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POTENTIAL FOR HYDROELECTRIC POWER GENERATION, ISLAND OF PONAPE, PONAPE DISTRICT, TRUST TERRITORY OF THE PACIFIC

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MEMORANDUM OF THE CHAIRMAN

To Members of the Senate Committee on Energy and Natural Resources:

At my request, during November 1978, a staff team of the Senate Committee on Energy and Natural Resources conducted a field investigation of several issues in the Trust Territory of the Pacific Islands. One purpose of the investigation was to determine the potential for hydroelectric development on Ponape. The findings of the staff team are set forth in this report.

One of the principal objectives of U.S. administration of the Trust Territory has been the development of an infrastructure which is adequate to enable the various Micronesian peoples to achieve their future social, economic, and political aspirations. An essential element of this program is the provision of sufficient means of power generation.

At present the Trust Territory is entirely dependent upon imported fuel and has been particularly hard hit by the recent increases in the price of oil. An ever increasing part of the local budget is being consumed by the costs of fuel to maintain basic services. With the end of the Trusteeship approaching, it is imperative that all available alternatives for power production be explored.

The report, which was prepared by Russell R. Brown of the committee's professional staff, evaluates several sites which were thought to offer some potential for hydroelectric development. In light of the importance of the provision of adequate power to the future of the peoples of Micronesia, I have directed that the report be published as a committee print in order to make its findings and conclusions available to the members of the committee and interested members of the public.

The members of the team were Dr. Daniel Dreyfus, staff director, Mr. James P. Beirne, counsel, Mr. Russell R. Brown, professional staff, and Mr. Steve Crow, counsel to the minority.

HENRY M. JACKSON, *Chairman.*

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POTENTIAL FOR HYDROELECTRIC POWER GENERATION, ISLAND OF PONAPE, PONAPE DISTRICT, TRUST TERRITORY OF THE PACIFIC

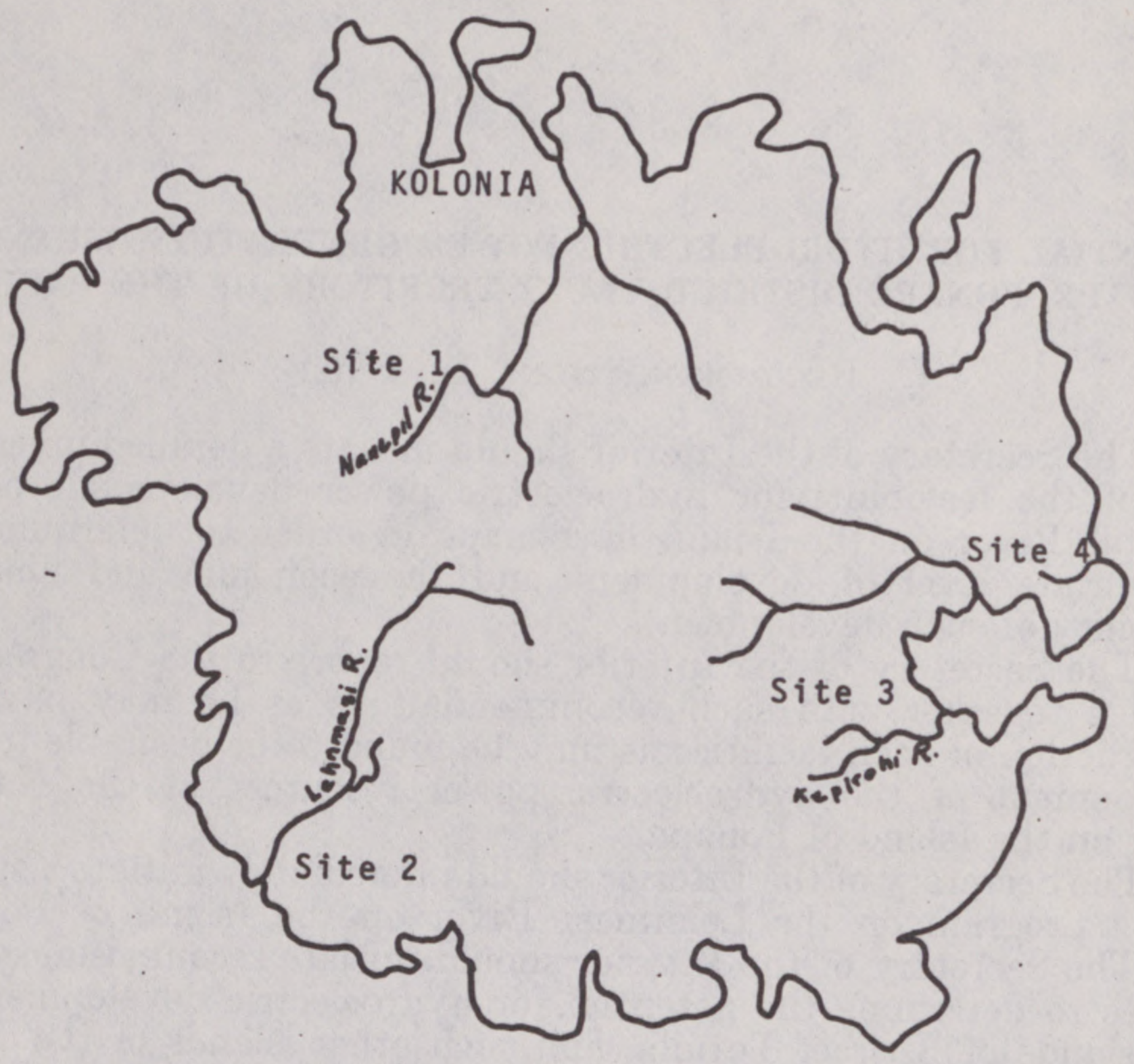
Recommendations In Brief

1. The Secretary of the Interior should initiate a detailed investigation of the feasibility for hydroelectric power development of the Nanepil River on the Island of Ponape in order to determine the appropriate level of development and the economic and financial feasibility of such development.

2. The Secretary of the Interior should report to the Congress his findings together with such recommendations as he may have for construction of such facilities as may be found to be desirable for the development of the hydroelectric power resources of the Nanepil River on the Island of Ponape.

3. The Secretary of the Interior should immediately initiate a stream gaging program on the Lehnmasi River on the Island of Ponape.

4. The Secretary of the Interior should initiate reconnaisance level studies to determine the potential for hydroelectric development on the Islands of Kosrae, Tutuila, and such other islands of the Trust Territory of the Pacific Islands or territories and possessions of the United States as might have potential for such development and based upon such studies he should establish appropriate stream gaging programs in support of more detailed investigations.



PONAPE

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Background and Recommendation

In "Management of Public Works Programs In the Trust Territory of the Pacific Islands" a staff report published in February 1975, at the request of Senator Henry M. Jackson, chairman of the then-Committee on Interior and Insular Affairs, it was noted:

> Micronesia has been particularly hard hit by recent increases in fuel prices. The increased price of oil is reflected not only directly in the cost of petroleum products at the refinery, but indirectly in the increased cost of transportation of the fuel to the islands.
>
> There are opportunities for small hydroelectric installations on some of the islands. The Japanese constructed such facilities on Ponape, for example. No serious studies are presently in progress.[1]

In the intervening 4 years, world crude oil prices have continued to rise with a corresponding impact on energy costs to the islands of the Pacific. Augmenting the increased prices has been an increase in demand on the part of the inhabitants for energy consuming goods. Modernization of existing structures and construction of new facilities have created new demands for electricity which, for the most part, are satisfied by diesel-powered generators located at central stations.

In 1977, as part of the Ponape capital improvement program (PCIP), a contract was let for an independent study of the hydropower potential of two sites on the Island of Ponape. (See app. I.) Shortly thereafter, a further study was commissioned to evaluate the "economics of Hydroelectrical Generation" at the most attractive of the two sites examined in the first study. (See app. II.)

In January 1979, the United Nations' Department of Technical Cooperation and Development issued a "Report on a Mission to the Pacific Region" in which the potential for hydropower development on Ponape was further discussed. The pertinent extract from the report is included in appendix III.

At the direction of the chairman, professional staff of the Senate Committee on Energy and Natural Resources examined four potential hydroelectric power generation sites on the Island of Ponape in November 1978. Following the analysis of the information gathered on the field investigation and a review of the existing studies, the committee recommends that the United States take appropriate action to initiate development of the hydroelectric power potential of the Nanepil River on the Island of Ponape as a supplemental source of electric energy for the island. In addition, it is recommended that additional studies be undertaken to further evaluate and determine the potential for hydroelectric development of the Lehnmasi River on the Island of Ponape and the hydroelectric potential of the Island of Kosrae, also in the Caroline Islands.

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[1] P. 36, "Management of Public Works Programs in the Trust Territory of the Pacific Islands", Senate Committee on Interior and Insular Affairs, 94th Congress, 1st session, February 1975.

Physical Setting

The Island of Ponape is located in the southern North Pacific Ocean, 500 miles north of the Equator and about 3,100 miles west of Hawaii. Ponape is volcanic in origin and is surrounded by a barrier reef and lagoon. It is characterized as a "high" island with interior elevations exceeding 2,400 feet. An average annual rainfall of over 200 inches supports dense tropical vegetation on the island proper with mangrove swamps skirting the island shore of the lagoon. The weather station in the town of Kolonia on the north side of the island records a mean annual rainfall of 196.2 inches for the period of record beginning in 1928, but estimates of rainfall in the interior of the island reach as high as 400 inches per year.

Several streams, which are major by Pacific island standards, originate on Ponape, and the U.S. Geological Survey has carried out a program of gaging and partial record surveys at seven sites. Streamflows are relatively consistent but can fluctuate greatly as a direct result of precipitation runoff. The underlying dense volcanic strata are virtually impervious so there is little groundwater to maintain streamflows during periods of low precipitation. The U.S. Geological Survey streamflow records are included in appendix IV.

The major population center of Ponape is the town of Kolonia—approximately 4,000. Here, too, are the major existing electrical loads which are served by two large diesel generating plants and several smaller plants. The remainder of the island's population of 21,000 do without electricity or rely upon small independent generating units.

Existing Power Facilities

The two largest generating facilities are the Kolonia Plant—nameplate capacity 3,000 kilowatts—and the Nanpohnmal Plant—nameplate capacity 2,400 kilowatts. The Nanpohnmal facility began operation in May 1978, and was designed to accommodate installation of three additional generators of 800 kilowatts each. The Kolonia plant is unable to operate at peak due to lack of maintenance and is in need of repair. The most recent power production figures for the two plants are as follows:

[In kilowatt hours]

Period of record	Kolonia	Nanpohnmal
January 1978	958, 000	(1)
February	880, 600	(1)
March	877, 000	(1)
April	877, 000	(1)
May	888, 000	338, 800
June	760, 800	380, 800
July	643, 800	246, 400
August	636, 800	263, 200
September	494, 820	274, 400
October	754, 000	338, 800
November	786, 000	366, 900
December	897, 600	406, 300
January 1979	487, 600	491, 200
February	770, 600	406, 300

[1] Not in service.

For the month of February 1979, the Kolonia plant consumed an average of 2,130 gallons of diesel fuel per day at a cost of 58.4 cents per gallon. The Nanpohnmal plant consumed an average of 965 gallons of diesel fuel per day at a cost of 59.4 cents per gallon. Total production costs per kilowatt-hour in 1978 were estimated to be approximately 117 mills with the rate charged to the consumer set at 3 mills per kilowatt-hour. Comparable production costs in the United States range from 0.5 mills per kilowatt-hour for the most efficient hydroelectric production to 32 mills per kilowatt-hour for new oil-fired thermal plants.

Additional diesel generating capacity in the Kolonia area is provided for three specific functions; hospital plant—500 kilowatts—refrigeration plant—50 kilowatts—and communications and airport—155 kilowatts. Combined production for the units from January 1978, through February 1979, was just over 2,076,000 kilowatt-hours with the major portion, or 1,950,000 kilowatt-hours produced by the hospital plant.

It is anticipated that fuel costs will continue to be the largest as well as an increasing component of energy production costs on Ponape. Of particular significance is Ponape's reliance upon mid-east oil production for supplies and direct subjugation to world oil price increases as well as actual or embargoed shortages. Storage capacity of 96,000 gallons of diesel fuel for the Kolonia and Nanpohnmal powerplants provides a 30-day supply based upon average production/consumption in 1978. However, it should be noted that power production was reduced during the period of July–September 1978 due to power rationing. Any extended interruption of oil supplies to the Island would cause extreme hardship.

Since February, diesel fuel costs at Ponape have risen 54 percent to about 90 cents per gallon. Projections of future prices are nebulous at best; however, the September 21 spot price for diesel fuel in Rotterdam was $1.04 per gallon. It can be assumed that fuel costs will continue to rise.

Potential Hydroelectric Generating Sites

Committee staff field party visited four potential hydroelectric generating sites identified by District authorities. Two of the sites had been previously examined and evaluated as part of the PCIP. A fifth site, mentioned in the United Nations report was not visited. Of the four sites, development of the potential of the Nanepil River basin appears to be the most viable.

SITE 1—NANEPIL RIVER

The Tawenjokola River basin includes approximately 11 square miles. The site determined to be the most attractive by the PCIP study and visited by committee staff is located on the Nanepil River or west branch of the Tawenjokola about 2½ miles south of Kolonia. The Nanepil drainage basin is about 2.9 square miles in extent. The site is readily accessible and is noteworthy for having been developed for hydroelectric generation during the time Ponape was under Japanese

administration. The Japanese facility consisted of a diversion structure at elevation 100 meters, an open canal approximately 0.4 mile in length and a related powerhouse with two turbines and generators. The remains of the diversion structure, canal, surge tank, and one generator are still visible. Local sources stated that the plant had been in operation until 1949 and estimated the capacity at 600 kilowatts.

The PCIP studies proposed the following project features:

Penstock, length 1 mile, diameter 36 inches;
Intake structure located at elevation 117 meters;
Surge tank—capacity 50,000 gallons;
Generator/turbine, 750 kilowatts;
Powerhouse at elevation 50 meters—site of Japanese structure—and transmission line, 3.8 miles.

Estimated capital costs of the project are $797,000 with an annual generation of 2.5 million kilowatt-hours.

A variation of the above proposal calls for the construction of a storage reservoir of approximately 10,000 acre-feet capacity which would optimize power production at approximately 5 million kilowatt-hours annually. However, the estimated cost of the reservoir is $2 million and this alternative was dismissed upon economic grounds in the PCIP study.

The economic study of the Nanepil site concluded with the following recommendations:

1. Reject the idea of constructing a reservoir to provide storage for hydroelectric generation during dry periods. It is too costly.
2. Reject the notion that a hydroelectric plant will be capable of meeting the base electrical demand in Ponape. The physical resource is inadequate to provide the needed electricity.
3. Consider the possibility of constructing a hydroelectric plant as part of the overall electrical generating scheme which would provide electricity on an "as generated" basis. A substantial savings in fuel can be realized during the times the hydroelectric plant is in operation and the fluctuations of the worldwide oil market may be equalized by the fuel thus saved.

ALTERNATE NANEPIL DEVELOPMENT

In a further effort to determine the potential for development of the Nanepil site, the committee informally requested the Department of the Interior's Bureau of Reclamation to review the site using the following information:

1. 1:25,000 scale map of Ponape with 10 meter contours—Army Map Service.
2. USGS runoff records 1970–1977.
3. PCIP background and economic studies.

Based on the above information, it was determined that the plan offering the greatest economy would consist of a dam located about 600 meters upstream from USGS Station 8976; a penstock leading from the right abutment area of the dam around the nose of the right abutment for a distance of about 900 meters; a surge tank at about elevation 140 meters; a continuation of the penstock directly to the Nanepil River bed at about elevation 70 meters where the powerplant would be located.

The dam would consist of a largely concrete O-Gee section for spillway with short nonoverflow sections on each side of the central spillway. Three dam heights were investigated to give regulated storage of 500, 1,500, and 2,500 acre-feet. These storage values would permit continuous average release of 10, 20, and 25 cubic feet per second respectively. Only the 1,500 acre-foot reservoir with a 20-cubic-feet-per-second release was judged economically feasible. The maximum dam height above stream bed for the 1,500 acre-feet plan is about 70 feet with a length of about 900 feet. Reservoir area would be about 70 acres.

The penstock would consist of a welded steel line 30 inches in diameter, three-sixteenths-inch thick and 4,200 feet long. A valve would be installed, shortly below the dam, to provide an outlet works for the dam. A steel or reinforced concrete surge tank would be provided directly above the powerplant at elevation 140 meters.

The powerplant would consist of an 800-kilowatt generator with turbine operating at 1,200 revolutions per minute at elevation 70 meters. It would be operated by remote control from the existing powerplant headquarters with only occasional maintenance and repair trips required. The powerplant could be moved farther downstream to about elevation 50 meters which would give 20 percent more energy with little additional cost. However, this would violate the rule of thumb that distance from the surge tank to powerplant should not exceed five times the head. It is possible, however, that further study of the project might indicate that speed regulation devices could be installed which would allow for the longer penstock thereby realizing the additional energy.

The estimated costs of the above proposal are:

Dam	$5, 481, 000
Penstock	511, 000
Powerplant	431, 000
Total	6, 423, 000
10 percent interest during construction	642, 000
Total	7, 065, 000
20 percent unlisted items	1, 413, 000
Total	8, 478, 000
25 percent contingency	2, 119, 000
Total	10, 597, 000
15 percent engineering and overhead	1, 593, 000
Total cost	$12, 190, 000

The estimate is based upon an assumed 10-foot depth to competent rock for the dam foundation. If the depth were to be 25 feet, the cost would increase about $4 million.

