ENVIRONMENTAL PLANNING FOR AN ALASKAN WATER-ORIENTED RECREATION AREA

Environmental planning for an Alaskan water-oriented recreation area
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INTRODUCTION

In 1971, R. Sage Murphy, then director of the Institute of Water Resources, prepared a proposal entitled "Environmental Planning for an Alaskan Water-Oriented Recreational Area," which was submitted to the then Office of Water Resources Research (OWRR) and the Alaska Division of Parks under the matching grant program of OWRR. Funding was denied in 1972. Robert F. Carlson, the new IWR director, urged D. W. Smith to rewrite the proposal. Subsequently, OWRR provided funding for one-half of the project in 1973. In a letter dated May 18, 1973, the director of the Alaska Division of Parks stated he had set aside the necessary funds for the project. On July 1, 1973, the project officially commenced.

OBJECTIVES

The principal objective of this study was to detail the procedures, methods, alternatives, and considerations necessary for the development of environmental management programs for Alaskan water-oriented recreational areas. Major emphasis was to be placed on the Nancy Lake area. As procedures for evaluation were to be used at the Nancy Lake State Recreation Area as they were developed, it was hoped that a valuable data base could be established for the area. Such information could be extremely valuable in making management decision, in monitoring changes that may occur, and in modifying plans for the area.

In order to better handle project objectives, three specific document types were planned:

1. a report on the basic evaluation of the environmental conditions of the Nancy Lake Recreation Area
2. a field operational guide for data acquisition with several alternate methods proposed when possible
3. a manager's guide for planning and developing water-oriented recreational areas in cold climates.

Although all parts of the project were started conceptually, only the limnological studies of Part 1 of the project received significant effort. In late summer of 1974, the project objectives were reevaluated. After considerable discussion between the Institute of Water Resources and Division of Parks personnel, it became apparent that agreement could not be reached concerning the objectives and the form of report to be submitted; therefore, it was agreed that the Nancy Lake phase of the project should be terminated.

This report is a compilation of the data collected by IWR staff up to September 1, 1974.

ATTACHMENTS

ATTACHMENT A

OUTLINE OF PROPOSED PROJECT REPORTS

OUTLINE OF PROPOSED PROJECT DOCUMENTS

Although portions of the outline of the proposed project documents had been expanded into draft text form at the time of the project termination, they were not suitable for printing and distribution. Therefore, only the outline is included with the report.

Environmental Planning for an Alaskan
Water-Oriented Recreational Area

Specific Document Objectives

I. Manager's guide for planning and developing water-oriented recreational areas in cold climates
   A. Essential planning considerations
      1. Demand
         a) Population estimates
         b) Use projections
      2. Site alternatives
      3. Site evaluations
      4. Scheduling program as a critical path approach to site evaluations
   B. Economic considerations
      1. Demand as indicated by public support of bonding
      2. Cost of alternative site development
      3. Cost of site evaluations
      4. Economic decisions in relation to total project costs
   C. Purposes of guide
      1. To allow manager to base each development decision on costs determined by each additional item of information pertaining to site suitability
      2. To allow manager to base each development decision on data acquired in field evaluation

II. Field operations guide for data acquisition
   A. Major subdivisions
      1. Hydrologic evaluations
      2. Limnologic evaluations
      3. Land use evaluations
      4. Aesthetic considerations
      5. Facilities planning
      6. Economic considerations
   B. Hydrological evaluations
      1. Precipitation

a) Amount and time of year
b) Form: rain, snow, etc.
c) Micrometerology
   (1) Evaporation
   (2) Transpiration
   (3) Solar Radiation
d) Measurement techniques
e) Sparse data interpretation

2. Temperature, humidity, evaporation patterns
   a) Macro and micro considerations
   b) Dense air movements
   c) Areal variations
   d) Annual-daily variations
   e) Measurement techniques
3. Winds
   a) Ice pile-ups may be caused by wind-fetching
   b) Docks and other facilities may be damaged
4. Icing
   a) Potential facility locations
   b) Possible road locations
5. Surface water
   a) Lentic - standing
   b) Lotic - moving
   c) Locations, number, size
   d) Movement
      (1) Morpharatary
      (2) Flushing time
      (3) Inlet-outlet information
   e) Tie-together general hydrologic cycle
   f) Drainage patterns
   g) Examination techniques

