Comments on Public Notice POA-2007-1586:

The proposed Port Mackenzie Railroad extension

Knik Arm, Upper Cook Inlet, Alaska,

With emphasis on

FISHERIES and COOK INLET BELUGA WHALE

On behalf of the Appalachian Center for the Economy and the Environment

By

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I. EXECUTIVE SUMMARY

The proposed railway and the development of Port MacKenzie have been irrefutably linked for 40 years, strategically and economically by the Applicant(s). Thus, there is every rationale to link them environmentally. Viewed as a "whole", data presented in the Final Environmental Impact Statement (FEIS) indicate that the Federally-protected Cook Inlet Beluga Whale and its critical habitat will be severely impacted. "Critical habitat" by definition includes environmentally-sensitive areas for the sustainability of the species, including whale-foraging areas for anadromous salmonids.

A clear decline of 38% is depicted for commercial catch of anadromous fish stocks in Upper Cook Inlet from 2004 through 2007, the period for which the Applicant presented data in the FEIS. These data are further corroborated by (a) declining trends in "escapement" data for salmonids for 2004-2007 in the FEIS, i.e., those that have "escaped" harvest, as well as (b) more recent information published in the Federal Register / Vol. 76, No. 69 / Monday, April 11, 2011 for the listing of **Endangered and Threatened Species: Designation of Critical Habitat for Cook Inlet Beluga Whale** that discusses more recent declines in Cook Inlet salmonid stocks.

Data presented by the Applicant for (a) Water Resources and (b) anadromous and resident Fish(-eries) Resources within the footprint of the railway line in support of the FEIS were collected over a single period of 5 days during summer low-flow conditions. This data base is inadequate to depict seasonal, annual or decadal trends in fisheries stocks; water quality conditions; and hydrological variability for the study area. The data base also is insufficient to serve as a baseline for assessing impacts from both the construction phase and post-construction operational phase upon which mitigation measures need to be based. These weaknesses endanger the long-term management and sustainability of the fishery resources of the study area and the Essential Fish Habitat (EFH) for both anadromous and resident species.

Further, the FEIS

(a) presents no plans for long-term monitoring of water quality or biological resources beyond a 1-year post construction period,

(b) indicates no mitigation measures for assessment of long-term cumulative effects, especially in light of declining fish stocks, shifts in water quality, and regional warming of waterways,

(c) does not require compensation for either Fisheries or EFH impacted by the stated project, either short-term or long-term,

(d) does not address stream crossing requirements beyond the 100-year flood in the face of higher precipitation rates and flooding associated with climate warming, and

(e) ignores impacts to aquatic invertebrates which are (1) the basis of the food chain for anadromous and resident fish species, (2) critical to the functioning of the ecosystems in the study area, and (3) important as in-stream biological indicators of water quality.

II. INTRODUCTION

The Alaska Railroad Corporation (ARRC) has proposed to construct and operate a section of new rail line to connect the Port MacKenzie District in the Matanuska-Susitna Borough (MSB) in south-central Alaska to a point on the existing ARRC main line between Wasilla and just north of Willow, Alaska. The ARRC believes that the proposed rail connection would make the development (and exploitation) of natural resources in Interior Alaska, including coal, limestone, timber, and metallic mineral resources along the existing ARRC main line corridor more economically feasible.

The Surface Transportation Board (STB, or Board) is the lead Federal agency for the environmental review process. The Office of Environmental Analysis (OEA) is an office within the Board that ensures compliance with the National Environmental Policy Act (NEPA) and related environmental statutes. The Board has final authority to approve, disapprove, or approve with conditions, including environmental mitigation conditions, ARRC's proposed rail line (STB 2011: http://www.stbportmacraileis.com).

The OEA has published a Final Environmental Impact Statement (FEIS) that identifies a preferred route of the proposed rail line, known as the Mac East Variant (aka,"Mac Central")-Connector 3 Variant-Houston-Houston South Alternative, with a total distance of 32 miles (Anonymous 2011) and includes proposed mitigation measures. During the review process, OEA examined 12 build alternatives as well as a No-Action Alternative (Summary: FEIS) (see Figure 1 here, or G.3 in FEIS).

OEA believes that this alternative, with OEA's final mitigation recommendations, would most effectively avoid, minimize, and reduce potential environmental impacts to the extent reasonable. With emphasis only on Fisheries for the purpose of this Review, OEA reached this conclusion for the following reasons (Summary: FEIS) (FISH RELATED ONLY):

- The preferred route is 1 of 2 alternatives with the fewest overall water crossings (25 versus 26 to 51 for other alternatives), proposed drainage structures (2 versus 3 to 7), and culvert extensions (2 versus 3 to 13), and one of the fewest numbers of proposed culverts (19 versus 17 to 33);

- The preferred route is 1 of 4 alternatives with the fewest fish-bearing stream crossings (10 versus 13 to 18), and 1 of 2 alternatives with the fewest anadromous stream crossings (5 versus 6 to 9); and

- The preferred route is 1 of 2 alternatives with the lowest estimated index of upstream fish habitat potential (70,600 versus 75,500 to 271,400).

OEA recommended approximately 100 mitigation measures to reduce environmental impacts to a wide array of resources, including water, biological, recreational, and cultural. OEA anticipates, however, *"… that notwithstanding OEA's final recommended mitigation, adverse impacts could still occur to resource areas.* ***The largest potential impacts would occur to surface water, wetlands, fisheries****, cultural and historic resources, and parks and recreation resources."* (Author's emphasis).

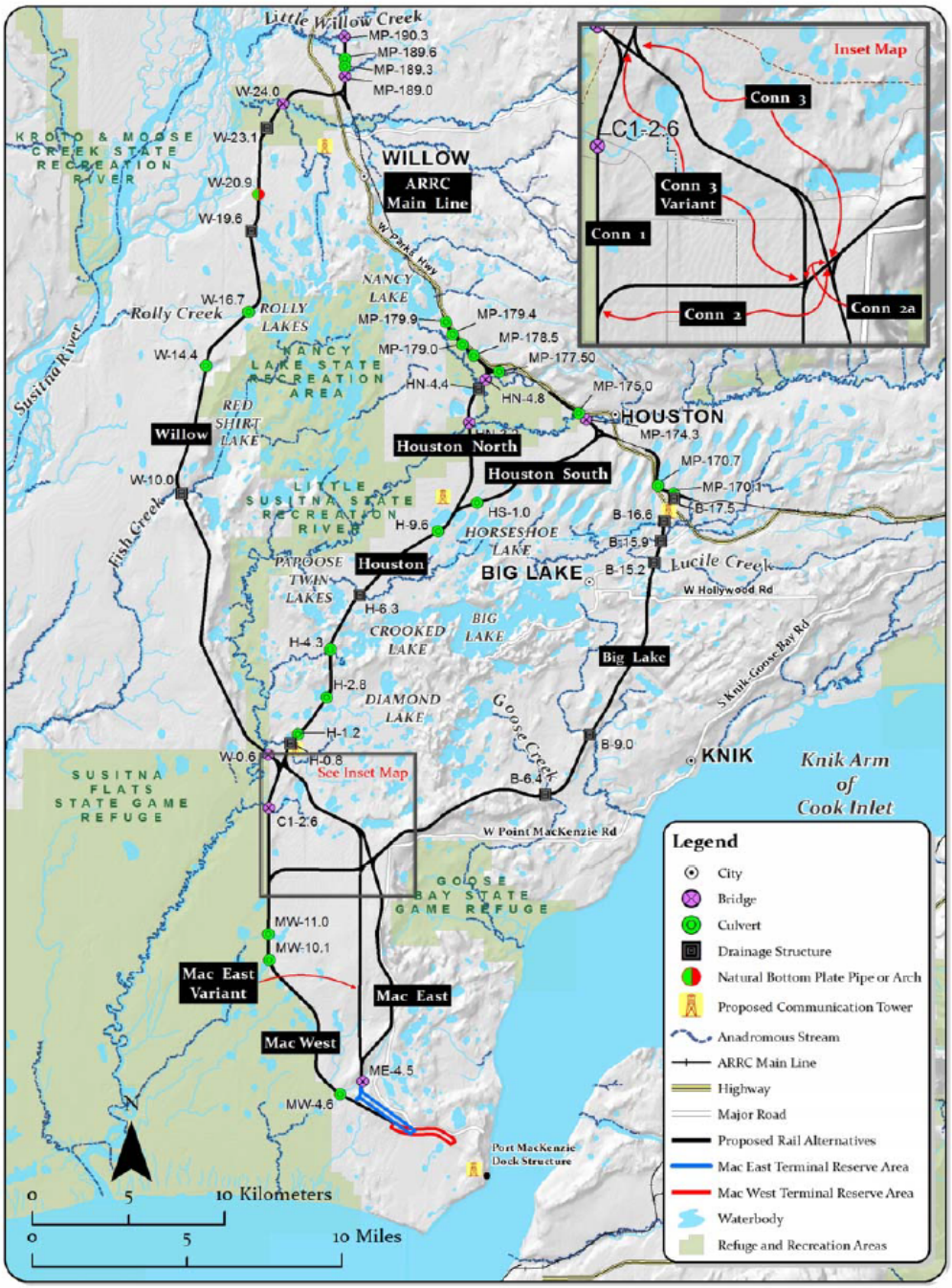

Figure G-3. Overview of Surface Water Connections and Potential Fish Habitat within the Study Area

FIGURE 1. Taken from FEIS (G-3), demonstrating potential routes for rail line.

Based on its independent environmental analysis and review of all public and agency comments, OEA recommended the Board require the Applicant to implement the mitigation measures set forth in Chapter 19 of the Final EIS (See Appendix 1 here), which includes all of the Applicant's voluntary mitigation measures and OEA's additional recommended mitigation measures, as conditions in any final decision approving the proposed action.