The average yearly output of energy resulting from the alternate development plan would be 3,496,000 kilowatt-hours of firm energy and 834,000 kilowatt hours of nonfirm energy.

Additional information requird for the preparation of a feasibility design and estimate include:

1. A minimum of five drill holes; three at the dam axis, one at the saddle to the east of the dam, and one at the poewrplant site. The holes are required to determine the depth to competent rock, foundation strength, and reservoir water holding capacity. The foundation

rock is described as basalt, and this type of rock is usually assumed to be associated with excess water loss.

2. Topographical surveys of the reservoir area, at 1:5,000 with a contour interval of 2 meters, a topographical survey of the damsite, powerplant site, and penstock alignment at 1:1,000 with 1 meter contour intervals.

3. Further hydrology records including rainfall data for correlation purposes.

4. Data to determine road and transmission requirements and estimates.

5. Unit price cost data and shipping costs to Ponape from which to determine feasibility estimates.

Estimated cost of the feasibility investigation and project design is $250,000 requiring approximately 1 year to complete. The construction period would be 12 to 18 months depending upon whether rainfall conditions would permit year around construction activity.

SITE 2—LEHNMASI RIVER

The Lehnmasi River, located in southwestern Ponape, has a drainage basin of about 8 square miles. The potential site identified by local authorities is approximately one-half mile upstream from where the river enters the lagoon. At the time committee staff visited the site, river flows appeared low with no evidence of sustained larger flows. Although the basin is significantly larger than those of the other sites visited, actual runoff may be less because of a rain-shadow effect caused by the interior mountains. Stream gradients as estimated from topographic maps are relatively steep further inland indicating a potential for development. It is recommended that a further investigation of the potential for development of the basin's resources be undertaken with initiation of stream gaging to determine flows.

SITE 3—KEPIROHI RIVER

The Kepirohi River basin drains approximately 2.4 square miles located in southeastern Ponape. The potential hydropower site identified in the PCIP study is located at a waterfall on the river approximately one-fourth mile from where the river enters the lagoon. The height of the falls is estimated to be 50 to 60 feet. For study purposes, the PCIP assumed that the same runoff per square mile is present in the Kepirohi River basin as that in the Nanepil River basin. It was estimated that the site is capable of generating 583,000 kilowatt-hours annually.

Although the Kepirohi site was considered in the initial PCIP study, it was not evaluated in the followup economic analysis. Committee staff visited the site and recommends that any further consideration for development be deferred because of the accessibility and beauty of the falls. Tourism in Ponape is relatively undeveloped, but it is anticipated that it will increase both in volume as well as importance as a source of outside income. The Kepirohi waterfall is one of the better known scenic attractions of the island.

SITE 4—MADOLENIHMW

A fourth site which is located in eastern Ponape was identified by local authorities and visited by committee staff. The site was deter-

mined to be not feasible for hydropower development because of low flows and minimal gradient.

Projected Fuel and Cost Savings

In February 1979, the Kolonia powerplant produced 770,600 kilowatt-hours with a fuel consumption of 59,600 gallons at 58.4 cents per gallon for a fuel cost per kilowatt-hour of 45 mills. Total production costs per kilowatt-hour for the Kolonia and Nanpohnmal powerplants in 1978 averaged 117 mills. With the current cost of diesel fuel at 90 cents per gallon the total cost per kilowatt-hour is in excess of 146 mills of which 70 mills is the cost for fuel.

Based upon current fuel costs in relation to the potential power production of the PCIP and alternate development proposals, fuel savings and related equivalent values resulting from the development of hydropower are as follows:

PCIP:	
Power produced annually (million of kilowatt-hours)	2. 5
Diesel fuel saved (gallons)	192, 000
Fuel cost saved	$173, 000
Alternate:	
Power produced annually (million kilowatt-hours)	4. 3
Diesel fuel saved (gallons)	330, 000
Fuel cost saved	$303, 000
Alternate with powerhouse at 50 m:	
Power produced annually (million kilowatt-hours)	5. 2
Diesel fuel saved (gallons)	396, 000
Fuel cost saved	$356, 000

Assuming that the estimated costs of construction of the two proposals are reasonable, the PCIP proposal would return the capital investment excluding interest in about 5 years, and the alternate in about 35 years. Based upon a staff estimate the cost for the PCIP proposal should be revised upward to $2 million for which the return would require 12 years.

Rationale for Development

In 1981, Ponape will join with Yap, Truk, and Kosrae in forming the Federated States of Micronesia thus ending the then 36 years of U.S. trusteeship. What the relationship between the Federated States of Micronesia and the United States will be is yet to be determined, but at this time it is the obligation and the policy of the United States to assist the people of the area to prepare for their new status. Of particular concern is the fragility of the economy of the Pacific Islands and the relatively new dependence upon outside sources for fuels and energy. In the case of Ponape, there is an opportunity to provide for a substantial savings in energy costs by substituting hydroelectric power for diesel generated power, provision for a "back-up" source of energy which is not subject to embargo, a sayings of capital which would otherwise be a constant drain on the Island's limited financial resources, and finally the social benefits which would accrue from making electricity available at the least possible cost.

These objectives, and more, justify the development of the feasible hydroelectric resources of Ponape at the expense of the United States without expectation of repayment or reimbursement of the capital costs involved on the part of the people of Ponape.

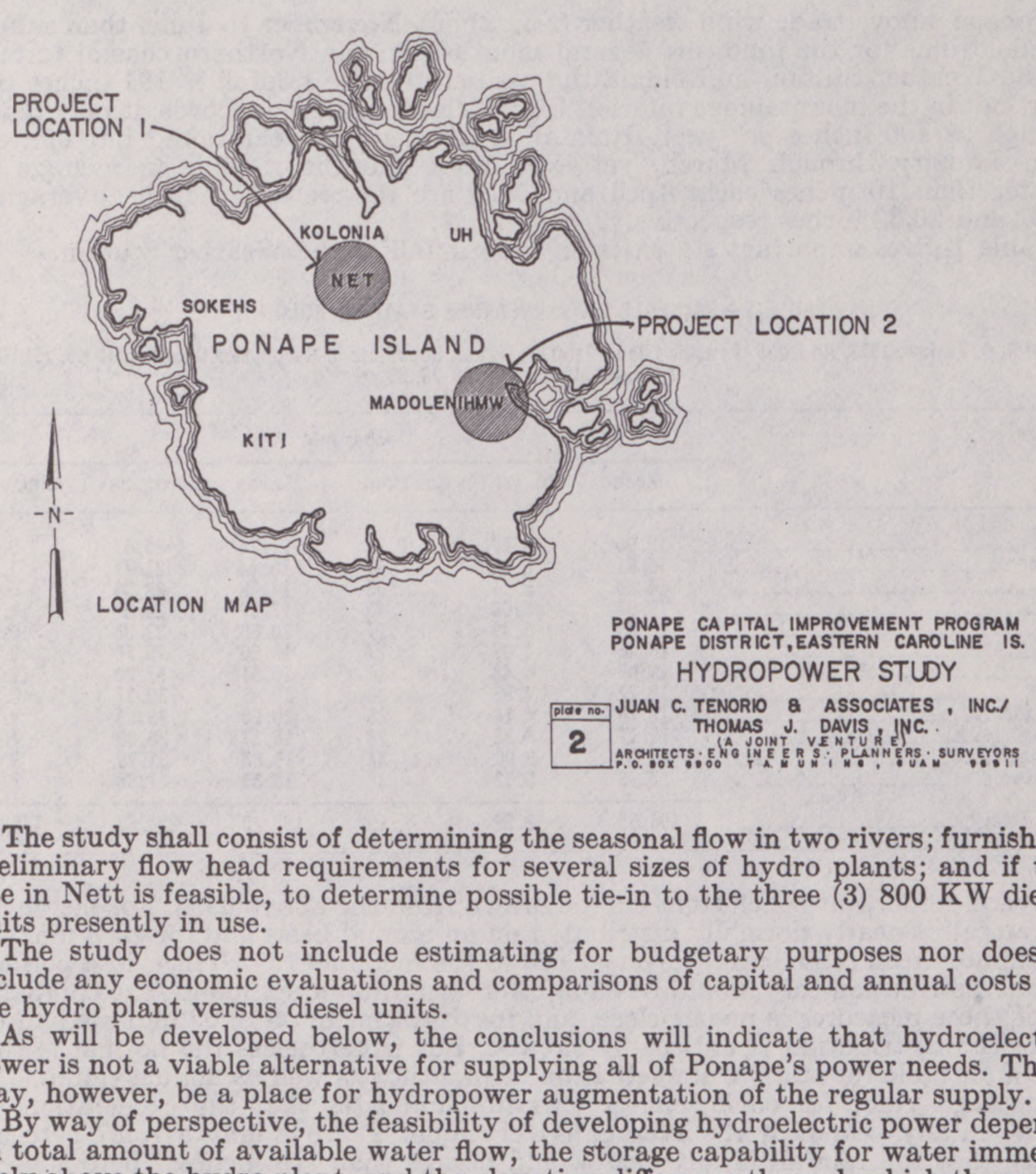
APPENDIXES

Appendix I

Background Paper on Hydroelectric Power Generation on Ponape Island, Ponape District, Trust Territory of the Pacific Islands, OICC, Marianas

I. Purpose and Scope

The purpose of this study is to identify the role which hydro power electric generation can have in the Ponape Power supply system. The scope of study is limited to three sites: two on the Nanepil River; and one at the Kepirohi Waterfall near the Ponape Agricultural Training Station (PATS) (See Plate 2).



The study shall consist of determining the seasonal flow in two rivers; furnishing preliminary flow head requirements for several sizes of hydro plants; and if the site in Nett is feasible, to determine possible tie-in to the three (3) 800 KW diesel units presently in use.

The study does not include estimating for budgetary purposes nor does it include any economic evaluations and comparisons of capital and annual costs for the hydro plant versus diesel units.

As will be developed below, the conclusions will indicate that hydroelectric power is not a viable alternative for supplying all of Ponape's power needs. There may, however, be a place for hydropower augmentation of the regular supply.

By way of perspective, the feasibility of developing hydroelectric power depends on total amount of available water flow, the storage capability for water immediately above the hydro plant, and the elevation difference through which the water

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falls. These are the geological and meteorological factors. But there are also economic and sociological factors which have been considered and which might affect the conclusion herein developed.

II. Background Information

Ponape, 129 square miles in area and lying 500 miles North of the equator experiences heavy rainfall throughout the year and is dissected by many streams, some of them quite large by small island standards. A few of the streams carry substantial flows throughout most of the year, and because within about 2 to 3 miles of the coast, channel gradients are moderately steep and waterfalls commonplace, the construction of hydropower facilities has often been suggested. In fact, during the Japanese Administration a small hydroplant was built at an elevation of about 164 feet (50 meters) to exploit the flow of the Left (West Branch of the Nanepil River) at an elevation of about 328 feet. (100 meters). However, there is a question of whether the plant was ever used. The remnants of the plant show that 2 turbines and 2 generators were installed in a small concrete structure on the west bank of the river near the confluence of its 2 main tributaries. Right (east) Branch has a very flat gradient between the confluence and the 328 feet (100 meters) contour over a distance of 1.5 miles and it is questionable whether its flow could readily have been exploited along with the flow of the Left Branch, where the gradient is steeper.

III. Climate

Ponape enjoys trade wind weather from about November to June, then suffers the doldrums for the following several months. On the Northern coastal terrace at the Weather Station in Kolonia the annual average rainfall is 194 inches per year, but in the mountainous interior, for which there are no records, it may reach as high as 400 inches per year. Rainfall is frequent all year round but lightest from January through March, yet even these months receive an average of greater than 10 inches each. April and May are the wettest months, averaging 19.07 and 20.33 inches respectively.

Table 1 gives important statistics on the rainfall at the Weather Station.

TABLE 1.—RAINFALL DATA: WEATHER STATION, KOLONIA

[From: R. C. Taylow, 1973, An Atlas of Pacific Island Rainfall: Hawaii Substitute of Geophysics Data Report No. 25HIG—73–9; period of record: 1928–72, 39 yr]

	Inches rain					
	Mean	Std. ser.	Coef. var.	Median	Maximum	Minimum
January	12.90	4.77	0.39	11.74	26.67	3.59
February	10.81	5.05	.47	10.44	21.71	1.71
March	14.68	5.11	.35	14.66	23.30	6.07
April	19.07	8.08	.42	17.37	26.07	11.72
May	20.33	5.49	.27	20.60	33.96	9.00
June	16.46	4.37	.27	16.66	26.76	9.00
July	18.09	6.43	.36	15.51	37.20	11.37
August	16.22	4.86	.30	16.47	30.37	8.20
September	16.70	4.14	.25	16.28	29.53	9.80
October	16.17	4.53	.28	15.27	28.00	7.37
November	16.36	6.00	.37	15.68	31.79	3.67
December	17.36	5.52	.32	18.33	27.38	2.40
Total	194.33	18.92	.10	196.20	231.63	138.72

Several important conclusions can be drawn from the above data. For instance, the rainfall is nearly normally distributed on an annual basis and for each month, the annual mean (194.33 in.) is very close to the median (196.20 in.); in a perfect normal distribution they would be equal. For each individual month the comparison of these measures is not as close, and for July (mean of 18.09 and median of 15.51) the distribution is noticeably skewed, but nevertheless the normal is the most applicable for statistical evaluation of monthly as well as annual rainfall.

The high value for coefficient of variation indicates that the expectation of rainfall in any year near the average is very high. There is only a 15.87 percent chance that the rainfall in any year would be less than 175 inches. There is very little chance (.14 percent or 1 year in 714 years) that the annual rainfall would fall below 138 inches. In fact, although short term droughts may occur, droughts lasting a year or more would be most unlikely.

IV. Geology

All of the island of Ponape consists of rocks derived originally from volcanic activity. The principal formations are basaltic, ranging from melanocratic varieties to andesite.

Sediments consists chiefly of talus, slopewash and the gravel alluvium in stream beds. The residual weathered layer on the bedrocks is relatively thin. Fine grain terrestrial sediments form extensive mangrove swamps around much of the island. Apparently no emerged limestone occurs.

In place, the basaltic rocks lie nearly horizontal. Intrusions, often in sheet like form, are common, cutting across the layered strata and forming ridges and localized protuberances because of their great resistance to erosion. The rocks are massive and dense and individual sections appear to be think (greater than 25 feet). Columnar and platy jointing frequently occurs, especially in resistant sections.

Because the basaltic formations are nearly horizontal and are thick and massive, the overall permeability of the rocks is low. Rainwater does not readily infiltrate into the rock mass and thus most of it is disposed of by direct overland runoff and in evapotranspiration. The average flow at the Nanepil gage is equivalent to 240, probably more like 80 percent (if average rainfall of 300 inches per year) of the rain that falls on the basin. Frequent rains enable the streams to maintain high flow during much of the time, but during dry spells most of the flow must seep from the weathered surface of the basalt.

The interior of the island has a youthful topography characterized by deep narrow valleys and steep slopes. Bedrock exposures commonly occur all the way to the coast; there is no sedimentary coastal plain of any significance. Typically the larger valleys, such as Nanepil, have a low gradient (less than .02) below an elevation of 164 feet and 656 feet (200 m.), and a steep gradient beyond. Storage reservoirs would have to be restricted, in general, to elevations greater than 164 feet and more likely 328 feet.

The general geology of Ponape with respect to water supply implies that stream flow is highly dependent on immediate rainfall. The streams flow continuously, however, because rainfall is frequent throughout the year. The geology also suggests that the bedrock would be favorable for dam and reservoir sites, though much work would be necessary to confirm this conclusion with respect to any particular location.

V. Hydrology

Since 1970 the U.S. Geological Survey has had a continuous flow recorder on the Nanepil River at elevation 390 feet (119 meters) that has provided 67 months of published data from which approximations of hydropower potential could be made. The Nanepil is the largest river on the island. A second site where development of hydropower has been proposed is at the Kepirohi Waterfall near the Ponape Agricultural Training Station (PATS). No continuous flow measurements have been taken on this stream (referred to as Kepirohi in this report) so that estimates of flow must be based on correlation with the record at Nanepil. The Kepirohi stream drains an area of 2.4 square miles, while the drainage area on the Nanepil above the U.S.G.S. site is 2.93 square miles. The U.S.G.S. data consists of tabulated daily flows in serial order and therefore sequential and non-sequential analyses are possible. The analyses in this report are based chiefly on non-sequential frequency statistics, although a simple sequential analysis of monthly flow is included. The nonsequential analyses are made for natural flows and do not deal with storage-yield relationships. The simple sequential analysis assumes several different storage capacities and seeks that capacity which would result in no interval of zero storage for the period of record.

The data base for the analyses is given in the U.S.G.S. reports, Water Resource Data for Hawaii and other Pacific Areas for each water year from 1970 to 1975. The longest record extends from March 1, 1970 to September 30, 1975. The streams on Ponape gaged by the U.S.G.S. and relevant data for each are given in Table 2.

NANEPIL RIVER LEFT BRANCH

A. Analysis

The entire drainage basin of the Nanepil River includes about 11 square miles but the U.S.G.S. gage at 390 feet elevation on the Left Branch measures flow from only 2.93 sq. miles. However, the gage site is downstream of the wettest part of the basin and is located where the valley gradient is moderate but steep enough to provide about 200 feet of head between it and the flatter portion of the valley

starting at elevation 164 ft. (50 m.) The gage sits 500 feet or so upstream of the small diversion dam used for the domestic water system. If Hydropower were to be developed the intake facility would likely be in this general location, and thus the record at the gage could serve as the data set for evaluating the potential energy that might be developed.

