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Annual EDP Report and Plan 1981/82

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Government Report

NATIONAL WATER RESEARCH INSTITUTE

COMPUTER SERVICES SECTION

ANNUAL EDP REPORT AND PLAN

1981 - 1982

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NATIONAL WATER RESEARCH INSTITUTE, COMPUTER SERVICES SECTION

ANNUAL EDP REPORT AND PLAN, 1981-82

(Custodian Department-Environment)

EXECUTIVE SUMMARY

Almost all of the general-purpose EDP requirements of the Canada Centre for Inland Waters (CCIW) complex were met with the current facilities. Large system usage increased by 57 percent over the previous year.

The Control Data Cyber 171 Computer System has now been operational for over two years and user migration to this facility is essentially complete. Extensive utilization of the features of the Cyber system has resulted in a relative decrease in labour and material-intensive aspects of the operation, so that the workload increase was accomplished within the predicted budget with the existing staff complement.

Total system down-time for fiscal 1980-81 was less than fifteen hours, an indication of the inherent reliability of current EDP hardware. No operating system software malfunctions resulting in down-time occurred during the past year.

As detailed in Table 7a and b, approval in principle is again being requested for a planned upgrade of Cyber 171 central memory and communcations ports next year.

REPORT

This report describes the EDP activities of the Computer Services Section, National Water Research Institute (NWRI), Burlington, Ontario. The Section provides operational and systems software support for dedicated, in-house computing facilities available to all components of the CCIW complex. The largest facility currently operated by the Section is a Control Data Cyber 171 computer system. This machine is operated in a multiprogrammed, timeshared configuration to provide over-the-counter batch processing and interactive services. Thirteen hardwired lines, twelve dial-up lines, and one dedicated Datapack line provide interactive access to the system. In addition, the Section provides plotting, interactive graphics, and a limited data preparation service. This is accomplished with a Calcomp 925/1036 plotting system, Digital Equipment (DEC) PDP-15 and PDP-8 computers, a Norpak MVP interactive graphics terminal connected to the Cyber 171, and a collection of IBM and Univac keypunches.

The batch computer workload at the Canada Centre for Inland Waters is composed primarily of programs written in the FORTRAN language, and a significant portion interface with the SYSTEM 2000 Database Management System. These programs encompass the entire spectrum of scientific EDP; applications include data reduction and quality control, scientific database creation and access, data analysis, and a wide variety of numerical modelling projects ranging

in scale from pesticide molecules to large lakes. The balance of the workload consists of application programs written in other languages and utility programs written in assembly language.

A substantial portion of the interactive workload is on-line program development comprising the editing of programs and data files, on-line debugging, and the submission of batch jobs from timesharing terminals. Considerable use is made of interactive SYSTEM 2000 and APL, while BASIC is used by only a few users. Because many of the computer applications at CCIW require considerable CPU time and often utilize magnetic tape, the bulk of production processing is done in the batch mode rather than by interactive execution. Limited use is made of interactive graphics, primarily for the previewing of Calcomp plots.

The Computer Services Section provides EDP Services to all components of the CCIW complex, with NWRI Branch accounting for the majority of usage. Within the branch, Aquatic Physics and Systems Division accounted for 35 percent of the billed usaged in 1980/81, Hydraulics Division accounted for 14 percent, Aquatic Ecology Division accounted for 8 percent, Environmental Contaminants Division accounted for 3 percent, Analytical Methods Division accounted for 1 percent, and Technical Operations Division accounted for 2 percent. In total, NWRI accounted for approximately 65 percent of billed usage. Outside of NWRI, Ontario Region, Inland Waters Directorate accounted for 8

percent of EDP usage, Lands Directorate accounted for 1 percent, the Environmental Protection Service accounted for 3 percent, and the Canadian Wildlife Service accounted for 0.1 percent. Total usage by Environment components at CCIW was 77 percent.

The section also provides services to components of Fisheries and Oceans located at CCIW. The Great Lakes Biolimnology Laboratory accounted for 3 percent of EDP usage and Central Region, Ocean Science and Surveys accounted for 20 percent of usage. In total, Fisheries and Oceans accounted for 23 percent of billed EDP usage. This represents a significant increase in non-departmental usage over 1979/80, when Fisheries and Oceans usage amounted to 16 percent of the total.

Additional information about usage growth patterns can be obtained by a comparison of shadow revenues for the past two fiscal years. Shadow revenue from Environment increased by 5 percent while shadow revenue from Fisheries and Oceans increased by 63 percent. Tables 5a and b reflect this shift in workload.

