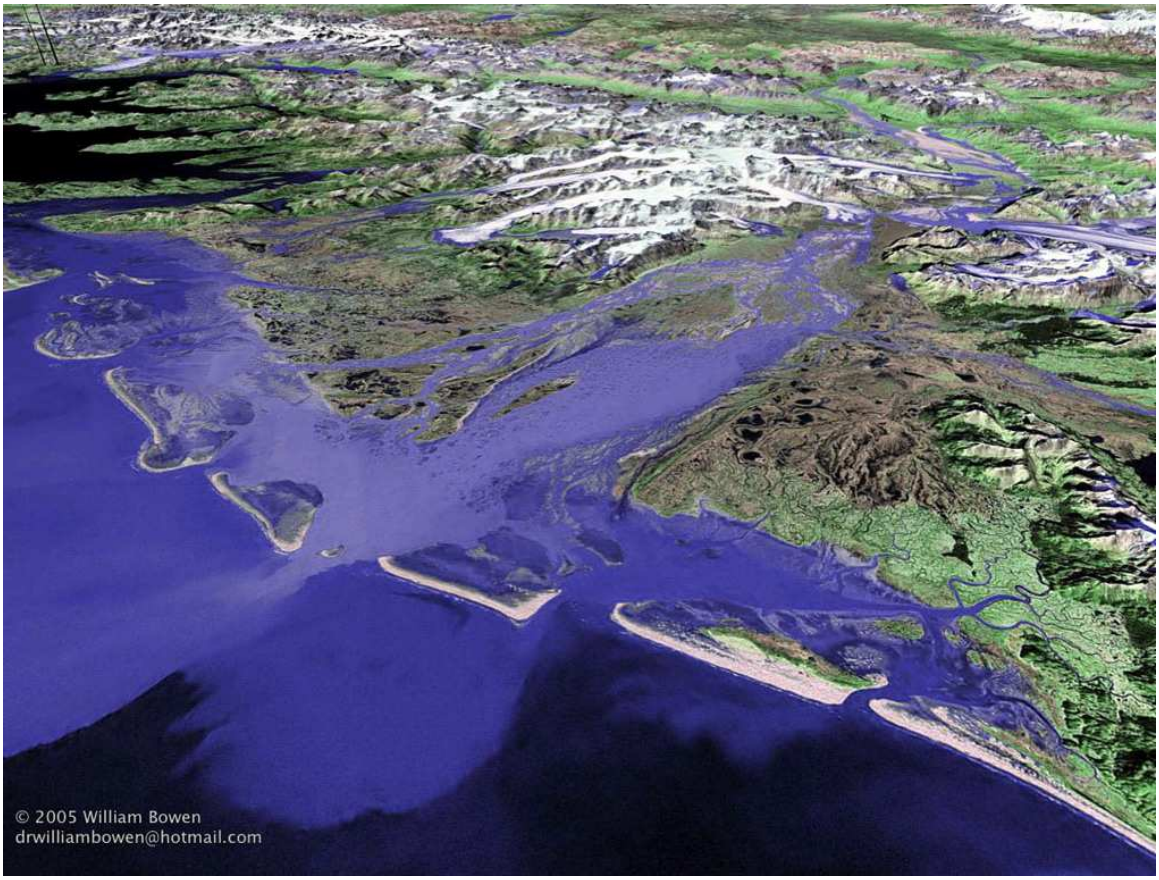

Figure 1. Aerial portrayal of the Copper River delta illustrating sand bars and entrances protecting estuary areas of the Copper River Critical Habitat area.

Oil that passes through the sand bars of the Copper River delta would enter the Gulf of Alaska and be subjected to the westward drift of the Alaska Coastal Current. This current would move oil along the outer coast of Hinchinbrook Island bringing it into Prince William Sound through Hinchinbrook Entrance. Some oil may also pass westward through Strawberry Channel into Orca Inlet and Hawkins Island Cutoff. Based on the assumptions in Table 2, approximately 250 bbl of oil would enter Prince William Sound.