TABLE 2.—U.S.G.S. FLOW RECORDS: PONAPE

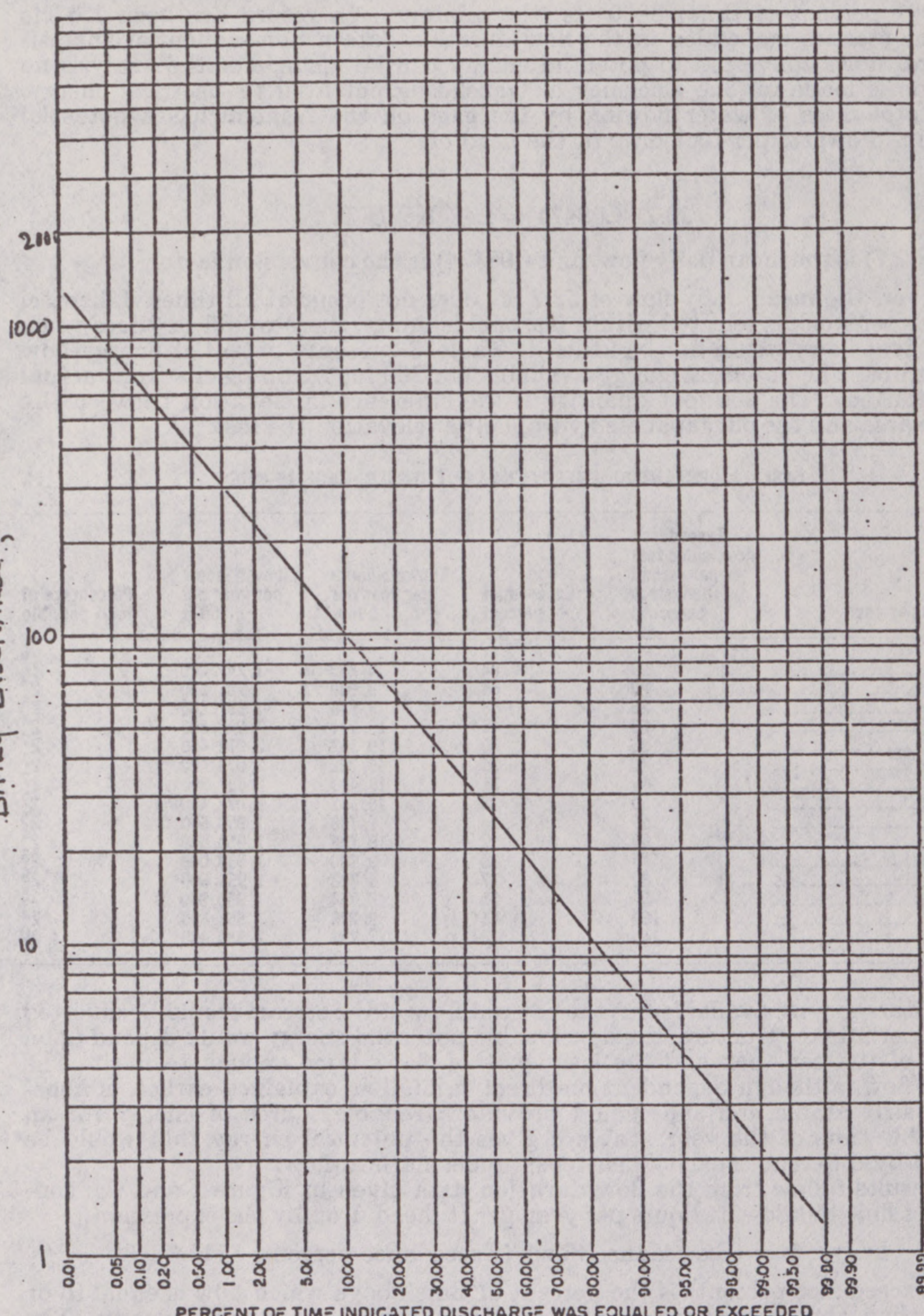
[Flow in cubic feet per second]

Stream	Gage	Coordination	Elevation feet	Drainage area, square miles	Average flow	Average flow, per mile	Minutes flow	Period of record
Nanepil	16–8976	6°55′11″N 158°12′36″E	390	2.93	52.7	18.0	1.6	Mar. 1, 1970–Sept. 30, 1975.
Lui	16–8979	6°55′30″N 158°12′55″E	270	.47	5.40	11.5	.13	Mar. 1, 1970–Sept. 30, 1975.
Lui	16–8982	6°57′07″N 158°13′16″E	40	2.06	2.79	13.5	.26	Mar. 1, 1970–Sept. 30, 1975.
Tawannu	16–8983	6°56′57″N 158°12′50″E	110	1.00	----------			Mar. 1, 1970–Dec. 31, 1974.
Lupwor	16–8986	6°54′15″N 158°09′45″E	100	1.12	----------			Sept. 1972–Sept. 30, 1975.

The diversion dam on the Left Branch rests on dense resistant basalt. Upstream to the U.S.G.S. gage the gradient is fairly flat, but about 500 feet above the gage additional resistant basalts crop out in the stream to cause rapids and a waterfall about 10 feet high. About 1000 feet upstream of the U.S.G.S. site an impressive high waterfall fills the gorge, its total height perhaps 100 feet. This waterfall is not shown on the U.S. Army Engineer map nor can it be inferred from the contour spacing on that map. Between the diversion dam and the U.S.G.S. gage the terrace bordering the river is too flat and wide for a dam and storage reservoir site. Above the gage the opportunities may be better. A rain forest covers most of the area above the diversion structure.

B. Potential energy

The duration curve of daily flows for the Nanepil River at U.S.G.S. gage 16–8976 is plotted in Figure 1. The flow frequency very closely follows a log-normal distribution.



FLOW DURATION DAILY FLOWS
NANEPIL RIVER
U.S.G.S. GAGE 16-8976
ELEV. 390 FT. AREA 2.93 SQ. MI.
RECORD; 3/1/70 - 9/30/75

The mean daily flow is 52.7 cfs, the median is 26.7 cfs, and the mode is 19 cfs. The maximum daily flow has been 1080 cfs and the maximum instantaneous flow (.001 percent of time) 8800 cfs; the minimum on record has been 1.6 cfs From the stastics embedded in the flow duration data a non-sequential analysis of natural flows converted to potential energy can be made. For the analysis no correction is made for the efficiency of translating potential to electrical energy.

The total mass of water flowing by the gage on the Nanepil has a potential energy in kilowatts per foot drop in the head of:

$$\underset{\text{CFs}}{(52.7)}\ (.08474) = 4.47\ \text{KW/FT},$$

where (52.7) is the mean daily flow, and (.08474) is the conversion factor

However, the mean daily flow of 52.7 cfs does not occur at all times. Likewise, whatever penstock is selected within reasonable limits, there would be times when greater river flows would not be utilized. Table 3 presents potential energy-flow relationships. The potential energy available per 200 foot drop results from actual field conditions. The 200 foot quantity is the difference in elevation between the gage site area and the old Japanese hydroplant at elevation 164 feet.

TABLE 3.—POTENTIAL ENERGY; NANEPIL U.S.G.S. GAGE 16-8976

Days per year	Exceedance flow, cubic feet per second (pennstock capacity)	Exceedance percent	kilowatt-hours per year per foot	kilowatt-hours per year per 200 ft	Percentage of total possible
308	10	84	6,235	1,247,000	16
221	20	60	8,908	1,781,800	23
192	25	53	9,836	1,967,200	25
166	30	46	10,244	2,048,800	26
145	35	40	10,392	2,078,400	27
128	40	35	10,392	2,078,400	27
113	45	31	10,489	2,097,800	27
102	50	28	10,392	2,078,400	27
88	55	24	9,798	1,959,600	25
80	60	22	9,798	1,959,600	25
69	70	19	9,690	1,938,000	25
60	80	17	9,798	1,959,600	25
53	90	15	9,754	1,950,800	25
46	100	13	9,279	1,855,800	24
26	140	7	7,794	1,558,800	20

If no storage were available but the natural flow of the stream would be diverted by a proper intake structure, the developable potential energy would depend upon the size of the penstock and the frequency of flows large enough to fill it. The Nanepil flow, although dependent on direct rainfall as explained earlier, is nonetheless fairly stable and thus could provide a reliable source of energy for an appreciable time of the year. Table 3 gives the potential energy that would be captured by different capacity penstocks under natural flow.

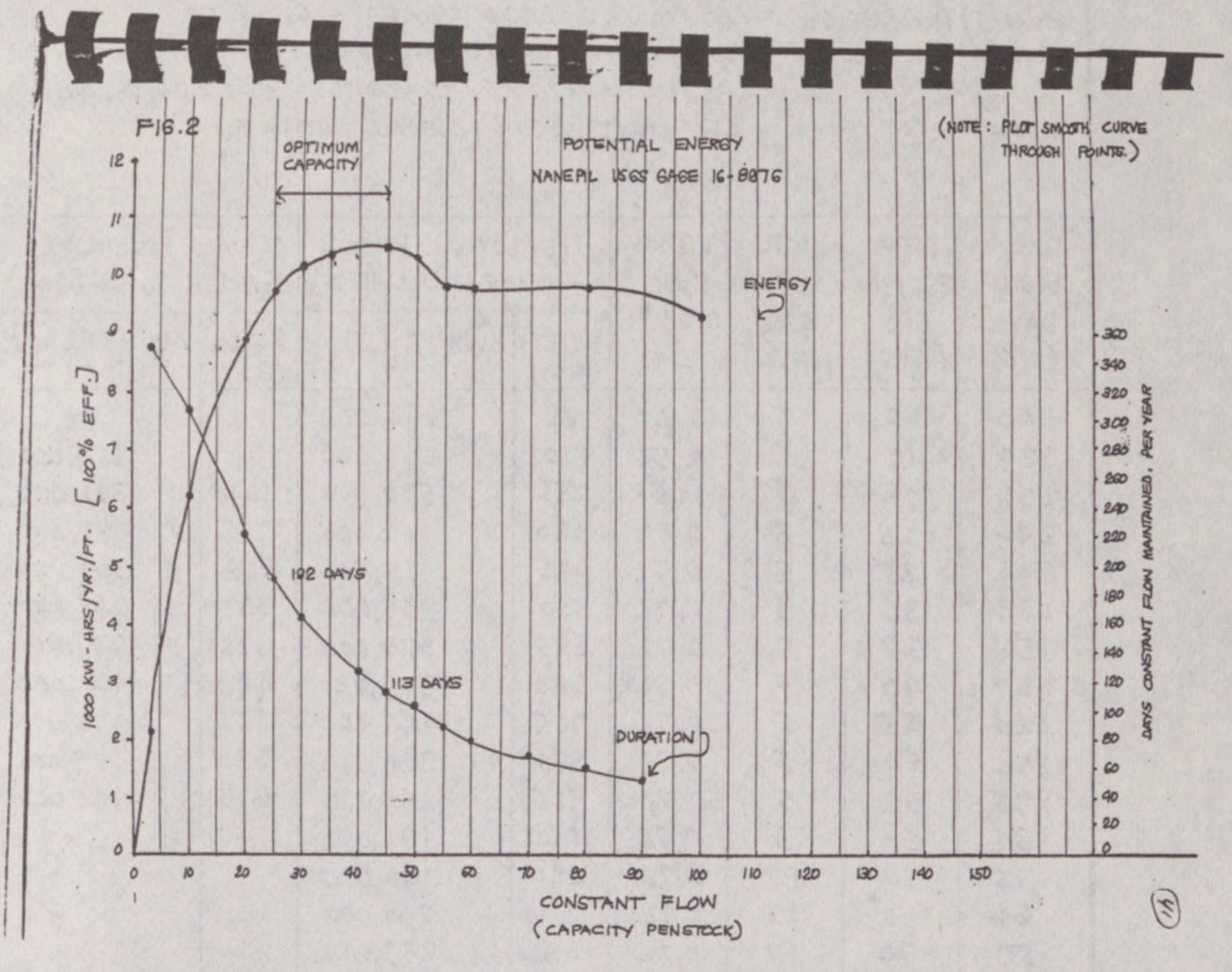
The results follow from the flow duration data given in Figure 1 and the conversion of flow to kilowatt hours per year per ft. head drop by the expression:

$$\text{kw—hr./yr./ft.} = (\text{Exceedance flow})\ (\text{Exceedance percent})\ (742.3),$$

where (exceedance percent) is the percent of time above which flow is equal to or greater than the exceedance flow, also equivalent to penstock capacity. The quantity (742.3) is the conversion factor. Also included in Table 3 is the number of days of the year for which flow is equal to or greater than exceedance flow, and therefore the number of days in which a given size penstock would be full. Another column lists in kilowatt hours the potential energy (at 100 percent efficiency) that would be produced each year if the fall in head were 200 feet. The last column gives the ratio of potential energy under natural flow conditions for given penstock size to total energy theoretically available, based on mean flow of 52.7 cfs. The analyses are based on daily flows. This model assumes that each day's flow is smoothed out by minimal type storage to assure that the average daily flow occurs uniformly throughout the day.

Figure 2 plots potential energy production per year against penstock capacity, and the duration of flow in days per year for each capacity. Optimum energy production under natural flow would be provided by an offtake capacity of 45 cfs, which would yield 2,097,800 kw./hr./yr./200 ft. but would operate only 113 days at the 45 cfs rate. The energy curve on Figure 2 slowly approaches the optimum

so that a capacity as low as 25 cfs over 200 feet would yield 1,967,200 kw.hr. but would operate over 192 days, somewhat over six months. The optimum capacity for the best production-duration condition would probably fall between 25 cfs and 45 cfs. In no case under natural flow would the energy produced account for more than 27 percent of the total available potential energy as computed from the mass flow of the stream. (Percent of total possible energy far exceeds flows and days per year is given in Table 3.)



A followup study [1] of the same site has assumed a maximum penstock size of 55 cfs, varying overall mechanical efficiencies (0.45 to 0.72), and 0.9 electrical efficiency. Based on these parameters, it is estimated that this installation could annually produce not over 2,557,000 KWH on an average rainfall year. Generation would be over an approximate 324-day period with outputs ranging from 92 KW to 673 KW from flows ranging from 10 to 55 CFS. (Refer to computation sheets 1 of 5 and 2 of 5.)

Overall, 45 percent of the potential energy would be converted to hydropower.

C. Reservoir alternative

To benefit from the total possible production of energy in the approximate area of the U.S.G.S. Station, a storage reservoir large enough to capture all flows in excess of the daily average flow would have to be built. Although the data base of 5 years is insufficient to accurately predict required storage capacity, a sequential analysis of flow by months was nevertheless made to provide a rough approximation of this capacity. The simplest model was used: given storages were ssigned to the start of the historical record, then the algebraic sum of inflow (+) and constant outflow (−), equivalent to average flow (52.7 cfs), was added to the remaining capacity at the end of each month.

A plot of the percentage of time that storage would go to zero, which is the same as the percentage of time flow would be less than the average of 52.7 cfs, against storage capacity is given in Figure 3. The curve suggests that storage somewhat in excess of 3 billion gallons would be required to guarantee the maximum possible 4.47 kw/ft. As per Table 3, the optimum natural flow production of potential energy is about 10,400 kw-hr/yr/ft. A reservoir one tenth the size of the maximum would yield the average flow of 52.7 cfs 50 percent of the time, resulting in potential energy production about two times better than the optional natural flow scheme could provide.

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[1] Keller & Gannon, Sept. 23, 1977.

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HYDRO-POWER GENERATION
NANEPIL RIVER - LEFT. BRANCH

PROJECT CAPITAL IMP. PROGRAM - PONAPE DISTRICT T.T. OF PACIFIC ISLANDS
SHEET NO. 1 OF 5 SHEETS

BASIC ASSUMPTIONS (43)

NET HEAD AVAILABLE = 200 FT.

