

MONITORING PLAN

LAKES SALLIE AND DETROIT
PELICAN RIVER WATERSHED

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MONITORING PLAN

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PELICAN RIVER WATERSHED

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LAKE SALLIE AND DETROIT PELICAN RIVER WATERSHED

INTRODUCTION

Federal regulations require that Phase I of the Clean Lakes Assistance Program include a diagnostic evaluation of characteristics for Lake Sallie and Detroit through a monitoring plan. The proposed plan will initiate in the spring of 1988 and continue until the spring of 1989 for the purpose of collecting hydrologic, nutrient and sediment loading characteristics influencing the study lakes. Work activities shall include stream gauging and rating of inlet and outlet points, monitoring lake elevations, stream and in-lake sampling of water characteristics.

The purpose of this monitoring plan is to accumulate the field data. The interpretation and analysis of this data shall be in the feasibility portion of the study to define methods and procedures for controlling the sources of pollution.

DEVELOPMENT OF A MONITORING PLAN:

The goals of this monitoring plan shall be:

- A. Nutrient-water budget to determine the sources and rates of nutrient silt loading.
- B. In-lake investigation to determine the state or condition of the study lakes.

To achieve these objectives, a systematic and comprehensive measurement of variables that impact the lakes will be documented.

HYDROLOGIC BUDGET

The hydrologic budget is a summary of the changes in the water volume of a lake as a result of precipitation, streamflow, changes in surface storage, groundwater flow and evaporation. The change in lake storage can be written as follows:

$$LV_f - LV_i = P_T + (I_T - O_T) + GW - E$$

where,

LV_i = initial lake volume
LV_f = final lake volume
P_T = total precipitation
I_T = surface inflow total
O_T = surface outflow total
GW = groundwater input
E = evaporation

The change in lake storage volume can be determined by measurement of lake elevations. Lake elevations will be monitored weekly, in addition to periodic monitoring as a result of major rainfall events.

Precipitation will be measured by an observer using a standard non-recording gauge. Records will be kept of storm events and total precipitation.

The hydrologic budget shall include monitoring of major inflow and outflow points to quantify sources of surface water. A field survey of Lakes Sallie and Detroit resulted in identification of major hydrologic sources to each lake and includes the Pelican River and several intermittent streams. Monthly measurements during winter and biweekly measurements during open water periods will be used to estimate mean discharges to the lakes. Direct runoff cannot be measured, but will be considered small in comparison to the total watershed area.

Groundwater input to a lake is difficult to determine. Calculation of groundwater as the residual in the hydrologic equation will be the primary method of groundwater input.

Evaporation will be considered from available data on annual rates of evaporation.

IN-LAKE MONITORING

A schedule for in-lake monitoring of Lake Sallie and Detroit will require physical, chemical and biological observations.

The physical requirements include water temperature, clarity and depth. The temperature and clarity will be documented twice monthly with temperature and secchi dish reading. Water depth mapping will be obtained from current lake contour mapping.

Chemical characteristics will be recorded by in-lake testing of a sample station in each lake for which several parameters will be tested at different depths. As a minimum, the tests shall consist of dissolved oxygen; phosphorus, nitrogen and pH. The tests will be taken from the deepest portion of the lake.

Biological observations will include documentation of algae blooms, chlorophyll a testing and fish species information from the Department of Natural Resources records.

Further information on testing is included in the Testing Requirements Section.

LOCATION OF DATA STATIONS

The location of data stations for sampling and stream flow are illustrated in the attached map of monitoring locations.