6. Ground water
    a) Soil conditions
        (1) Types
        (2) Permafrost
        (3) Bedrock
    b) USGS - State Geol.
    c) Potential location for wells
    d) Estimates of movement
        (1) Quantity
        (2) Rate
    e) Methods of determination
7. Topography effect on runoff
8. Snow melt patterns

C. Limnological evaluations
1. Lentic systems (lakes and ponds)
    a) Number
    b) Size
    c) Morphology
    d) Physical
        (1) Temperature
        (2) Color
        (3) Turbidity
    e) Chemical
        (1) Alkalinity
        (2) Dissolved Oxygen
        (3) Nitrogen
        (4) Phosphorus
        (5) pH
        (6) Total dissolved solids
    f) Microbial
        (1) Coliform
        (2) Other indicators

(3) Pathogens
(4) Vectors

2. Lotic systems (rivers and streams)
   a) Number
   b) Flow
   c) Slope
   d) Physical
      (1) Bottom characteristics
      (2) Temperature
      (3) Turbidity
      (4) Color
      (5) Bank characteristics
   e) Chemical
      (1) pH
      (2) Dissolved Oxygen
   f) Microbial
      (1) Coliform
      (2) Other indicators
      (3) Pathogens
      (4) Vectors

D. Land use evaluations
   1. Topography
   2. Forestation
   3. Other Vegetation
   4. Soil Types
      a) Characteristics
      b) Structural capacities
      c) Determinations
   5. Greenbelt planning
   6. Lake front planning and zoning

E. Aesthetic considerations
   1. Factors of importance

a) Amount of land
b) Amount of water surface
c) Micrometeorology
d) Vegetation

2. Techniques of evaluation
   a) Surveys
   b) Picture comparisons
   c) Others

3. Types of recreational potential
   a) Camping
      (1) Camper
      (2) Tent
   b) Hiking
      (1) Backpacking
      (2) Climbing
      (3) Nature trails
   c) Fishing
      (1) Stream/lake potential
      (2) Types of fish
      (3) Production rates
      (4) Rehabilitation potential
      (5) Regulations
   d) Hunting
      (1) Regulations
      (2) Wildlife available
      (3) Conflicting uses
   e) Boating
      (1) Pleasure boating
      (2) Sailing
      (3) Motorboating
      (4) Waterskiing
      (5) Canoeing

f) Skiing
(1) Downhill
(2) Cross country
g) Snowshoeing
h) Dogsledding
i) Organized activities
(1) Shuffle board
(2) Volleyball
(3) Tennis
(4) Baseball
(5) Basketball

4. Special considerations
a) Safety hazards
b) Vectors
(1) Types
(2) Population
(3) Habitats

F. Facilities planning
1. Access schemes
a) No access
b) Trails
(1) Hiking
(2) Nature trails
c) Roads
(1) Number
(2) Type
(3) Location
d) Aircraft
(1) Float planes
(2) Wheeled craft
(3) Helicopters
(4) Balloons

e) Exploration
   (1) Minerals
   (2) Soils
   (3) Water
   (4) Oil/Gas

2. Structures
   a) Types
   b) Design
   c) Space requirements

3. Sanitary considerations
   a) Population - estimating techniques
   b) Water supply
      (1) Criteria
         (a) State
         (b) Federal
      (2) Supply alternatives
         (a) Surface
         (b) Groundwater
         (c) Cisterns
         (d) Hauling
      (3) Considerations
         (a) Intake devices
         (b) Pumps
         (c) Piping
         (d) Heating
         (e) Storage
         (f) Treatment
   c) Wastewater control
      (1) Requirements
         (a) State
         (b) Federal
      (2) Limnological requirements

(3) Types of wastewater
    (a) Gray waters
    (b) Domestic sewage
    (c) Chemical contamination
(4) Collection systems
    (a) Buried pipe depth
    (b) Type of pipe
(5) Treatment systems
    (a) holding
        i) Vaults
        ii) Pits
    (b) Leaching
        i) Tank sizing
        ii) Absorption field sizing
        iii) Soil type
        iv) Piping
    (c) Lagoons
        i) Aerobic
        ii) Facilitative
        iii) Aerated
        iv) Upgrading
    (d) Controlled biological
        i) Activated sludge
        ii) Biological filters
        iii) Rotating disc
    (e) Physical-Chemical treatment
    (f) Sludge handling
        i) Amounts of sludge
        ii) Disposal techniques

d) Solid waste management
(1) Alternatives

(a) Cans
(b) Green boxes
(c) Others

(2) Collection techniques
(a) One man trucks
(b) Pick up trucks
(c) Routing plans
(d) Contracting