KW (T) THEORETICAL = CFS FLOW x 0.08474 x 200 FT = CFS x 17

KW (A) ACTUAL = KW (T) x EFF (OVERALL MECH x ELEC) EFF ELEC = 0.9

KWH/YR (T) = CFS FLOW x 17. x DAYS x 24 HRS = CFS x DAYS x 40.8

KWH/YR (A) = KWH/YR (T) x EFF. (OVERALL MECH x ELEC)

EXC FLOW DAYS (AVG)	TOTAL EST. FLOW CFS (AVG)	INCR EST. FLOW CFS (AVG)	MECH-ELEC OVERALL EFF.	THEORETICAL POWER GENERATION - (EST)		ACTUAL POWER GENERATION - (EST)	
				KW (T) (EST)	KWH/YR (T) (EST)	KW (A) (EST)	KWH/YR (A) (EST)
340	5	5	0.45	85	694.000		—
324	10	5	0.54	170	661,000	92	‖ 357,000
289	15	5	0.63	255	590,000	161	‖ 371,000
246	20	5	0.72	340	502,000	245	‖ 361,000
205	25	5	0.72	425	418,000	306	‖ 301,000
179	30	5	0.72	510	365,000	367	‖ 263,000
156	35	5	0.72	595	318,000	428	‖ 229,000
137	40	5	0.72	680	277,000	490	200,000
120	45	5	0.72	765	245,000	551	176,000
108	50	5	0.72	850	220,000	620	159,000
95	55	5	0.72	935	194,000	673	140,000
84	60	5	0.72	1020	171,000	—	—
75	70	10	0.72	1190	306,000	—	—
64	80	10	0.72	1360	261,000	—	—
57	90	10	0.72	1530	233,000	—	—
49	100	10	0.72	1700	200,000	—	—
					5,655,000		2,557,000 (45% of AVAILABLE

‖ KWH/YR (A) AS RELATED TO PATSAREA (KEPIROHI) = 1,882,000 KWH

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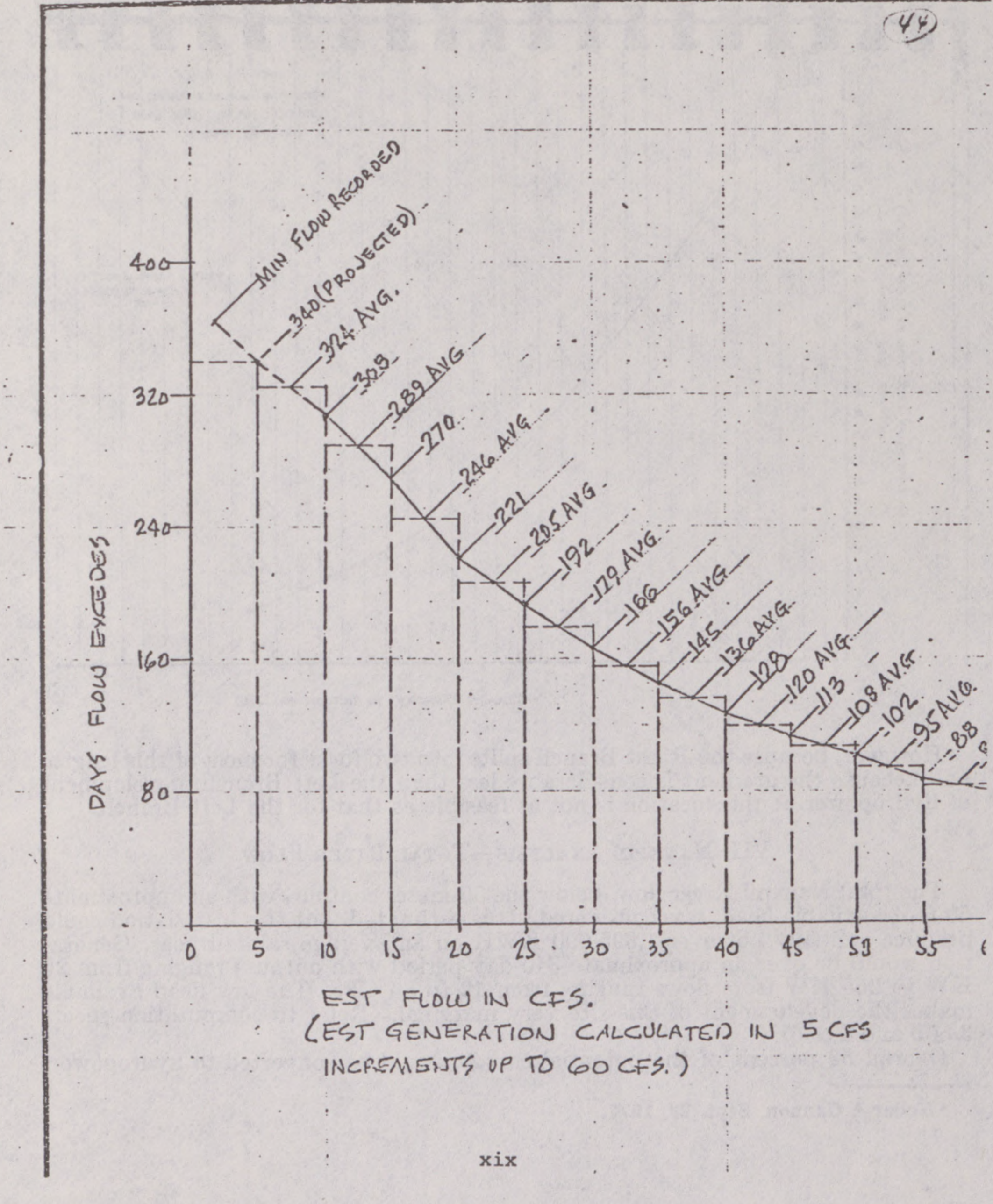
HYDRO-POWER GENERATION
NANEPIL RIVER - LEFT BR

PROJECT CAPITAL IMP PROGRAM - PONAPE DIST; T.T. OF PACIFIC ISLAN
SHEET NO. 2 OF 5 SHEETS

(44)



VI.. Nanepil Right Branch

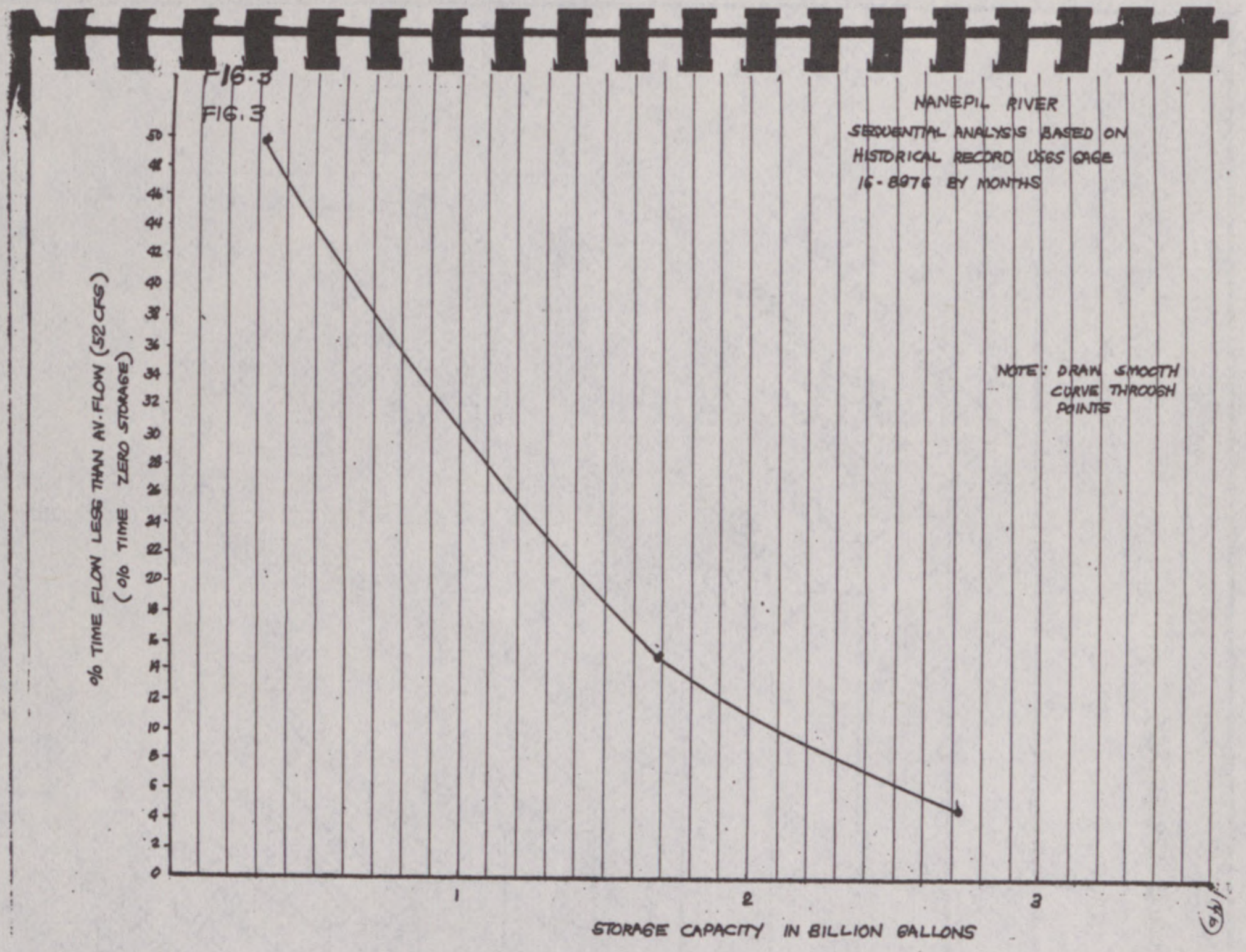
ANALYSIS

On the Right Branch of the Nanepil the drainage area above the 328 ft. (100 m.) contour totals 3.8 square miles but the Branch forks below the contour so that at 328 ft. two separate tributary basins of 1.4 square miles (left Fork) and 2.4 square miles (right Fork) comprise the total. This contour is about 1.5 miles above the confluence of the two main branches, while the comparable contour on the Left Branch is only 0.9 miles upstream.

Assuming that the entire Nanepil basin is hydrologically similar, the analyses performed on the Left Branch could be used for the Right Branch.

Similar potential energy calculations for the Right Branch of the Nanepil could be made by assuming perfect correlation between the two branches and correcting the dependent variables of flow in Figure 1 and kw-hrs/yr./ft. in Figure 2 by an area factor. The area above the 328 ft. (100 m.) contour on the Right Branch is 3.8 sq. miles, and therefore the correction factor is 3.8/2.93=1.3.

FIG. 3



However, because the Right Branch splits into two forks for most of this length, and because the gradient is considerably less than the Left Branch, development of hydropower at this location is not as feasible as that for the Left Branch.

VII. Nanepil Analysis—Total River Flow

The total Nanepil River flow, below the 50-meter contour, with an approximate 50-foot available head, was considered.[2] It is estimated that this installation could produce annually not over 1,395,000 KWH on an average rainfall year. Generation would be over an approximate 340-day period with outputs ranging from 26 KW to 255 KW from flows ranging from 12 to 86 CFS. The low head available makes the development of this site very marginal. (Refer to computation sheets 3 of 5 and 4 of 5).

Overall 53 percent of the potential energy would be converted to hydropower.

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[2] Keller & Gannon, Sept. 23, 1977.

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HYDRO-POWER GENERATION
NANEPIL RIVER (TOTAL)

PROJECT CAPITAL IMP. PROGRAM - PONAPE DISTRICT TT. OF PACIFIC ISLANDS
SHEET NO. 3 OF 5 SHEETS

(48)

BASIC ASSUMPTIONS:

NET HEAD AVAILABLE = 50FT.
KW (T) THEORETICAL = CFS FLOW × 0.08474 × 50 FT = CFS × 4.24
KW (A) ACTUAL = KW(T) × EFF (OVERALL MECH × ELEC) EFF(ELEC) = 0.9
KWH/YR (T) = = = CFS FLOW × 4.24 × DAYS × 24 HRS = CFS × DAYS × 102
KWH/YR(A) = = = KWH/YR (T) × EFF (OVERALL MECH × ELEC)

EXC. FLOW DAYS (AVG)	TOTAL EST FLOW CFS (AVG)	INCR EST FLOW CFS (AVG)	MECH-ELEC OVERALL EFF.	THEORETICAL POWER GENERATION - EST KW(T)	THEORETICAL POWER GENERATION - EST KWH/YR (T)	ACTUAL POWER GENERATION - EST KW(A)	ACTUAL POWER GENERATION - EST KWH/YR (A)
340	12	12	0.5	51	416,000	26	208,000
324	18	11	0.6	76	364,000	46	208,000
282	29	11	0.7	123	316,000	86	221,000
238	40	12	0.7	170	291,000	119	204,000
207	52	11	0.7	220	232,000	154	162,000
179	63	12	0.7	267	219,000	187	153,000
155	74	11	0.7	314	175,000	220	123,000
137	86	12	0.7	364	166,000	255	116,000
120	97	11	0.7	411	135,000	–	–
108	109	12	0.7	462	132,000	–	–
95	120	11	0.7	509	107,000	–	–
84	132	12	0.7	560	103,000	–	–
75							
					2,656,000		1,395,000

(53% OF AVAILABLE)

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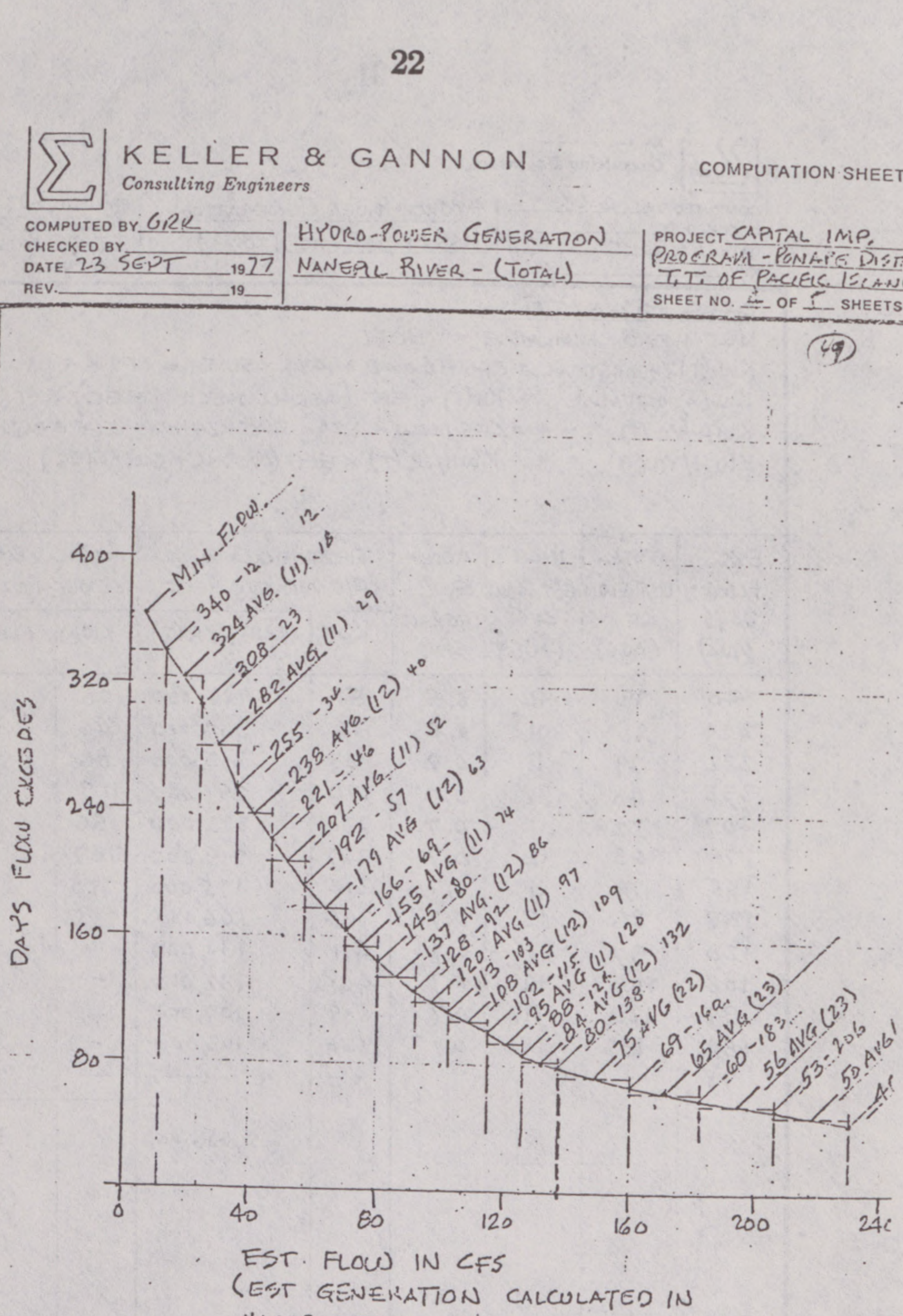
HYDRO-POWER GENERATION
NANEAL RIVER - (TOTAL)

PROJECT CAPITAL IMP. PROGRAM - PONAPE DIST. T.T. OF PACIFIC ISLANDS
SHEET NO. 2 OF 5 SHEETS

(49)



VIII. Kepirohi Waterfall

ANALYSIS

Near PATS on the east coast of Ponape the Kepirohi stream cascades as an approximately 50 feet high waterfall within 100 feet of the lagoon. The contour resolution of the U.S. Army map does not show this abrupt change in slope; it indicates instead, the top of the waterfall at 33 feet, (10m.) which is too low.

The face of the waterfall consists of jointed basaltic rocks. Below the falls, a thin layer of gravel and boulder alluvium fills the stream channel. Above, the stream flows over dense bedrock irregularly covered by large size alluvial material. For more than a mile inland of the falls, at least to elevation 328 ft. (100 m.), the valley is shallow and its gradient is relatively flat. There appears to be no

reasonable opportunity for a storage reservoir site. An intake structure would be easy to locate just above the falls, however, because the bedrock is firm and at the surface.

No continuous record of flow at the Kepirohi stream has been made nor do any miscellaneous measurements seem to be available. Flow at the waterfall can be estimated only by assuming a direct linear correlation with the flow per unit area at Nanepil. Linear correlation between streams on Ponape is reasonable because drainage basins that extend into the interior of the island have similar climate and geology, and therefore, hydrology. A correlation test of matched daily flows for U.S.G.S. gages 16–8982 on the Lui River and 16–8976 on the Nanepil gave a correlation coefficient of .78, suggesting that unit area flow frequencies are similarly distributed.

The values of the unit area flows may differ, however, if the total rainfall in the drainage basins differ. The Nanepil unit area flow is probably the highest for the island, but while that at Kepirohi may be somewhat lower, in the absence of any data at all, the assumption will be made that the unit area flows at Nanepil and Kepirohi are identical at 18.0 cfs/mi^2.