Not included in the above discussion of billed EDP usage is the operating overhead of the Computer Services Section. This amounted to 1.3 percent of the total usage for 1980/81 and represents a reasonable overhead for a facility of this size.

1980/81 was the second year of operation for the Cyber 171 system. Comparison of overall system activity for the periods August 1979 to March 1980 and August 1980 to March 1981 revealed a surprisingly large workload increase of 57 percent. This increase in system activity was accompanied by a decrease in unit record and magnetic tape usage, so shadow revenue and operating costs do not fully reflect the increase.

Program conversion and user orientation to the Cyber 171 were essentially complete by the end of 1980. Examination of Table 10a reveals a substantial migration to interactive computing. Although the bulk of processing is still performed in the batch mode because of the length and resource requirements of the jobs, reliance on over-the-counter job submission is decreasing rapidly. During the first year of Cyber operation, 36 percent of the batch stream was submitted from interactive terminals, during the second year this increased to 55 percent. For the first four months of 1981/82, 70 percent of the batch stream was submitted from terminals. Virtually all source program development and maintenance is performed interactively, and the increased disk capacity of the Cyber system has resulted in a substantial decrease in magnetic tape and card punch usage. Line printer usage dropped slightly during the second year, again the result of the use of interactive terminals. Because of this overall change in workload characteristics, the 57 percent increase

was accomplished within the predicted operating budget and with no increase in staff.

The reliability of the Cyber 171 system is indicative of the progress made by the EDP industry in this area. During 1980/81, hardware malfunctions resulted in only fifteen hours of system down-time. As this report is being prepared, the mainframe has been operational for over fifteen months since its last malfunction. No operating system software malfunction resulting in down-time occurred during 1980/81, and no system "crashes" have occurred since the Cyber became operational in June, 1979.

The DEC PDP-15 system is used for such specialized applications as interactive graphics, data editing, digitizing, and hands-on magnetic tape analysis. During 1980/81, only 261 hours of block time were logged for this system, considerably less than was anticipated. This resulted from a decrease in the field programs which generate the data edited on the PDP-15 and delays in the delivery of a digitizing table purchased by the Data Management Section, NWRI. This table finally arrived in March, 1981 and software development is now underway. When this facility becomes operational, PDP-15 usage will increase substantially.

The Calcomp 925/1036 plotter system has continued to provide the required hard-copy graphics throughput. During 1980/81, 4081 plot files were processed and 497 hours of plot time were used.

Use of the data preparation service provided by the section has decreased in recent years, and a full-time keypunch operator is no longer required. At the same time, demand in other areas is increasing so the keypunch operator's position has been rewritten to include peripheral equipment operation as the primary duty. If the observed decrease in data preparation usage continues, the service will be discontinued entirely within two years.

The installation of the Cyber 171 system has resulted in significant benefits to the user community at CCIW. The increased power and expanded capabilities of this system have resulted in:

a) a larger volume of production processing;
b) increased user productivity because of the availability of interactive program entry, development and testing;
c) greater accessibility to the databases retained at CCIW because of the availability of SYSTEM 2000;
d) new applications taking advantage of the increased speed, disk capacity, and usability of the Cyber 171.

Another significant benefit resulting from the Cyber 171 installation is the availability of a wide range of software packages. Such packages as SPSS (Statistical Programs for the Social Sciences), IMSL (International Mathematical and Statistical Library), the previously

mentioned SYSTEM 2000, and TIGS (Terminal Independent Graphics System) significantly reduce program development effort in many cases.

Two acquisitions, requested in last year's plan, were completed in April, 1981. Details of cost and duration are reported in Table 7a.

The replacement of three single density (844-21) disk drives with dual density (844-41) drives has eliminated the disk capacity problem which became critical late in 1980. This upgrade provided an additional 330 million characters of disk storage. No further disk upgrades are anticipated for next year.

The replacement of a seven track tape drive with a nine track drive resulted in a balanced tape configuration (2 x 7 track, 2 x 9 track) on the Cyber system. As tape usage has decreased since the last report and plan, additional tape drive acquisitions are no longer anticipated.

Planned acquisitions of central memory and communications ports for the Cyber 171 system were not completed during 1980/81, so these have been carried forward to next year.

