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August 26, 1982

Mr. Stephen Bredthauer
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Dear Steve,

I have reviewed and corrected the typed copy of the literature search on baseline information on upper Cook Inlet, which I delivered to you on August 13.

A manual and computer literature search was conducted to identify additional references on the limnology and water quality of glacial lakes.

Two computer searches were completed. Selected Water Resources Abstracts was searched by combining the keywords dams or reservoirs or glacial lakes with any of the following: ice cover, ammonia, eutrophication, dissolved oxygen, phosphorus, supersaturation, and trophic level. The 152 references were reviewed by Larry Peterson, who stated that none pertained to glacial lakes. Cold Regions (the computerized version of the CRREL bibliography) was searched utilizing a similar strategy, and 58 references were generated. Several pertinent references had already been identified in a manual search of volumes 28-33 of the CRREL bibliography, utilizing the keywords dams, reservoirs, glacial lakes, ice cover, dissolved gases, nitrogen, nutrients, oxygen, phosphorus cycle, water temperature, and turbidity.

The same keywords were used to check all CRREL technical publications, and 40 references were identified for your review. Bibliographies of six additional reports were reviewed, but no additional references were identified.

Alaska, University, Arctic Environmental Information and Data Center. 1980. An assessment of environmental effects of construction and operation of the proposed Terror Lake hydroelectric facility, Kodiak, Alaska; Raptor studies; Intragravel water temperature studies. Report for Kodiak Electric Association, Inc., Kodiak, AK. 57 pp.

____. 1980. An assessment of environmental effects of construction and operation of the proposed Tyee Lake hydroelectric project, Petersburg and Wrangell, Alaska. Report for Robert W. Retherford Associates Div., International Engineering Company, Inc. 1 vol.

_____. 1981. An assessment of environmental effects of construction and operation of the proposed Terror Lake hydroelectric facility, Kodiak, Alaska; Instream flow studies; Final report. Report for Kodiak Electric Association, Inc., Kodiak, AK. 419 pp.

Bell, M. 1973. Fisheries handbook of engineering requirements and biological criteria. Fisheries Engineering Research Program, Corps of Engineers, North Pacific Div., Portland, OR. 1 vol.

Feulner, A.J., and K.M. Reed. 1977. Bibliography of reports by members of the U.S. Geological Survey on the water resources of Alaska; 1870-1976. U.S. Geological Survey, Anchorage, AK. Open-file Report 77-687. 112 pp.

McNeil, W.J., and J.E. Bailey. 1975. Salmon rancher's manual. Northwest Fisheries Center Auke Bay Fisheries Laboratory, National Marine Fisheries Service, Auke Bay, AK. Processed Report. 95 pp.

In summary, I found several references that may assist you and Acres in determining the effects of ice cover, but no additional references that will assist Larry Peterson with his water quality report. For your information, Joe LaBelle and Jim Wise at AEIDC are completing an ice atlas, and may have additional information that will be of use.

Please contact me if you have any questions.

Sincerely,

Linda Perry Dwight

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enclosure

INTRODUCTION

A literature search was conducted to obtain information on baseline data on upper Cook Inlet, with special emphasis on data near the mouth of the Susitna River. The search focused on data on ice, sediment, salinity, tides, and biological productivity.

The bibliography contains annotations for 18 references. Appendix A is a chronological listing of 11 reports that contain data on sea ice conditions in Cook Inlet between 1969 and 1980. Appendix B is a chronological listing of six reports that contain data on physical, chemical, and biological parameters collected for outfall studies at Collier Carbon and Chemical Corporation near Kenai. All reports are available at the University of Alaska's Arctic Environmental Information and Data Center (AEIDC).

Gatto (1976) presented a detailed description of oceanographic processes in Cook Inlet, and Sharma et al. (1974) described circulation and sediment transport in upper Cook Inlet. The University of Alaska's Institute of Marine Science (IMS) has collected data in the vicinity of the Susitna River estuary on temperature, salinity, oxygen, dissolved and particulate carbon, suspended sediments, and nutrients (Kinney, Groves, and Button 1970). Sharma and Burrell (1970) described the sedimentary environment of upper Cook Inlet. Unpublished IMS data were referenced in other reports. Poole and Hufford (1982) analyzed meteorological and oceanographic factors associated with the variability of ice formation.

Data collected under the Outer Continental Shelf Environmental Assessment Program pertained only to lower Cook Inlet. Data listed in AEIDC's climatic atlas were too generalized. Data compiled by the Alaska Department of Fish and Game for Cook Inlet were not site specific. Data collection for studies on

Anchorage wastewater discharge and the Knik River crossing did not extend into the vicinity of the Susitna River estuary. The following publications lists and bibliographies were utilized.