- *"To avoid or minimize the potential environmental impacts to **surface water** from the proposed rail line, OEA is recommending that the Board impose 28 mitigation measures, including 10 measures volunteered by the Applicant. These measures include requiring:*

    - *maintenance of natural water flow and drainage; design of bridges and culverts over fish-bearing waters to meet National Marine Fisheries Service (NMFS) requirements; limitation of construction in anadromous streams during low-flow conditions and following other Alaska Department of Fish and Game (ADF&G) timing recommendations to the extent practicable;*

      Notwithstanding the recommended mitigation measures, there still would be potential unavoidable impacts to surface water from the proposed rail line. Potential impacts would include: potential changes to natural drainage and altered flood hydraulics near crossings; increased potential for debris jams and overbank flooding upstream of water crossings; reduced floodplain area; increased scour and bank erosion at crossings; and increased turbidity, sediment loads, and concentrations of pollutants during construction. (Author's emphasis)

- *To avoid or minimize the potential environmental impacts **to fisheries** from the proposed rail line, OEA is recommending that the Board impose 28 mitigation measures, including 12 measures volunteered by the Applicant. These measures include requiring: acquisition of appropriate Federal and state permits; maintenance of natural water flow and drainage by installing bridges and equalization culverts; minimization of temporary stream crossings and stream disturbance; design of bridges and culverts for fish-bearing waters to meet NMFS requirements; limitation of construction in anadromous streams during low-flow conditions and following other ADF&G timing recommendations to the extent practicable; utilization of best management practices imposed by the USACE; removal of debris from wetlands and waters at rail line crossings; inspections of culverts to ensure fish passage; implementation of Essential Fish Habitat conservation measures; minimization of detonation impacts to fish-bearing waters; and prior written authorization to narrow an anadromous waterbody within mean high water.*

Notwithstanding the recommended mitigation measures, there still would be potential unavoidable impacts to fisheries from the proposed rail line. Potential impacts would include: fish habitat loss and modification at stream crossings along the proposed rail line; loss of rearing, foraging, and cover habitat along the banks within the rail line footprint; loss of overhanging bank habitat structure and vegetation within the rail line footprint; potential changes to natural drainage and altered flood hydraulics; potential for debris jams and overbank flooding upstream of water crossings; potential direct mortality of fish during construction; and

potential loss of redds, eggs, and fry due to changes in sedimentation, turbidity, and pollutants during construction." (Author's emphasis).

Given the above summary, the FEIS and other documentation were examined to determine if there were understated concerns of the proposed rail line to the sustainability of the Fishery and Cook Inlet Beluga Whale resources and their critical habitat. The following issue were identified.

III. ISSUES OF CONCERN

A. FOREWORD: SNAPSHOT IN TIME

The OEA relies heavily in the FEIS on the water quality, hydrological and fisheries survey conducted by Noel et al. (2008) over a 5-day period in August 2008. Such a data base is summarily inadequate for either historical comparisons or future projections. As stated by NMFS in their comment (62-10) of the FEIS **Chapter 23. COMMENT SUMMARIES AND RESPONSES:**

> *"The DEIS (Table 4.2-2, pg 4.2-7), as well as additional data submitted to NMFS (Noel, 2010) indicate that STB-ARRC contractors conducted limited fisheries and hydrology surveys in August of 2008 (8/12-8/16). Surveys conducted for one week in mid August of any year at any proposed crossing do not represent the various seasonal life cycle stages of all anadromous species, nor would these studies represent the complexity of seasonal high flows, typical of April and May during spring snow melt, draining wetlands, or streams and rivers. Survey design, sampling methods and efforts need to be conducted in a manner that generates defensible results that assist in the design of conveyance structures that avoid and minimize impacts to EFH and anadromous species."* (62-10)

Rather than merely accepting the fact that Noel et al. (2008) conducted a field survey in support of the FEIS, one is challenged "to think", i.e., to actually comprehend the level of influence of this survey on the overall implications of the FEIS. More to the point, a single 5-day survey has been used by the Applicant to extrapolate conclusions within various chapters/ subchapters of the FEIS, including this partial list:

- Water Quality Conditions (at 31 stations);
- Environmental Consequences;
- Waterbody Crossings and conveyance structures (at over 100 sites);
- Fishery Resources;
- Essential Fish Habitat;
- Threatened and Endangered Species;
- Biological Assessment (for Beluga Whale); and
- Navigation Resources.

As an observation, if 5 days are multiplied by a 10-hour day, that equals 50 work hours. If 50 hours are divided by 31 stations JUST FOR WATER QUALITY, this equals an average of 1.6 hours per station, never mind time for travel, preparation for sampling, post-sampling writing up of notes, lunches, etc. Then one must factor in fish collecting, EFH, hydrological measurements, and so forth. **The purpose here is to draw attention to the huge reliance of the FEIS on a single VERY short-term 5-day data source that stands virtually alone.**

These data are inadequate to profile the complexities of the aquatic ecosystems themselves, their hydraulics, and their fisheries on a seasonal basis, much less annual or decadal.

B. COOK INLET BELUGA WHALE….and THE BIG PICTURE

The Cook Inlet Beluga whale stock (*Delphinapterus leucas*) is considered as depleted and is listed as Endangered by the National Marine Fisheries Service (NMFS) under the Endangered Species Act (ESA) of 1973. Population estimates have declined from 1994 to 2008 even after a harvest moratorium was established in 1998. Beluga proximity to Anchorage has increased significantly since the late 1970s; NMFS has expressed concern for Cook Inlet belugas affected by development projects that could restrict their passage along Knik Arm, which seasonally may hold up to 60% of the entire population.

The National Marine Fisheries Service (NMFS) is responsible for the review of Federal agency actions that may impact marine mammals protected under the Marine Mammals Protection Act (16 U.S.C. § 1361). NMFS responded to the DEIS on March 9, 2010 concluding *that "the project "may affect, but is not likely to adversely affect" the Cook Inlet beluga whale or its designated Critical Habitat (Section1.5.3.4, FEIS). This consideration fulfills NMFS' obligation related to the proposed rail line extension under section 7 of the Endangered Species Act and the Marine Mammal Protection Act unless modifications are made that would cause effects not previously considered."*

Thus, OEA in the FEIS determined that with implementation of avoidance and minimization measures, rail line construction and operation *may affect, but is not likely to adversely affect* the Cook Inlet beluga whale (see Appendix H). **APPENDIX H BIOLOGICAL ASSESSMENT** noted (**H.6 Effects Analysis**) that NMFS *"…did not identify any direct impacts that would result from construction or operation of the rail line to beluga whales or beluga whale habitats."*

The Port of Anchorage (POA) provided written comments (10 May 2010) to the STB/OEA, rebutting opinions offered in the DEIS:

> *Comment*
>
> *We read with great interest Section 19.2, Mitigation Measures, both the voluntary mitigation measures and your recommended final mitigation measures, particularly in the area of essential fish habitat (EFH). The POA Intermodal Expansion Project also has to perform EFH mitigation in and around the Ship Creek estuary. What was striking to us was the severity of the difference between permit conditions that could be mandated on an Alaska Railroad construction permit, and those that have been levied on the POA for similar situations. Of particular concern is that as a part of our 404 permit, we are required to maintain a mitigation escrow account in order to fund projects that will compensate for projected losses of EFH in the Ship Creek area. That account was set at $8.6 million. Ironically, two of the projects to be funded through this account will be Cook Inlet beluga whale prey species EFH in the Mat-Su Borough. It is troubling that none of the recommended mitigation measures in this draft EIS require anything similar for the rail extension project. We believe this matter should be closely re-examined with an eye towards leveling the playing field*

and recommending a similar mitigation escrow account be established as a part of this project's permit conditions." (66-6).

OEA responded:

First, the mitigation measures presented in the Draft EIS do not include recommended conservation measures from the NMFS because comments on the EFH assessment were not available to OEA when the Draft EIS was published. The NMFS's standard procedure for EFH review is to review the Draft EIS and then provide comments as part of the NEPA comment process. Second, according to the Port of Anchorage's comment, the mitigation requirements mentioned resulted from the section 404 process with the USACE. The NMFS likely provided input to the USACE during this permit process, as the USACE is required to consult with the NMFS prior to issuing a permit. ARRC has not completed the section 404 permit process, but when the section 404 Public Notice is published, the NMFS will be able to comment and suggest recommended conservation measures regarding EFH, and the USACE can make these measures binding as a condition of the section 404 permit if they choose to do so. Third, OEA did consult with the NMFS on EFH and Endangered Species Act issues (for the beluga whale) early in the NEPA process. An EFH assessment report and BA were submitted to the NMFS for their review. OEA received comments from the NMFS on the Draft EIS on May 10, 2010, and they have stated that they would provide more input after a preferred alternative is chosen. OEA would evaluate the NMFS's recommended conservation measures at that time.

The Applicant consulted with the NMFS under section 7 of the Endangered Species Act to discuss potential impacts to the Cook Inlet beluga whale that could result from the construction and operation of the proposed rail line. The NMFS requested a BA to analyze the potential indirect impacts from the proposed project, and specifically requested an analysis of the potential effects of the rail line on salmon and salmon habitat (forage fish/habitat) that the beluga whale relies on as a food source. Because all salmon-bearing streams would be crossed with fish passable bridges and culverts per NMFS and state design standards, the NMFS concurred with OEA that the proposed project "may affect, but is not likely to adversely affect" the Cook Inlet beluga whale or its designated Critical Habitat. The NMFS's concurrence with OEA is considered the official position and concludes OEA's and the NMFS's obligation under section 7 of the Endangered Species Act. A complete administrative record of the consultation is on file at the NMFS's Juneau office. In addition, OEA has a correspondence from NMFS dated March 9, 2010 stating their concurrence with OEA (see Appendix A). It also should be noted that any construction or expansion activities conducted by Port MacKenzie would be considered a separate action from the proposed rail line. Port MacKenzie would be required to conduct their own section 7 consultation with the NMFS regarding threatened and endangered species, including the Cook Inlet beluga whale. (Author's highlight).