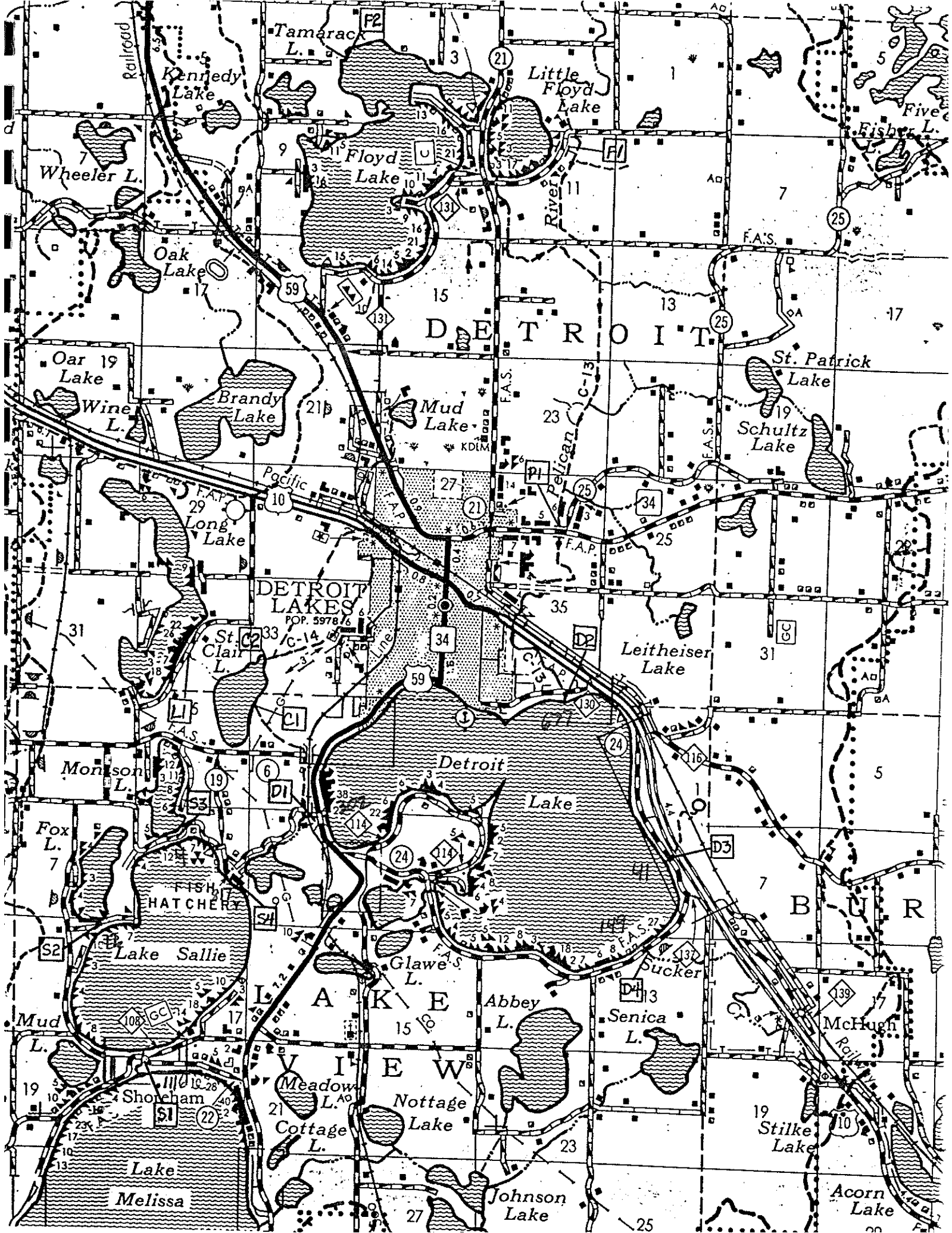
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LAKES SALLIE AND DETROIT - FLOW MONITORING POINTS

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No.	Location	Description
<u>Primary</u>		
S1	Sallie Outlet	Structure
S2	Fox Lake Outlet	Culvert
S3	Monson Lake Outlet	Culvert
S4	Dam at Fish Hatchery	Structure
D1	Detroit Lake Outlet	Stream Cross-Section
D2	Pelican River Inlet	Stream Cross-Section
D3	East Shore Drive Inlet	Culvert
D4	Sucker Creek	Culvert
<u>Secondary</u>		
C1	St. Clair Outlet	Culvert
C2	St. Clair Inlet: Ditch	Stream
L1	Long Lake Outlet	Culvert
P1	Pelican River @ #34	Culvert
F1	Floyd Lake Outlet	Structure
F2	Floyd Lake Inlet Campbell Creek	Culvert

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FLOW MONITORING

The frequency of flow monitoring will depend upon the type of station and the precipitation events that occur. The monitoring points are classified as primary and secondary. Primary locations are those directly adjacent to the lake, such as the Pelican River inlet to Detroit Lake. These points will be utilized in the lake water budget. Secondary points are those locations removed from the lake which will assist in determining quantitative sources of flow to the lakes. Primary points will be measured biweekly, whereas secondary locations will be measured weekly. Summary sheets for each sample point are attached to the Monitoring Plan.

TESTING REQUIREMENTS

Sampling will be conducted at the primary and secondary flow monitoring points and in-lake. The following are schedules for which monitoring will be done:

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SAMPLING AT FLOW MONITORING STATIONS

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Location	Parameter	Frequency	Total Tests
Primary Stations (8)			
	Phosphorus	Monthly (9)	72
	TSS	Monthly (9)	72
Secondary (6)			
	Phosphorus	3	18
	TSS	3	18
Total			180

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A sampling station will be established at one location in each lake to document parameters at various depths. Field testing will be done for pH, temperature and dissolved oxygen during each sampling at intervals not exceeding five meters in depth. Four conductivity tests will be taken during the year.