PLAN

Workload prediction is difficult in the volatile computing environment which can exist in a scientific institution. The 1980/81 plan anticipated an increase of 15 to 20 percent but the actual increase was 57 percent. However, the workload appears to have stabilized during the first half of 1981, suggesting a further 20 percent increase in 1981/82.

The trend to increased central memory requirements for batch jobs, reported in last year's plan, has continued. In 1980/81, 53 percent of the batch CPU time was utilized by programs which required more than half of the available memory on the Cyber 171. This represents a large class of jobs which cannot multiprogram with each other and overlap computation with input/output. Since a substantial portion of jobs in this class use System 2000 with its heavy disk input/output load, overall central processor utilization suffers. Since this trend is expected to continue, the central memory upgrade requested in last year's plan but not installed is now planned for April 1982. If the upgrade is not feasible at that time, limitations on user access to the Cyber 171 system may be necessary.

As an aid to system optimization and future planning, performance monitoring software recently announced by CDC has been ordered for NWRI. This software provides information about many

aspects of the Cyber's operation, and even as a system tuning tool should be worth the cost (less than $2,000 per year).

In the fall of 1981, 2½ years before the expiry of the Cyber 171 system lease, a planning team will begin considering computing requirements for CCIW in the period 1984 to 1989. This should provide sufficient lead time to ensure a smooth transition from the Cyber 171 to the appropriate new EDP facility. The assistance and guidance of the Computer Science Co-ordination Branch will be sought to ensure that all planning is conducted in accordance with departmental and Treasury Board EDP policy and guidelines.

EDP PERSON-YEARS BY FUNCTION AND REGION – 1981 EDP REPORT AND PLAN

TABLE 2

Department: Environment | Centre: NWRI

REGION	FUNCTION	PY: 1980/81	CY: 1981/82	Upcoming year: 1982-83	Planning year 1: 1983/84
OTTAWA-HULL	Managerial				
	Systems and Programming				
	Data Conversion				
	Data Production				
	Others / SUB-TOTAL				
B. OTHER QUEBEC	Managerial				
	Systems and Programming				
	Data Conversion				
	Data Production				
	Others / SUB-TOTAL				
C. OTHER ONTARIO	Managerial	0.5	0.5	0.5	0.5
	Systems and Programming	0.5	0.5	0.5	0.5
	Data Conversion	1.0	0.3	0.2	
	Data Production	4.0	4.7	4.8	5.0
	Others / SUB-TOTAL	6	6	6	6
D. ATLANTIC	Managerial				
	Systems and Programming				
	Data Conversion				
	Data Production				
	Others / SUB-TOTAL				
E. PRAIRIES (including the Territories)	Managerial				
	Systems and Programming				
	Data Conversion				
	Data Production				
	Others / SUB-TOTAL				
F. BRITISH COLUMBIA	Managerial				
	Systems and Programming				
	Data Conversion				
	Data Production				
	Others / SUB-TOTAL				
G. TOTAL EDP PERSON-YEARS	Managerial	0.5	0.5	0.5	0.5
	Systems and Programming	0.5	0.5	0.5	0.5
	Data Conversion	1.0	0.3	0.2	
	Data Production	4.0	4.7	4.8	5.0
	Others				
	TOTAL ➤	6	6	6	6