A second POA Comment was:

"We also have concerns that future construction activities associated with the Port Mackenzie expansion following a rail extension, may negatively impact marine mammal noise mitigation efforts underway for the Port of Anchorage Intermodal Expansion Project. For several years, we have been working cooperatively with the

National Marine Fisheries Service (NMFS) to minimize potential impact to the beluga whale, recently listed under the Endangered Species Act (ESA). The POA is very sensitive to the noise generated by port operations, especially from in water construction work being performed as part of the ongoing intermodal expansion project. In response, the POA complies with several permit conditions specifically mandated in order to mitigate potential harm to Cook Inlet beluga whales. These measures include, but are not limited to, shutting down in-water work for two hours on each side of every low tide and shutting down for two full weeks each summer for local hatchery smolt releases. Any additional construction efforts outside of, but in proximity to, our Port Expansion footprint must take into consideration cumulative noise and vibration impacts and must not interfere with, or compound, mitigation measures and safety radii already in established Port of Anchorage marine mammal permits.

Construction at Port MacKenzie will be approximately 1 to 2 miles away from Port Expansion construction activities, depending upon phasing and staging. The Port's marine mammal safety radii, as established by NMFS to prevent harassment, currently extends 4,991 meters offshore. Any noise from Port MacKenzie construction would have an additive effect increasing safety and harassment radii for existing POA permits. In closing, the POA fully expects that similar permit conditions will be put in place should future expansion of the Port MacKenzie dock be undertaken." (66-8)

"Any further expansion on this port will make this much more dangerous. The effect of this narrowing affects our salmon. They migrate through this area. But more importantly than that, these salmon are the food to the beluga whale. This is the number one area for beluga whale in this – the whole area. Beluga whale went on the endangered species list in 2008, in October, because we went from 5,000 in 1970 down to only 300 today. In fact, NOAA clearly states that they will not approve our bridge across Knik Arms because of the damage it could do to the whales." (124-7)

A Private Citizen contributed:

"You'll note that the year that they started building this addition to the port with their dock going out into the water was the year that they began finding there were 1370 beluga whales in the inlet. And subsequently in 207 – or 2007, they discovered we're down to 300 plus whales. So it's clear that changing the navigational structure of Cook Inlet not only affects the Department of Defense, but it also affects the atmospheric conditions set by NOAA and the whales." (130-2)

In turn, the OEA responded

Comments noted. The expansion of Port MacKenzie is not part of the proposed action. As discussed in Section 1.3 of the EIS, the MSB plans for expansion of the port facilities are independent of the proposed rail line. OEA consulted with the NMFS under section 7 of the Endangered Species Act regarding the potential impacts of the proposed rail line on the Cook Inlet beluga whale. OEA prepared a BA to evaluate potential impacts to the Cook Inlet beluga whale that could result from construction and operation of the proposed rail line. The NMFS concurred with OEA that any of the alternatives for the proposed project "may affect, but is not likely to adversely

> *affect" the Cook Inlet beluga whale or its designated Critical Habitat. The NMFS' concurrence with OEA is considered the official position of the NMFS and concludes OEA's and the NMFS' obligation related to the proposed rail line extension under section 7 of the Endangered Species Act and the Marine Mammal Protection Act unless modifications are made that would cause effects not previously considered.* (Author's highlight).

Through this and other examples (e.g., shoaling), the OEA thus distinguishes between the proposed rail line and the expansion of Port MacKenzie, and their separate impacts. However, the proposed line and Port expansion go hand-in-hand. For instance, **Section 1.1 Introduction** of the FEIS states:

> *Referred to as the Port MacKenzie Rail Extension, the proposed rail line would provide a rail connection for freight services between Port MacKenzie and Interior Alaska. The port facility is owned and operated by the MSB, and the MSB is a cosponsor of the proposed rail line.*

Section 1.1.2 Previous Port and Rail Planning Studies continues

> *The MSB began investigating the development of Port MacKenzie and supporting infrastructure, including a rail line, in the 1970s. In 1993, the MSB established the port district area and designated the land for development, including development of Port MacKenzie, in the MSB Coastal Management Plan. A rail extension to Port MacKenzie has been part of previous planning studies, which have noted that good surface transportation access would be necessary to accommodate growth at Port MacKenzie and to develop it as a strong economic driver in the MSB.*

The FEIS for **Resumption of Year-Round Firing Opportunities** at nearby Fort Richardson, AK included a report entitled **BIOLOGICAL ASSESSMENT OF THE COOK INLET BELUGA WHALE (DELPHINAPTERUS LEUCAS)** (U.S. Army Garrison Fort Richardson 2009). Under **Section 5.7 Cumulative Effects**, it was related:

> *"…NMFS recognizes that not enough is known about the effects of each specific threat, and they do not definitively understand the level of impact each threat has on Cook Inlet beluga whales. Cook Inlet beluga whales may be affected by multiple threats at any given time, compounding the impacts of the threats. Without an understanding of how individual threats impact beluga whales, the cumulative effects of all the threats on Cook Inlet beluga whales remain unknown."* (Author's highlight).

With specific reference to Port MacKenzie, the Ft. Richardson FEIS states in **Section 5.7.1**

> *"Port MacKenzie is the center of transportation and development plans for the west side of northern Knik Arm. It currently consists of a 500-foot bulkhead barge dock, a 1,200-foot deep-draft dock with a conveyor system, a landing ramp, and 8,000 acres of adjacent uplands available for commercial or industrial development. The Matanuska-Susitna Borough plans to provide services for bulk commodity storage, a floatplane base to serve Anchorage air taxi and private pilots, and a public boat*

launch ramp for commercial and private use. The Port MacKenzie project includes plans for the Knik Arm Crossing bridge, a Cook Inlet ferry service, and an ARRC rail extension.

The new development at Port MacKenzie will add to the disturbance of Cook Inlet beluga whales. Noise levels will increase from construction activities. The build-up of infrastructure at Port MacKenzie will lead to greater vessel traffic on the west side of Knik Arm, with the associated increase in noise and risk of ship strikes and hazardous material releases. The planned floatplane base will increase aircraft noise. There is concern that all of the increases in development within the action area may prevent beluga whales from reaching important feeding areas in upper Knik Arm."

To summarize the BIG PICTURE, there is a 40-year history of MSB promoting jointly the railway expansion and Port development. While the Applicant and OEA contend that the proposed railway and associated impacts are separate from the expansion of Port MacKenzie, they are irrefutably strategically and economically linked. Indeed, all of NMFS's (2008) concerns for Cook Inlet belugas will be realized with the expansion of Port MacKenzie (H.5 Environmental Baseline) along Knik Arm. These include:

- **Encroachment into the lower Knik Arm from the west due to expansion of Port MacKenzie;**
- **Increased dredging requirements with port expansions;**
- **Increased ship traffic due to expansion of both ports in lower Knik Arms, new boat launches, and possible operation of a commercial ferry;**
- **Increased in-water noise levels due to port construction, port operations, and the associated increased vessel traffic; and**
- **Increased need for vessel anchorage off both ports.**

The BIG PICTURE, either logically or environmentally, should not be ignored for the sustainable management of the Cook Inlet Beluga Whale and its critical habitat.

C. WATER RESOURCES

The Federal and Alaskan water quality criteria for fresh waters in natural environments put forward in the FEIS (Table 4.2-1) are well recognized and accepted by the academic community. Water quality data collected by Noel et al. (2008) indicate all parameters are well within the range of acceptable limits of the criteria. The issue is that such water quality measurements are scant for the region, and the Noel et al. (2008) data base was collected over a 5-day period from 12-17 August 2008 in support of the DEIS. As stated in the FEIS, most prior available data for the area were collected between 1952 and 1986….and there are no USGS monitoring stations within the proposed railway footprint. In effect, there is no baseline to actually compare shifts in the criteria, whether they be natural or man-impact related, on an annual basis much less seasonal. Nor, does the FEIS indicate a need for routine monitoring of these criteria as a mitigation measure or early warning system.

Table 4.2-1 (from FEIS). Federal and Alaska Water Quality Standards for Fresh Water in Natural Environments.

Parameter	Criteria
Alkalinity	Alkalinity is a measure of the pH-buffering capacity of water or waters' resistance to changes in pH (such as the capacity of water to neutralize acids). This capacity is caused by the waters' content of carbonate, bicarbonate, hydroxide, and occasionally borate, silicate, and phosphate. Alkalinity is expressed in milligrams per liter of equivalent calcium carbonate. Alkalinity less than 20 milligrams per liter of calcium carbonate can be harmful to aquatic life.
Color	Color can indicate dissolved organic material, inadequate treatment, high disinfectant demand, or possible excessive production of disinfectant byproducts or inorganic contaminants, including metal. Color points begin at 0. A point is the equivalent of a milligram of the substance in question per liter. Color or apparent color may not reduce the depth of the compensation point (the point at which there is just enough light for a plant to survive) for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life. For all waters without a seasonally established norm for aquatic life, color or apparent color may not exceed 50 color units or the natural condition, whichever is greater.
Dissolved Oxygen	Dissolved oxygen is the amount of gaseous oxygen dissolved in the water. Oxygen enters water through aeration (rapid movement) diffused from the surrounding air or as a waste product of photosynthesis. Dissolved oxygen must be greater than 7 milligrams per liter in water used by anadromous or resident fish. In no case may dissolved oxygen be less than 5 milligrams per liter to a depth of 20 centimeters in the interstitial waters (water occupying interstices or pore volumes in rock) of gravel used by anadromous or resident fish for spawning. For water not used by anadromous or resident fish, dissolved oxygen must be greater than or equal to 5 milligrams per liter but may not exceed 17 milligrams per liter. In no case may dissolved oxygen be greater than 17 milligrams per liter. The concentration of total dissolved gas may not exceed 110 percent of saturation at any point of sample collection. Dissolved oxygen below 1 to 2 milligrams per liter or beyond 110 percent can be harmful to aquatic life.
Total Dissolved Solids	Total dissolved solids are the combined content of all inorganic and organic substances in a molecular, ionized, or micro-granular suspended form. Total dissolved solids are measured only in fresh water because the salinity of sea water comprises ions that are counted as total dissolved solids. Total dissolved solids may not exceed 1,000 milligrams per liter. Water may not exceed a certain level of total dissolved solids if that concentration causes or reasonably could be expected to cause an adverse effect to aquatic life. Most aquatic ecosystems can tolerate total dissolved solids levels of 1,000 milligrams per liter. Total dissolved solids levels can be inferred from conductivity.
Petroleum Hydrocarbons	Petroleum hydrocarbons are contaminants with the potential to impact human and environmental health (because they could be carcinogenic, mutagenic, or teratogenic). Total aqueous hydrocarbons in the water column (the water from the top of the substrate to the surface of the water) may not exceed 15 micrograms per liter. Total aromatic hydrocarbons in the water column may not exceed 10 micrograms per liter. There may be no concentrations of petroleum hydrocarbons, animal fats, or vegetable oils in shoreline or bottom sediments that cause deleterious effects to aquatic life. Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration.
pH	pH is the measure of acidity or alkalinity and is a logarithmic scale measure of hydrogen ions. "Pure water" has a neutral pH, equal to 7.0 on the logarithmic scale. pH levels below 7 are considered acidic and greater than 7 are basic or alkaline. The water quality standard requires that pH not be less than 6.5 or greater than 8.5 or vary more than 0.5 pH unit from natural conditions.
Residues	Residues are floating solids, debris, sludge, deposits, foam, scum, or any other material or substance that occurs in water as a result of human activity. Residues may not, alone or in combination with other substances, be present in concentrations or amounts that form objectionable deposits that are undesirable or a nuisance to aquatic or other species.
Temperature	Water temperature may not be caused to exceed 20 degrees Celsius (°C) at any time. The following maximum temperatures may not be exceeded, where applicable: (1) migration routes, 15°C; (2) spawning areas, 13°C; (3) rearing areas, 15°C; and (4) egg and fry incubation, 13°C. For all other waters, the weekly average temperature may not