Samples will also be taken for lab analysis on the following basis:

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LAKE SAMPLING (Each Lake)

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Parameter	Frequency		Number Per Sampling	Total
	May - August	September - April		
✓ Total Phosphorus	Semi Bimonthly (twice)	Monthly	5	80
✓ Ortho Phosphorus	Semi Bimonthly	Monthly	5	80
Organic Nitrogen	Semi Bimonthly	Monthly	5	80
Nitrate, Nitrite	Monthly	Four	5	40
✓ Total Suspended Solids	Monthly	Four	5	40
Coliform	Monthly	Monthly	1	12
Chlorophyll a	Monthly	Four	1	8

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Depth sample frequencies shall not exceed five meter intervals. Therefore, depending upon the actual depth of the sampling station, the number of tests may vary. The sampling schedule is based upon a 20 meter sample depth.

Analysis will be made by a laboratory approved by EPA for testing the parameters presented above.

FLOW MONITORING AND SAMPLING EQUIPMENT

Supplies and equipment necessary to complete the flow monitoring and sampling shall include the following:

- Staff gauges (14)
- Pygmy meter
- Van Doren water sampling bottle
- Sample bottles (to be supplied by lab)
- 100' Cable DO, pH and temperature meter
- Conductivity meter
- Secchi disc

LABOR REQUIREMENTS

The manpower for the monitoring program will include three or four individuals to be responsible to read the staff gauges and take periodic water samples. One individual will be responsible to take the in-lake samples and perform the required field tests.

PELICAN RIVER WATERSHED

STREAM FLOW MONITORING

GAUGING STATION

IDENTIFICATION NO.:

S1

LOCATION:

Pelican River at Lake Sallie Outlet.

DESCRIPTION:

Bridge on Becker County Road No. 22 approximately 250 feet south of Lake Sallie outlet.

GAUGE:

Staff gauge at downstream from bridge wing wall.

CHANNEL AND CONTROL:

Dam at inlet to Lake Melissa. Stop-log changes must be noted.

METHOD OF FLOW DETERMINATION:

Rating curve based upon channel. Cross-section and velocity measurements with a pygmy meter. Staff gauge measurements recorded twice a week.

VERTICAL CONTROL:

OBSERVER:

PELICAN RIVER WATERSHED

STREAM FLOW MONITORING

GAUGING STATION

IDENTIFICATION NO.: S3

LOCATION: Monson Lake outlet to Lake Sallie.

DESCRIPTION: Fifty feet upstream from culvert or 100 feet downstream from Monson Lake.

GAUGE: Staff gauge located near pumphouse.

CHANNEL AND CONTROL: Culvert is highwater level control and channel may be low level control if weed growth is significant in the channel.

METHOD OF FLOW DETERMINATION: Rating curve by discharge measurements of the channel and culvert. Rating curve may need adjustment for low level flows. Staff gauge read at least weekly.

VERTICAL CONTROL:

OBSERVER:

PELICAN RIVER WATERSHED

STREAM FLOW MONITORING

GAUGING STATION

IDENTIFICATION NO.:

S4

LOCATION:

Pelican River at Muskrat Lake outlet to Lake Sallie (Fish Hatchery).

DESCRIPTION:

Boat lock channel between Muskrat Lake and Lake Sallie.

GAUGE:

Staff gauge on boat lock channel.

CHANNEL AND CONTROL:

Lake Sallie.

METHOD OF FLOW DETERMINATION:

Rating curve has been developed by the U.S. Geological Survey office. A record of stop-log changes must be recorded.

VERTICAL CONTROL:

OBSERVER:

Department of Natural Resources

PELICAN RIVER WATERSHED

STREAM FLOW MONITORING

GAUGING STATION

IDENTIFICATION NO.:

D1

LOCATION:

Pelican River at Detroit Lake outlet.

DESCRIPTION:

Bridge on County Road No. 22 crossing the Pelican River at the outlet of Detroit Lake.

GAUGE:

Staff gauge on wing wall of bridge structure.

CHANNEL AND CONTROL:

The channel of the Pelican River or the dam at Muskrat Lake.

METHOD OF FLOW DETERMINATION:

Flow rating curve from channel measurements downstream from the bridge. Twice weekly staff gauge readings.

VERTICAL CONTROL:

OBSERVER:

PELICAN RIVER WATERSHED

STREAM FLOW MONITORING

GAUGING STATION

IDENTIFICATION NO.: D2

LOCATION: Pelican River inlet to Detroit Lakes.

DESCRIPTION: Bridge across Pelican River on North Shore Drive.