SUMMARY OF EDP COSTS AND REVENUES
1981 EDP REPORT AND PLAN

TABLE 3

Department: Environment

Centre: NWRI

			EDP EXPENSE/REVENUE CLASS	EXPENSE/REVENUE ($ 000) PY: 1980/81 Planned	PY: 1980/81 Actual	CY: 1981/82	Upcoming year: 1982/83	Planning year 1: 1983/84
A. BUDGETARY	PERSONNEL	02	Salaries	115	115	127	140	154
		05	Employee Benefits	17	17	19	21	23
		0811	Consultants (Non-Government)	2	1	0	0	0
		0812	Consultants (Government)	0	0	0	0	0
			SUB-TOTAL ►	134	133	146	161	177
	EQUIPMENT AND SUPPORT	12	Equipment Rental-Actual	144	144	158	181	185
		18	Equipment Maintenance	94	98	105	115	127
		21	Data Transmission	8	10	12	14	16
		2411	External Facilities — Non-Government	0	0	0	0	0
		2412	External Facilities — Government	0	0	0	0	0
		27	Software	96	96	100	106	113
		39	Production Supplies	24	24	24	26	29
		44	Accommodation	28	28	31	34	37
		48	Office Furniture and Equipment	2	1	2	2	3
		52	Travel	2	2	2	3	3
		55	Printing and Stationery	1	1	1	1	1
		58	Telephone and Telegraph	1	1	1	1	1
		69	Other Expenses	3	2	2	3	4
			SUB-TOTAL ►	403	407	438	486	519
			TOTAL COST ►	537	540	584	647	696
B. OTHER COSTS		15	Equipment Rental — Imputed	82	82	82	82	82
		61	Interest on Working Capital	18	21	23	25	27
		72	Departmental Support Costs	64	65	70	78	84
		75	Other Government Costs	2	2	2	2	3
		78	Language Training (Deduct)	0	0	0	0	0
			TOTAL COST ►	166	170	177	187	196
FULL EDP COST (A + B)				703	710	761	834	892
C. REVENUE		90	Non-Departmental	114	168	185	204	224
		94	Internal (Centres Only)	584	558	614	676	744
			TOTAL ►	698	726	799	880	968
BALANCE OF REVENUE ►				- 5	16	38	46	76
D. CAPITAL EXPENDITURES ►				0	3	0		

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SUMMARY OF SERVICE PROVIDED WITHIN DEPARTMENT
1981 EDP REPORT AND PLAN

NOTE: TOTAL COST REPRESENTS THAT PORTION OF FULL COSTS ON TABLE 3 INCURRED IN PROVIDING SERVICE TO DEPARTMENTAL USERS.

CENTRE: National Water Research Institute

SERVICE TYPE	COST ($ 000)				
	PY: 1980/81		CY: 1981/82	Upcoming year: 1982/83	Planning year 1: 1983/84
	PLANNED	ACTUAL			
I. MACHINE-BASED					
1.09 COMPUTER PROCESSING					
A. Batch, over the counter	480	413	453	515	540
B. Batch-Terminal					
C. Text Processing					
D. Time-Sharing (interactive)	92	112	122	139	146
E. On-Line Inquiry					
F. On-Line Data Entry					
G. Other					
SUB-TOTAL (1.09) ➤	572	525	575	654	686
1.40 DOCUMENT READING					
1.43 COMPUTER-OUTPUT-TO-MICROFILM					
1.46 AUXILIARY AND UNIT RECORD					
1.50 DATA PREPARATION	21	21	10	7	-
1.59 OTHER MACHINE-BASED					
SUB-TOTAL (1.40 TO 1.59) ➤					
TOTAL ➤	593	546	585	641	686
II. PERSON-BASED					
5.60 SYSTEMS					
5.70 PROGRAMMING					
9.91 TRAINING					
OTHER PERSON-BASED					
TOTAL ➤					
TOTAL COST (I + II) ➤	593	546	585	641	686

LE 5B

SUMMARY OF SERVICE PROVIDED TO OTHER DEPARTMENTS
1981 EDP REPORT AND PLAN

NOTE: TOTAL COST REPRESENTS THAT PORTION OF FULL COSTS ON TABLE 3 INCURRED IN PROVIDING SERVICE TO USERS IN OTHER DEPARTMENTS.

CENTRE: NWRI, Services provided to Fisheries and Oceans at CCIW

SERVICE TYPE	COST ($ 000)				
	PY: 1980/81		CY: 1981/82	Upcoming year: 1982/83	Planning year 1: 1983/84
	PLANNED	ACTUAL			
I. MACHINE-BASED					
1.09 COMPUTER PROCESSING					
A. Batch, over the counter	90	127	137	151	162
B. Batch-Terminal					
C. Text Processing					
D. Time-Sharing (Interactive)	17	34	37	41	44
E. On-Line Inquiry					
F. On-Line Data Entry					
G. Other					
SUB-TOTAL (1.09) ➤	107	161	174	192	206
1.40 DOCUMENT READING					
1.43 COMPUTER-OUTPUT-TO-MICROFILM					
1.46 AUXILIARY AND UNIT RECORD					
1.50 DATA PREPARATION	3	3	2	1	-
1.59 OTHER MACHINE-BASED					
SUB-TOTAL (1.40 TO 1.59) ➤					
TOTAL ➤	110	164	176	193	206
II. PERSON-BASED					
5.60 SYSTEMS					
5.70 PROGRAMMING					
9.91 TRAINING					
99 OTHER PERSON-BASED					
TOTAL ➤					
TOTAL COST (I + II) ➤	110	164	176	193	206

TABLE 7A

SIGNIFICANT ACQUISITIONS (*PREVIOUSLY APPROVED) OF EDP GOODS AND SERVICES COMPLETED OR SCHEDULED FOR COMPLETION FROM PY THROUGH THE UPCOMING YEAR – 1981 EDP REPORT AND PLAN

*APPROVED IN PRINCIPLE BY MEANS OF AN EARLIER EDP REPORT AND PLAN OR OTHER SUBMISSION.