Impacts to Fisheries

The closure of the Gulkana River to boat traffic as discussed in Scenario No. 1, would be necessary. In addition, further closures or restrictions may be necessary in the Copper River. The sport fishery on the Gulkana River would be closed as described above. Due to the increased magnitude of the impacts from this spill it would be likely that the state departments of Fish and Game and Environmental Conservation would develop a MOU (Zero Tolerance Policy) similar to the one employed for the Exxon Valdez spill. Because federally managed subsistence fisheries would need to be closed, as well as state managed fisheries, the MOU developed for this oil spill situation would need to incorporate federal resource managers, (BLM, USFS, NPS and OSM).

Due to the contamination of river bars along the Copper River below the Gulkana, there would be a high likelihood that fish wheels and dip nets would be fouled by oil. Consequently, all subsistence and personal use fisheries in the Glennallen and Chitina Subdistrict would be closed. Subsistence fishing in the Glennallen subdistrict above the Gulkana could continue, if fish were tested for contamination and certified safe by DEC, or as directed under the MOU. The subsistence harvest taken above the Gulkana River historically constitutes only a small portion of the total up-river subsistence harvest. Because there are limited areas to fish, it is very unlikely that fishers displaced due to the closures below the Gulkana would find alternate resources here. Consequently, the closures described above would be devastating to subsistence fishers of the Copper River basin. As discussed previously, fear of contamination of subsistence resources would spill over into other subsistence food items such as water foul, and the total subsistence take would be very likely remain reduced for a year or two after fisheries are reopened.

Around 8,000 fishers participate in the state managed personal use dip net fishery at Chitina. Additional fishers participate in the fishery under a federally managed subsistence permit. A majority of these harvesters are from Fairbanks, with the balance coming from Anchorage and other communities. The Chitina fishery provides a staple source of salmon for their families. The closure of this fishery would be very disruptive and place hardship on many of these fishers. While Anchorage based fishers could opt to go to the Kenai as an alternative, Fairbanks dip netters would be out of luck.

The ex-vessel value of the Copper River Commercial salmon fishery was roughly $20 million in 2005 (Hollowell et.al., 2007). In addition to the value commercial fishermen receive for their catch, processing, transport and other support industries multiply the value of this fishery. A volume of 750 to 1,000 bbl of Alaska north slope crude oil flowing into the heart of the Copper River commercial fishing district would be very disruptive. In order to eliminate all risk of putting contaminated fish into the market, it would be necessary to close the entire Copper River commercial fishing district. Oil contaminating over 100 miles of river banks above the fishing district would continue to leach oil into the district long after the main body of oil reached the district. Consequently the impacts would linger over a long period of time. Cleanup efforts upriver would run the risk of further introduction of oil into the river and into the district.

In the1989 Exxon Valdes spill, the Department of Fish and Game made every effort to open salmon fisheries, in times and areas such that there was no risk to contaminating the harvest with oil. The previously mentioned MOU directed the roles of both ADF&G and DEC to achieve this objective. Areas of the sound that had heavily impacted beaches were closed for the entire 1989 season. If oil severely impacts the sand bars of the Copper River delta, a similar season long closure would be necessary. If some bars were not severely impacted, it may be possible to conduct highly regulated short openings in small fishing zones. In 1989 Department of Fish and Game managers were stationed aboard research vessels on the fishing grounds, in districts that were not impacted by the Exxon spill. In order to open the salmon fishery, managers first had all fishing vessels depart the areas being considered for an opening. Then aerial surveys were flown over the area searching for the existence of oil sheens on the waters. If there were no oil

sheens, the manager would then map out a small area and announce an opening of short duration within the described area. Fish that were harvested in such controlled openings were then inspected while still on tenders prior to off loading at the processing plants. If DEC inspectors detected even one contaminated fish, the entire tender load would be destroyed.

Such a management scenario packed numerous boats into the small areas for short duration openings. Using this type of strategy to conduct orderly fishery openings in the Copper River district would be extremely difficult and costly. As a result, commercial fishermen would very likely forego a large portion of, if not the entire, salmon harvest for the fishing season following the spill. Even more devastating than the foregone harvest, the fishermen and related industries would suffer the lasting market impacts to the Copper River brand recognition in world salmon markets. There is also a subsistence fishery on the Copper River delta that would be either closed or severely restricted.