(3) Disposal
(a) On site land fill
(b) Local disposal area
(c) Sanitary land fill
(d) Land fill

G. Health and Safety Considerations

1. Physical

a) Vehicular

(1) Land vehicles

(a) Types
i) All-terrain vehicles (ATV's)
ii) Trail bikes
iii) Snow machines

b) Attendant hazards
i) Bluffs and cliffs
ii) Thin or cracked ice
iii) Other

(2) Aircraft

(a) Potential requirements
i) Open water suitable for float planes
ii) Open areas adequate for wheels/skiis
iii) Air traffic control facilities
iv) Adequate available service

(b) Potential hazardous conditions

i) Dangerous terrain

ii) inclement weather

b) Body contact

(1) Accident statistics (per 100,000 population, non-native rates, Boyd, *et al.*, 1968)

(a) Falls - U.S.: 10.6; Ak.: 3.1

(b) Aircraft - U.S.: 0.8; Ak.: 17.8

(c) Firearms - U.S.: 1.3; Ak.: 4.6

(d) Drowning - U.S.: 3.6; Ak.: 14.7

(2) Water sports

(a) Water temperature

i) Cramping

ii) Exposure

(b) Currents in flowing waters

(c) Bottom profile

i) Slope

ii) Irregularities

(d) Bottom materials

i) Rocks

ii) Muck

(e) Boating facilities

i) Ramps

ii) Docks

(f) Multiple-use controls

i) Sailing

ii) Motorboats

iii) Canoes and rowboats

iv) Fishing

(g) Swimming supervision

(3) Hiking

(a) Air temperature

i) Exposure

ii) Frostbite

iii) Adverse reactions to solar radiation

(b) Terrain

i) Ledges

ii) Sand bluffs

(c) Proper bridges over water

2. Chemical irritations resulting from body contact with water sport activities

a) pH: mucous membrane irritation

b) Pesticides

(1) Ingestion of water containing the contaminant

(2) Consumption of fish at below morbidity levels

c) Oil: irritation and/or discomfort

3. Biological

a) Possible extent of hazards or nuisances

(1) Widespread

(2) Serious

(3) Unrecognized by public

b) Types of hazards

(1) Nuisance organisms

(2) Those producing morbidity or mortality

(3) Large mammals

(a) Bears

i) Proper control of wastes, especially solid

ii) Avoidance of bear/human contact

a. Export and control population

b. Visitor education and controls

(b) Wolves and Foxes

i) Population control

ii) Visitor education

a. High incidence of rabies in foxes

b. Relative tameness when diseased

(4) Other mammals

(a) Population control

(b) Visitor education

(5) Other zoonotic diseases

(a) Cystic and gloeolar hydatid disease

i) Arctic form (*E. granulosus*) common to arctic Alaska

ii) Wolf-moose-wolf life cycle though it may sometimes include dogs and deer

iii) Relatively benigh in man

(b) Alveolar hydated disease (*E. multilocularis*)

i) High mortality rate in humans

ii) Generally isolated on St. Lawrence Island

(c) *E. echinoccocus*, pathogen

i) Sometimes water borne

ii) May necessitate filtration of surface water supplies

(d) Brucellosis

i) Endemic in reindeer

ii) Mainly of concern to hunters

iii) Controlled by education and personal hygeine

iv) Not significant for recreation

(e) Trichinosis

i) Endemic in bear and marine mammals

ii) Not significant for recreation

(f) Tapeworm

i) Endemic in certain fish

ii) Not significant for recreation

(g) Tularemia

i) Endemic in Arctic hare

ii) Contracted through fur and flesh

iii) Controlled by education and personal hygeine

c) Water-borne pathogens

(1) *Entamoeba histolytica*

(a) Cause of amoebic dysentery

(b) Filtration necessary for surface water supplies

(2) Other water-borne pathogens (Fournelle, *et al.*, 1959)

(a) *Entamoeba coli*

(b) *Diphyllobothrium* sp.

(c) *Enterobius vermicularis*

(d) Others

4. Groundwater contamination

a) Chemical

b) Biological

H. Economic Considerations

1. Methods for project priorities

2. Funding mechanisms

a) Bonds

b) Force account

c) Fees

3. Other assistance

a) Government programs

(1) N.Y.C.

(2) Y.C.C.