Relying on the above assumption, the flow duration curve for Kepirohi at the waterfall may be computed by applying a correction factor of 0.82 to the Nanepil (Left Branch) daily discharge frequencies plotted in Figure 1. The Kepirohi drainage area is 2.4 sq. miles while the Nanepil drainage (Left Branch) is 2.93 sq. miles. The average flow at Kepirohi should then be 43 cfs, the median 22 cfs, and the minimum flow 1.3 cfs. In figure 2, the same correction factor may be applied to the energy curve (the duration curve remains the same) to yield the optimum potential energy output under natural flow of about 8500 kw-hrs/yr/ft. at penstock capacitieis ranging from about 21 to 37 cfs. For a 50 feet head drop, this would yield approximately 425,000 kw-hrs./yr. at 100 percent efficiency.

Subsequent study[3] of the Kepirohi area indicates that this site might be developed to produce a head of 75-feet, but with a minimum of water storage similar to the Nanepil River area. Extrapolating from the Nanepil Left Branch data, it is estimated that this installation could produce annually not over 583,000 KWH on an average rainfall year. Generation would be over an approximate 324-day period with outputs ranging from 19 KW to 88 KW from flows ranging from 5 to 20 cfs. Power demands in the Kepirohi area could be relatively low; however, diesel-engine-driven power backup would be required for year-round power and periods of low water flow should the Kepirohi area not be served by the island-wide power system (Refer to computation sheet 5 of 5).

IX. Capital Equipment Availability

Although the United States' manufacture of smaller hydraulic turbine equipment has diminished to about one firm, this equipment has become readily available from European and Far Eastern manufactures. Capacity and performance data is relatively difficult to secur at this time, but it is anticipated that with the present enegy crisis there will be an increased interest in the manufacture of hydro equipment as a means of securing electrical energy production from every practicable source. Hydro power is a most attractive source being relatively pollution-free; however, especially in the smaller size facilities, capital cost investment can be high, resulting in high unit costs per KW. The need for diversion dams, forebays and long penstocks, in addition to the power plant equipment, accounts for the relatively high construction costs per KW generated. The fact that hydroelectric plants are usually constructed in remote and difficult locations adds to the above problem.

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[3] Keller & Gallon, Sept. 23, 1977.

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HYDRO-POWER GENERATION
P.A.T.S. AREA
KEPIROHI WATERFALL

PROJECT CAPITAL IMP PROGRAM - PONAPE DISTRICT I.T. OF PACIFIC ISLANDS
SHEET NO. 5 OF 5 SHEETS

P.A.T.S. AREA

RELATING P.A.T.S. AREA TO NANEPIL RIVER - LEFT BRANCH DRAINAGE AREA IN ACCORDANCE WITH THE HYDROLOGICAL STUDY:

1. AREA FACTOR = NANEPIL (L. BR.) × 0.82
2. RAINFALL FACTOR = SAME AS NANEPIL (L. BR.) = 1.00
3. ASSUMED NET HEAD AVAILABLE = 75 FT
4. TOTAL FACTOR = $0.82 \times 1.0 \times \frac{75}{200}$ = 0.31.
5. KWH/YR (A) P.A.T.S. AREA = KWH/YR (A) NANEPIL (AS NOTED ON COMP SHEET 1 OF 5.) × 0.31

KWH/YR (A) P.A.T.S. AREA = 1,882,000 × 0.31 = 583,000 KWH

6. KW (A) (FLOW 5 CFS) = 5 × 0.08474 × 75 × 0.6 = 19 KW (A)
KW (A) (FLOW 10 CFS) = 10 × " × 75 × 0.7 = 44 KW (A)
KW (A) (FLOW 20 CFS) = 20 × " × 75 × 0.7 = 88 KW (A)

X. Conclusions

As outlined in the hydrological study, the Left Branch of the Nanepil River appears to be the most attractive for hydro electric power development because of the availability of actual water flow data, terrain and accessibility. The lack of potential water storage sites limits this, and the other potential sources, to the development of low storage diversion and forebay installations. This, together with economic limitations on the sizing of the penstocks with relation to flowdays expectancy, results in a fairly wide divergence between available and usable hydro power. This, in addition to taking the mechanical and electrical generation equipment efficiencies into account, further reduces the useable power up to approximately 50 percent, depending upon available flows.

At the present time, the island's electrical power system has a demand in the 1,500–2,000 KW range without the expected addition of the new hospital and other new facility loads; therefore, it is readily apparent that the possible hydro electric power sources outlined above could not become an important factor with respect to supplying the island-wide power demands. Stated briefly, usable river flows are relatively low during substantial portions of the year; this, together with minimum storage capabilities, prevents hydro electric generation from having a serious impact on the present and ultimate island-wide power system and the sizing of the generation plants. However, with proper selection and control of the hydro generation plants, power thus generated could flow into the system on an "as generated" basis. The KWH thus generated would result in reduced fuel requirements for the island diesel electric plants. To allow an estimate of the fuel savings to be made for the various proposed hydro systems, a fuel rate of 0.078 gallons per KWH can be assumed.

The above comments are applicable to the Nanepil River system in the Municipality of Nett and the Kepirohi area in the Municipality of Metalanim. On the basis of economics, it may be difficult to justify any hydro project on the basis of fuel savings (KWH) alone. As a practical matter, that may be the total savings involved; however, as fuel costs continue to rise and its availability decreases for a remote island such as Ponape, the economics may become less of a factor in such a decision.

Appendix II

Economics of Hydroelectric Generation, Ponape Island, E. C. I., Ponape District, Trust Territory of the Pacific Islands

Introduction

Rain is a regular phenomenon in Ponape. And because of the volcanic nature of the island, the surface run-off resulting from the storms become streams and rivers which dissect the island.

At first glance it would then seem that hydro-generated electricity is a natural advantage of the island. Areas with less rain have been able to realize the development of hydroelectric power plants. So why not in Ponape where rainfall averages 195 inches per year?

That first glance has been focused specifically by the "Background Paper on Hydroelectric Power Generation on Ponape Island" developed and presented to OICC by this consulting Joint Venture as part of the Five Year Capital Improvement Program. However, a limited economic analysis was not included as part of the report. A "fine focusing" on the feasibility of hydroelectric power generation has been requested and is thus presented as this economic feasibility study.

The background paper presented analyses of the hydroelectric potential at two rivers: the Nanpil River and the Kepirohi Waterfall. Furthermore, the analysis Nanpil River included several schemes:

1. Development of an intake structure on the left branch of the river with connection to the power plant provided by an appropriately sized penstock;
2. Provision of additional storage by development of a reservoir on the left branch;
3. Diversion of flows from the right branch in similar fashion as in (1), above;
4. Diversion of flows from the total river flow.

The physical development analyses concluded that the Nanpil River's left branch afforded the best opportunities for hydroelectric power generation principally because of the magnitude of streamflow available and topographic constraints. This economic analysis will thus concentrate on the left branch of the Nanpil River and the two schemes envisioned for that branch will be separately compared to a diesel-fired power plant.

Problem Statement

Because the scope of this economic analysis is limited, it is first necessary to state the economic problem in a general context before comparing each of the hydroelectric schemes to a diesel power plant. The economic problem statement is presented as: Determine the feasibility of providing 750 KW of electricity through either a hydroelectric or a diesel power plant.

As is obvious, no mention is made of the role either type of plant will play in the overall electrical generation system for Ponape. This limitation presents certain problems especially with respect to determining costs involved when the Nanpil River's flows are insufficient with which to generate electricity. This aspect will be further discussed in a later section of the report. (The size of the power plant as stated above was determined as outlined in Appendix A. Details such as the determination of the size of the plant as well as other calculations supporting the analysis in this report will be presented as Appendices.)

As was concluded in the background paper, the feasibility of hydroelectric power generation depends on the relative amount of savings that can be realized through reduced consumption of diesel fuel. It is evident then, that the number of kilowatt-hours the diesel plant is operated bears significantly on the analysis. Let it be noted again that for the purpose of this analysis, the diesel plant will be assumed to operate the same number of hours as the hydroelectric plant. Such a

case must be considered hypothetical since the assumption presupposes that electricity is not needed on a year-round basis. This is acknowledged as being unrealistic and will be dealt with in the form of a sensitivity analysis subsequent to the strict economic comparisons.

Methodology of Analysis

Equivalent uniform annual costs (EUAC) will be used as the basis for comparison. The choice of annual costs over benefit/cost ratios and present worths is made for the simple reason that diesel costs will be incurred annually and will fluctuate on the same basis. It is thus felt that annual costs will not only shed light on economic feasibility, they will also give an indication of the sensitivity of the decision to fluctuations in the price of fuel.

The use of the EUAC does not omit the possibility of utilizing the benefit/cost ratio in certain areas of the analysis. And, of course, the same conclusions can be reached using either the benefit/cost ratio or the present worth costs—provided care and consistency in identifying costs are exercised throughout the analysis.

ASSUMPTION UNDERLYING THE METHODOLOGY

In utilizing equivalent uniform annual costs as a basis for comparison, certain assumptions must be stipulated, principal of which is the "minimum attractive rate of return (MARR)" or, as will be denoted in the analysis, the i*. For the purposes of the economic comparisons, the following assumptions are made unless otherwise noted:

1. MARR, i.e. i*=8.0%;
2. The effect of taxes is not considered significant;
3. Cost of land involved is presumed to be absorbed by the government and will not make a difference among alternatives;
4. In comparing alternatives with different lives or in arriving at the capitalized costs of equipment and facilities, it is assumed that the costs of replacement assets will repeat the costs that have been forecast for the initial asset;
5. Equivalent uniform annual costs = First Cost × Capital Recovery Factor (for factors, see Appendix D in Engineering Economy, 6th Edition, 1976 Grant, Ireson, Leavenworth);
6. Capital Recovery Factors for assets with lives longer than 100 years are equal to i*;
7. Salvage values of all equipment and facilities will be neglected.

Several of the above mentioned assumptions require justification and/or explanation.

Stipulation of a minimum attractive rate of return at 8 percent ensures that the government can make a decision which will account for the costs of money due to inflation and for the risks involved in the construction required for the hydroelectric alternatives. The capital costs for a hydroelectric plant, with or without reservoir, will be significant. Utilizing a high interest rate will assure that the government, if analyses prove it feasible, can invest captial improvement funds on the alternative and still realize a high return for the investment. If the analyses prove the alternative isn't feasible based on an i* of 8.0 percent, then the government can be assured that the funds should be invested for other "more worthwhile" ventures. In short, a high interest rate aids in the capital budgeting process.

Assuming that the costs of land involved will be absorbed by the government presupposes several things. First, that land involved will be government-owned. Secondly, that the land can be used for no other productive means. That is, that land, which may be inundated for a reservoir, cannot be utilized for development and/or agriculture, etc. And lastly, that the difference in costs that land may make with respect to each alternative is considered negligible by the government. These assumptions regarding land costs are made more for the sake of practicality in conducting the analyses than for any other reason.

The last assumption which requires explanation deals with the costs of replacement assets. An illustration should serve the purposes of this report adequately.

As will be evident later, the economic lives of a reservoir and a generator differ quite markedly. A reservoir is presumed to last 150 years while a generator only 20 years. That a replacement generator will cost the same 20 years hence of the initial investments all that is meant by replacement costs repeating initial costs. In reality, of course, such an assumption disregards the effects of inflation and/or technological advancements. However, the uncertainty of the future as well as practicality in conducting this limited economic analysis dictate that simplifying assumptions be utilized. Moreover, it is felt that the use of an i* equal to 8.0 percent accommodates just such uncertainties.

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Alternatives to be Evaluated

ALTERNATIVE I. DIESEL POWER PLANT

The diesel-fired power plant under consideration in this analysis has the following features:

1. Generating capacity: 750 KW;
2. Constant generation period=102 days;
3. Building dimensions: 30′ x 50′ x 20′;
4. A fuel delivery system consisting of a 2″ diameter pipe approximately 16,200 lineal feet;
5. Approximately 2.5 miles of overhead transmission lines from the power plant to the load center.
6. Operating manpower requirements will total 3.35 man-years considering the reduced operations necessary for compatibility with the hydro-plant;
7. Fuel consumption will total 143,208 gallons over a 102 day constant operating period.

ALTERNATIVE II. HYDROELECTRIC PLANT WITH PENSTOCK ONLY

The features of the hydroelectric plant scheme deriving its generating water from available streamflows only, i.e. without provisions for a storage reservoir are enumerated as follows:

1. A mile long, 36″ diameter penstock of reinforced concrete pipe exposed for ease of maintenance;
2. A steel surge tank with a 50,000 gallon capacity;
3. A 750 KW generating unit complete with a hydraulic turbine;
4. A building with dimensions of 30′ x 50′ x 30′ which includes both substructure and superstructure;
5. Operating manpower requirements, chiefly consisting of spot surveillance duties and totaling approximately 612 man-hours per year.

ALTERNATIVE III. HYDROELECTRIC PLANT WITH A RESERVOIR

The only additional feature this alternative has over Alternative II is the dam required to provide for storage of streamflows. As concluded in the background paper, a 300 million gallon reservoir should be able to provide the average flow of 52 cfs for half the year. Such a reservoir would require a dam approximately 60 feet long. It is anticipated that an earthen dam would be constructed to minimize construction costs.

Economic Comparisions

Tables 1A, 1B, and 1C outline the equivalent annual costs of the three alternatives for a generating period of 102 days. It is evident that, based on costs alone, Alternative II, the hydroelectric plant with only a penstock provided to divert flows, is most economical. The primary reason, as can be deduced from the annual cost breakdown, is the fact that the capitalized costs for the hydroelectric facilities approximate the costs for diesel fuel in generating over the 102 day period. The equipment costs that are chargeable to the diesel plant therefore become extra costs, especially since the hydroelectric plant also saves on operations and maintenance costs.

TABLE 1A.—ECONOMICS OF ALTERNATIVE I, DIESEL-FIRED POWER PLANT

Asset	Description	Life [1] (years)	1st cost	CRF [2]	EUAC [3]
Generator	750 kW	20	$101,200	0.10185	$10,307
Building	30 x 50 x 20	40	133,200	.08386	11,170
Fuel delivery system	2-in diameter pipe; 16,200 lin ft	20	54,000	.10185	5,500
Transmission lines	Overhead lines, 2.5 mi	15	100,000	.11683	11,683
Labor	4 employees per shift, 3 shifts, 102 days		[4] 4,000		13,414
Fuel	1,836,000 kWh, 143,208 gal		[5] .513		73,466
Maintenance	5 percent of capital investment				19,420
Total annual costs					144,960

[1] Source: Water Resources Engineering, Linsley & Franzini/"Electrical Power Cost Study," Dunn, District Planning Officer, Ponape.
[2] Engineering Economy, app. D, Grant, Ireson. Leavenworth (i=8 percent).
[3] 1st cost × CRF = equivalent uniform annual cost.
[4] Per man-year.
[5] Per gallon.

TABLE 1B.—ECONOMICS OF ALTERNATIVE II, HYDRO PLANT WITH PENSTOCK ONL

Asset	Description	Life [1] (years)	1 cost	CFR [2]	EUAC [3]
Penstock	36 in diam. etc RCP, exposed, 1 mi	50	$275,000	0.08174	$22,478
Surge tank	50,000 gal steel tank	40	30,000	.08386	2,516
Generator	750 kW complete with turbine	20	140,000	.10185	14,259
Building	30 x 50 x 30	40	200,000	.08386	16,772
Transmission line	3.8 mi	15	152,000	.11683	17,758
Labor	6 hr/day, 102 days		[4] 4,000		838
Maintenance	3 percent of capital investment				23,910
Total annual costs					98,531

[1] Source: Water Resources Engineering, Linsley & Franzini/"Electrial Power Cost Study, "Dunn, District Planning Officer, Ponape.
[2] Engineering Economy, app. D, Grant, Ireson, Leavenworth (i equals 8 percent).
[3] 1st cost times CRF equals equivalent uniform annual cost.
[4] Per man-year.

TABLE 1C: ECONOMICS OF ALTERNATIVE III, HYDRO PLANT WITH A RESERVOIR

Asset	Description	Life [1] (years)	1st cost	CRF [2]	EUAC [3]
Reservoir	60 ft high, 475 ft long earthen dam	150	$2,000,000	0.08000	$160,000
Penstock	36 in diameter, RCP exposed 1 mi	50	275,000	.08174	22,478
Surge tank	50,000 gal steel tank	40	30,000	.08386	2,516
Generator	750 kw complete with turbine	20	140,000	.10185	14,259
Building	30 x 50 x 30	40	200,000	.08386	16,772
Transmission line	3.8 mi	15	152,000	.11683	17,758
Labor	6 hr/day, 102 days		[4] 4,000		838
Maintenance	1 percent of capital investment				27,970
Total annual costs					262,591

[1] Source: Water Resources Engineering, Linsley & Franzini/"Electrical Power Cost Study," Dunn, District Planning Officer, Ponape.
[2] Engineering Economy, app. D, Grant, Ireson, Leavenworth (i equals 8 percent).
[3] 1st cost times CRF equals equivalent uniform annual cost.
[4] Per man-year.

It should be noted that the foregoing conclusion holds only for the case of a generating period not longer than 102 days. If electric generation is desired for a longer term, the physical resource constraints significantly influence the economics of hydroelectric generation.

It will be virtually impossible to generate electricity at the rated capacity by a hydroelectric plant simply because the Nanpil River's flows are insufficient to power the turbines. It therefore becomes necessary to supplement the hydroelectric plant with an alternative generating plant. It is thus unavoidable to discuss the role each type of plant will play in the overall electrical generating scheme for Ponape. It also becomes necessary to deviate from the hypothetical problem statement presented previously. But since such a discussion is outside the scope of work for this analysis, only a brief and superficial discussion will be presented in the form of a sensitivity analysis.