	exceed site-specific requirements needed to (1) preserve normal species diversity and (2) prevent the appearance of nuisance organisms (i.e., must be such that the nuisance organisms are prevented from appearing).
Turbidity	Turbidity is the cloudiness or haziness of fluid caused by suspended solids generally invisible to the naked eye. Turbidity may not exceed 25 nephelometric turbidity units above natural conditions. For all lake waters, turbidity may not exceed 5 nephelometric turbidity units above natural conditions.

What is also not included in the FEIS is how these parameters interrelate to one another. For instance, with all factors considered equal, temperature is the single most important limiting factor in the aquatic environment for poikilotherms (cold blooded animals), including fish (Fry 1947). As a brief overview, fish have upper and lower temperature thresholds in which they must carry out their life cycle, and these thresholds vary by species and life stage (i.e., egg, larvae, juvenile, adult). Within the range of thermal tolerance for any fish species, there is a direct relationship between metabolic rate and ambient water temperature, i.e., higher ambient temperatures result in an increased metabolic rate of the individual, and with this there is an increased need for oxygen in the water column. For certain species, subtle shifts in ambient temperature can interfere with the well being of the species and its ability to successfully complete its life cycle. Rapid shifts in temperature either up or down can be catastrophic resulting in mortality.

The Federal and Alaskan water quality criteria are not simply discrete measurements that must fall within a certain range, rather they are interrelated and shifts in one can influence how another "behaves." For instance, temperature is a "controlling factor" that influences how other criteria might affect the various life stages of fish, anadromous or resident. As water temperature goes up, the level of saturated oxygen decreases, and this synergistic relationship might be detrimental to certain species, e.g., salmon that require comparatively lower temperatures and higher dissolved oxygen concentrations than other species. Too, as water temperature goes up, other parameters (e.g., pH) that otherwise fall within an acceptable range and are otherwise benign, can become a concern for aquatic organisms. pH, or the percentage of hydrogen ions in water, is considered neutral at a level of 7.0. Water pH is more alkaline at levels above 7.0 and more acidic at levels below 7.0. As pH decreases in value below 7.0, acidity and the number of hydrogen ions (H^+) increases which in turn increases the potential for metal and petro-chemical toxicity to aquatic organisms. Higher temperatures exacerbate this relationship. This point is specifically raised given (1) the inadequate baseline data for temperature, pH and metals, (2) the stated objective to transport coal and metals on the railway, (3) the prospect of petrochemicals being introduced into the system through spillage and runoff, (4) the long-term need for stream crossing and rail bed maintenance, and (5) the unknown impact of climate warming in the study area.

The FEIS states "*all water quality parameters met Federal and State of Alaska water quality standards, except iron concentrations at the Little Susitna River station.*" Low ph values and high iron concentrations have led to the sterile conditions of many aquatic systems globally, e.g., Appalachia (Kleinmann, 2000). The study area's waterways can be contaminated from coal dust either blown off or washed off the transport cars, hence lowering pH and changing the natural properties of the receiving waters. The BNSF Railway Company has acknowledged dust escapement as an issue, reporting that from 500 lbs to a ton of coal can escape from a single loaded coal car. BNSF cited other reports that indicated as much as 3% of the long-haul coal loaded into a coal car can be lost in transit (http://www.bnsf.com/customers/what-can-i-ship/coal/coal-dust.html). Coal itself contains (a) iron-sulfide pyrite which leads to low pH values, and (c) heavy metals such as lead,

mercury and arsenic, which are highly toxic to aquatic organisms at low pH's and persistent in the environment (Roberts 2011). Synergistically, the waterbodies can be deleteriously impacted from common non-point sources. For instance, air pollution and acid rain are significant sources that are not easily controllable, with the study area sitting downwind from heavily industrialized Eurasia (Davis 1979; Gedney and Shaw 1982; Shaw 1992) and with nearby Russia often having uncontrolled fires of 100,000s of thousands of acres creating a sulphuric acid haze over Alaska's interiors (Science Daily 2010).

Although not fully understood globally, it is a matter of fact that Alaska is warming. The Alaska Department of Environmental Conservation (ADEC) has set maximum water temperature criteria for salmon as 13 C for egg & fry incubation, 13 C for spawning areas, 15 C for migration routes, 15 C for rearing areas, and 20 C as the maximum temperature for any time of year (Cullenberg 2008). The Cook Inletkeeper, a non-profit Anchorage-based citizen's organization, has established a data logger system (Mauger 2008) for measuring stream temperatures in and around upper Cook Inlet. They have increasingly recorded stream temperatures that are higher than the ADEC criteria, and unfortunately this trend is likely to continue if not accelerate. Alaska's average air temperature has increased 4 degrees F over the past 50 years and winter temperatures have risen 7-10 degrees F (http://inletkeeper.org/issues/climate-change); water temperature is directly linked to air temperature. Concern over Arctic warming led the North Pacific Fisheries Management Council to recommend a moratorium on commercial fishing in 2009 to cover a 200,000 square mile area (Benton 2009). Some species have already been documented in shifting their range in response to temperature shifts (Kruse 2008). Increased temperatures can also lead to a plethora of other impacts to fisheries, e.g., increased parasitism, diseases, susceptibility to toxins, and competition with other species (perhaps non-native) that are more tolerant of higher temperatures.

These data suggest that a conservative approach toward development be undertaken in the study area to minimize direct impact to the riparian zone, wetlands and bridge crossing areas that might lead to (even subtle) increases in water temperature and introduction of petrochemicals, hazardous materials, and coal and metal dust from both the pre-operational construction phase and the post-construction operation of the rail line. Contrary to this need to ensure long-term sustainability of the Water Resources and Fisheries, the FEIS offers:

In Section **23. COMMENT SUMMARIES AND RESPONSES - 23.13.5 Hazardous Sites and Materials,** a specific public comment was made concerning accidental discharge of hazardous materials:

> ***Comment***
> *"The transmission of coal and other bulk products in open rail cars will subject the landscape to unwanted non-native dust and debris being cast down into the immediate area of the rail line. Although currently stated that hazardous materials will not be transmitted, if they are transmitted and an accident takes what are the plans to mitigate the effects on the environment? Any hazardous accident will be devastating to the area."* (83-3)

This Comment was followed up with another that specifically addressed water resources:

> ***Comment***
> *"One of the concerns that needs to be addressed is the amount of coal, coal dust, gravel, gravel dust, whatever flying out of the train cars as they come by. I grew up near train tracks and played with a lot of coal growing up. So I know it does happen and spilling into Willow Creek in the swamps the – all the streams that this is going to cross is going to have a huge negative impact."* (155-3)

The singular response in the FEIS was

> ***Response***
> *"As discussed in Chapter 1 of the EIS, the commodities that would be shipped are unknown at this time, but are expected to include bulk materials and to not include hazardous materials. Nevertheless, potential impacts of hazardous materials transport and provisions for emergency response are discussed in* ***Sections 5.2.4 and 11.3*** *of the EIS, respectively. Emergency preparedness is also addressed in mitigation measures* ***VM-28, VM-45, and VM-46****."*

Actually, **Section 5.2.4** refers to Vegetation and **Section 11.3** is in reference to Transportation Safety & Delay, without any specific reference to surface waters, water quality and aquatic biota including fisheries.

> ***VM-28*** states *"The Applicant shall coordinate with Federal, state, and local emergency management officials in the project area. The Applicant shall provide, upon request, applicable hazardous-materials training and/or project-related information to enhance readiness. The Applicant shall incorporate the proposed rail line into its existing emergency response process and shall update its Oil Spill Contingency Plan to include the proposed rail line."*

The OEA did not specifically require this measure for Water Resources and Fisheries.

VM-45 and VM-46 are in reference to **Section 19.9 Land Use 19.9.1 Applicant's Voluntary Mitigation Measures**.

> ***VM-45*** states *"In accordance with the Applicant's Oil Spill Contingency Plan and Emergency Response Plan, the Applicant shall make the required notifications to the appropriate Federal and state environmental agencies in the event of a reportable hazardous materials release. The Applicant shall work with the appropriate agencies, such as the Alaska Department of Environmental Conservation, the U.S. Environmental Protection Agency, and the U.S. Fish and Wildlife Service, to respond to, and remediate releases."*

The OEA did not specifically require this measure for Water Resources and Fisheries.

> **VM-46** states *"At least one month before initiating construction activities in the area, the Applicant shall provide the information described below regarding project-related construction of the proposed rail line, and other information, as appropriate, to fire departments within the project area, the Federal Emergency Management Agency, and the Matanuska-Susitna Borough Emergency Operations Department…"*

As such, **VM-46** concerns only pre-operational construction impact with no relevance to post-construction operation and mitigation, particularly as related to water resources.

In summary, the long-term cumulative impact of the project is understated in the FEIS. Without routine monitoring and surveillance procedures in place for water quality standards, including control stations, cause and effect relationships that might either imperil or alternately assist in mitigating shifts in water quality will neither be identified nor assist as an early warning system. These shifts might be indeed natural, or man-related through non-point sources that are not controllable, or related to the operational rail line. If the latter, mitigation measures can be placed. Mitigation should be planned for any project-related activity to the riparian zone of streams in the study area that might result in increased ambient temperatures, either in the short-term or long-term, to safeguard and sustain anadromous and resident fish migration, spawning, and rearing areas (EFH). **The FEIS alludes to, but does not include mitigation measures and contingency plans for Hazardous Wastes and Oil Spills, or other catastrophic events, specific to Water Resources and Fisheries.**

D. FISHERY RESOURCES

1. Fishery(-ies) population status.- An assessment of the fishery resources of the area was performed in support of the DEIS (Noel et al. 2008). Subsequently for the FEIS, a GIS geomorphic analysis (Appendix F in FEIS) was performed to characterize further the fish habitat potential upstream of the proposed rail crossings. Some 26 fish species were recognized that might occur within the Rail Extension Study Area (FEIS Table 5.4-1). Of these, 5 species of anadromous salmon are Federally regulated, inhabiting Cook Inlet, and protected under the EFH provisions of the Magnuson-Stevens Act: Chinook or king salmon (*Oncorhynchus tshawytscha)*, chum or dog salmon (*Oncorhynchus keta)*, coho or silver salmon (*Oncorhynchus kisutch)*, pink or humpy salmon (*Oncorhynchus gorbuscha)*, and sockeye or red salmon (*Oncorhynchus nerka).* Other marine anadromous species included eulachon (*Thaleichthys pacificus*); and Dolly Varden (*Salvelinus malma*). In the study area, there could be anadromous fish populations using one or more different life-history strategies, including freshwater residents, freshwater migratory, and saltwater migratory (FEIS).

Data were provided to demonstrate that the recommended route (Mac East Variant-Connector 3 Variant-Houston-Houston South Alternative) would have least impact on resident and anadromous fishes based on it being

- 1 of 2 alternatives with the fewest overall water crossings (25 versus 26 to 51 for other alternatives), proposed drainage structures (2 versus 3 to 7), and culvert extensions (2 versus 3 to 13), and one of the fewest numbers of proposed culverts (19 versus 17 to 33);

- 1 of 4 alternatives with the fewest fish-bearing stream crossings (10 versus 13 to 18), and 1 of 2 alternatives with the fewest anadromous stream crossings (5 versus 6 to 9); and

- 1 of 2 alternatives with the lowest estimated index of upstream fish habitat potential (70,600 versus 75,500 to 271,400).

The recommended route was also supported by an Index of Fish Habitat Potential developed for the EIS process.

Data for salmonids were presented in FEIS Table G-3 to demonstrate commercial salmon harvest in Upper Cook Inlet. **Of troubling nature, (1) the data base was only through Year 2007 and (2) there was a general decline of total harvest by 38% from 2004 through 2007**.

Table G-3
Upper Cook Inlet Commercial Salmon Harvest 1997 to 2007[a]

Year	Chinook	Sockeye	Coho	Pink	Chum	Total
1997	13,292	4,176,738	152,404	70,933	103,036	4,516,403
1998	8,124	1,219,242	160,660	551,260	95,654	2,034,940
1999	14,383	2,680,510	125,908	16,174	174,541	3,011,516
2000	7,350	1,322,482	236,871	146,482	127,069	1,840,254
2001	9,295	1,826,833	113,311	72,559	84,494	2,106,492
2002	12,714	2,773,118	246,281	446,960	237,949	3,717,022
2003	18,490	3,476,159	101,756	48,789	120,767	3,765,961
2004	27,476	4,926,220	311,056	357,939	146,164	5,768,855
2005	28,171	5,238,168	224,657	48,419	69,740	5,609,155
2006	18,029	2,192,730	177,853	404,111	64,033	2,856,756
2007	17,625	3,316,779	177,339	147,020	77,240	3,736,003
Average, 1997 – 2006	15,732	2,983,220	185,076	216,363	122,345	3,522,736

This concern over declining salmonid stocks in upper Cook Inlet since the EIA was performed is further supported by information included in the Federal Register / Vol. 76, No. 69 / Monday, April 11, 2011 for the listing of **Endangered and Threatened Species: Designation of Critical Habitat for Cook Inlet Beluga Whale.** Specifically, it is stated as a NMFS Response to a Comment:

> *"The size of several king (Chinook) salmon returns in 2009 and 2010 was substantially below average, resulting in closures of sport and commercial fisheries in the Inlet…. The Susitna River sockeye salmon runs failed to meet minimum escapement goals for 5 of 7 years between 2001 and 2007. Sockeye commercial harvests for the Northern District of Cook Inlet fell from an average of 180,000 fish in the 1980s to an average of 26,000 since 2002. The Alaska Department of Fish and Game forecasts Kenai River sockeye runs to be below average for 2010, citing management decisions leading to over-escapement as a contributing factor. "*

Table G.4 (from FEIS) provides a view of salmonid "escapement" for the study area, i.e., those that have "escaped" harvest. These data are compiled by ADF&G which monitors salmon stocks returning to index streams in the study area to ensure stock sustainability. There is a distinct downward trend for chinook salmon from 2005 to 2007.

Table G-4
Salmon Escapement in Index Streams in the Port MacKenzie Rail Extension Study Area[a]

System	Sustainable Escapement Goals		Escapements			
	Data Source	Range	2004	2005	2006	2007
Chinook Salmon						
Little Susitna River	Single aerial survey index	900 to 1,800	1,694	2,095	1,855	1,731
Little Willow Creek	Single aerial survey index	450 to 1,800	2,227	1,784	816	1,103
Willow Creek[b]	Single aerial survey index	1,600 to 2,800	2,985	2,463	2,217	1,373
Coho Salmon						
Little Susitna River	Weir[c]	10,100 to 17,700	40,199	16,839	8,786	17,573
Sockeye Salmon						
Fish Creek (Big Lake)	Weir	20,000 to 70,000	22,157	14,215	32,562	27,948

[a] Sources: Shields, 2007; Tobias and Willette, 2008.
[b] Willow Creek escapement includes hatchery fish.
[c] Weir washed out of the Little Susitna River in 2005 and 2006; counts were incomplete.

2. ESSENTIAL FISH HABITAT (EFH)

To assess the potential impact of the project, it is required to couple the above population data to EFH information for the five stocks of anadromous salmonids. Data for these five salmonids are sufficient to point out that pre- and post -construction activities could indeed be detrimental to both anadromous and resident species without due consideration for both short-term and long-term impacts on EFH and adequate mitigation. Table G.1, or a.k.a. Table 5.4-2 (from FEIS), adequately portrays the annual spawning runs for anadromous salmon in the study area, generally extending from May through September, annually.

Table G-1
Salmon Spawning Run Timing within the Port MacKenzie Rail Extension Study Area[a]

Salmon and Streams	May	June	July	August	September
Chinook Salmon					
Parks Highway Streams	■	■			
Susitna River Streams		■			
Little Susitna River	■	■	■		
Lower	■	■			
Upper		■	■		
Chum Salmon (less abundant)					
Susitna River Streams			■	■	
Coho Salmon					
Parks Highway Streams				■	■
Susitna River Streams				■	
Little Susitna River			■	■	■
Lower			■	■	
Upper				■	■
Pink Salmon (abundant in even years)					
Susitna River Streams			■	■	
Sockeye Salmon					
Susitna River Streams			■	■	
Little Susitna River			■		

[a] Source: ADF&G, 2009a.

Table G-2 (from FEIS) in combination with Table G-1 demonstrates that all fish-bearing streams within the study site are important to each salmonid species' life history *year round*, be it for spawning, overwintering, hatching or development.

Table G-2
Salmon Habitat and Ecology[a] (page 1 of 2)

Common Name (Species)	Spawning Habitats/ Rearing Habitats	Overwinter Habitats	Ecology
Chinook Salmon (*Oncorhynchus tshawytscha*)	Spawn in fast deep water over gravelly or rocky bottoms of clearwater streams where they can dig redds; fry and juveniles use sloughs, backwaters, tributaries, shallows along gravel bars, and beaver ponds. Can rear for 1-3 years in fresh water.	Overwinter as eggs or juveniles. Can be found in Willow Creek and the Little Susitna River.	Juveniles smolt and outmigrate in spring following hatching, and outmigration appears to occur soon after ice breakup, peaking in mid to late May. Extensive movement within the river system in the first year of life, adults return to spawn after 4- to 5-year marine residence.
Chum Salmon (*Oncorhynchus keta*)	Spawn in small side channels and areas of larger rivers with upwelling springs; fry emerge from the gravel in spring and immediately outmigrate downriver, feeding on small insects and other detritus.	Overwinter as eggs.	Fry emerge from the gravel in early to mid April, with peak outmigration before the end of May. Adults return to spawn after 3- to 5-year marine residence (adults infrequently found in study area).
Coho Salmon (*Oncorhynchus kisutch*)	Spawn in gravel areas of clearwater habitats, usually spring-fed; juveniles use ponds and pools in streams and rivers or stream margins, usually among submerged woody debris and in scour pools.	Juveniles overwinter near springs and in spring-fed streams; areas with upwelling are important for both egg and fry survival.	Spend 1 to 3 years in streams, spend 1 year in marine waters before returning. Sizeable run in the Little Susitna River.
Pink Salmon (*Oncorhynchus gorbuscha*)	Spawn in the lower reaches of freshwater streams in shallow riffles over coarse gravel; eggs hatch midwinter in the gravel and emerge in late winter to migrate to marine waters.	Eggs in the gravel until spring; do not overwinter as juveniles in Southcentral Alaska.	Two-year cycle that is stronger on even years; can be found in most area streams during summer migration.
Sockeye salmon (*Oncorhynchus nerka*)	Usually spawn in rivers and streams and upwelling areas along lake beaches. Eggs hatch during winter and young emerge and move into rearing areas along lakes and streams.	Juveniles use deeper large lakes for overwintering.	In stream systems with large lakes; spawning in streams and rivers, will occur in backwater sloughs or oxbows. The Fish Creek-Big Lake drainage has a moderate run of sockeye salmon.