DEPARTMENT: Environment/NWRI

PROJECT (FROM TABLE 1)	ITEM	COST ($000)		* RENT	CONTRACT MTH/YR		PROVINCE	SOURCE/REASON
		CAPITAL	ANNUAL		START	END	CONS. OR INST.	
Environmental Conservation Service, National Water Research Institute	Additional 844-41 disk drive for CDC Cyber 171 system		11	R	4/80	6/84	Ont.	Directed-Control Data Canada. Installed April 22, 1980
	Replace one 7-track tape drive with one 9-track tape drive on Cyber 171 system		4	R	4/81	6/84	Ont	Directed-Control Data Canada Installed April 25,1981
	Additional 6 communications ports for Cyber 171 front end		2	R		6/84	Ont.	Directed-Control Data Canada. To be acquired as needed
	Replace 3 of 844-21 disk drives with 844-41 disk drives on CDC Cyber 171 system	3	10	R	4/81	6/84	Ont.	Directed-Control Data Canada. Installed April 1, 1981

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* R: RENTAL P: PURCHASE

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TABLE 7B

SIGNIFICANT ACQUISITIONS OF EDP GOODS AND SERVICES FOR WHICH APPROVAL IN PRINCIPLE IS REQUESTED THROUGH THE UPCOMING
1981 EDP REPORT AND PLAN

DEPARTMENT: Environment/NWRI

PROJECT (FROM TABLE 1)	ITEM	COST ($ 000)		CONTRACT MO./YR.		SOURCE/REASON
		CAPITAL	ANNUAL	START	END	
Environmental Conservation Service, National Water Research Institute	Additional 32,768 words of central memory for Cyber 171 system		29	4/82	6/84	Directed-Control Data Canada

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TABLE 9 - EDP SERVICES PROVIDED BY CUSTOMER AND TYPE
NATIONAL WATER RESEARCH INSTITUTE
BURLINGTON, ONTARIO

Customer Name	Shadow Revenue ($000) 1979/80			
	Batch	Inter-active	Data Prep'n	Total
A. ENVIRONMENT	424.3	129.5	4.0	557.9
1. National Water Research Institute	368.8	98.3	3.2	470.3
a) Environmental Contaminants	22.3	2.1	0.0	24.4
b) Hydraulics	89.8	8.4	1.0	99.2
c) Aquatic Ecology	35.8	23.2	0.2	59.2
d) Aquatic Physics and Systems	203.3	58.4	1.9	263.6
e) Analytical Methods	4.3	1.3	0.1	5.7
f) Engineering Support	0.0	0.1	0.0	0.1
g) Technical Operations	12.9	3.7	0.0	16.6
h) NWRI Branch Administration	0.4	1.1	0.0	1.5
2. Ontario Region, IWD	39.3	18.2	0.7	58.2
a) Policy Research	0.4	1.0	0.0	1.4
b) Water Planning and Management	14.7	12.5	0.3	27.5
c) Water Quality	24.2	4.7	0.4	29.3
3. Lands Directorate, EMS	2.0	3.3	0.0	5.3
4. Environmental Protection Service	14.1	9.0	0.1	23.2
5. Canadian Wildlife Service	0.1	0.7	0.0	0.8
B. FISHERIES AND OCEANS	144.9	22.2	0.9	168.0
1. Great Lakes Biolimnology Lab	11.0	6.8	0.6	18.4
2. Central Region, OSS	133.9	15.4	0.3	149.6
a) Canadian Hydrographic Service	7.4	1.5	0.1	9.0
b) Research and Development	126.5	13.9	0.2	140.6
TOTAL	569.2	151.7	4.9	725.8

Note : Computer usage by the Data Management Section, NWRI, in support of various components of CCIW has been reported as part of the usage incurred by those components.