Sensitivity Analysis

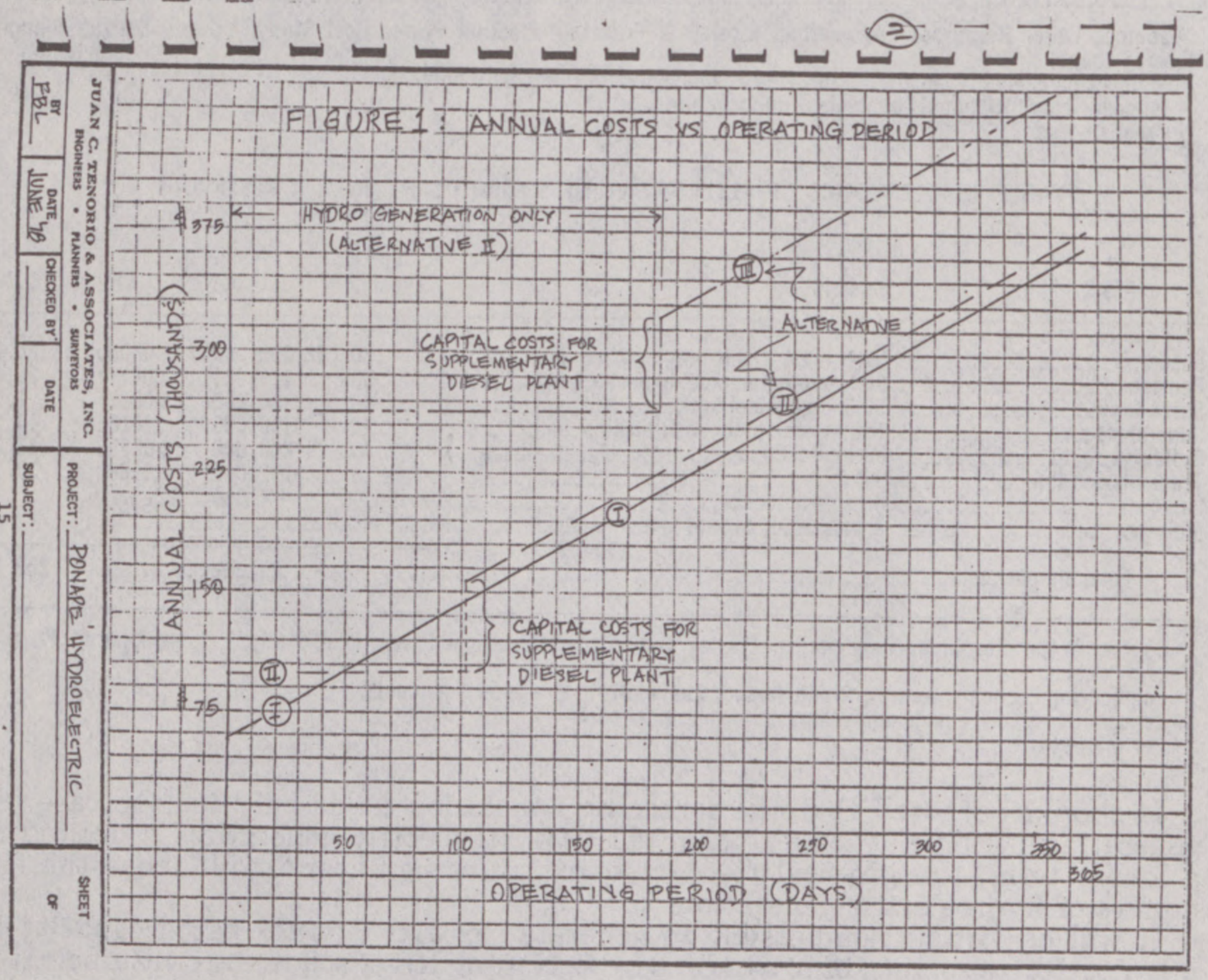
SENSITIVITY TO LENGTH OF OPERATING PERIOD

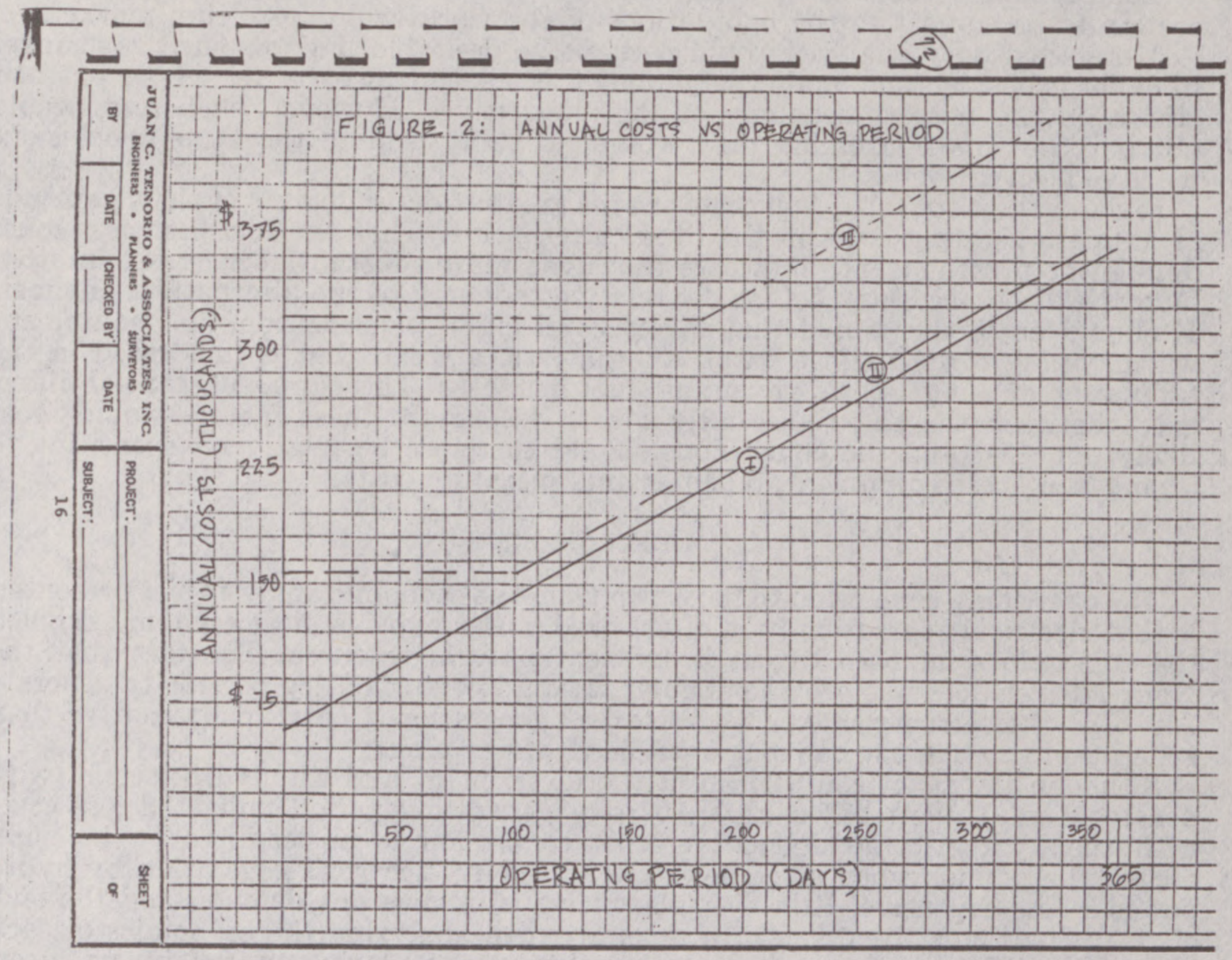
When electrical generation capability is required for a full year, Figure 1 indicates that the diesel generating plant becomes more economical. The reason, as shown on Figure 1, lies in the fact that when river flows are insufficient to generate electricity, the costs for the supplementary generating plant (assumed to be a diesel plant for the purposes of this analysis) including capital and operating requirements, place the costs of Alternative II above those for Alternative I. The conclusion that can be drawn is therefore that the diesel-fired plant is most economical for electrical generation over a year's time due to the physical resource constraints.

Figure 1 has been drawn to reflect the relative economy of all hydroelectric generating schemes during the 102-day period that the river flows are sufficient to

power the turbines. It is perhaps more correct to indicate that the costs for the supplementary diesel plant required to meet a full year's demand are chargeable to Alternative II at the start of the operating period rather than at the point when the supplementary plant is required. The resulting cost vs. operating period curve for Alternative II would lie entirely above the curve for Alternative I at every point during the year. Figure 2 depicts this situation and indicates that the diesel plant is the most economical alternative.

The cost curves shown in Figure 1 have been presented merely to shed light on the hypothetical problem statement. During the period when the hydro plant can meet the necessary electric demands, and if it could continue meeting that demand, then it would be more economical. The facts and realities prove otherwise.





SENSITIVITY TO INCREASES IN DIESEL FUEL COSTS

The annual costs that have been presented so far were detemined assuming that diesel costs would remain constant over a 20 year period, the economic life of the generator. It is of prime interest, however, to determine the effects of increases in fuel costs upon the relative economy of the alternatives in question.

Table 2 outlines the costs of each alternative for the indicated increases in diesel fuel costs. The tabulation of costs indicates that Alternative I (the diesel plant) becomes less economical than Alternative II (hydroplant with penstock only) when diesel costs are increasing at 15 percent per annum or greater. Alternative III cannot be considered to be economically justified since diesel costs must be increasing by 60 percent in order for it to be more economical than the diesel plant. Moreover, even if the costs of fuel were to increase annually at such a rate, Alternative III still fails in economic competition with Alternative II.

The conclusion is therefore that the relative economy of the diesel plant over the hydroelectric plants is somewhat sensitive to increases in diesel fuel, but that the increases must be equal to or greater than 15 percent per annum. It should be also noted that, based on the electric cost study conducted by the District Planning Officer, the 15 percent increase represents almost a doubling of tbe present trends in diesel fuel increases.

TABLE 2.—ANNUAL COSTS DUE TO INCREASES IN FUEL COSTS

Percent increase in fuel costs	Annual costs		
	Alternative I, diesel	Alternative II, penstock only	Alternative III, reservoir
0	$368,972	$380,623	$448,809
5	390,067	391,120	459,357
9	397,771	401,374	463,208
15	410,972	410,886	469,809
20	422,959	419,523	475,802
25	435,462	428,532	482,054
30	448,257	437,751	488,451
40	474,255	456,484	501,450
50	500,457	475,364	514,552
60	526,720	494,288	527,683
100	631,864	570,049	580,255

The probability of such an occurrence has not been investigated although it is certain to be subject to the fluctuations of the world-wide petroleum market.

More sensitivity analyses would perhaps be desirable. Factors such as changes in labor, construction, and/or equipment costs can also be tested as to their effects on the relative economy of the alternatives. However, such tests would not only be time-consuming they would probably lead to the same conclusions as have been arrived at.

It should be noted that fuel costs are the greatest determinants of the magnitude of annual operating costs in the diesel alternative. That the fuel increases must double the present trends indicates that even more substantial increases in other factors will be necessary before the relative economy of the alternatives changes. It should be further noted that increases in labor, construction, and equipment will have an upward effect on all alternatives, a trend that is illustrated in the tabulation of annual costs vs. annual fuel increases. Therefore, substantial differences between the three alternatives with respect to these factors would most likely not exist and the conclusions should therefore be relatively insensitive to changes in these equipment, facilities and operating costs.

Conclusions

The overriding conclusion to be drawn from the economic analysis just presented is that electrical generation by a diesel-fired power plant is most economical given the constraints imposed by an insufficient natural resource. The fact that the Nanpil River does not provide enough streamflow during dry periods to generate 750 KW of electricity makes hydroelectric generation a costlier alternative than generation through the conventional diesel power plant.

Although the strict comparison of the diesel plant and the hydroelectric (with penstock only) plant based on a 102 day generating period indicated less costs with the hydroelectric alternative, this conclusion is misleading. To be sure, during the periods when river flows are sufficient, electrical generation by hydro power is less expensive. However, electricity is in constant demand and the lack of river flows must be taken into account when analyzing the economics of each alternative. The need to operate a supplementary plant powered by an alternative form of energy during dry periods is a real cost chargeable to the hydroelectric plant.

That the diesel plant withstands the economic challenge of hydro power despite fuel increases of as much as 15 percent per year—nearly double the present increases in fuel costs—is yet another reason that justifies the overriding conclusion. However, it should be cautioned that when fuel increases approach the 15 percent level, the costs for each alternative must be carefully re-examined to determine which alternative provides electricity at the least cost.

The following recommendations conclude this report:

1. Reject the idea of constructing a reservoir to provide storage for hydroelectric generation during dry periods. It is too costly.
2. Reject the notion that a hydroelectric plant will be capable of meeting the base electrical demand in Ponape. The physical resource is inadequate to provide the needed electricity.
3. Consider the possibility of constructing a hydroelectric plant as part of the overall electrical generating scheme which would provide electricity on an "a s generated" basis. A substantial savings in fuel can be realized during the time s the hydroelectric plant is in operation and the fluctuations of the world-wide o market may be equalized by the fuel thus saved.

Basis for Comparison

I BASIS FOR DETERMINING SIZE OF POWER PLANTS

1. Average flow = 52.7 cfs
2. as per attached brochure, James Leffel & Co.

Proposition No. 1:

1000 Horsepower generator $\Longleftrightarrow$ 51.5 cfs

$$1000\ HP \times \frac{1\ KW}{1.34\ HP} = 746.27\ KW \quad \text{say } 750\ KW$$

II. BASIS FOR DETERMINING SIZE OF PENSTOCK:

USE $Q = 75$ cfs

$$Q = \frac{0.463}{n} D^{8/3} S^{1/2}$$ where n = roughness value, D = diameter, S = slope

assume $n = .015$ $S = .04$ FT/FT

$$D = \left[\frac{nQ}{.463 S^{1/2}}\right]^{3/8} = \left[\frac{.015(75)}{.463(.04)^{1/2}}\right]^{3/8}$$

$D = 2.6$ FT $= 31''$

USE 36" ϕ PIPE

JUAN C. TENORIO & ASSOCIATES, INC. ENGINEERS • PLANNERS • SURVEYORS				PROJECT: PONAPE HYDROELECTRIC	SHEET 1 OF
BY FBL	DATE	CHECKED BY	DATE	SUBJECT: ECONOMIC ANALYSIS	

III SENSITIVITY TO INCREASES IN DIESEL FUEL.

ASSUME COSTS INCREASE 8.8% or 9% as per Dunn "Electrical Power cost study"

YEAR	COST	
0	$ 131,400	131,400 X 1.09 = 143,226
		143,226 X 1.09 = 196,116
5	202,175	196,116 X 1.09 = 170,167
		170,167 X 1.09 = 185,482
10	311,071	185,482 X 1.09 = 202,175
15	478,624	

$131,400 (F/P, i, 15) = $478,624 Where (F/P, i, 15) denotes single payment compound amount factor

find i:

$$(F/P, i, 15) = \frac{478,624}{131,400} = 3.64$$

as per Appendix D, Engineering Economy

$(F/P, 9\%, 15) = 3.6425$

∴ increase in fuel at 9% cost is the same as compounding at 9% on the first year cost of $131,400

To get annual costs, use capital recovery factor with interest equal to the rate of fuel increases.

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BY	DATE	CHECKED BY	DATE	SUBJECT:	

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ANSWER		
DATE		

September 22 - 1977

PHONE MEMORANDUM AIR MAIL

Keller & Gannon
Consulting Engineers
560 Mission St.
San Francisco, California. 94105.

Attention; Mr. George Keller

Subject: Leffel W 77-2682
Hydro Study for
South Pacific Islands

In answer to your phone call of earlier today, we now have the following information for you.