Publications Lists -- University of Alaska

Alaska Climate Center
Arctic Environmental Information and Data Center
Geophysical Institute
Institute of Marine Science
Institute of Water Resources
Sea Grant Program

Bibliographies

Alaska Dept. of Natural Resources, Planning and Research Section. 1977. Resource bibliography; Susitna River Basin. 317 pp.

Alaska Dept. of Natural Resources, Div. of Research and Development, Land and Resource Planning Section. 1979. Susitna River basin resource bibliography; supplement 1979. 244 pp.

Alaska, University, Arctic Environmental Information and Data Center. 1982. Alaska coastal bibliography and index; statewide. Anchorage, AK. 1 vol.

Maher, J.C., and W.M. Trollman. 1969. Geological literature on the Cook Inlet basin and vicinity, Alaska. Report for Alaska Dept. of Natural Resources. 82 pp.

McGee, D.L., et al. 1977. Bibliography of the Cook Inlet (1969-1976). Div. of Geological and Geophysical Surveys, Alaska Dept. of Natural Resources, College, AK. 33 pp.

ANNOTATED BIBLIOGRAPHY -- UPPER COOK INLET BASELINE DATA

1. Alaska, University, Arctic Environmental Information and Data Center. 1974. Alaska regional profiles. Vol. 1. Southcentral region. Report for Alaska Office of the Governor. 253 pp.

   Summarizes all available information. Includes Institute of Marine Science and National Weather Service reports (described below). Limited site specific data.

2. Carlson, R.F., and C.E. Behlke. 1972. A computer model of the tidal phenomena in Cook Inlet, Alaska. Institute of Water Resources, University of Alaska, Fairbanks, AK. Report 17. 38 pp.

   Description of model of hydraulic flow for Cook Inlet and Knik Arm developed as data base for dispersion transport model for examining Anchorage waste outfall.

3. Carlson, R.F., R.D. Seifert, and D.L. Kane. 1977. Effects of seasonability and variability of streamflow on nearshore coastal areas. Institute of Water Resources, University of Alaska, Fairbanks, AK. Report 78. 1 vol.

   Contains specific data on Susitna River, but no analyses.

4. Evans, C.D., et al. 1972. The Cook Inlet environment; a background study of available knowledge. Resource and Science Service Center, University of Alaska, Anchorage, AK. 1 vol.

Summarizes all available information. Includes Institute of Marine Science and National Weather Service reports (described below). Limited site specific data.

5. Gatto, L.W. 1976. Baseline data on the oceanography of Cook Inlet, Alaska. Cold Regions Research and Engineering Laboratory, U.S. Army Corps of Engineers, Hanover, NH. Report 76-25. 92 pp.

   Investigation to compile baseline information on ocean circulation, with emphasis on the extent and pattern of tidal flushing and tidal currents in Cook Inlet, utilizing aircraft and satellite imagery with ground truthing. Regional relationships between river hydrology, sediment transport, circulation, and coastal processes were analyzed. Institute of Marine Science (IMS) data collection is referenced (but sites are not located) and unpublished IMS data on temperature, salinity, and suspended sediment are included. Detailed description of oceanographic processes in Cook Inlet.

6. Howard, Needles, Tammen & Bergendoff. 1972. Knik Arm highway crossing. Report for Alaska Dept. of Highways, Anchorage, AK. 1 vol.

   Study to determine feasibility of Knik Arm crossing. Specific data is extremely limited and is within Knik Arm.

7. Hutcheon, R.J. 1972. Forecasting ice in Cook Inlet, Alaska. National Weather Service, Alaska Region, Anchorage, AK. NOAA Technical Memorandum AR-5. 14 pp.

General discussion of factors used to forecast ice. Rivers release large freshwater ice cakes during breakup. River ice is harder than sea ice, unaffected by tidal action, remains in the rivers till breakup, and reaches a thickness of six to seven feet.

8. Kinney, P.J., D.K. Button, and D.M. Shell. 1969. Kinetics of dissipation and biodegradation of crude oil in Alaska's Cook Inlet. Pages 333-340 in Proceedings of the Joint Conference on Prevention and Control of Oil Spills, New York, NY, December 15-17, 1969. American Petroleum Institute and Federal Water Pollution Control Federation.

   Report on Institute of Marine Science (IMS) study to quantitatively define magnitude of Cook Inlet oil pollution problems. Although Cook Inlet flushing is 90 percent complete in 10 months, biodegradation occurs in a few months, and is more important. Flushing depends on river input rate and salt water replacement rate due to mixing entrainment. However, other investigators have found that flushing times are not a strong function of seasonal river input variations. Data on which the analysis in this report is based are presented in other IMS reports.

9. Kinney, P.J., J. Groves, and D.K. Button. 1970. Cook Inlet environmental data. R/V Acona cruise 065 - May 21-28, 1968. Institute of Marine Science, University of Alaska, College, AK. Report R-70-2. 1 vol.