III. Basic Evaluation of the Environmental Condition of the Nancy Lake Recreation Area

A. Baseline information on the Nancy Lake Recreation Area

B. Included will be hydrologic and limnologic information on the lakes in the area.

C. Types of information

1. Precipitation

2. Runoff

3. General chemical characteristics
4. Temperature profiles
5. Dissolved oxygen profiles
6. Estimates of trophic state.

D. Recommended changes in development of plan based on condition of lakes.

ATTACHMENT B

SUMMARY OF LIMNOLOGICAL DATA COLLECTED

SUMMARY OF LIMNOLOGICAL DATA COLLECTED

INTRODUCTION

A preliminary site visit was made by the limnological subproject team in August of 1973. Based upon this reconnaissance, it was decided that the most useful and easily obtained limnological data for this area could be taken in the summer by means of a float plane. On July 25, 1974, a float plane was chartered by the team and flown to the Nancy Lakes area where twelve lakes were sampled and certain limnological parameters measured. A graduate student, Roger Nash, spent two months living at the area in the summer of 1974 and, during August, collected additional limnological data on many of the lakes.

METHODS

Morphometric maps of surveyed lakes were provided this task team by the Alaska Department of Fish and Game. Alkalinities and total dissolved solids were run according to the methods presented in *Standard Methods of Water and Wastewater Analysis (1971)*. Oxygen profiles for August 1973 and July 1974 were taken with a Martek Mark II multimeter which simultaneously measures depth, temperature, conductivity, pH, and dissolved oxygen. The oxygen probe was calibrated to a saturated bucket of water in which it was immersed. August 1974 oxygen values were taken with a YSI Oxygen Meter and the data corrected for temperature, using the temperatures that were measured simultaneously.

DISCUSSION OF RESULT

Attachment D of this report consists of a folder containing all the data collected on each of the lakes of this lake area. Fish capture information was provided by the Alaska Department of Fish and Game. Temperatures are represented by small triangles and oxygen values represented by small circles on the graphed vertical profiles.

The first lakes to be considered are the four large lakes within the lakes area: Nancy Lake, Lynx Lake, Red Shirt Lake, and Butterfly Lake. Unfortunately, morphometric information is not available for these lakes and thus detailed limnological measurements were not justified.

LARGER LAKES

Nancy Lake

The lake appears to be in good condition. The fish population consists of rainbow trout, Dolly Varden, whitefishes, burbot, Coho (silver) salmon, sockeye (red) salmon, and chinook (king) salmon, which would indicate good water conditions, oxygen-wise and temperature-wise, for cold stenothermic fish. The lake also contains the longnose sucker and several kinds of sticklebacks. This lake is heavily developed with cottages and is being developed for a state recreation area with a wayside. There is also one private recreation area on the lake. The fishing is reported to be fairly good. The only morphometric map for this lake is a rough one prepared by State Department of Parks personnel. From the oxygen profiles that we have, it seems apparent that the lake suffers some summer oxygen problems, at least near the major inlets, Nancy Creek and Lily Creek. It is hard to pinpoint exactly the problems causing these low oxygens but it is speculated that there are nutrient and organic inputs from these inlets that are being deposited in the sediments in these areas and biological oxidation of these inputs is causing the oxygen problem. Obviously, the problem is not so serious as to cause fish kills, but the fish may be avoiding these areas and, thus, the lake may not be providing its entire potential fish habitat. Supersaturation of the oxygen is seen on many of these profiles and it is undoubtedly due to algal photosynthesis. The alkalinity of Nancy Lake is in the moderate range for lakes. The total dissolved solids are fairly high and the color, for a lake of that area, is moderate (Table 1).

Table 1 Miscellaneous Data on Selected Lakes of the Nancy Lakes Area

Lake	Color	Total Dissolved Solids (mg/l)	Alkalinity (mg/l $CaCO_3$)	Morphoedaphic Index (MEI)*	MEI**
Nancy	20	81	45.0	--	--
Red Shirt	15	65	42.0	--	--
Butterfly	15	44	17.5	--	--
Lynx	15	95	38.5	--	--
Sheetna	20	48	18.5	9.6	3.7
Heart	35	30	9.0	6.2	1.9
Chicken	5	18	9.0	2.2	1.1
James	20	18	9.0	6.2	2.4
Owl	25	24	5.0	8.9	1.9
Big Noluck	30	18	9.0	3.9	2.0
Milo #1	15	13	5.5	1.4	0.6

* Total Dissolved Solids (mg/l)/mean depth (m)