GAUGE: Staff gauge upstream from bridge.

CHANNEL AND CONTROL: Bridge at North Shore Drive during high flow conditions and Detroit Lake during normal flows.

METHOD OF FLOW DETERMINATION: Rating curve from channel measurements. Twice weekly staff gauge readings.

VERTICAL CONTROL: _____

OBSERVER: _____

PELICAN RIVER WATERSHED

STREAM FLOW MONITORING

GAUGING STATION

IDENTIFICATION NO.:

D3

LOCATION:

Culvert across East Shore Drive in Section 12 Township 138N Range 41W, 2½ miles southeast of Detroit Lakes.

DESCRIPTION:

Channel from culvert on East Shore Drive to Detroit Lake.

GAUGE:

Staff gauge downstream from the culvert.

CHANNEL AND CONTROL:

Detroit Lake during normal flows. Possible weed obstruction during low flows.

METHOD OF FLOW DETERMINATION:

Stream measurements for a rating curve near inlet to lake. Weekly staff gauge readings.

VERTICAL CONTROL:

OBSERVER:

PELICAN RIVER WATERSHED

STREAM FLOW MONITORING

GAUGING STATION

IDENTIFICATION NO.:

D4

LOCATION:

Sucker Creek near Detroit Lakes.

DESCRIPTION:

Culvert located on Becker County No. 24 with channel to Detroit Lakes.

GAUGE:

Staff gauge downstream from culvert near bank of the stream.

CHANNEL AND CONTROL:

Detroit Lake and possible sand bar deposition at the inlet to the lake.

METHOD OF FLOW DETERMINATION:

Rating curve for channel prior to entering Detroit Lake. Weekly staff gauge readings.

VERTICAL CONTROL:

OBSERVER:

PELICAN RIVER WATERSHED

STREAM FLOW MONITORING

GAUGING STATION

IDENTIFICATION NO.:

C1

LOCATION:

St. Clair Lake outlet.

DESCRIPTION:

Upstream of culvert on Highway No. 59 in channel outlet from St. Clair Lake.

GAUGE:

Staff gauge in channel bed upstream of the culvert.

CHANNEL AND CONTROL:

Culvert during high flow. Channel during low flows.

METHOD OF FLOW DETERMINATION:

Rating curve in channel compared to U.S. Geological Survey rating curves previously done. Weekly staff gauge readings as a minimum.

VERTICAL CONTROL:

OBSERVER:

PELICAN RIVER WATERSHED

STREAM FLOW MONITORING

GAUGING STATION

IDENTIFICATION NO.: L1

LOCATION: Long Lake outlet.

DESCRIPTION: Culvert crossing blacktop road at Joy Creek (Long Lake outlet).

GAUGE: Staff gauge on downstream of culvert.

CHANNEL AND CONTROL: Channel form the control.

METHOD OF FLOW DETERMINATION: Channel rating curve. Staff gauge readings periodically.

VERTICAL CONTROL:

OBSERVER:

PELICAN RIVER WATERSHED

STREAM FLOW MONITORING

GAUGING STATION

IDENTIFICATION NO.: P1

LOCATION: Pelican River crossing at Highway No. 34.

DESCRIPTION: Large culvert crossing of Highway with well defined channel.

GAUGE: Staff gauge on downstream side of culvert in channel.

CHANNEL AND CONTROL: Channel will be the level control.

METHOD OF FLOW DETERMINATION: Rating curve of channel. Staff gauge readings will be taken periodically.

VERTICAL CONTROL:

OBSERVER:

PELICAN RIVER WATERSHED

STREAM FLOW MONITORING

GAUGING STATION

IDENTIFICATION NO.:

F1

LOCATION:

Floyd Lake outlet.

DESCRIPTION:

Dam structure at the outlet of Little Floyd Lake.

GAUGE:

Staff gauge located on the headwall of the dam.

CHANNEL AND CONTROL:

Channel downstream from the dam.

METHOD OF FLOW DETERMINATION:

Rating curve from channel measurements. Staff gauge readings taken periodically.

VERTICAL CONTROL:

OBSERVER:

PELICAN RIVER WATERSHED

STREAM FLOW MONITORING

GAUGING STATION

IDENTIFICATION NO.: F2

LOCATION: Campbell Creek north of Floyd Lake.

DESCRIPTION: Metal culvert at road crossing of gravel road north of Floyd Lake.

GAUGE: Staff gauge downstream from the culvert.

CHANNEL AND CONTROL: Channel.

METHOD OF FLOW DETERMINATION: Rating curve of the channel. Flow measurements taken periodically.

VERTICAL CONTROL:

OBSERVER:
