

APPLICATION OF SIMPAK PROGRAM TO THE
COLUMBIA RIVER BASIN

by

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Before reproducing
revision file # CI-H.06
to read CI-H.04

is SIMPAK output filed
in same file as SSARR
output

- (- SSARR 1967 to 1974-5)
- (- SIMPAK 1975-76 to date)

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PREFACE

The SIMPAK computer program described herein performs the functions which have been served by both the SSARR program (5.24-6) and DUNDAM program (5.24-4) in annual Columbia River pre-project computations carried out for the Columbia River Treaty Permanent Engineering Board. As the Columbia SIMPAK Model has been fully tested under the SIMPAK program, the two programs have become obsolete for application to the Columbia River computations.

Commencing 1975-76 reporting year, the computer printout from the Columbia SIMPAK Model will be filed under C1-H.W~~6~~⁸ which will supersede the following computer output files: ←

- (1) DUNDAM computation by the DUNDAM program (C3-H.W8)
- (2) Arrow Inflow computation by the SSARR program (C4-H.W9)
- (3) Columbia pre-project computation by the SSARR program (C1-H.W4) ✓

The computer output from Kootenay Lake post Corra Linn computation will be filed in CK1-H.W2 which contains the previous Kootenay Lake hand routing computation.

The version of the SIMPAK program used for the Columbia computations described in this report is stored in a file named PO.CL.SIMPAK. However, it is expected that there will be revisions and additions to the SIMPAK program in the future and therefore the Columbia SIMPAK Model must be revised accordingly.

** Subsequent to the completion of this report, the implementation of the metric conversion program made it necessary to build in additional capability to handle metric units in the SIMPAK program and the Columbia SIMPAK Model. Therefore, revisions were made during early 1980 to both the program and the model. Instructions for using the revised model are given in Appendix attached to this report. The original version, although now superseded, is still available.

** Paragraph added April 1980.

APPLICATION OF SIMPAK PROGRAM TO THE

COLUMBIA RIVER BASIN

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APPLICATION OF SIMPAK PROGRAM TO
THE COLUMBIA RIVER BASIN

Pre-Project Flow Computation

(1) General Description

The SIMPAK computer program has been adapted to the Columbia River Basin in Canada to calculate pre-project flows for the Columbia River Treaty Permanent Engineering Board's annual report. This change from using the SSARR model and some other procedures consolidates and streamlines the work to save time and money. The adaptation was made in the period November 1975 through February 1976. The Columbia Basin configuration for SIMPAK includes all required computations and is hereafter referred to as the Columbia SIMPAK Model to distinguish it from the SSARR model for the Columbia River Basin. A separate smaller model was also set up to compute the effects of the Treaty projects only on peak stages of Kootenay Lake and of the Columbia River at Trail. This model is described separately under the heading "Kootenay Lake Post Corra Linn Computation". The SIMPAK model was set up at the University of British Columbia computing centre and the instructions in this report are in terms of present procedures at that centre.

(2) Model Configuration

The Columbia SIMPAK Model carries out a sequence of computations to reconstitute pre-project flows throughout the basin in Canada. The flow chart in Figure 1 describes this sequence. The model is defined by a card deck as listed in Exhibit 1 which consists of title card, station cards, control card and operation cards and includes all necessary information about stations, characteristics and sequence. For details of card format and information, one should refer to the SIMPAK User's Manual. The model is available both as cards and in a file stored on SAVE-DATA tape under the name of COL.MOD.

(3) Input Data

- (a) 6D data - A list of stations requiring daily data in 6D card format and its associated data type is given in Table 1; this card format is the same as that used by the SSARR model. The elevations or discharges are read from 6D cards as daily average values. However, there is an option available to convert elevations into midnight values for any station by setting a non-zero switch on column 26 of station card.
- (b) Initial conditions - These must be the beginning of day values. "LAKE" operation requires initial outflow, "RESE" operation requires initial storage and "BLAKE" operation requires discharge and elevation. A sample calculation of initial conditions is given in Table 2. Note that when obtaining initial conditions from SIMPAK runs, elevations and storages are printed as end of day values and there will be no need to compute them.
- (c) Model cards - The following types of card must be updated for each run:
 - i) Run title card to identify each run properly.
 - ii) Time control card.
 - iii) Initial condition in "LAKE", "RESE" and "BLAKE" operation cards.
 - iv) "SARP" and "PLOT" operation cards to ensure that extreme values are within plotting scales for the Columbia SIMPAK Model are given in Tables 3 and 3a respectively. These scales should be verified each year before making production runs.

(4) Preparation for Computer Run

To make a computer run for the Columbia SIMPAK Model, the following steps are necessary:

- (a) Load the Columbia 6D data to a file named COL.6D.
- (b) Restore from the SAVE-DATA tape the Columbia storage and backwater tables under the name of COL.TAB. To restore the file, run with:

```
$SIG EDPR  
Password  
$CONTINUE WITH SAVE-DATA  
R COL.TAB  
STOP  
$END  
$CONTINUE WITH SIG
```

- (c) Load the card deck Columbia SIMPAK Model to a file named COL.MOD, or restore file COL.MOD.1976 (for example) from SAVE-DATA tape and make the necessary revisions.

- (d) Create a file named KOOT.6D to receive output for subsequent Kootenay Lake routing with Post Corra Linn Condition. The model as set up directs the required data to this file at the end of the run.
- (e) Also create a sequential file named COL.LONG to receive long record for the adjustment of CALCAMP plotting scales if required.
- (f) The SIMPAK object deck is stored under the name of PO.CL.SIMPAK on SAVE-WORK tape or SAVE-PGMS tape. It should be restored to active file prior to the run. The required commands for the run are:

```
    $SIG EDPR T=35 P=300

    Password

    $CRE KOOT.6D

    $CRE COL.LONG TYPE=SEQ

    $R PO.CL.SIMPAK 5=COL.MOD 8=COL.TAB 16=COL.6D
      7=KOOT.6D 15=COL.LONG 9= -A(plot file)

    $R PLOT:Q PAR= -A BLANK SMALL

    $CONTINUE WITH SIG
```

(5) Development, Testing and Evaluation

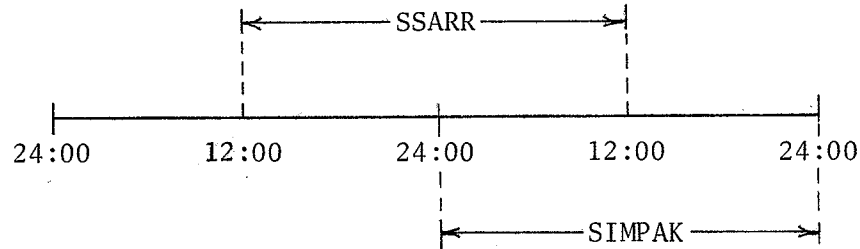
The annual Columbia pre-project computations previously consisted of three separate computer runs. These were:

- (a) Duncan Dam pre-project computation by computer program DUNDAM.
- (b) Arrow Lake inflow computation by the SSARR program.
- (c) Major Columbia pre-project computation by the SSARR program.

Since the SIMPAK program has the capacity of performing all these tasks, it was decided that the above three runs could be merged into one single model as shown in Figure 1. In addition, the SIMPAK plotting subroutine was modified to take full advantage of the Calcomp Plotter to produce the necessary plots for the Annual Report.

The Columbia SIMPAK Model was tested for the period of May 1 to July 31, 1975 and the results were compared to those from the SSARR model. A copy of computer output is given in Exhibit 2 and a plot by the Calcomp Plotter is given in Exhibit 3. The backwater calculating procedure for the Arrow Lakes was tested previously as reported in a separate section of this report. In comparing the output for lake or

reservoir routing, one should remember that the elevations and storages are not directly comparable since the SSARR printout shows midday values while SIMPAK printout gives midnight values. This can be illustrated by the following graph:



The comparison of the output from the SIMPAK and the SSARR indicates that both are generally in good agreement except that in some instances back routing through reservoirs to obtain inflows showed minor differences. This is attributable to the different time periods which create a half-day lag with slightly different storage changes. These differences are not meaningful and it is felt that the SIMPAK gives a slightly more rational result by working in terms of average daily flows. The use of a 24-hour computing period with SIMPAK compared to the 12-hour period with SSARR created no identifiable differences.

In conclusion, it is estimated that the application of the SIMPAK program to the Columbia pre-project computation will reduce costs and time requirements by at least one-third.

Kootenay Lake Post Corra Linn Computation

(1) General Description

One of the major purposes of annual Columbia pre-project computations is to define the amount of peak flow reduction due to regulation by the Treaty projects. The Columbia SIMPAK Model described previously produces pre-project flows under the natural condition, that is, without any flow regulation throughout the basin. However the Corra Linn Dam controlling Kootenay Lake was constructed before the Treaty projects and also provides some flow regulation. Therefore it is necessary to route the pre-project inflow through Kootenay Lake with regulation by Corra Linn to determine what the peak stages of Kootenay Lake and at Trail would have been if only the Treaty projects were deleted. The differences between these values and the observed values represents the effect of the Treaty projects.

This computation was previously done by a hand computation (see Exhibit 4) but the availability of the SIMPAK program makes it possible to do this easily by computer.

(2) Model and Input Data

A small model was set up to accept the pre-project Arrow Lakes outflow and Kootenay Lake inflow from the Columbia SIMPAK model and to compute the Kootenay Lake routing and flows downstream under post Corra Linn conditions (see Figure 2). The required flow data is available from the results of the Columbia SIMPAK model in the file KOOT.6D. It is in 6D card format and consists of:

Kootenay Lake inflow (223 226 220)
Lower Arrow Lake Pre-project Flow (222 410 020)
Slocan River Observed Flow (123 229 000)
Trail Local Inflow (123 230 620)

Also required are:

Kootenay Lake Storage Table dated March 24, 1969
Kootenay Lake Discharge Table dated April 16, 1969
and an initial Kootenay Lake outflow derived as free-fall discharge associated with the recorded elevation of Kootenay Lake on May 1 of the year under study.

(3) Preparation for Computer Run

The following steps are necessary to make a computer run:

- (a) Required 6D data was loaded to a file name KOOT.6D at the end of the Columbia SIMPAK Model computation.
- (b) Load Kootenay Lake storage and discharge tables to a file named KOOT.TAB.
- (c) Update initial condition on 'LAKE' operation card and load card deck for the model to a file named KOOT.MOD.
- (d) To make a run, set up the required command cards as follows:

\$SIG EDPR

Password

\$R PO.CL.SIMPAK 5=KOOT.MOD 8=KOOT.TAB

16=KOOT.6D

\$CONTINUE WITH SIG

(4) Testing and Evaluation

A test run was made for the period of May 1 to July 31, 1975 and the output is shown in Exhibit 2. The output was verified against the hand computation done for that period and it was found that an almost identical result was obtained. It is concluded that the application of the SIMPAK program to the computation of the modified Kootenay Lake condition is very useful not only in avoiding the tedious hand routing work but also in making results available at an earlier date.

Testing and Evaluation of Backwater Procedure

(1) General Description

One of the main features in the Columbia Basin pre-project computation is the complex backwater situation in the Upper and Lower Arrow Lakes. The outflow from each of the lakes is dependent on downstream water conditions that vary with backwater effects due to the flow in the Kootenay River. To handle this complex situation, a special backwater routing procedure is required. The U.S. Corps of Engineers in Portland derived a method and made it available as part of the SSARR program which has since been used for the annual Columbia pre-project computations. The same backwater procedure has now been adopted for the SIMPAK program. The procedure has been tested against actual record for the case of the Upper and Lower Arrow Lakes and is judged adequate, not only for the Columbia pre-project computation, but also for general use in the SIMPAK program.

(2) Backwater Procedure

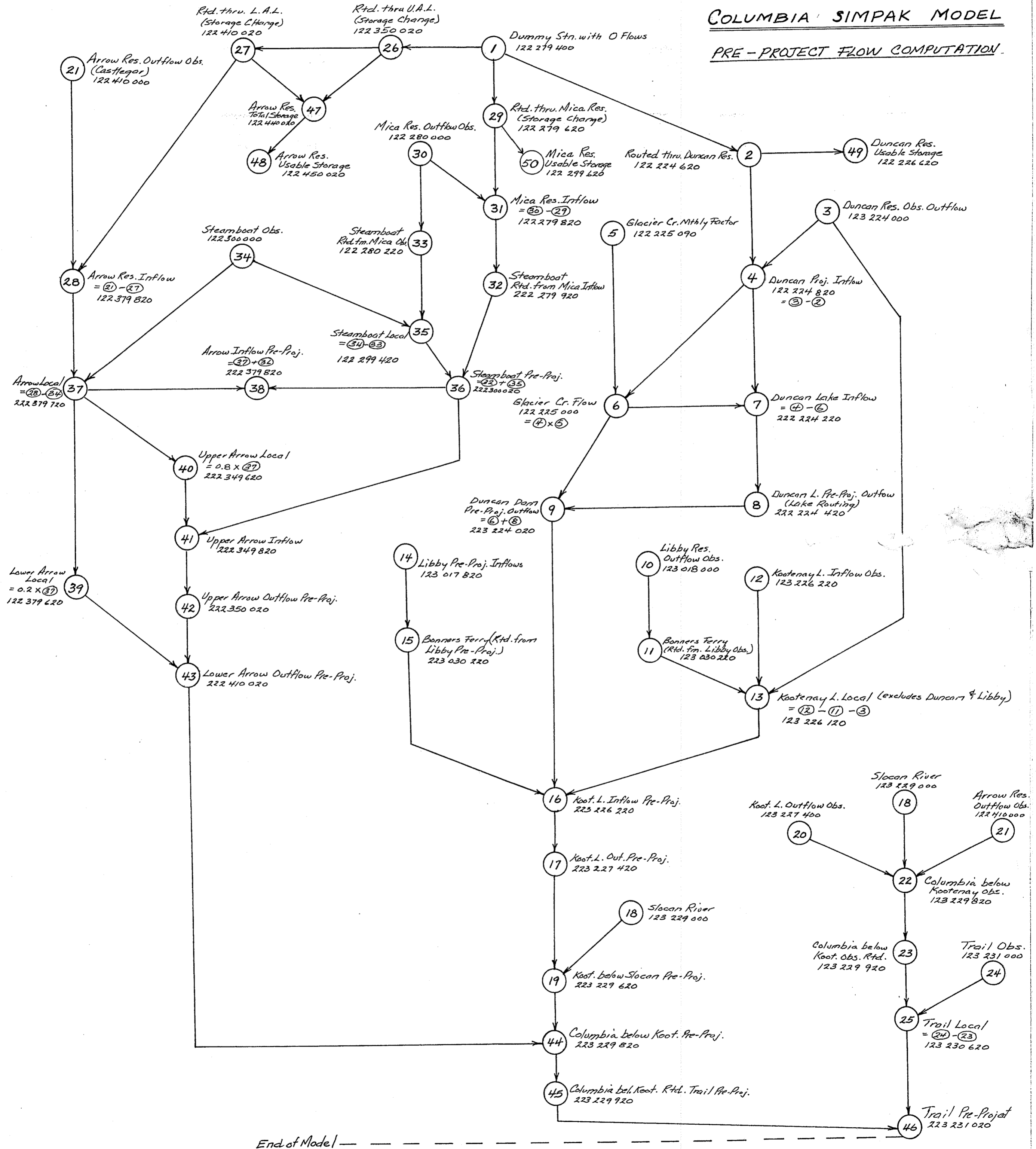
The purpose of a backwater routing computation is to determine lake outflow for any combination of lake elevation and downstream control parameter. The downstream parameter is essentially elevation but can also be stated in terms of flow when the cause is a confluence with another stream. The discharge capability is usually defined by a family of stage discharge curves incorporating the downstream control elevation or discharge. The required calculation is a more complex variation of normal lake routing and also requires a storage elevation curve for the lake. A flow chart for the calculation is given in Figure 3.

It was assumed that, in the case of the double lake backwater routing of the Arrow Lakes, the elevation at the end of the previous day at the downstream controlling point would serve as the control parameter for the current day in order to simplify the computation process. It appears that this simplified procedure does yield a result in close agreement to what could have been produced by a more elaborate method and this procedure has been adopted for general use.

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Ref. Library 5.24-7

Figure 1.
COLUMBIA SIMPAK MODEL
PRE-PROJECT FLOW COMPUTATION.



End of Model

(3) Testing of the Procedure

A model was set up for the Upper and Lower Arrow Lakes as shown in Figure 4. Inflows were obtained by back routing with recorded lake elevations to compute total storage changes and subtracting these changes from observed Lower Arrow Lake outflows to obtain total Arrow inflows. The inflows were proportioned and routed through Upper and Lower Arrow Lakes using the backwater procedure to obtain outflows which were then compared with the observed records.

Observed records for natural lake condition are available for the period of 1961-64 prior to the beginning of the Arrow Project. This period was selected because 1961 and 1964 were high flow years and 1962 and 1963 were about average. The computation of required initial conditions is given in Table 4. Exhibits 6 and 7 show the computer output for years 1961 and 1964 respectively and Exhibits 8 and 9 show the results for 1962 and 1963.

(4) Evaluation of the Procedure

The results of 1961 and 1964 runs were examined and it was found that the computed and observed Lower Arrow outflows are in good agreement for year 1964 while in poor agreement for year 1961 during the high flow period. The discrepancies for the 1961 computation are most obvious during the periods June 3-6 and June 25-July 12 when the newly installed recording gauge for the Columbia River at Castlegar was not operating properly. The gaps created during the breakdowns were filled in by manual gauge readings which were not of the same quality. The results for 1962 and 1963 are acceptable although they are not in as good agreement with the records as that of 1964. In general, the computed values tend to be higher on a rising limb and lower on a falling limb than the observed values. This is understandable since the elevation at the end of the previous day in Lower Arrow Lake was assumed as the control parameter for the current day in order to simplify the computation, and this represents a half day lag of the control parameter. In spite of this minor flaw, it is apparent that the backwater procedure tested herein produces an acceptable result.

TABLE 1

LIST OF STATIONS REQUIRING 6D DATA

Station Name	Station No.	Data Type	Source
1. Duncan Reservoir Elev.	122 224 620	Elev.	BCH via WSC
2. Duncan Res. Outflow Obs.	123 224 000	Flows	BCH via WSC
3. Libby Pre-Proj. Inflow	123 017 820	Flows	U.S.
4. Libby Res. Outflow Obs.	123 018 000	Flows	U.S.
5. Slocan R. nr. Crescent Valley	123 229 000	Flows	WSC
6. Kootenay L. Inflow Obs.	123 226 220	Flows	WKPL Co. via WSC
7. Kootenay L. Outflow Obs.	123 227 400	Flows	WKPL Co. via WSC
8. Arrow Res. Outflow Obs. (Castlegar)	122 410 000	Flows	WSC
9. Upper Arrow at Nakusp	122 350 020	Elev.	WSC
10. Lower Arrow at Fauquier	122 410 020	Elev.	WSC
11. Mica Reservoir Elev.	122 279 620	Elev.	WSC
12. Mica Reservoir Outflow Obs.	122 280 000	Flows	WSC
13. Col. R. ab. Steamboat Rapids	122 300 000	Flows	WSC
14. Col. R. at Trail (Birchbank)	123 231 000	Flows	WSC
15. Glacier Cr. Monthly Factor	122 225 090	Coefficient	Revised date on existing card deck
*16. Libby Res. Elev.	123 018 620	Elev.	U.S.

* For plotting Libby storage diagram under separate run.

TABLE 2

INITIALS CONDITIONS FOR THE COLUMBIA SIMPAK MODEL

- (1) Upper Arrow Back Route (122 350 020):
May 1/75 Storage = $\frac{1}{2}(786,834 + 797,728) = 792,281$ ac.ft.
- (2) Lower Arrow Back Route (122 410 020):
May 1/75 Storage = $\frac{1}{2}(707,895 + 696,841) = 702,368$ ac.ft.
- (3) Mica Reservoir Back Route (122 279 620):
May 1/75 Storage = $\frac{1}{2}(6,200,168 + 6,189,885) = 6,195,026$ ac.ft.
- (4) Upper Arrow Backwater Route (222 350 020):
May 1/75 Discharge = $\frac{1}{2}(14,900 + 15,500) = 15,200$ cfs.
Elevation = $\frac{1}{2}(1379.44 + 1379.67) = 1379.56$ ft.
- (5) Lower Arrow Backwater Route (222 410 020):
May 1/75 Discharge = $\frac{1}{2}(14,500 + 14,900) = 14,700$ cfs
Elevation = $\frac{1}{2}(1372.79 + 1372.93) = 1372.86$ ft.
- (6) Kootenay Lake Route (223 227 420):
May 1/75 Discharge = $\frac{1}{2}(14,800 + 15,400) = 15,100$ ac.ft.
- (7) Duncan Reservoir (122 224 620)
May 1/75 Storage = 58,371 ac.ft.

Duncan Lake (222 224 420)
May 1/75 Discharge = $\frac{1}{2}(1200 + 1235) = 1218$ cfs

NOTE: Initial conditions for Duncan Reservoir and Lake were taken from DUNCAN output of 1974-75.

TABLE 3

CALCOMP PLOTTING SCALES FOR THE COLUMBIA SIMPAK MODEL

(Units on Y-axis: All flows are in cfs and all storages in acre-feet)

<u>SITES</u>	<u>TYPE</u>	<u>STATION NUMBER</u>	<u>MIN Y-AXIS</u>	<u>Y-AXIS/INCH</u>	<u>X-AXIS/INCH</u> (days)
Mica	Observed Outflow	122 280 000	0	10,000	20
Mica	Pre-project Flow	122 279 820	0	10,000	20
Mica	Usable Storage*	122 299 620	3,000,000*	1,000,000	30
Arrow	Observed Outflow	122 410 000	0	25,000	20
Arrow	Pre-project Outflow	222 410 020	0	25,000	20
Arrow	Pre-project Inflow	222 379 820	0	25,000	20
Arrow	Usable Storage	122 450 020	-1,000,000	1,000,000	30
Libby	Observed Outflow	123 018 000	0	10,000	20
Libby	Pre-project Flow	123 017 820	0	10,000	20
Libby	Usable Storage**	123 018 620	-1,000,000	1,000,000	30
Duncan	Observed Outflow	123 224 000	0	2,500	20
Duncan	Pre-project Outflow	223 224 000	0	2,500	20
Duncan	Usable Storage	122 226 620	-500,000	500,000	30
Birchbank	Observed Flow	123 231 000	0	25,000	20
Birchbank	Pre-project Flow	223 231 020	0	25,000	20

* Mica usable storage is 12 MAF including 7 MAF active treaty Storage. Therefore, dead storage = 20,075,200 - 12,000,000 = 8,075,200 ac-ft. The operating range of usable storage is normally between 5 to 12 MAF, therefore the plotting scale is set between 3 to 13 MAF usable storage.

** For 1976-77 reporting year, Libby storage curve will be plotted by separate run with back routing through Libby Reservoir.

TABLE 3a

PRINTER PLOT SCALES FOR INPUT DATA

<u>STATION DESCRIPTION</u>	<u>TYPE</u>	<u>STATION NUMBER</u>	<u>MIN Y-VALUE</u>	<u>MAX Y-VALUE</u>
Duncan Reservoir	Elev.	122 224 620	1794 ft.	1894 ft.
Slocan River	Flow	123 229 000	0 cfs	25,000 cfs
Koot. Inflow Obs.	Flow	123 226 220	0 cfs	150,000 cfs
Koot. Outflow Obs.	Flow	123 227 400	0 cfs	150,000 cfs
Upper Arrow Obs.	Elev.	122 350 020	1350 ft.	1450 ft.
Lower Arrow Obs.	Elev.	122 410 020	1350 ft.	1450 ft.
Mica Reservoir	Elev.	122 279 620	2380 ft.	2480 ft.
Steamboat Rapids	Flow	122 300 000	0 cfs	200,000 cfs

TABLE 4

INITIAL CONDITIONS FOR BACKWATER TESTING

Assuming computer run starts on May 3, 1961, the initial conditions are needed for beginning-of-day on May 3:

(1) U.A. Elev. = $\frac{1}{2}(1380.76 + 1381.33) = 1381.05$ ft.