   The major purpose of the cruise was to gather data on the dissipation, biodegradation, and accumulation of petroleum hydrocarbons. Hydrographic, chemical, and geological parameters were also measured. Data collected in the vicinity of the Susitna River estuary include temperature, salinity,

oxygen, dissolved and particulate carbon, suspended sediments, and nutrients (phosphate, nitrate, nitrite, ammonia, and silicate).

10. Matthews, J.B., and J.C.H. Mungall. 1972. A numerical tidal model and its application to Cook Inlet, Alaska. Journal of Marine Research. 30(1): 27-38.

11. Mungall, J.C.H. 1973. Cook Inlet tidal stream atlas. Institute of Marine Science, University of Alaska, Fairbanks, AK. Report R-73-6. 27 pp.

12. Mungall, J.C.H., and J.B. Matthews. 1973. Numerical tidal models with unequal grid spacing. Institute of Marine Science, University of Alaska. Fairbanks, AK. Report R-73-2. 213 pp.

The above three publications describe a numerical model for predicting tides and tidal currents, with a description of the application to Cook Inlet.

13. Peyton, H.R. 1966. Sea Ice in Cook Inlet. Arctic Environmental Engineering Laboratory, University of Alaska. 25 pp.

General discussion of mechanical properties of sea ice relative to designing large offshore drilling platforms in Cook Inlet.

14. Poole, F.W., and G.L. Hufford. 1982. Meteorological and oceanographic factors affecting sea ice in Cook Inlet. Journal of Geophysical Research. 87(3): 2061-2070.

Meteorological and oceanographic factors associated with the variability of ice formation are analyzed. The primary parameter in the upper inlet is air temperature (adjusted frost-free days), adjusted for relative thermal conditions of the water. River runoff is an important parameter in the lower inlet. Freshwater ice forms on river deltas and streams in the upper inlet in late November, followed by sea ice formation. Residence time of freshwater in the upper inlet is not known.

15. Sharma, G.D., and D.C. Burrell. 1970. Sedimentary environment and sediments of Cook Inlet, Alaska. Bulletin of the American Association of Petroleum Geologists. 54(4): 647-654.

    Data collected in the vicinity of the Susitna River estuary on cruises 026 (1966) and 043 (1967) of the R/V Acona, including standard hydrographic parameters, bottom grab samples, and suspended sediment samples, are summarized. Three sedimentary facies are described. When large quantities of glacial sediment enter the inlet during early summer months, strong currents prevent deposition of most of the silt and clay. The rate of sediment supply is minimal during the winter season, and sediments are reworked by ice rafting. Most material is deposited in the area adjacent to the Forelands. Note: unpublished reports are referenced.

16. Sharma, G.D., et al. 1974. Sea-surface circulation, sediment transport, and marine mammal distribution, Alaska continental shelf. Report for Goddard Space Flight Center, National Aeronautics and Space Administration, Greenbelt, MD. 77 pp.

ERTS-1 imagery is utilized to provide synoptic data for seawater parameters and sea-ice characteristics. Ground truthing was obtained from two cruises in 1972 in the vicinity of the Susitna River estuary for salinity, suspended sediment, and temperature. Circulation and sediment movement in the upper inlet is described as follows:

> Circulation in upper Cook Inlet, as interpreted from both ERTS-1 imagery and ground truth data, appears to be a clockwise gyre. Apparently the jet effect of the East-West Forelands areas, where during flood tide the configuration of the Forelands jets the flooding water to the west side of the inlet, is sufficient to overcome Coriolis force, which would normally maintain northward flow up the east side of the inlet and result in a net counterclockwise gyre as in the lower inlet. Consequently sediments from Knik Arm move south down the east side of the inlet and the clearer flooding water from the lower inlet moves north on the west side of the inlet. The clockwise gyre appears to break down near the upper reaches of the upper inlet and water movement in this area is probably a northeast-southwest pulsation due to the flood and ebb of the tides.

17. U.S. Army Corps of Engineers, Alaska District, and Municipality of Anchorage. 1979. Metropolitan Anchorage urban study; Volume 3; Water quality, Knik Arm-upper Cook Inlet. Anchorage, AK. 1 vol.

    Study to determine effects of Anchorage wastewater effluent discharges on Knik Arm and Cook Inlet water quality. Field data collected in the vicinity of Point Woronzof is reported.

18. Wayne, W.W. 1977. Final report on tidal power study for the United States Energy Research and Development Administration. Stone and Webster Engineering Corporation, Boston, MA. 2 vols.

General discussion of proposed Cook Inlet tidal power projects and environmental effects.

APPENDIX A

The following reports contain data on sea ice conditions in Cook Inlet between 1969 and 1980, and are listed in chronological order.