** Alkalinity (mg/l $CaCO_3$)/mean depth (m)

Red Shirt Lake

Red Shirt Lake is larger than Nancy Lake, but is the farthest lake from any road and so is not well developed nor well used and remains relatively unstudied. We have very limited information of our own on this lake. We have one oxygen profile from July 1974, and since it only reached 8 meters before encountering bottom, we don't know very much about the hypolimnetic condition as far as oxygen or temperature, but we would assume that it is well oxygenated and cold in the deep spots. We have one rough morphometric map available to us from Fish and Game which shows two holes around 40 feet deep and one around 34 feet. This probably means that the lake has very little hypolimnetic volume and since it is in an extremely open area, it is probably well oxygenated during the summer due to winds alone. Winter conditions are unknown. Alaska Department of Fish and Game has reported fairly good fishing from the area with salmon, whitefishes, and trout, and also, of course, stickleback and suckers. The native fish species are rainbow trout, Dolly Varden, whitefishes (not divided into the different types) and Coho (silver) salmon. Fishing is reported fair to fairly good by Alaska Department of Fish and Game.

Butterfly Lake

Butterfly Lake is a fairly large lake, probably the fourth largest in the proposed recreation area. It is also a fairly remote lake with regard to access by road. We have very little data on this lake as does Alaska Department of Fish and Game. We have three profiles, one from July 1974 and two from August 1974. Again, it is in a fairly open and unforested area and winds are probably fairly important with regard to oxgenation in the summer. The water seems fairly well oxygenated with hypolimnetic oxygen in July appearing to be at least 6 parts per million dissolved oxygen. In August, the exact sampling locations are not well known but a shallow location is well oxygenated until the bottom sediments are reached. At the deeper spot that was profiled, some oxygen depletion was found past 5 or 6 meters where the thermocline was encountered. The deepest this oxygen profile for

August reached was about 12 meters and this profile appears to show, as previously mentioned some depletion of oxygen to as low as 2 parts per million as sediments are reached. This may indicate present or potential summer oxygen problems in Butterfly Lake, or it just may be an artifact caused by the low amount of sampling done at that lake. Alaska Department of Fish and Game does not have much to report on that particular lake as far as fish collection. They have captured rainbow trout, whitefishes, and suckers from that lake and don't report anything concerning fishing success.

Lynx Lake

The last large lake within Nancy Lakes recreation area is Lynx Lake. We do not have a morphometric map of the lake but we have an indication from Fish and Game that the maximum depth is 50 feet. Fish known to be in the lake in this case are rainbow trout, longnose sucker, whitefishes, and sticklebacks. It has good numbers of whitefishes which are reported to be small. Our oxygen profiles both of July 25, 1974, and August 25, 1974, show oxygen problems in the hypolimnion of this lake. At 10 meters, the oxygen was as low as 3 parts per million in July and one month later was below 2 parts per million. In fact, at 12 meters there is less than 1 part per million oxygen and at 13, 14, and 15 meters, zero parts per million oxygen was measured. It can be speculated that extra organic input to this lake could cause severe oxygen problems and perhaps even cause fish kills in the future. This lake has an alkalinity of 38.5 mg/l as measured on July of 1974; this is the third highest alkalinity of the lakes studied, with only Nancy and Red Shirt Lakes having higher alkalinity. The total dissolved solids of Lynx Lake were the highest of all of these lakes sampled on July 25, 1974, at 95 mg/l. The color was moderate for the lake region.

THE SMALLER LAKES

Because of the availability of morphometric data for many of the smaller lakes within the Nancy Lakes area, the smaller lakes can be evaluated as to fisheries potential using the morphoedaphic index. A recent review of the

morphoedaphic index is presented in *Journal of Fisheries Research Board of Canada, 31,* 5 (Ryder, *et al.,* 1974). Table 1 of this attachment of this report, contains the morphoedaphic indices for selected lakes of the Nancy Lakes area calculated in two different ways. It is interesting to note that nearly the same ranking is given to each lake, whether the morphoedaphic index numerator consists of total dissolved solids measurements or alkalinity measurements. Had morphometric data been available for the larger lakes of the lake area, fisheries potential, as indicated by the morphoedaphic index, could have been calculated for these important lakes. A measure of the morphoedaphic index for each lake within the lake area would have been very useful information to the consultant who prepared *The Nancy Lake Plan, Program, and Budget* for the Department of Natural Resources. This kind of information could also have been vital to the fisheries potential study conducted by the Alaska Department of Fish and Game.

ATTACHMENT C
DATA FOLDER OF LAKES IN THE STUDY REGION