L.A. Elev. = $\frac{1}{2}(1373.31 + 1373.63) = 1373.47$ ft.

(2) U.A. Storage = 298,356 sfd = 591,780 ac.ft.

L.A. Storage = 234,171 sfd = 464,471 ac.ft.

(3) L.A. Outflow = $\frac{1}{2}(18,800 + 19,700) = 19,300$ cfs
(Castlegar)

U.A. Outflow computation:

$$\begin{aligned} \Delta S_{U.A.} \text{ on May 2} &= \left[\frac{1}{2}(1381.33+1380.76) - \frac{1}{2}(1380.76+1380.35) \right] \times 27,900 \text{ sfd/ft. change} \\ &= 14,000 \text{ sfd} \end{aligned}$$

$$\begin{aligned} \Delta S_{L.A.} \text{ on May 2} &= \left[\frac{1}{2}(1373.63+1373.31) - \frac{1}{2}(1373.31+1373.04) \right] \times 18,000 \text{ sfd/ft. change} \\ &= 5,400 \text{ sfd} \end{aligned}$$

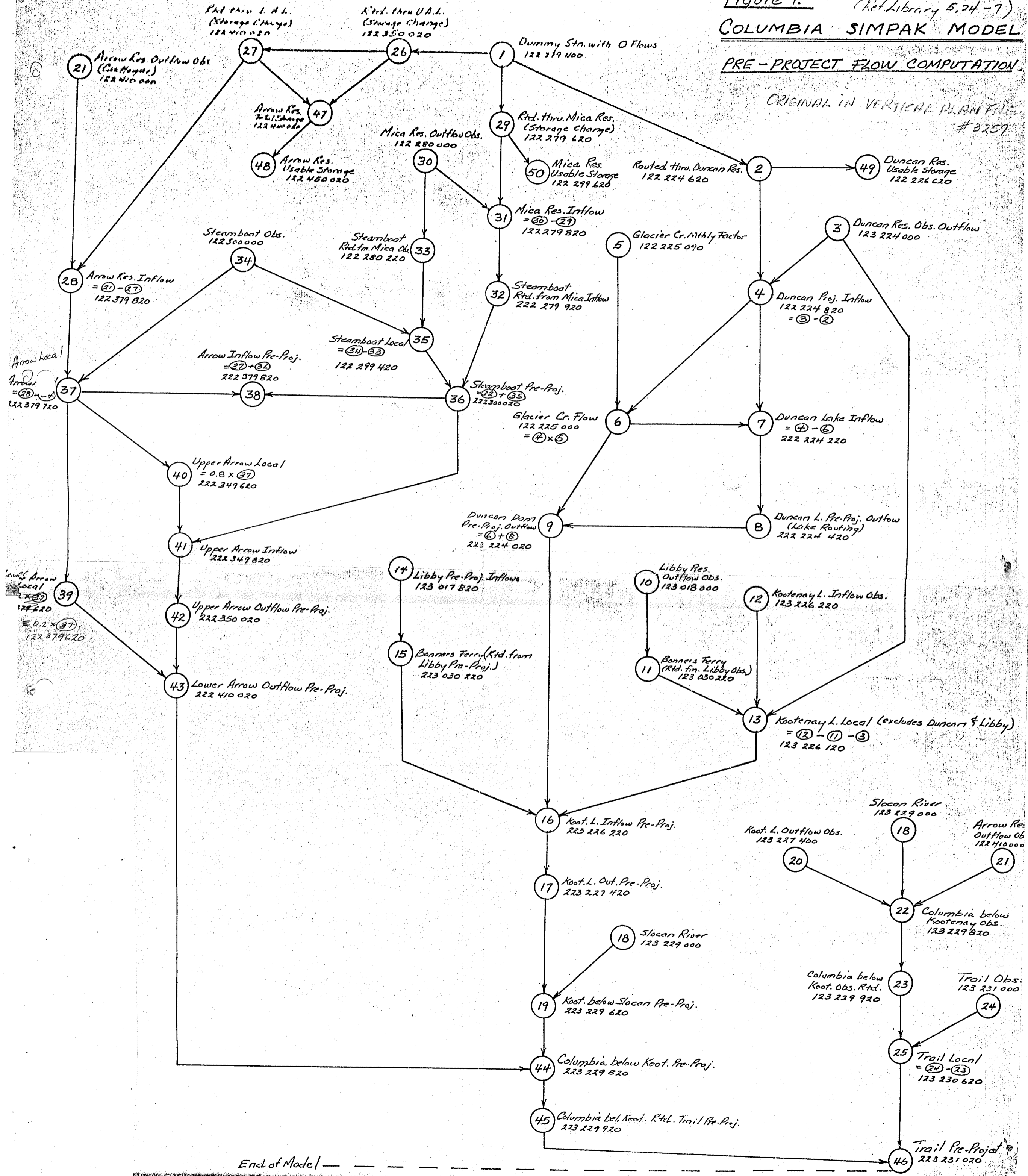
$$\begin{aligned} \text{Total Arrow Inflow on May 2} &= \text{L.A. Outflow} + \Delta S_{U.A.} + \Delta S_{L.A.} \\ &= 18,000 + 14,000 + 5,400 \\ &= 38,200 \text{ sfd} \end{aligned}$$

$$\text{U.A. Local Inflow} = (38,200 - 15,000) \times 0.8 = 18,600 \text{ cfs}$$

$$\begin{aligned} \text{U.A. Outflow on May 2} &= \text{Steamboat} + \text{U.A. Local} - \Delta S_{U.A.} \\ &= 15,000 + 18,600 - 14,000 \\ &= 19,600 \text{ cfs} \dots \text{ use this as the end-of-day outflow} \end{aligned}$$

Figure 1. (Ref. Library 5.24-7)
COLUMBIA SIMPAK MODEL
PRE-PROJECT FLOW COMPUTATION