We decided to figure on (1) wheel -and will call it PROPOSITION NO. 1. It is - 50 cubic feet per second - 200-ft., net head - and have figured a horizontal, spiral case, Francis turbine - 1200 RPM, and as given below:

% LOAD	H.P.	EXPECTED EFFICIENCY	-EXPECTED C.F.S.
1.00	1000	85.6	51.5
.95	950	87.8	47.7
.90	900	89.0	44.5
.80	800	89.0	39.6
.70	790	87.4	35.3
.60	600	85.0	31.1
.50	500	81.8	26.9
.40	400	77.0	22.9
.30	300	68.8	19.2

PONAPE DISTRICT

ELECTRICAL POWER COST STUDY

	1977	1978	1979	1980
Labor costs	$127,280	$142,935	$151,511	$160,602
Fuel costs	447,715	635,482	728,285	827,038
Depreciation	151,421	240,796	257,000	262,000
Capital costs at 15 percent	401,415	615,915	620,915	629,000
Miscellaneous	7,500	9,000	10,200	11,000
Total	1,135,331	1,644,128	1,767,911	1,889,640
Kilowatt-hours generated (millions)	10.53	14.0	14.7	15.4
Cost per kilowatt-hour	$0.108	$0.117	$0.120	$0.123
Rate charged	$0.03			

ELECTRICAL POWER RATE STUDY, DEC. 27, 1977

I. Power system:

A. 1. Power generation:

	Year	Life (years)	Value
(a) Old Powerplant 64 ft by 67 ft	1954	[1] 40	$346, 341
(b) New powerplant 50 ft by 100 ft	1975	[2] 40	402, 834
Total			749, 175

2. Engine generators complete with exhaust systems, cooling systems, engine panels, control panels, starting systems, etc:

(a) 500 kW Caterpillar	1965	15	114, 420
(b) 500 kW Caterpillar	1965	15	114, 420
(c) 500 kW Caterpillar	1965	15	114, 420
(d) 750 kW White Superior	1972	20	171, 630
(e) 750 kW White Superior	1973	20	175, 309
(f) 800 kW Caterpillar	[2] 1978	17	[3] 91, 333
(g) 800 kW Caterpillar	[2] 1978	17	[3] 91, 333
(h) 800 kW Caterpillar	[2] 1978	17	[3] 91, 333
Total			963, 898

3. Fuel delivery system:

(a) Pipeline:

Size and length:

2 in by 7,109 ft	1972	20	23, 681
2 in by 16,200 ft	1978	20	53, 966
Total			77, 647

(b) Storage tank capacity:

24,000 gal	1954	30	32, 000
24,000 gal	1957	30	38, 000
48,000 gal	[4] 1978	----------	72, 000
Total			142, 000

B. Power distribution:

1. Substations, Kolonia:

(a) Transformers:

50 kVA (3 each)	1971	20	3, 390
500 kVA (3 each)	1971	20	18, 000
Total			21, 390

(b) Oil circuit breakers, Westinghouse:

144GC250 (2 each)	1971	----------	2, 400

(c) High velocity switching equipment:

Type and make:

Hc5 Ideal Electric (8 each)	1965	20	----------
Westinghouse (2 each)	1971	20	----------
Square-D (1 each)	1971	20	----------
Total			1, 900

(d) Fencing:

Type, Height, and length:

Cyclone, 10 ft, 34 ft 3 in	1971	20	680
Cyclone, 10 ft, 50 ft	1975	20	1, 564
Total			2, 244

2. Distribution system:

(a) Transformers:

Kilovolt-ampere:	Make	Year	Quantity	Estimated life (years)	Estimated cost
3	Westinghouse	Various	1	20	$353
5	do	do	6	20	2, 400
10	do	do	33	20	19, 320
15	do	do	38	20	25, 125
25	do	do	89	20	67, 195
30	do	do	3	20	2, 625
37.5	do'	do	6	20	5, 850
45	do	do	3	20	3, 150
50	do	do	18	20	20, 340
75	do	do	6	20	9, 000
100	do	do	7	20	12, 600
500	Unknown	do	1	20	5, 960
Total					$174, 008

2. (b) Wood poles, with crossarms, insulators, hardware, down guys, span guys, etc.:

Height and class:	Year	Quantity	Estimated life (years)	Installed cost
30 ft, 4	Various	18	15	$9,000
30 ft, 6	do	87	15	43,500
35 ft, 6	do	16	15	9,120
40 ft, 4	do	294	15	296,940
45 ft, 4	do	22	15	25,300
50 ft, 4	do	18	15	22,680
80 ft, 4	do	4	15	5,920
Total		459		412,460

(c) Aerial distribution wires and cables:

	Cost
Primary circuits: 210,500 lin ft	$221,025
Secondary circuits: 4,500 lin ft	2,745
Total	223,776

(d) Underground distribution wires and cables:

	Cost
Primary circuits: 5,700 lin ft	$15,000
Secondary circuits: 1,200 lin ft	1,932
Total	16,932

	Quantity	Estimated life (years)	Cost
(e) Kilowatt-hour meters	474	20	$19,908

3. Maintenance equipment:

	Year	Estimated life (years)	Cost
(a) Vehicles:			
Type and make:			
Chevrolet Pole Cat 1	1970	10	$36,000
Chevrolet serVI. lift 1	1974	10	19,342
Total			55,342
(b) Hand tools and test equipment			16,400

II. Operation and maintenance cost:

	Cost
A. Personnel salaries:	
1. Administrative	(5)
Employee title	(6)
Kotelawala DPW	$10,000
Marcelino	10,000
Secretaries	9,600
Total	19,600
2. Power generation (with night differential): (a) 13 employees	57,906
3. Power distribution: (a) 16 employees	39,774
Total	127,280

B. Supplies and materials:

1. Power generation:

(a) POL:

	Unit	Annual use	Unit cost	Cost
Desc.:				
Diesel	Gal	885,736	$0.488	$417,612
Lube oil	do	7,700	3.90	30,030
Gasoline	do	100	.53	53
Grease	do	35	.56	20
Total				447,715

(b) Other:

Filter	Each	108	4.50	486
Rags	Bags	6	20.50	123
Cleaning compound	Gal	8	4.00	32
Miscellaneous				30
Total				671

1 Extensions made in 1957 and 1965.
2 Acquired in 1975. Will be placed in operation 1978.
3 Special price due to canceled Kwajelain contract.
4 To be completed 1978.
5 Salary.
6 Allocated.

	1977		
	Amount	Percent	1978
Powerplant	$749, 175		
Engines	963, 898		
Pipelines	77, 647		
Tanks	142, 000		
Pumps	2, 800		
Substation transformers	21, 390		
Oil circuit breakers	2, 400		
Switching equipment	1, 900		
Fencing	2, 244		
Transformers—distribution	174, 008		
Wood poles—complete	412, 460		$1, 430, 000
Aerial wires and cables—O.H	223, 770		
Aerial wires and cables—V.G	16, 932		
Kilowatt-hour meters	19, 908		
Maintenance vehicles	55, 342		
Hand tools	16, 400		
Total	2, 882, 274		4, 312, 274
Depreciation:			
Powerplants	749, 175	2.5	18, 729
Engines	963, 898	6.67	64, 292
Pipelines	77, 647	5.0	3, 822
Tanks	142, 000	3.33	4, 728
Pumps	2, 800	5.0	140
Substations/transformers	21, 390	5.0	1, 069
Oil circuit breakers	2, 400	4.0	96
Switching equipment	1, 900	4.0	76
Fencing	2, 244	4.0	89
Transformers—Distribution	174, 008	5.0	8, 700
Wood poles and hardware	412, 460	6.67	27, 494
Distribution wire—O. H	223, 770	5.00	11, 188
Distribution wire—V. G	16, 932	6.67	1, 129
Kilowatt-hour meters	19, 908	5.0	995
Maintenance vehicles	55, 342	10.0	5, 534
Tools	16, 400	20.0	3, 280
Total			151, 421

Note: 1978: $1,430,000 times 6.25 percent equals $89,375 plus $151,421 equals $240, 796.

WOOD POLES [1]

	Quantity	Materiel cost	Installed cost	Total cost	Acquisition cost
Height and class:					
30 ft, 4	18	$400	$100	$500	$9, 000
30 ft, 6	87	400	100	500	43, 500
35 ft, 6	16	450	120	570	9, 120
40 ft, 4	294	800	210	1, 010	296, 940
45 ft, 4	22	900	250	1, 150	25, 300
50 ft, 4	18	1, 000	260	1, 260	22, 680
80 ft, 4	4	1, 200	280	1, 480	5, 920
Total	459				412, 460

[1] Span guys, down guys, hardware, and crossarms.

POLES 410—TRANSFORMERS

	Quantity	Cost	Installed	Cost plus Installation	Total cost
Kilovoltampere size:					
3	1	$212	$141	$353	$353
5	6	250	150	400	2, 400
10	42	300	160	460	19, 320
15	41	435	180	615	25, 215
25	89	505	250	755	67, 195
30	3	600	275	875	2, 625
37. 5	6	675	300	975	5, 850
45	3	700	350	1, 050	3, 150
50	18	740	390	1, 130	20, 340
75	6	1, 050	450	1, 500	9, 000
100	7	1, 300	500	1, 800	12, 600
500	1	5, 360	600	5, 960	5, 960
Total					174, 008

DIESEL FUEL

[Consumption 12.31 gal/kWh]

	1977	1978	1979	1980
Kilowatt-hours generated (millions)	10.53	14.0	14.7	15.4
Cost of fuel [1]	0.488	0.53	0.58	0.63
Gallons of fuel [2]	855,402	1,137,266	1,194,151	1,251,015
Fuel cost	$417,436	$602,750	$692,607	$788,139
Lube oil [1]	30,030	32,732	35,678	38,889
Total	447,466	635,482	728,285	827,038

[1] Increase 9 percent.
[2] Increase 5 percent.

Note: 1,800 kW average load. 10,530,000 divided by 1,800 equals 5,850 kWh/kW. 2,300 times 5,850 equals 13,460,000 kWh. 10.53 times 0.05 equals 0.53/13,990,000 kWh.

POWERPLANT

DIESEL FUEL CONSUMPTION

[In gallons]

	1974	1975	1976	1977
January	59,600	----------	64,700	67,150
February	59,600	----------	63,920	73,750
March	65,200	----------	66,670	64,510
April	61,438	----------	63,930	67,380
May	64,048	----------	64,580	78,900
June	59,600	----------	[1] 65,350	73,780
July	55,170	----------	64,700	67,660
August	60,995	----------	61,690	68,720
September	60,450	----------	67,090	71,590
October	65,810	----------	67,980	73,900
November	65,130	----------	64,480	77,110
December	67,889	----------	63,810	NA
Total	744,930	----------	788,970	784,450
12 mo	855,754	----------	778,970	855,754
	744,930	----------	744,930	----------
	110,824	----------	34,040	----------

[1] 536 m in use.

Note: 110,824 divided by 3 equals 36,941. 36,941 divided by 744,930 equals 0`0495. 110,824 divided by 744,930 equals 0.1488.

POWER GENERATED

[In kilowatt-hours]

	1974	1977
January	432, 300	803, 400
February	432, 300	874, 200
March	650, 200	925, 000
April	667, 900	648, 400
May	810, 500	967, 000
June	525, 100	864, 000
July	525, 000	711, 000
August	623, 900	1, 154, 000
September	723, 000	982, 000
October	973, 200	898, 800
November	607, 200	825, 400
December	687, 000	NA
Total (11 mo)	7, 257, 600	9, 653, 200
12 mo		10, 530, 763

Note: 10,530,763 divided by 7,257,600 equals 1.45. 45 divided by 3 equals 15-percent increase per year.

FUEL COST

	Year	Gallon
February	1976	$0. 431
September	1977	.488

Note: 0.488 minus 0.431 equals 0.057 divided by 18 equals 0.003167 per month/0.038 per year. 0.038 divided by 0.431 equals 8.8 percent per year.

Appendix III

Report on a Mission to the Pacific Region (November 4 to December 21, 1978)

By Robert Dijon, International Adviser, Water Resources Branch, Centre for Natural Resources, Energy and Transport, United Nations Department of Technical Cooperation for Development

1. Tahiti (French Polynesia), November 4 to 7.
2. Rarotonga (Cook Islands), November 7 to 9.
3. Niue, November 9 to 10.
4. Apia (Western Samoa), November 11 to 13.
5. Funafuti (Tuvalu), November 15 to 16.
6. Suva/Nadi (Fiji), November 16 to 23.
7. Ebeye (Marshall Islands TTPI),[1] November 27 to 30.
8. Ponape (Caroline Islands TTPI), December 1 to 7.
9. Yap (Caroline Islands TTPI), December 8 to 12.
10. Saipan (Mariana Islands), December 12 to 18.
11. Bangkok (Thailand), December 20 to 21.

* * * * * * *

Trust Territory of the Pacific Islands (Micronesia)

GENERAL

A. Trusteeship territory of the United Nations since February 1947, and which will come to an end in 1981, Micronesia covers an area of three million square miles in the Pacific. Southern boundary is the Equator. Dimensions are about 2,000 km North to South and 4,200 km east-west. Total land area amounts to 1,800 km² on more than 2,000 islands of which 97 are inhabited.

The climate of the TTPI is tropical humid. Relative humidity is in the range of 80 percent. Rainfall decreases from the south (3,000 to 4,000 mm per year), to the north (1,500 to 2,200 mm); the seven districts are:

Northern Marianas: High rise islands (now a U.S. Commonwealth) (population 15,000);
Yap: High rise (volcanic/metamorphic) island (8,500);
Palau: High rise (volcanic/metamorphic) island (13,500);
Ponape: High rise volcanic islands, and atolls (21,000);
Kusaie: High rise volcanic island (4,500);
Truk: High rise volcanic islands and atolls (35,000);
Marshalls: Coralline atolls (27,000);
Total: about 125,000.

The districts which requested the visit of the adviser were the Marshalls (Ebeye), Ponape and Yap.

* * * * * * *

PONAPE (TRUST TERRITORY OF THE PACIFIC ISLANDS)

The visit to Ponape included:

(1) Discussions with: Mr. Bermin Weilbacher, Acting Governor; Mr. Strik Yoma, Acting Lieutenant Governor; Mr. Saraphin James, Assistant Planning Officer; and Mr. Jitsuo Nishimura, Agricultural Station Rice Project.

(2) A review and an analysis of the following documents:

Master Plan for Physical Planning—Ponape Island. Final report. Hawaii Architects and Engineers Inc., November 1968.

Five year Indicative Development Plan. Panpoe District 1976–81.

Long-range operations and maintenance plan for infrastructure, (1979–88), Department of Public Works TTPI, April 1978.

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[1] Trust Territory of the Pacific Islands.

Report to the Congress of Micronesia on Water Resources, by G. Finlanson, Chief, Water Resources Section, *ESCAP*. April 1976, (pages 22 to 30 of that report deal with the water resources situation in Ponape at that time).

Background paper of Hydroelectric Power Generation on Ponape Island. Juan Tenorio and Assoc. Inc/Thomas J. Davis Inc., Guam 1977.

Economics of Hydroelectric Generation—Ponape Island. Juan Tenorio and Assoc. Inc./Thomas J. Davis Inc., Guam 1978.

(3) A field visit to the rice cultivation project in Lukop (the dam site on Nanapil river could not be visited, as no 4-wheel drive vehicle could be made available).

Background information

Ponape is a high-rise volcanic island with eleven peaks of over 2000 feet (600m) elevation. Maximum diametre of the roughly pentagon-shaped island is 21 km. Land area is 325 km². Total population is about 21,000 (1978) of which about 8000 are concentrated in the district capital, Kolonia, and its surroundings, which grows rapidly. The other 13,000 are scattered along the narrow coastal strips which outflank the volcanic core of the island, practically uninhabited. About 50 percent of the population are under 15 years of age. Population growth rate exceeds 3 percent.

Rainfall is abundant and quite regular. Yearly rainfall is about 200 inches (5 metres) on the coast, twice as much in the centre of the island covered by a thick tropical rain forest. The country is fertile and would be self-sufficient in food production (including fish and pork meat) if the dietary habits of the population had not changed significantly as a result of large imports of wheat flour, rice, frozen meat and poultry, canned food; all of these products are now in great demand.

The headings of this short mission report are those of the 7-page section on Ponape contained in Mr. Finlanson's report. This will enable the evaluation of the changes which have occurred in the course of the last 2½ years.

(a) *Municipal and industrial water.*—Water for Kolonia municipal supply system originates at an elevation of about 100m above sea-level from an intake located on Nanapil river which feeds four strategically located storage tanks with a total storage capacity of 3.5 million gallons (14,000 m³).

The distribution system supplies 580 customers, of which 440 are metered, and 27 (unmetered) governmental customers. Some 30 million gallons per month of water (1 million or 4,000 m³ per day) are tapped by the water intake on Nanapil river while about 11 million only are metered (October 1978).

This means that the losses and waste amount to at least 40/50 percent of the water production. Effective per capita consumption may be in the range of 250 to 300 litres (60 to 75 gallons) per day which is fairly high by all standards (equivalent to average consumption in large cities of Western Europe). The system is gravity fed and delivers treated water. Most of the year (250 days) the average flow of the river at the intake exceeds 700 1/s (or 60,000 m³/day). It is therefore unlikely that Kolonia will suffer from a shortage of water in the years to come if the water treatment and distribution systems are adequately managed and maintained.

The modest industrial projects mentioned in the Indicative Development Plan do not call for large quantities of water (most of the projects are agriculture-oriented and are located outside of Kolonia area).

Regarding village water supply, there are requests for improvements, especially in villages which can be reached only by sea-barge. One project is under consideration for the supply of 400 inhabitants by means of a dam feeding a distribution system. The cost of the project may be in the range of $120,000, which is an investment of $300 per capita, which seems fairly high as compared with generally accepted standards ($80–100 is considered a maximum in many countries; UNICEF has developed elementary drinking water schemes which call for an investment of $10–20 per capita at most.

(b) *Agriculture.*—If substantial projects for rice, vegetable and other crops are developed, irrigation water will have to be provided during the "dry season" (January–March).

It is estimated that 1000 to 1500 acres (400 to 500 hectares) could be developed for rice cultivation on Ponape island, which would cover most of the present needs. In his report, Mr. Finlanson mentions the objective of "228 acres in full production" to be reached by year 1980. It is now expected (December 1978) that some 160 acres will be in production in 1979, according to most recent estimates, in Lukop area (Metalanim). In that area, 400 acres (160 hectares) can be cultivated if irrigation is provided which will probably require that a storage dam be constructed.

However, it is unlikely that the need for additional irrigation water will materialize, say before 5 years at least, due to the slow rate of increase in rice cultivated areas over the year. That slow rate is due to several factors: unfavourable topography and soil conditions (insufficient drainage), rapid growth of jungle vegetation on vacant lots, diseases affecting rice plants, birds damaging the crops, high cost of labour, lack of incentive to the population to work under difficult conditions in rice fields.

Nevertheless, if someday it appears necessary and feasible to develop all of the potential acreage of Ponape suitable for the cultivation of cash crops (1,500 to 2,000 acres) an inventory of the water sources available for irrigation will have to be made together with a selection of dam sites (including specification). Some of such projects may be designed to serve a dual purpose: irrigation and power generation.