TABLE 10a - CYBER 171 SYSTEM UTILIZATION STATISTICS
NATIONAL WATER RESEARCH INSTITUTE
BURLINGTON, ONTARIO

DESCRIPTION	UNITS	1979/80	1980/81
A. FACILITY USE			
Power on and work in progress	Hours	2,972.7	4,234.0
Down-time	Hours	38.9	14.9
- Hardware Malfunctions	Hours	34.9	14.9
- Software Malfunctions	Hours	4.0	0.0
Preventive Maintainance	Hours	301.	234.
Central Processor Use	Hours	1,070.8	1,743.0
- Batch	Hours	973.3	1,560.0
- Interactive	Hours	97.5	183.0
Central Memory Use	K. bits x hours	2,142,696	4,348,038
- Batch	K. bits x hours	1,997,580	4,070,712
- Interactive	K. bits x hours	145,116	277,326
Cards read	No. of cards	7,980,530	4,632,737
Lines Printed	No. of lines	81,795,829	81,653,077
Cards Punched	No. of cards	864,183	523,090
Magnetic Tapes Mounted	No. of tapes	22,313	19,606
Interactive Connect Time	Hours	9,294	12,725
B. WORKLOAD DATA - BATCH			
Jobs completed	No. of jobs	41,917	44,079
Average concurrent jobs	No. of jobs	2.8	2.4
Average CPU time/job	Seconds	83.6	127.4
Average central memory/job	K. bits	1,668	1,974
Average elapsed time/job	Minutes	11.9	13.7
Fraction of jobs using printer	Percent	86.7	86.1
Average lines printed/job	No. of lines	1,980	1,803
Average tape drives/job	No. of drives	0.53	0.44
Jobs using no tape drives	Percent	62.4	67.5
Jobs using 1 tape drive	Percent	25.2	23.6
Jobs using 2 tape drives	Percent	12.2	8.7
Jobs using 3 tape drives	Percent	0.2	0.1
C. WORKLOAD DATA - INTERACIVE			
Sessions completed	No. of sessions	31,335	42,783
Average concurrent sessions	No. of sessions	3.1	3.0
Average CPU time/session	Seconds	11.2	15.4
Average central memory/session	K. bits	858	882
Average connect time/session	Minutes	17.8	17.9
Fraction of sessions using printer	Percent	17.1	18.5
Average lines printed/session	No. of lines	1,834	1,665
Batch jobs submitted via terminal	Percent	36.0	55.4

Note : 1979/80 covers the period June 4, 1979 to March 31, 1980.

TABLE 10b - AUXILIARY SERVICES UTILIZATION STATISTICS
NATIONAL WATER RESEARCH INSTITUTE
BURLINGTON, ONTARIO

DESCRIPTION	UNITS	1979/80	1980/81
A. CALCOMP 1036 PLOTTING			
Plot Files Processed	No. of files	2,853	4,081
Plot Time	Hours	407.3	497.1
B. PDP-15 PROCESSING			
PDP-15 Block Time	Hours	663.3	261.0
C. DATA PREPARATION			
Keypunching/Verifying	No. of cards	120,287	110,228
Interpreting	No. of cards	899,434	445,524

PRICE SCHEDULES

CYBER 171 PROCESSING

Batch usage	$0.05 / system resource unit[1]
Interactive usage	$0.08 / system resource unit[1]
Interactive connect time	$7.00 / connect hour
Card reading	$1.00 / thousand cards read
Line printing	$1.50 / thousand lines printed[2]
Card punching	$5.00 / thousand cards punched[2]
Tape mounting	$1.50 / tape mount

CALCOMP 1036 PLOTTING

Plotter setup charge	$0.50 / plot file
Plotter usage	$75.00 / hour

PDP-15 PROCESSING

PDP-15 Block time	$30.00 / hour

DATA PREPARATION SERVICES

Keypunching and verifying	$25.00 / thousand cards[2]
Interpreting	$ 4.00 / thousand cards

EXPLANATORY NOTES:

1. The basic accounting unit for the Cyber 171 system is the "System Resource Unit" (SRU). The SRU is a measurement during a job or session of the following resources:

   Central Memory
   Central Processor Time
   Mass Storage (Disk)
   Magnetic Tape
   Permanent Files

   The formula used for calculating the SRUs used is:

   $$SRU = CP + 0.1 \times IO + 0.003\ (CP + IO)\ CM + AD$$

   where

   CP is Central Processor time in seconds

   IO is Input/Output activity in units. IO units are calculated from mass storage, tape, and permanent file activity.

   CM is central memory field length expressed in units of 512 words.

   AD is job step activity in units.

2. Printing and punching charges include paper and card stock.