[a] Source: ADF&G, 2007a; 2007b; 2009a; Mecklenburg *et al*., 2002.

Thus, (declining) population data in combination with EFH data (Tables G-1 and G-2) place substantial constraints upon the Applicant fulfilling Voluntary Mitigation Measure **VM-11**:

> *"The Applicant shall time project-related construction in anadromous streams to minimize adverse effects to salmon during critical life stages when practicable. The Applicant shall incorporate timing windows (i.e., those time periods when salmon are least vulnerable to disturbances) as specified by the Alaska Department of Fish and Game Division of Habitat, into construction contract specifications for instream work. The Applicant shall design and construct stream crossings so as not to impede fish passage or impair the hydrologic functioning of the waterbody."*

VM-12 states *"When project-related activities, such as culvert and bridge construction, require work in stream beds, the Applicant shall conduct activities, to the extent practicable, during either summer or winter low-flow conditions."*

In summary, data presented in the FEIS indicate a clear downward trend (38%) in salmonid populations in Upper Cook Inlet from 2004-2007, and a concurrent decline in overall escapement. Thus, a conservative approach to salmonid management is required in the waters of Upper Cook Inlet (and presumably being pursued by ADFG since the preparation and review of the FEIS). With regards to the proposed project, the Applicant does not offer insight as to such an approach given their own data base of regionally-declining stocks and escapement. For instance, the setting of "timing windows" will be difficult to achieve to mitigate impact, i.e., summer low-flow conditions are during the peak of anadromous salmon migrations and winter low-flow conditions are critical to overwintering stocks of all life stages (eggs, juveniles, adults).

(NOTE: Also see Section E. below re: **AQUATIC ANIMALS OF CONSERVATION CONCERN** with reference to Bering cisco (*Coregonus laurettae)).*

3. **<u>Stream crossings</u>**.- The recommended (**G.3.5.12**) Mac East Variant-Connector 3 Variant-Houston-Houston South Alternative route

> *"…would involve crossing 5 streams that provide EFH (Table… G-10). Based on field reconnaissance, there is spawning and overwintering habitat at 2 stream crossings. All streams that this alternative would cross provide rearing habitat and passage for salmon during seasonal migrations (Noel et al., 2008). ARRC has proposed to construct a bridge at the Little Susitna River crossing (MP-174.3) next to an existing bridge. The bridge over the Little Susitna River would require instream pilings within a reach with documented spawning habitat for 3 of 5 Pacific salmon …. ARRC has proposed to use 2 drainage structures to cross EFH-bearing streams. ARRC would use culverts to cross the remaining 2 EFH-bearing streams (… Table …G-10). Three of the stream crossings along this alternative are in areas where development has created potential unnatural blockages because of ineffective culverts (Table G-10).*

Table G-10
Summary of EFH-Bearing Streams Crossed by Alternatives[a]

	Mac West-Conn 1-Willow	Mac West-Conn 1-Houston-Houston North	Mac West-Conn 1-Houston-Houston South	Mac West-Conn 2-Big Lake	Mac East-Conn 3-Willow	Mac East-Conn 3-Houston-Houston North	Mac East-Conn 3-Houston-Houston South	Mac East-Big Lake	Mac East Variant-Conn 2a-Big Lake	Mac East Variant-Conn 3a-Willow	Mac East Variant-Conn 3a-Houston-Houston North	Mac East Variant-Conn 3a-Houston-Houston South
Fish Communities												
Anadromous	7	9	6	8	6	8	5	8	8	6	8	5
Habitat												
Spawning	4	2	2	2	4	2	2	2	2	4	2	2
Rearing	7	9	6	8	6	8	5	8	8	6	8	5
Migration	7	9	6	8	6	8	5	8	8	6	8	5
Overwiintering	4	2	2	4	4	2	2	4	4	4	2	2
Potential Blockages												
None	5	3	3	0	4	2	2	0	0	4	2	2
Natural-Beaver Dams	1	0	0	0	1	0	0	0	0	1	0	0
Artificial-Up Stream	0	0	0	1	0	0	0	1	1	0	0	0
Artificial-Down Stream	1	3	2	0	1	3	2	0	0	1	3	2
Artificial-Up and Down Stream	0	3	1	7	0	3	1	7	7	0	3	1
Conveyance Structure												
Bridge	5	3	2	0	4	2	1	0	0	4	2	1
Culvert	0	3	2	1	0	3	2	1	1	0	3	2
Drainage Structure[b]	1	3	2	6	1	3	2	6	6	1	3	2
Natural Bottom Plate Pipe/Arch Structure	1	0	0	0	1	0	0	0	0	1	0	0
Relocation	0	0	0	1	0	0	0	1	1	0	0	0
Total Crossings	**7**	**9**	**6**	**8**	**6**	**8**	**5**	**8**	**8**	**6**	**8**	**5**

[a] Source: Johnson and Daigneault, 2008; Noel *et al.*, 2008.
[b] Drainage structures would be determined during the final design process and could include multi-plate culverts, pre-cast arches, and single or multiple short span bridges.

This alternative would cross waters important for sustaining recreational and commercial salmon fisheries in Southcentral Alaska, including the Little Susitna River and several unnamed Little Susitna tributaries. Fish-bearing waters and upstream habitat along this alternative have the lowest estimated index of fish habitat potential among all alternatives (Table G-11).

Table G-11
Summary Comparison of Fish Habitat Potential for Fish-Bearing Streams Crossed by the Alternatives

	Mac West-Conn 1-Willow	Mac West-Conn 1-Houston-Houston North	Mac West-Conn 1-Houston-Houston South	Mac West-Conn 2-Big Lake	Mac East-Conn 3-Willow	Mac East-Conn 3-Houston-Houston North	Mac East-Conn 3-Houston-Houston South	Mac East-Big Lake	Mac East Var-Conn 2a-Big Lake	Mac East Var-Conn 3 Var-Willow	Mac East Var-Conn 3 Var-Houston-Houston North	Mac East Var-Conn 3 Var-Houston-Houston South
Watershed Geomorphic Characteristics												
Upstream Watershed Area (acres)	484,941	171,510	146,020	82,942	478,190	164,759	139,269	80,395	80,395	478,190	164,759	139,269
Mean Elevation (feet)	1,302	1,157	1,341	215	1,319	1,199	1,400	218	218	1,319	1,199	1,400
Average Slope (percent)	6.4	7.4	8.6	1.8	6.5	7.6	9.0	1.9	1.9	6.5	7.6	9.0
Mean Rugosity[b]	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Mean Annual Precipitation (inches)	26	26	27	20	26	26	27	20	20	26	26	27
Accessible Stream Length (miles)[c]	781.3	296.0	250.6	78.1	776.3	291.0	245.7	76.5	76.5	776.3	291.0	245.7
Index of Fish Habitat Potential[a,d]	**220,300**	**80,700**	**62,100**	**74,100**	**216,100**	**76,400**	**57,900**	**72,800**	**72,800**	**216,100**	**76,400**	**57,900**
Fish Communities												
Chinook	30,192	12,713	9,682	7,400	29,159	11,679	8,649	6,892	6,892	29,159	11,679	8,649
Sockeye	83,242	32,339	24,072	52,996	81,013	30,110	21,843	52,494	52,494	81,013	30,110	21,843
Coho	106,879	35,640	28,366	13,718	105,896	34,657	27,383	13,387	13,387	105,896	34,657	27,383

The FEIS justifies the preferred route as having fewer stream crossings and less impact to fish habitat as opposed to other construction alternatives. Having said this, the FEIS does not address long-term monitoring as a mitigation measure in the post-construction operational environment even though the rail line, bridges and culverts will require routine inspection, and in time, remediation.

Regardless of the rationale of the recommended route, mitigation measure 16 is inadequate: *"The Applicant shall ensure that all project-related culverts and bridges are sufficiently clear of debris to avoid blockages to free-fish passage (where applicable), stream-flow alteration, and increased flooding. The Applicant shall inspect all project-related bridges and culverts semi-annually (or more frequently, as seasonal flows dictate) for debris accumulation and remove and properly dispose of debris promptly. "* **Streams are not created equal in sediment and debris transport, seasonal and average annual flows, scouring, and as fish migration routes, and these parameters can vary, e.g., (a) year-by-year in the same stream or (b) in adjacent streams in the same frame (daily, monthly, annually).** One time data points add no insight to the functioning of these systems and whether proposed mitigation measures will be effective.

Further, **no consideration is given to the prospect of increased flooding due to increased precipitation as related to climate warming (Min et al. 2011), therein decreasing the efficiency and effectiveness of stream crossing structure designs based on historical stream flow trends**. Stated a different way, designs based on the 100-year flood may well prove inadequate in the future given the increase precipitation patterns.

As a caveat to the above points, the phrase "*…or more frequently, as seasonal flows dictate"* should be substitutes with "*monthly, or as seasonal flows dictate*". It can be argued easily that either more frequent monitoring is required during low-flow conditions when it is critical that waterways be open for fish movement, or alternately during high flow conditions when flotsam, sediment and debris can clog stream crossings.

The reference to "project related" in Mitigation Measure **16** infers no commitment to long-term monitoring and mitigation of stream crossings, since the "project" is interpreted several times in the FEIS as the construction phase. This short-term view is underscored by OEA's mitigation measure **(62)** to wit *"The Applicant shall retain a third-party contractor to assist the Surface Transportation Board's Office of Environmental Analysis in the monitoring and enforcement of mitigation measures until 1 year after the Applicant has completed project-related construction activities."* This is a gross understatement concerning the mitigation of the railway in the long-term.

In summary, a Standard Operating Procedures (SOP) protocol is required for routine monitoring and remediation steps in the operational environment with specific reference to both Water Resources and Fisheries. Such inspection should be conducted at least on a monthly basis by a third party qualified/certified Fisheries Biologist experienced in fish passage and EFH.

4. Third party monitoring.- Under **Chapter 19. MITIGATION** of the FEIS, **Section 19.10 Monitoring and Enforcement** (See Appendix 1 here for mitigation measures related to Water Resources and Fisheries), required Mitigation Measure **62** states:

> *"The Applicant shall retain a third-party contractor to assist the Surface Transportation Board's Office of Environmental Analysis in the monitoring and enforcement of mitigation measures until 1 year after the Applicant has completed project-related construction activities."*

With regards to Fishery Resources (and Water Resources) **Section 19.10** is remiss in (a) not specifically referencing a "third party qualified/certified Fisheries Biologist" who is trained in the evaluation of fish migration and EFH projects, and (b) by limiting post-construction monitoring to 1 year, i.e., lacking a view toward long-term post-construction operational impacts. Only in **Mitigation Measure 32a** (Appendix 1) did the OEA require a "… *wetland scientist, fisheries biologist, or other qualified individual shall perform the inspections*" in reference to inspecting culverts on fish-bearing waters and it states "the Applicant" will perform these inspections rather than a third-party.

This is further accented in **Chapter 23 COMMENT SUMMARIES AND RESPONSES, Section 19. 2.3 Biological Resources** where the Comment

> *"Free fish passage will be maintained across the project reach for the life of the project. This includes, but is not limited to, blockages through culverts and bridges caused by beaver activity and perched culverts."* (65-84)

was responded to by OEA as

> *"…the Applicant would be required to inspect all project-related bridges and culverts."*

The "Applicant" is not a third party. A "third party qualified/certified Fisheries Biologist" who is trained in the evaluation of fish migration and EFH projects should assess mitigation measures and conduct long-term monitoring.

5. **Fisheries/EFH compensation**.- **Neither "Fisheries compensation" nor "EFH compensation" were included as voluntary measures, nor were they required by the OEA, in the FEIS in the event of construction or operational impacts of the railway line on fisheries of EFH**. Examples of fish compensation and habitat compensation can be found at Southwick and Loftus (2003) and http://www.dfo-mpo.gc.ca/habitat/role/141/1415/14155/compensation/index-eng.asp, respectively, for evaluating and financially compensating for loss of resources and their habitat.

By comparison, ***VM-4*** specifically states regarding wetlands:

> *"The Applicant shall avoid and minimize impacts to waters of the U.S., including wetlands, to the extent practicable. The Applicant shall provide compensatory mitigation for unavoidable impacts to wetlands as part of the U.S. Army Corps of Engineers section 404 permit, to the extent practicable in accordance with the reasonable requirements of the Clean Water Act."*

This is an oversight placed into the context of the **Summary** statement of the FEIS:

> *"Notwithstanding the recommended mitigation measures, there still would be potential unavoidable impacts to fisheries from the proposed rail line. Potential impacts would include: fish habitat loss and modification at stream crossings along the proposed rail line; loss of rearing, foraging, and cover habitat along the banks within the rail line footprint; loss of overhanging bank habitat structure and vegetation within the rail line footprint; potential changes to natural drainage and altered flood hydraulics; potential for debris jams and overbank flooding upstream of water crossings; potential direct mortality of fish during construction; and potential loss of redds, eggs, and fry due to changes in sedimentation, turbidity, and pollutants during construction."*

6. **Aquatic Animals of Conservation Concern**

Chapter 5.4 Fisheries Resources and **APPENDIX F. FISHERIES RESOURCES** of the FEIS present much data on the fishery resources of the study area, including **Impacts to Aquatic Animals of Conservation Concern** that reports three fish species (threespine stickleback [*Gasterosteus aculeatus*], ninespine stickleback [*Pungitius pungitius*], and Pacific lamprey [*Lampetra tridentate*]) are of conservation concern in Alaska waters, but the preferred route for the proposed rail line would have the fewest potential occurrences (5) of these three species in fish-bearing streams.

Other species of Conservation Concern in Alaska that are expected to occur in the study area, but were not collected by Noel et al.(2008) are Bering Cisco (*Coregonus laurettae)*, Rainbow Smelt (*Osmerus mordax), and* Wood Frog (*Rana sylvatica)* (Table F-5 in the FEIS).

The life cycle of the Bering cisco, an anadromous whitefish, is noteworthy. As referenced in the FEIS, they occur in the Susitna River and are fall spawners with peak spawning during the second week of October (ADF&G, 1986). Combined with timing data for salmon (Table G-1, above), this increases the "window" for spawning of anadromous species in the study area from May through October, annually. **Also, see EFH above**.

7. Aquatic Invertebrates

A glaring omission in the DEIS and resultant FEIS is the lack of attention to invertebrates, i.e., primary prey items for resident and anadromous fishes. Invertebrates are crucial to the functioning of aquatic ecosystems, including wetlands, and are important biological indicators of changes in water quality. No data are presented for these organisms be it a species listing, resource inventory, life cycle considerations, population status, role in aquatic productivity, or status in EFH.

Invertebrates are only cursorily mentioned in **Section G.3.2.4 Degradation of Water Quality**:

> *"Fuel leaks from construction equipment could reduce water quality and result in toxic affects to fish and aquatic invertebrate forage. Spills and leaks could enter the water either directly as equipment crossed streams or indirectly with runoff from bridges and adjacent road beds or rail beds."*

Aquatic invertebrates are susceptible to the very same common construction impacts associated with the project as referenced for fish under **Appendix G.3 Effects of the Proposed Project on Essential Fish Habitat**, i.e.,

> **G.3.2.1 Loss or Alteration of Instream and Riparian Habitats**
> **G.3.2.2 Mortality from Instream Construction**
> **G.3.2.4 Degradation of Water Quality**
> **G.3.2.5 Alteration of Stream Hydrology**
> **G.3.2.6 Noise and Vibration Impacts**

In terms of acute stress from an accidental occurrence, invertebrates are usually much more susceptible to environmental perturbations than fish in that they generally lack the mobility to escape stressors and to seek refuge in more favorable environs.

E. LONG-TERM IMPACTS

Within the FEIS **Chapter 23 COMMENT SUMMARIES AND RESPONSES, Section 23.17 Short-Term Use Versus Long-Term Productivity of the Environment**, OEA did not receive public comments on this topic, or alternately such comments are included elsewhere under other sectional commentary. Chapter 17 of the FEIS touched briefly on the **SHORT-TERM USE VERSUS LONG-TERM PRODUCTIVITY OF THE ENVIRONMENT** and under **Section 17.2.2 Water Resources** recognized (amongst other things):

> *"Potential long-term effects to productivity from the proposed rail line could result where the rail bed or access roads would be near or adjacent to waterbodies. Spring ice break-up, snowmelt, and rainstorms could affect water quality through increased transport of fine-grained sediments; increased concentrations of pollutants that could alter waterbody chemistry and pH; and fugitive dust from rail operation and vehicle use of access roads. Bridges and culverts could change channel hydraulics and impact water quality due to increased sediment transport loads and increased sedimentation."*

Under Section **17.2.3 Biological Resources** it was recognized

> *"Primary direct effects to fisheries from rail line construction and operation would include increased erosion and sedimentation from removal of riparian vegetation, loss or alteration of stream and riparian habitats due to placement of structures, alteration of stream and wetland hydrology, and blockage of movements. The extent of impacts would depend on the alternative and type of crossing."*

Appendix G of the FEIS devotes attention to the potential for long-term post-construction operational impacts of the rail line, noting "*Operation-related impacts would be common for all stream crossings along the proposed rail line."* Potential impacts were categorized as

> **G.3.3.1 Loss or Alteration of Instream and Riparian Habitats,**
> **G.3.3.2 Blockage of Fish Movement,** and
> **G.3.3.3 Degradation of Water Quality.**

To summarize, the Applicant offered **VM-10** that states "*For all project-related crossings of fish-bearing waters that incorporate bridges or culverts, the Applicant shall design, construct, and maintain the conveyance structures in accordance with the National Marine Fisheries Service 2008 publication…"* However, **VM-10** can be interpreted as pertaining to the structure itself and not to maintenance of aquatic resources. The issue is **the lack of stated commitment to a combination of long-term monitoring of environmental productivity and mitigation measures to address such impacts if they were to occur in the post-construction operational environment.**

As put so well by Mauger (2008) of the Cook Inletkeeper for temperature:

> *"Despite the association between warm water temperatures and reduced salmonid survivorship, there is little or no consistent, long-term water temperature data for salmon streams in Alaska. Without such basic information, it is impossible to gauge the health of Cook Inlet's salmon habitats and resources, and equally difficult to develop management responses to improve watershed resiliency to climate and land-use change."*

In summary, **the FEIS presents no plan for the long-term monitoring and surveillance of the operational project on environmental productivity as related to water resources, aquatic ecosystems, fisheries, and Beluga whale**.

IV. SUMMARY

1. The data base presented by the Applicant for Water Resources, Hydrology and Biological Resources, collected over a 5-day period during summer low-flow conditions 12-17 August 2008, is very inadequate to profile the complexities of the aquatic ecosystems themselves, their hydraulics, and their fisheries on a seasonal, annual or decadal basis.

2. The Applicant(s) and OEA separate the proposed railway from the expansion of Port MacKenzie in the FEIS when indeed this combined activity has been irrefutably strategically and economically linked over a 40-year history by the co-Applicant, Matanuska-Susitna Borough (MSB). Indeed, all of NMFS's (2008) concerns for Cook Inlet belugas will be realized with the fulfillment of an expanded Port MacKenzie and its required rail line (H.5 Environmental Baseline) along Knik Arm. These concerns include:
   - Encroachment into the lower Knik Arm from the west due to expansion of Port MacKenzie;
   - Increased dredging requirements with port expansions;
   - Increased ship traffic due to expansion of both ports in lower Knik Arms, new boat launches, and possible operation of a commercial ferry;
   - Increased in-water noise levels due to port construction, port operations, and the associated increased vessel traffic; and
   - Increased need for vessel anchorage off both ports.

3. The long-term cumulative impacts of the project are understated in the FEIS in that it does not consider the inter-relatedness of water quality criteria and how these criteria can shift in a post-construction operational environment, nor is consideration given to post-construction monitoring and mitigation of railway operational impacts.