ORIGINAL IN VERTICAL PLAN FILE #3259



End of Model

FIGURE 2

THE SIMPAK MODEL FOR KOOTENAY LAKE POST CORRA LINN COMPUTATION

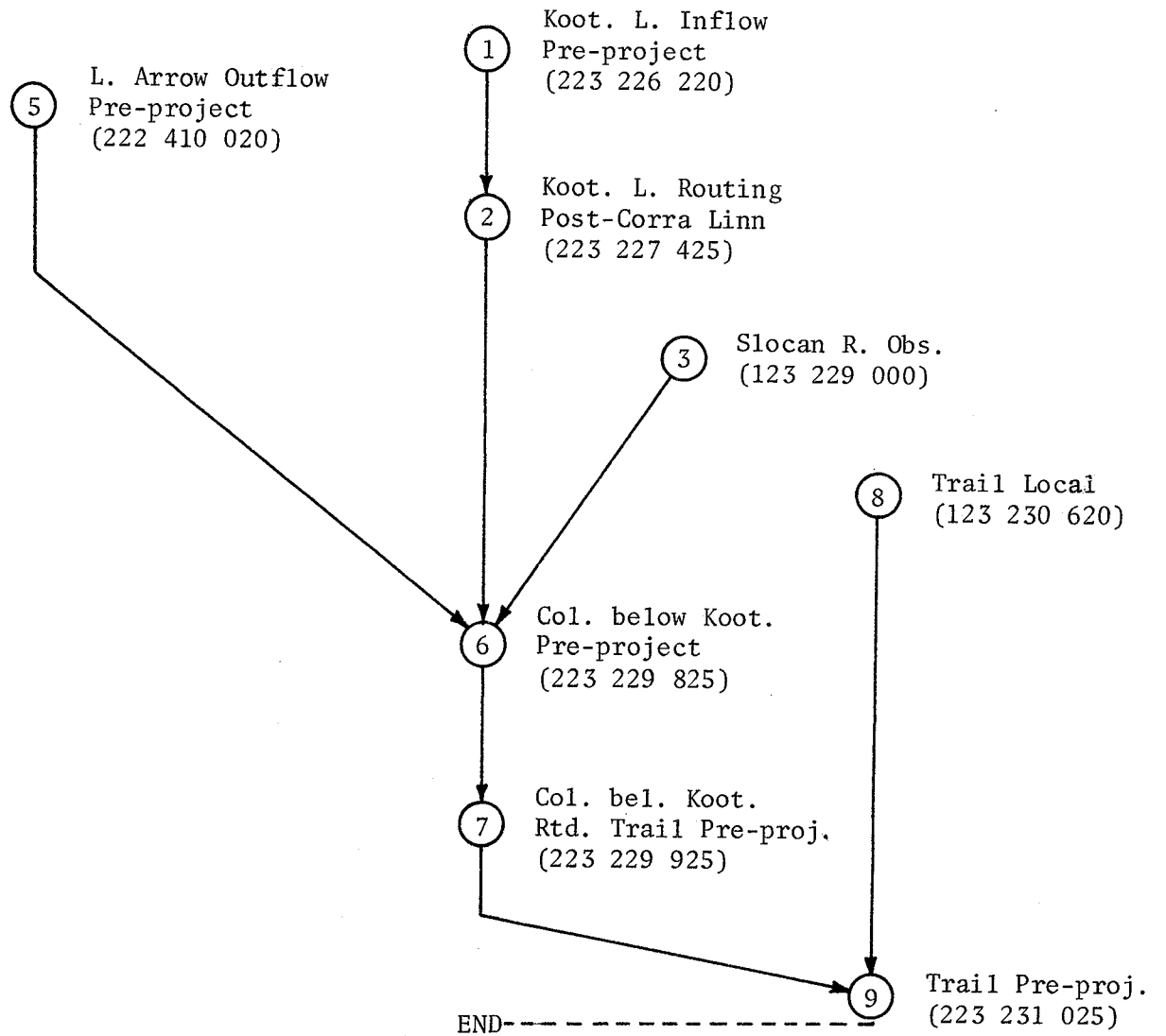


FIGURE 3

FLOW CHART FOR BACKWATER COMPUTATION PROCEDURE

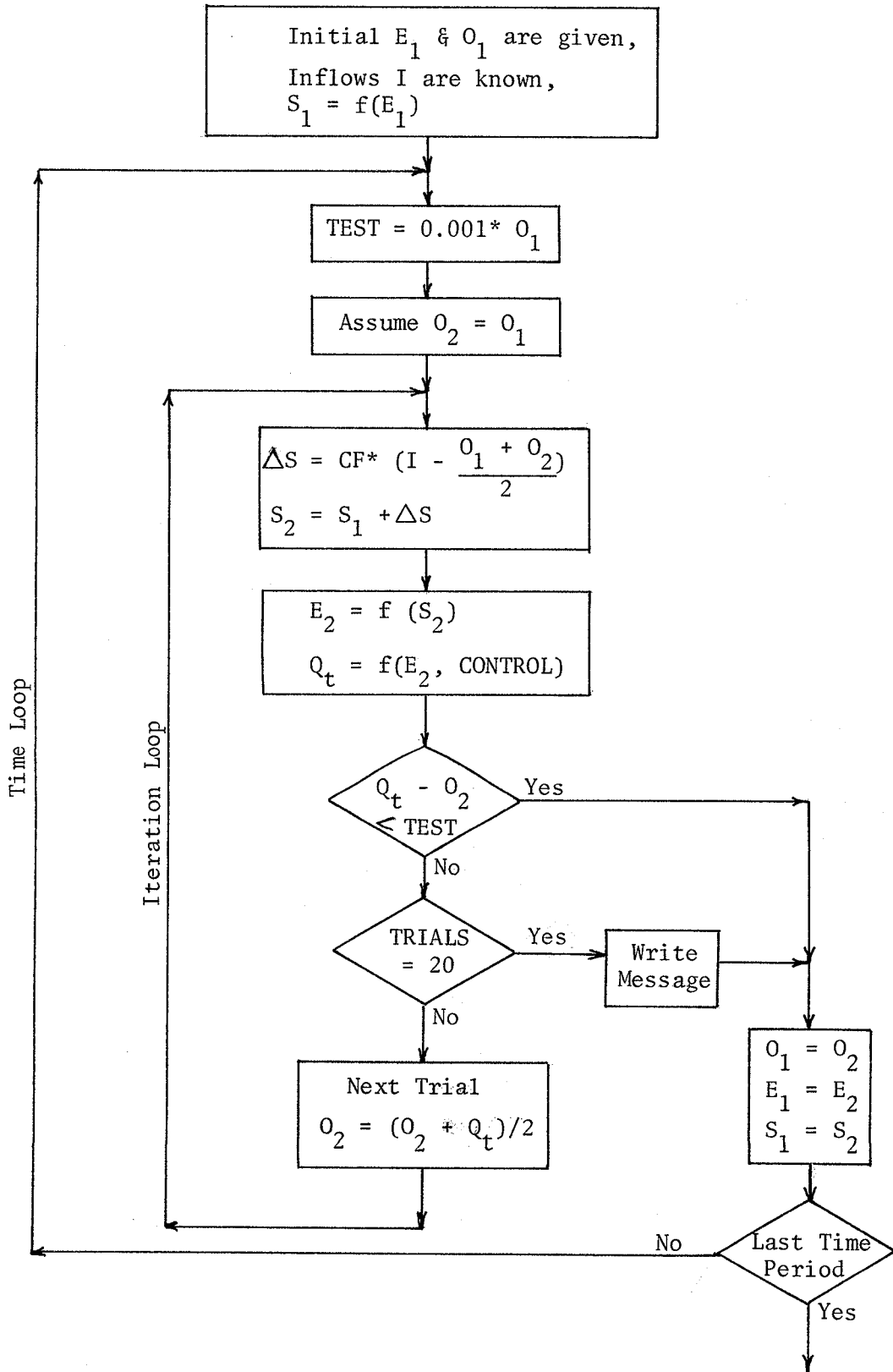
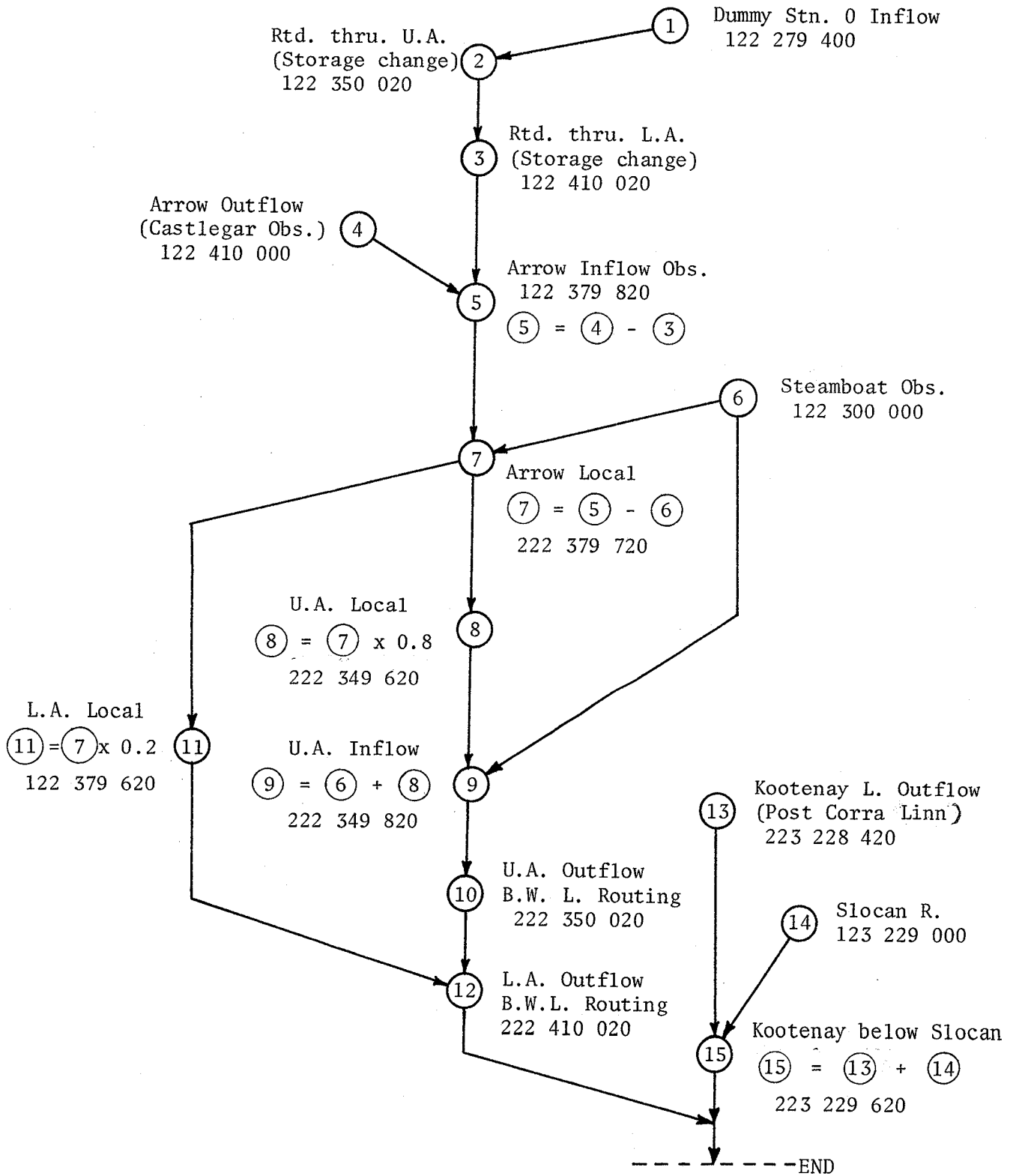


FIGURE 4

UPPER AND LOWER ARROW LAKES BACKWATER MODEL CONFIGURATION



**INLAND WATERS
DIRECTORATE**

PROJECT:

SHEET

DETAIL:

OF
FILE NO.

COMPUTED	DATE	CHECKED	DATE
<i>MPC</i>	<i>May 27/76</i>		

For Exhibits #'s. 1 to 9, see computer printout binder 524-7 which is filed in wooden cupboard in Neill Lyons' office.