With 250 bbl oil entering Prince William Sound, the MOU directed fishery management strategies would need to be employed for the sound's nine fishing districts. This would require an aerial surveillance program for oil, test fishing prior to any district openings, and an ongoing DEC fish inspection program. Oil booms would be deployed to protect hatchery areas. It is likely that this quantity of oil could be managed under the MOU without much lost in harvest. However such an intensive management program requires substantial funds for dedicated staffing, aerial surveillance, lab time, and chartered vessels. These costs extend well beyond normal agency operational funds.

Dependant upon the path of oil, some subsistence resources such as herring roe on kelp, may be impacted.

The second fishing season following the Exxon Valdez oil spill required continued management measures under the MOU (Brady et. al., 1991b). This would be the case for this spill scenario, particularly for the Copper River district.

Scenario No. 3 -Tazlina Contingency Area – spill of 25,954 BBL, (1,090,626 gal) at PLMP 686.7 – 689.2 (Segment 4)

This scenario differs from the first two scenarios by its location, the pipeline crossing at Tazlina River, and the spill volume which is slightly larger. As with the previous scenarios, it is presumed that the spill occurs at or very near the Tazlina River crossing. The pipeline crossing here, like the one at Gulkana is above ground. Such a pipeline failure would immediately dump oil into the Tazlina River. The Tazlina has a significantly higher flow volume than the Gulkana (4,000 – 16,000 cfs vs 500 – 2,000 cfs respectively). While August flows are low for the Gulkana, the Tazlina receives peak flows in August, with a historic maximum flow of 47,000 cfs recorded on August 31, 1955 (Embick, 1997).

Perhaps the most significant difference in this scenario from the previous is that the spill site lies less than 5 miles from the confluence of the Tazlina with the Copper River.

Consequently oil spilled into the Tazlina River at the pipeline crossing would travel to the confluence of the Copper River in the span of about an hour. The principal response strategy is to contain oil at CS10-20 located at the confluence of the Tazlina and Copper Rivers. This location will be extremely challenging as a containment site due to the flow velocity and volume of the Tazlina, particularly during high flows in August.

Fate of Oil

I assume that this spill of approximately 26,000 bbl is from a fairly rapid discharge. Given a 6 hour response time as published in the DNV Study, (DNV 2005, Bates page 8170), a significant volume of oil would be well past the containment site before the response crew arrives. Due to the problematic nature of the containment site, I predict that less than 5% of the spill would be contained, placing about 24,700 bbl into the Copper River. Table 3, illustrates the fate of this oil, showing a three fold increase in the amount of oil entering the Copper River delta. Similarly, the amount of oil pressing on to Prince William would increase to approximately 1,000 bbl.

Table 3. Hypothetical estimates of the volume of oil passing mileage points and land marks along the oil spill trajectory for Scenario No. 3, a 25,954 bbl spill into the Tazlina River at pipeline crossing using a constant rate of decay of 30% for each 25 miles of travel.

Miles From Spill	Landmarks on spill path	Spill Volume reaching Point
0	Tazlina R. Crossing	24,700
25		17,290
50		12,103
75	Wood Canyon	8,472
100		5,930
125		4,151
150	CR Delta	2,906
175		2,034
200		1,424
225	Hinchenbrook Ent.	997
250	PWS	698
275		488
300	Exit PWS	342
325		239
350		168
375		117
400		82
425		57
450	Cook Inlet	40
475		28
500		20
525		14
550	Kodiak	10

Impacts to Fisheries

Because the spill is below the previous spill scenarios, it would not be necessary to close upper Copper River sport fisheries. However impacts to the subsistence and personal use fisheries in the Glennallen and Chitina subdistricts would require closures as described in Scenario No. 2 above.

Similarly, the impacts to the Copper River commercial salmon fishery would be similar to that described in Scenario No. 2. With an increase in the spill volume, impacts will be more widely spread, and more prolonged. At this level of contamination in the Copper River district, there would be little if any hope for small intensively managed fishery openings under an MOU. Consequently commercial fishermen would lose all harvest opportunities within the Copper River district for the season. The subsequent season would need to be intensively managed under an MOU, with the potential for additional foregone harvests.