4. There was not an Applicant Voluntary Measure (VM) or OEA-required mitigation measure in the FEIS that specifically addresses either Water Resources or Fisheries for hazardous materials and petro-chemicals that enter the waterways, be it accidental or otherwise, in a post-construction operational environment. It is deemed insufficient that *"The Applicant shall follow all applicable Federal regulations and standard protocols for transporting hazardous substances and other deleterious compounds to minimize the potential for a spill occurrence"*. A Standard Operation Procedure manual should be available that specifically addresses long-term mitigation measures for Water Resources and Fisheries, including routine monitoring (Also see **Fisheries/EFH compensation** below).

5. The FEIS depicts a clear downward trend (38%) in salmonid populations in Upper Cook Inlet from 2004-2007, and a concurrent decline in overall escapement. These data were corroborated with more recent findings published elsewhere, thus strongly suggesting that a conservative approach is required for the protection of salmonid sustainability in the study area. The FEIS presents data that the anadromous salmonid prime spawning period is from May through September, annually, with over-wintering of adults, egg incubation, hatching, and development through the various

life stages occurring the remaining months of the year. Another Alaskan species of concern, the anadromous Bering cisco, spawns in October. Combined, these data indicate that Essential Fish Habitat (EFH) in fish-bearing waters is year round for anadromous species. This does not take into account spawning etc. of resident species that are valuable within themselves. The FEIS does not present insight on a conservative approach toward mitigation for fish population sustainability in light of declining population and escapement statistics. For instance, the setting of "timing windows" for construction activities will be difficult to achieve to mitigate impact, i.e., summer low-flow conditions are during the peak of anadromous salmon migrations and winter low-flow conditions are critical to overwintering stocks of all life stages (eggs, juveniles, adults).

6. The FEIS provides information on the attributes of the preferred route (Mac East Variant [aka,"Mac Central"]-Connector 3 Variant-Houston-Houston South Alternative) with regards to water resources, fisheries, and the numbers of stream crossings that will be required. Regardless of the rationale of the recommended route, mitigation measure **16** is inadequate: *"The Applicant shall inspect all project-related bridges and culverts semi-annually (or more frequently, as seasonal flows dictate) for debris accumulation and remove and properly dispose of debris promptly."* Streams are not created equal in sediment and debris transport, seasonal and average annual flows, scouring, and as fish migration routes. The reference to "project related" infers no commitment to long-term monitoring and mitigation measures. Additionally, no consideration is given to the prospect of increased flooding due to increased precipitation as related to climate warming, therein decreasing the efficiency and effectiveness of stream crossing structure designs based on historical stream flow trends.

7. The FEIS with OEA concurrence refers continuously to "*The Applicant shall monitor*….". The "Applicant" is not a third party. Specifically, monitoring should be conducted by a "third party qualified/certified Fisheries Biologist" who is trained in the evaluation of fish migration and EFH.

8. The FEIS offers **VM-4** "The Applicant shall avoid and minimize impacts to waters of the U.S., including wetlands, to the extent practicable. The Applicant shall provide compensatory mitigation for unavoidable impacts to wetlands…". Nowhere in the FEIS, either as a Voluntary Mitigation Measure or OEA-required, is there a gesture of compensation for the loss of either anadromous or resident fish stocks, or their EFH, "for unavoidable impacts…" either short-term during construction phases or long-term during the post-construction operational environment.

9. To repeat certain points in common from above, the Applicant's FEIS is negligent in not offering long-term physical, chemical and biological monitoring as a long-term mitigation measure for Water Resources and Fisheries. Mitigation measure (62) that limits monitoring and enforcement of mitigation measures to *"…1 year after the Applicant has completed project-related construction activities"* is short-sighted.

10. The FEIS and the OEA ignore the value of the aquatic invertebrate community in EFH, either as (a) forage for anadromous and resident fish species, (b) vital components of ecosystem productivity, or (c) as important biological indicators of water quality. No historical or recent data are presented of any nature.

11. The FEIS presents no plan for the long-term monitoring and surveillance of the operational project on environmental productivity as related to water resources, aquatic ecosystems, fisheries, and Beluga whale.

V. REFERENCES

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ABBREVIATED VITAE
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PERMANENT RESIDENCE: Namibia **CITIZENSHIP:** USA

EDUCATION: Virginia Polytechnic Institute and State University - Ph.D., 1974

EMPLOYMENT HISTORY (Chronological from most recent)

1) Current: I provide ***consulting services*** to government ministries, donor organizations, NGOs and the private sector. I specialize in the principles of sustainable resource utilization, transboundary resource management, environmental impact assessment, integrated water resource management, and training/capacity development, particularly in relation to the Millennium Development Goals of economic development, food security and poverty alleviation.

My experience includes, but is not limited to the following:

- Administration and coordination of multidisciplinary teams
- Negotiation and administration of multiple-sourced donor funds
- Project design, implementation, data collection and interpretation
- Programme review
- Monitoring & evaluation
- Workshop facilitation
- Strategic planning, including use of the Logical Framework Approach (LFA)
- Curriculum design and technology transfer
- Liaising between multiple stakeholders

2) University of Alaska Fairbanks, Fairbanks, AK

Position: Special Assistant to the Provost (June 2004 until May 2005)

- Facilitating the development of a University triangle park, linking academia, state government, & industry

Position: Associate Dean *and* Professor (tenured) (2002 to June 2004), School of Fisheries & Ocean Sciences (SFOS)

Administrative duties (including, but not limited to assisting the Dean)

- Administer $ 20+ million budget of base and extramural funding
- Administer 80 +/- employees, distributed across 6 centers within SFOS
- Administer undergraduate and post-graduate programs (MS, PhD)
- Lead strategic planning efforts for SFOS to evolve into a "Center of Excellence", including prioritization of research & training agenda
- Establish linkages and MOUs with state, federal, public, private & international bodies
- Direct public outreach and advisory programs
- Lead and participation in state, regional & national workshops, conferences, symposia, etc.,
- Director, Rasmuson Research Center
- Member, Pollock Conservation Cooperative Research Center

3) BENEFIT Programme, Swakopmund, NAMIBIA

Position: Chief Executive Officer, BENEFIT Secretariat, January 1998 –January 2002

Duties/Terms of Reference (included but not limited to these duties; see also pp. 9-10):

- Setting up an operating structure for the Secretariat, and direction of all Secretariat activities
- Working under the directives of the BENEFIT Ministerial Board, Management Action Committee and the International Scientific Advisory Panel regarding conduct of the Programme
- Establishing & administering BENEFIT Working Groups, Task Groups and committees as required, especially a 3-country Research Working Group and Training Working Group, the latter comprised of nine regional universities and polytechnics
- Initiation of workshops and other technical meetings, as necessary
- Facilitating the travel and arrangements for routine regional meetings of BENEFIT's policy and governance committees, working groups, international steering committees, and conferences throughout the year
- Coordination and promotion of scientific activities through close liaison with national BENEFIT scientific coordinators, senior staff of research institutes and academic institutions in Angola, Namibia and South Africa, cooperating institutions abroad, NGOs and the Southern African Development Community (SADC)
- Raising support for BENEFIT from international donors, preparation of submissions to donors, and production of performance reports to donors on projects funded by them
- Drafting and administration of the Programme's budget, totaling N$ 15-20 million per annum
- Coordination of BENEFIT's metadata system with SADC
- Establishing a BENEFIT webpage and newsletter
- Maintaining links between BENEFIT and affiliated programmes regionally and globally
- Negotiation and planning for foreign participation in BENEFIT activities

4) University System of Maryland

Position: Assistant Professor – 1977-1982

Position: Tenured Associate Professor – 1982-1988

Position: Full Professor of Fisheries & Natural Sciences – 1988-1998 and
Director, Coastal Ecology Research Laboratory – 1994-1998

Duties/Terms of Reference (included but not limited to):

- Leading and facilitating capacity development activities and research initiatives
- Negotiation, management and administration of $1 million/annum of extramural funding support obtained from multiple sources
- International development and institutional linkages, focusing on Africa
- Curriculum design
- Providing professional advisory and consulting services to state and federal agencies, industry & private sectors
- Serving on citizens advisory committees
- Public service, outreach and environmental education, especially aimed toward historically disadvantaged communities
- Mentoring professional development of junior faculty & post-graduate students

5) Other Positions Held:

- Liaison Officer & Visiting Professor, University of Namibia, 1992 - 1994
- Visiting Associate Professor, University of Zimbabwe, 1986-1987

EDUCATIONAL & CAPACITY DEVELOPMENT ORGANIZATIONS (invited participation):

- African Internships to Study Abroad, Rockefeller Foundation
- Fulbright Fellowship Program, USIA
- Institute of International Education, USIA & Kellogg Foundation
- International Foundation for Science, Sweden
- Leadership for Environment & Development (LEAD)
- National Security Education Program, Academy for Educational Development
- Partners in International Education & Training (PIET), USAID

INTERNATIONAL CONSULTING/DONOR EXPERIENCE:

African Development Bank
Africare
DANIDA
DFID
EU
FAO
French Mission for Cooperation & Culture
Global Environment Facility (GEF)
German Agency for Technical Co-operation (GTZ)
ICEIDA
Industry Council for Development (ICD)
Institute for Water & Sanitation Development (IWSD), Harare, Zimbabwe
NORAD
Rockefeller Foundation
Southern Africa Development Community (SADC)
Swedish International Development Cooperation Agency (Sida)
United Nations Development Programme (UNDP)
U.S. Agency for International Development (USAID)
U.S. Information Agency (USIA)
World Bank

INTERNATIONAL EXPERIENCE:

France	Denmark
Germany	Hungary
Iceland	Italy
Monaco	Netherlands
Norway	Sweden
United Kingdom	

Africa

Angola	Botswana
Kenya	Lesotho
Malawi	Mauritius
Namibia	Senegal
Seychelles	South Africa
Swaziland	Tanzania
Zambia	Zimbabwe

PUBLICATIONS: I have published over 125 books, book chapters and peer reviewed manuscripts during my career. A complete list is available upon request.