*OP Black
27 May 76.*

APPENDIX - REVISIONS TO HANDLE METRIC INPUT DATA

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- E-2 List of Storage and Backwater Tables Used by the Columbia SIMPAK Model
- E-3 List of the Revised Columbia SIMPAK Model
- E-4 Sample Output from the Revised Columbia SIMPAK Model (9D Input)
- E-5 Sample Output from the Revised Columbia SIMPAK Model (6D Input)
- E-6 Sample Output from Computer Run for Libby Storage Diagram

APPENDIX - Revisions to Handle Metric Input Data

General Description

The SIMPAK program and the Columbia SIMPAK Model described previously works only with English units. With implementation of the metric conversion program, Water Survey of Canada will publish flow and elevation data in metric units commencing with 1980. In other words, WSC will supply 1980 data in metric units for the annual Columbia SIMPAK pre-project flow computations. This change-over plus other updating to the SIMPAK program made it necessary to develop a new version of the program which has been named PO.LMSIMPAK3. This new version has capability to accommodate up to 60 stations and run with 400 days of data. Accordingly, the Columbia SIMPAK Model has been revised and tested successfully at the UBC computing centre. This model, named COL.MOD2 (see Exhibit 3), has the capability to accept input data in either English or metric units. However, the model is set up to produce output in English units to be in line with the units used in the Columbia River Treaty and its related documents. This model can be easily revised in the future if the need to produce metric outputs arises.

Preparation for Computer Run

The '9D' format specifies metric input. To make a computer run for the Columbia SIMPAK Model, with SSARR input in metric units, the following steps are necessary:

- (a) Prepare data cards for flows and elevations in metric units with 9D format (see next section for 9D format).
- (b) Load the Columbia 9D data to a file named COL.9D.
- (c) Restore from the SAVE-DATA tape the Columbia storage and backwater tables under the name of COL.TAB2 (see Exhibit 2). To restore the

file, run with:

```

$SIG EDPR

Password

$CONTINUE WITH SAVE-DATA

R COL.TAB2

STOP
$END
$CONTINUE WITH SIG

```

- (d) Load the card deck Columbia SIMPAK Model to a file named COL.MOD2 or restore file COL.MOD2 (for example) from SAVE-DATA tape and make the necessary revisions as described in (3)(b) and (3)(c) under 'Pre-project Flow Computation'.
- (e) Create a file named KOOT.6D to receive output for subsequent Kootenay Lake routing with Post Corra Linn Condition. The model as set up directs the required data to this file at the end of the run.
- (f) Also create a sequential file named COL.LONG to receive long record for the adjustment of CALCAMP plotting scales if required.
- (g) The SIMPAK object deck is stored under the name of PO.LMSIMPAK3 on SAVE-PGMS tape. It should be restored to active file prior to the run. The required commands for the run are:

```

$SIG EDPR T=35 P=300

Password

$CRE KOOT.6D

$CRE COL.LONG TYPE=SEQ

$R PO.LMSIMPAK3 5=COL.MOD2 8=COL.TAB2 16=COL.9D
7=KOOT.6D 15=COL.LONG 9= -A(plot file)

$R PLOT:Q PAR= -A BLANK SMALL

$CONTINUE WITH SIG

```

Coding Instruction for '9D' Format

All the input data cards to the Columbia SIMPAK Model can be coded in 6D or 9D format except that Glacier Creek monthly factors must be coded in 6D format only. SSARR '9D' format used to hold daily data in metric units is described below:

<u>Column</u>	<u>Description</u>
1-2	'9D' for metric units
3-4	can be used to hold the century number (if years are 1900-1999 leave this blank) or synthetic data specification (e.g. 'S1'). Note that in the present version this field cannot be ignored. When transferring data from SSARR output these columns are often filled with card sequence numbers and these must be removed before re-reading.
5-13	station number
14	number of days on the card (if eight this can be left blank)
15-17	ignored by SIMPAK
18-19	day
20-21	month
22-23	year
	} date of first value on the card
24	data code 1 = mean daily discharges (cms) 2 = elevation (1/1000 meters) 3 = storage ($10^4 m^3$) 4 = change in storage (cms-days)
25-31	1st data value on the card
32-38	2nd data value on the card
39-45	3rd data value on the card
46-52	4th data value on the card
53-59	5th data value on the card
60-66	6th data value on the card
67-73	7th data value on the card
74-80	8th data value on the card

The format is almost the same as for English units except that the first two columns must be coded 6D for English units versus 9D for metric units. The data itself must be entered in accordance with the instruction given on page 22 of the SIMPAK User's Manual.

Testing and Evaluation

The revisions of the SIMPAK program and the Columbia SIMPAK Model were carried out during the month of February, 1980. The revised model has been fully tested with new version of the SIMPAK program. Flow and elevation data for the month of September 1979 were selected for the test run. The original data was obtained in English units and prepared in 6D format. Instead of converting the data manually into metric units and then coding and punching onto cards in 9D format, a program was written to convert data directly from 6D to 9D format and load into a file called COL.9D (see Exhibit 1).

Exhibit 4 shows the computer run for the Columbia SIMPAK Model with 9D input under new version of the SIMPAK program. For the purpose of comparison, another computer run for the same model was made with 6D input (see Exhibit 5). Theoretically the output from both runs should be identical. However, there are some insignificant differences due to the loss in precision in truncating when converting 6D data into 9D data and then converting from 9D data back to English units for internal computations by the SIMPAK program. Therefore the insignificant differences in the test runs are understandable and should cause no problems when we prepare input directly from WSC data in metric units.

The run for plotting the Libby storage diagram has been updated and tested under the new version of the SIMPAK program. It is noted that the model for Kootenay Lake Post Corra Linn Computation does not require any changes to run under the revised program. This model still receives 6D input which is the output from the Columbia SIMPAK model.

**INLAND WATERS
DIRECTORATE**

PROJECT:

SHEET

DETAIL:

OF
FILE NO.

COMPUTED	DATE	CHECKED	DATE
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For Exhibits #s E-1 & E-6
See computer printout binder 5.24-7
which is filed in wooden cupboard
in Neill Lyon's office.

CW Clark

29 April 1980