1. Hutcheon, R.J. 1972. Sea ice conditions in Cook Inlet, Alaska, during the 1969-1970 winter. National Weather Service, Alaska Region, Anchorage, AK. NOAA Technical Memorandum AR-6. 11 pp.

2. _____. 1972. Sea ice conditions in Cook Inlet, Alaska, during the 1970-1971 winter. National Weather Service, Alaska Region, Anchorage, AK. NOAA Technical Memorandum AR-7. 17 pp.

3. _____. 1973. Sea ice conditions in Cook Inlet, Alaska, during the 1971-1972 winter. National Weather Service, Alaska Region, Anchorage, AK. NOAA Technical Memorandum NWS AR-8 18 pp.

4. Schulz, R. 1977. Sea ice conditions in Cook Inlet, Alaska, during the 1972-1973 winter. National Weather Service, Regional Headquarters, Anchorage, AK. NOAA Technical Memorandum NWS AR-17.

5. _____. 1977. Sea ice conditions in Cook Inlet, Alaska, during the 1973-1974 winter. National Weather Service, Regional Headquarters, Anchorage, AK. NOAA Technical Memorandum NWS AR-18. 14 pp.

6. _____. 1977. Sea ice conditions in Cook Inlet, Alaska, during the 1974-1975 winter. National Weather Service, Regional Headquarters, Anchorage, AK. NOAA Technical Memorandum NWS AR-19. 13 pp.

7. _____. 1978. Sea ice conditions in Cook Inlet, Alaska, during the 1975-1976 winter. National Weather Service, Regional Headquarters, Anchorage, AK. NOAA Technical Memorandum NWS AR-20. 11 pp.

8. Poole, F.W. 1980. Sea ice conditions in Cook Inlet, Alaska, during the 1976-1977 winter. National Weather Service, Regional Headquarters, Anchorage, AK. NOAA Technical Memorandum NWS AR-27. 12 pp.

9. Eaton, R.B. 1980. Sea ice conditions in Cook Inlet, Alaska, during the 1977-1978 winter. National Weather Service, Regional Headquarters, Anchorage, AK. NOAA Technical Memorandum NWS AR-28. 15 pp.

10. Poole, F.W. 1981. Sea ice conditions in Cook Inlet, Alaska, during the 1978-1979 winter. National Weather Service, Regional Headquarters, Anchorage, AK. NOAA Technical Memorandum NWS AR-30. 15 pp.

11. _____. 1981. Sea ice conditions in Cook Inlet, Alaska, during the 1979-1980 winter. National Weather Service, Regional Headquarters, Anchorage, AK. NOAA Technical Memorandum NWS AR-32. 10 pp.

These reports contain a description of ice conditions based on observations by U.S. Navy ice observers, assisted by National Weather Service marine forecasters, and analyses of satellite imagery. Reports from Cook Inlet oil platforms were also used. Data presented includes ice concentration, ice thickness, mean monthly temperature and frost-free days at Anchorage, Kenai, and Homer, and sea water temperatures at the oil platforms.

APPENDIX B

The following reports contain data on physical, chemical, and biological parameters collected for outfall studies at Collier Carbon and Chemical Corporation near Kenai. They are listed in chronological order.

1. Rosenburg, D.H., et al. 1967. Oceanography of Cook Inlet with special reference to the effluent from the Collier Carbon and Chemical Plant. Institute of Marine Science, University of Alaska, College, AK. Report 67-3. 105 pp.

2. Hood, D.W., et al. 1968. Summary report on Collier Carbon and Chemical Corporation studies in Cook Inlet, Alaska. Institute of Marine Science, Univerity of Alaska, College, AK. Report 68-9. 1 vol.

3. Rosenburg, D.H., K.V. Natarajan, and D.W. Hood. 1969. Summary report on Collier Carbon and Chemical Corporation studies in Cook Inlet, Alaska; Part I, November 1968 to September 1969. Institute of Marine Science, University of Alaska, College, AK. Report 69-13. 1 vol.

4. _____. 1969. Summary report on Collier Carbon and Chemical Corporation studies in Cook Inlet, Alaska; Part II, November 1968 to September 1969. Institute of Marine Science, University of Alaska, College, AK. Report 69-13. 1 vol.

5. Kinney, P.J., et al. 1970. Quantitative assessment of oil pollution problems in Alaska's Cook Inlet. Institute of Marine Science, University of Alaska, College, AK. Report R-69-16. 116 pp.

6. Rosenburg, D.H., ed. 1972. Oceanographic data, Collier Carbon and Chemical Corporation pier, Cook Inlet, Alaska, January 1971 through December 1971. Institute of Marine Science, University of Alaska, College, AK. Report R-72-2. 21 pp.