With 1,000 bbl of oil entering Prince William Sound, there would be an increased potential for gear to be fouled and/or product contaminated.

Scenario 4. Klutina Contingency Area – spill of 48,820 BBL, (2,050,440 gal) at PLMP 686.7 – 689.2

This final scenario is located at the Klutina River pipeline crossing. The pipeline crossing is buried under the river. Thus in this scenario, the pipeline failure occurs underground. This is by far the highest volume of the four scenarios, with a volume of 48,820 bbl. This volume is roughly 20% of the volume of the Exxon Valdez spill.

The pipeline crosses the Klutina River approximately 1.5 miles above its confluence with the Copper River. Klutina flows range from 2,000 – 6,000 csf through the summer months (Embick, 1994). Oil entering the waters of the Klutina at the pipeline crossing would reach the Copper River in less than 20 minutes. The principal response strategy is to contain oil at CS11-2 located at the confluence of the Klutina and Copper Rivers. This location will be extremely challenging as a containment site.

Fate of Oil

I assume that this spill of approximately 48,820 bbl is from a fairly rapid discharge. Given a 6 hour response time, as published in the DNV Study, a significant volume of oil would be well past the containment site before the response crew arrives. Due to the problematic nature of the containment site, I predict that less than 5% of the spill would be contained, placing about 46,400 bbl into the Copper River. Table 4 illustrates the fate of this oil. The amount of oil entering the Copper River delta has more than doubled from Scenario No. 3. Similarly, the amount of oil passing into Prince William has increased to approximately 2,675 bbl at Hinchinbrook Entrance. This spill is of sufficient magnitude that weathered oil and tar balls would be detectable in lower Cook Inlet and possibly as far west as Kodiak.

Table 4. Hypothetical estimates of the volume of oil passing mileage points and land marks along the oil spill trajectory for Scenario No. 4, a 48,820 bbl spill into the Klutina River at pipeline crossing using a constant rate of decay of 30% for each 25 miles of travel.

Miles From Spill	Landmarks on spill path	Spill Volume reaching Point
0	Klutina R. Crossing	46,400
25		32,480
50	Wood Canyon	22,736
75		15,915
100		11,141
125	CR Delta	7,798
150		5,459
175		3,821
200	Hinchinbrook Entrance	2,675
225	PWS	1,872
250		1,311
275	Exit PWS	917
300		642
325		450
350		315
375		220
400		154
425	Cook Inlet	108
450		76
475		53
500		37
525	Kodiak	26
550		18

Impacts to fisheries

The subsistence and personal use fisheries in the Glennallen and Chitina subdistricts would require closures, as described in Scenario No. 3 above.

Impacts to the Copper River commercial salmon fishery would be compounded further beyond the description for Scenario No. 3. With an increase in the spill volume, impacts will be more widely spread and more prolonged. At this level of contamination in the Copper River district, there would be little if any hope for small intensively managed fishery openings under an MOU. Consequently commercial fishermen would lose all harvest opportunities within the Copper River district for the season. The subsequent season would need to be intensively managed under an MOU, with the potential for additional foregone harvest.

The purse seine fishery in Prince William Sound targets principally pink and chum salmon. A large portion of the production comes from hatcheries. In 2005, the ex-vessel value of the purse seine fishery in Prince William Sound was $14.2 million (Hallowell et. al., 2007).

With 1,000 bbl of oil entering Prince William Sound, there would be an increased potential for gear to be fouled, and/or product contaminated. Some area closures may be necessitated do to oiling on beaches. The presence of oil in the Sound would necessitate more intensive management and monitoring strategies, consistent with the MOU. Time and area restrictions placed on the seine fishery could result in unmanageable buildups of fish in front of the hatcheries in the sound. The result of this could be that; 1) some of the harvest fishermen might otherwise have taken is foregone, 2) delays in fishery openings result in a decline in flesh quality of the harvested fish and 3) the price fishermen receive for their catch is reduced. Market fears about contaminated salmon coming out of the Prince William Sound fishery could further erode salmon prices.

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