3. Electric power generation

In his report Mr. Finlanson recommends that a study be made of the hydropower potential of Nanapil river (which may be in the range of 600 to 1,000 kw) to the north, and of Lihnmasi river (to the south-west).

Preliminary studies of hydropower production on Ponape rivers were made by Tenorio and Davis. Development of hydropower was recognized as feasible technically (1977) but generally not economical (1978).

It has to be mentioned that quite recently (early this year) a new generating power station was put into operation at Nanpohnmal, about two miles from the old station (equipped with two 750 kw and three 50 kw diesel generators, still operating. The new station was designed so as to receive six 800 kw diesel generators of which three are installed and in operation. It is likely that this project will cover the needs for the 5 to 10 years to come if the "old" station is still running by then. Therefore, the development of hydropower production is not considered a priority in Ponape unless a deep energy crisis is expected.

A summary of the main data and conclusions of the Tenorio and Davis reports is presented hereafter:

Three sites are considered in the 1977 study: Two on Nanapil river, to the north of Ponape island; and one on Kepirohi waterfall (Metalanim) to the East (the Lihnmast river potential—to the south-west, mentioned in Mr. Finlanson's report, is not considered).

(i) *Nanapil river (left branch), Run-of-the-river hydropower potential.* Topographic features command the location of the site at elevation of about 100 metres above sea level. The United States Geological Survey has installed in 1971 (and operated since then) a gauging station on the Nanapil river. That station commands a watershed of 2.93 sq. miles (7.5 km^2) which can be considered the wettest part of the entire Nanapil watershed (11 square miles or 27.5 km^2). It is located on an elevation of 120 metres, 150 metres upstream of the water intake of the Kolonia municipal supply system, on the left branch of the river. Values of the flow are:

	Cubic feet per second	c/s
Average flow	52.7	1,420
Median flow	26.7	720
Maximum daily flow	1,080.0	29,160
Maximum instantaneous flow	8,800.0	237,600
Minimum flow	1.6	43

The total mass of water crossing the gaging station has an energy of 4.47 kw per foot (or 13.5 kw per metre). The exploitable head between the station and the site of the former Japanese hydroplant is about 200 feet (60m). Potential production is estimated at 2.5 million kwh annually as a maximum over a 324 day period, with outputs ranging from 92 kw to 673 kw. Overall, 45 percent of the potential energy would be converted to hydropower.

(ii) *Nanapil river; left branch, storage reservoir.*—It is estimated that energy production would be about two times better (4.5 to 5 million kwh annually, if a 300 million gallon storage reservior (1.2 million m^3) is added.

(iii) *Nanapil river, right branch.*—Natural conditions are less favourable here and projects will be more costly; however, the potential which can be developed there is theoretically of *the same order of magnitude* (if not slightly greater) than that of the left branch.

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(iv) *Nanapil river, total flow, run-of-the-river hydroplant.*—Such a project at an elevation of about 50 metres above sea level (15m head) may generate only 1.4 million kwh per year for a 340 day period.

(v) *Kapirohi waterfall, run-of-the-river.*—No flow data available. Drainage area is 2.4 square miles. Median flow would be 22 cfs. For a 75 foot head drop (22m) with minimum storage the production would not exceed 583,000 kwh per year (for a 324 day duration).

Comments

It seems that nearly 10 million kwh could theoretically be produced per year on the sites described above if proper storage is built. That represents the consumption of 1977 (10,530,763 kwh). Linhmasi river is not included in that assessment. Each kwh produced by a hydroplant saves an import of 0.08 gallons of fuel.

However, the government has not considered the development of hydropower a priority, and no mention of such a project is made in the 5-year plan. Instead, a considerable capacity for the production of diesel-generated electricity has been developed as a result of the construction of the Nanpohnmal plant. Such a policy finds its justification in the report on "Economics of Hydroelectric Generation, Ponape Island" by J. Tenorio and T. Davis.

The economic analysis concentrates on the most economical projects, that of Nanapil river (left branch). It applies to the provision of 750 kw of electricity in 102 days in a year (which is possible for that period, by means of a run-of the-river hydroplant.) On the basis of various hypotheses, the costs are estimated for the period of time as follows:

Alternative 1, diesel-fired power plant, $144,960.
Alternative 2, hydroplant (run-of-the-river), $98,531.
Alternative 3, hydroplant (reservior), $262,591.

For a full year (365 days) Alternative 1 is considered more economical because Alternative 2 is to be complemented by a thermal plant during 365—102=263 days.

Alternative 3 is considered much too expensive in all cases.

It is estimated that Alternative 2 may become economical if fuel costs are increasing at a rate of 15 percent per year.

The overall conclusion of the study is that diesel electric generation is the most economical in Ponape "given the not-too-favorable hydrological conditions." The recommendations are that:

(1) The construction of reservoirs would be costly and should be disregarded.
(2) One hydroelectric plant (only) will not meet the electrical demand.
(3) An hydroelectric plant could be part of an overall electrical generating scheme. It would provide complementary electrical production on an "as generated" basis.

Conclusion

Theoretically speaking, enough hydropower potential is available in Ponape to cover most of present electrical consumption (10 million kwh 1977), 45 to 50 weeks per year. However, due to the high capital costs, and the technical complexity of hydropower projects, the government has chosen to develop a considerable capacity for the production of diesel generated electricity (Nanpohwmhal plant).

It is clear, however, that one of the ways towards self-sufficiency in Ponape is through the development of one of its major natural resources: water, through irrigation and hydropower projects (possibly in combination).

Recommendations

The United Nations could assist the government in Ponape—and especially in view of the possible transfer of the central government of the TTPI from Saipan to Ponape—in an evaluation of the water and hydropower potential and of their development in a long-term prospective.

As a first step, it is recommended to make available the following documents to the Centre for Natural Resources, Energy and Transport, Water Branch, Room DC–700, United Nations, New York, through the UNDP Regional Representative for the Pacific in Suva (Fiji):

Topographical map of Ponape;
Rainfall and hydrological records (USGS);
Statistics on energy consumption (1970–78); and
The two Tenorio/Davis reports for review and detailed evaluation and comments.

As a second step, an assessment of the water resources potential and an identification of potential dam sites, both for irrigation and power production (with basic specifications) could be made (if the government is interested) through a modest UNDP/UN project at a cost which may not exceed $100,000.

Any comments on this report and especially its conclusion and recommendations (and rectifications of possible errors) are to be directed to the United Nations (Department of Technical Co-operation for Development, Asia and Pacific Branch) through the UNDP Regional Office in Fiji.

* * * * * * *

Appendix IV

Excerpts From Stream Flow Records, Island of Ponape, U.S. Geological Survey



FIGURE 16.--MAP OF PONAPE, SHOWING LOCATIONS OF GAGING AND PARTIAL-RECORD STATIONS.

Caroline Islands, Island of Ponape

16897600 NANEPIL RIVER

Location.—Lat 6°55′11″ N., long 158°12′36″ E., on left bank 1.4 miles northeast of Mount Tamatamansakir and 1.4 miles southeast of Rekisau.
Drainage area.—2.93 sq mi.
Period of record.—March to September 1970.
Gage.—Water-stage recorder. Altitude of gage is 390 ft (from topographic map).
Extremes.—Maximums and minimums (discharge in cubic feet per second, gage height in feet).
Remarks.—Records fair. No diversion above station.

ANNUAL MAXIMUM DISCHARGE AND PEAK DISCHARGE ABOVE BASE (2,000 FT³/S), MARCH TO SEPTEMBER 1970
WATER YEAR, 1970

Date	Time	Discharge	Gage height
Maximum:			
Apr. 26, 1970	0200	2,460	[1]6.52
July 25, 1970	1330	2,760	6.62
Aug. 29, 1970	1430	2,700	6.60
Sept. 4, 1970	1100	3,450	6.85
Minimum:			
Mar. 3–6, 23, 1970		3.8	

[1]Floodmark in well.

Note: Discharge determined from rating curve extended above 110 ft³/s.

DISCHARGE, IN CUBIC FEET PER SECOND, MARCH TO SEPTEMBER 1970

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1						5.4	4.3	10.0	48.0	39.0	22.0	41.0
2						4.9	16.0	42.0	25.0	37.0	9.2	27.0
3						4.3	16.0	21.0	16.0	26.0	56.0	17.0
4						4.3	8.4	11.0	11.0	101.0	42.0	121.0
5						4.3	21.0	20.0	26.0	39.0	35.0	38.0
6						4.3	163.0	17.0	123.0	20.0	31.0	25.0
7						41.0	179.0	11.0	35.0	34.0	16.0	43.0
8						9.2	31.0	25.0	100.0	52.0	32.0	23.0
9						30.0	57.0	91.0	40.1	23.0	35.0	14.0
10						273.0	26.0	99.0	31.0	16.0	71.0	198.0
11						72.0	79.0	23.0	100.0	30.0	47.0	100.0
12						20.0	88.0	16.0	53.0	61.0	48.0	67.0
13						11.0	35.0	22.0	63.0	21.0	88.0	35.0
14						8.4	24.0	13.0	53.0	17.0	43.0	19.0
15						6.8	17.0	31.0	29.0	13.0	26.0	17.0
16						5.7	12.0	84.0	42.0	163.0	14.0	19.0
17						5.2	11.0	99.0	102.0	26.0	22.0	10.0
18						5.4	20.0	42.0	39.0	14.0	23.0	12.0
19						4.9	10.0	28.0	20.0	30.0	101.0	23.0
20						4.6	8.0	191.0	15.0	26.0	56.0	18.0
21						4.6	38.0	62.0	16.0	24.0	115.0	12.0
22						5.4	31.0	25.0	37.0	13.0	100.0	16.0
23						22.0	45.0	17.0	150.0	62.0	107.0	59.0
24						19.0	76.0	19.0	35.0	24.0	44.0	59.0
25						41.0	59.0	19.0	71.0	147.0	26.0	48.0
26						19.0	169.0	14.0	66.0	30.0	14.0	74.0
27						7.6	93.0	8.8	86.0	16.0	10.0	54.0
28						25.0	21.0	128.0	32.0	12.0	56.0	29.0
29						12.0	22.0	94.0	33.0	7.6	146.0	122.0
30						7.2	16.0	85.0	88.0	6.0	181.0	33.0
31						5.2	-------	43.0	-------	7.6	57.0	-------
Total						692.7	1,395.7	1,367.8	1,585.0	1,137.2	1,673.2	1,373.0
Mean						22.3	46.5	44.1	52.8	36.7	54.0	45.8
Max						273.0	179.0	191.0	150.0	163.0	181.0	198.0
Min						4.3	4.3	8.8	11.0	6.0	9.2	10.0
Acre-feet						1,370.0	2,770.0	2,710.0	3,140.0	2,260.0	3,320.0	2,720.0

Caroline Islands, Island of Ponape

16897600 NANEPIL RIVER

Location.—Lat 6°55′11″ N., long 158°12′36″ E., on left bank 1.4 miles northeast of Mount Tamatamansakir and 1.4 miles southeast of Rekisau.

Drainage area.—2.93 sq mi.
Period of record.—March 1970 to current year.
Gage.—Water-stage recorder. Altitude of gage is 390 ft (from topographic map).
Extremes.—Current year: Maximum discharge, 5,400 cfs Apr. 27 (gage height, 7.40 ft), from rating curve extended above 110 cfs; minimum, 3.2 cfs Sept. 14, 15.
Period of record: Maximum discharge, 5,400 cfs Apr. 27, 1971 (gage height, 7.40 ft), from rating curve extended above 110 cfs; minimum, 3.2 cfs Sept. 14, 15, 1971.
Remarks.—Records fair except those above 200 cfs, which are poor. No diversion above station. Records of chemical analyses for the water year 1971 are published in Part 2 of this report.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	64.0	36.0	45	160.0	19.0	18.0	33.0	19.0	27.0	33.0	87.0	23.0
2	79.0	91.0	39	230.0	27.0	26.0	42.0	51.0	28.0	19.0	58.0	85.0
3	83.0	49.0	21	95.0	36.0	89.0	53.0	111.0	19.0	26.0	26.0	101.0
4	108.0	21.0	164	55.0	15.0	114.0	33.0	45.0	28.0	24.0	26.0	37.0
5	30.0	36.0	65	35.0	14.0	30.0	26.0	95.0	69.0	13.0	35.0	35.0
6	17.0	39.0	43	26.0	18.0	50.0	123.0	147.0	59.0	38.0	71.0	60.0
7	52.0	52.0	21	250.0	12.0	20.0	32.0	51.0	74.0	106.0	108.0	45.0
8	53.0	106.0	14	44.0	30.0	150.0	32.0	93.0	86.0	44.0	20.0	21.0
9	120.0	41.0	14	90.0	30.0	30.0	17.0	31.0	16.0	23.0	12.0	12.0
10	56.0	20.0	68	32.0	61.0	17.0	11.0	67.0	112.0	71.0	44.0	8.4
11	51.0	18.0	121	21.0	214.0	26.0	41.0	55.0	35.0	60.0	23.0	6.4
12	33.0	100.0	29	14.0	35.0	126.0	103.0	48.0	23.0	26.0	13.0	5.2
13	29.0	70.0	19	10.0	20.0	36.0	16.0	32.0	239.0	31.0	11.0	4.6
14	60.0	51.0	90	8.4	15.0	83.0	16.0	79.0	69.0	124.0	153.0	3.5
15	45.0	21.0	51	7.2	80.0	304.0	11.0	27.0	62.0	56.0	80.0	5.4
16	56.0	61.0	27	6.0	50.0	126.0	50.0	20.0	37.0	78.0	65.0	15.0
17	35.0	32.0	18	5.7	30.0	133.0	69.0	14.0	45.0	348.0	23.0	6.4
18	22.0	23.0	46	5.7	22.0	91.0	160.0	15.0	30.0	68.0	30.0	5.2
19	15.0	16.0	67	9.2	40.0	31.0	65.0	12.0	110.0	30.0	28.0	29.0
20	78.0	12.0	62	16.0	25.0	19.0	62.0	23.0	59.0	31.0	17.0	12.0
21	30.0	12.0	48	42.0	40.0	14.0	34.0	69.0	43.0	28.0	94.0	51.0
22	19.0	32.0	35	10.0	25.0	29.0	28.0	78.0	83.0	222.0	31.0	13.0
23	40.0	17.0	34	7.2	13.0	71.0	93.0	254.0	60.0	71.0	16.0	26.0
24	21.0	33.0	28	5.7	50.0	30.0	66.0	236.0	38.0	50.0	12.0	48.0
25	57.0	26.0	58	6.0	59.0	16.0	164.0	38.0	34.0	23.0	51.0	17.0
26	72.0	31.0	150	8.8	88.0	11.0	112.0	20.0	67.0	33.0	17.0	12.0
27	23.0	30.0	42	14.0	91.0	11.0	190.0	30.0	31.0	99.0	10.0	53.0
28	14.0	19.0	23	27.0	31.0	46.0	47.0	42.0	16.0	38.0	8.4	94.0
29	109.0	44.0	29	23.0	-------	33.0	30.0	66.0	11.0	19.0	16.0	38.0
30	68.0	39.0	19	51.0	-------	40.0	28.0	54.0	31.0	12.0	163.0	65.0
31	67.0	-------	28	60.0	-------	32.0	-------	51.0	-------	44.0	84.0	-------
Total	1,606.0	1,178.0	1,518	1,374.9	1,190.0	1,854.0	1,787.0	1,973.0	1,641.0	1,888.0	1,432.4	937.1
Mean	51.8	39.3	49	44.4	42.5	59.8	59.6	63.6	54.7	60.9	46.2	31.2
Max	120.0	106.0	164	250.0	214.0	304.0	190.0	254.0	239.0	348.0	163.0	101.0
Min	14.0	12.0	14	5.7	12.0	11.0	11.0	12.0	11.0	12.0	8.4	3.5
Acre-feet	3,190.0	2,340.0	3,010	2,730.0	2,360.0	3,680.0	3,540.0	3,910.0	3,250.0	3,740.0	2,840.0	1,860.0

Note: Water year, 1971: Total, 18,379.4; mean, 50.4; maximum, 348; minimum, 3.5; acre-feet, 36,460.

PEAK DISCHARGE (BASE, 2,400 ft³/s. REVISED)

Date	Time	Gage height	Discharge
Mar. 15	2300	6.70	3,000
Apr. 18	1500	6.54	2,520
Apr. 27	1100	7.40	5,400
May. 23	2200	6.68	2,940
July 17	1500	6.68	2,940
July 22	0930	7.24	4,760
Aug. 30	1330	6.62	2,760

Caroline Islands, Island of Ponape

16897600 NANEPIL RIVER

Location.—Lat 6°55′11″ N., long 158°12′36″ E., on left bank 1.4 miles northeast of Mount Tamatamansakir and 1.4 miles southeast of Rekisau.
Drainage area.—2.93 sq mi.
Period of record.—March 1970 to current year.

Gage.—Water-stage recorder. Altitude of gage is 390 ft (from topographic map).
Extremes.—Current year: Maximum discharge, 8,200 cfs May 31 (gage height, 8.04 ft., from Floodmark in well), from rating curve extended above 110 cfs; minimum, 4.9 cfs Dec. 22.

Period of record: Maximum discharge, 8,200 cfs May 31, 1972 (gage height, 8.04 ft, from Floodmark in well), from rating curve extended above 110 cfs; minimum, 3.2 cfs Sept. 14, 15, 1971.

Remarks.—Records fair except those above 200 cfs, which are poor. No diversion above station.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1971 TO SEPTEMBER 1972

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	29.0	30.0	38.0	226.0	16.0	127.0	111.0	60	60.0	39	106.0	336.0
2	294.0	23.0	60.0	95.0	20.0	118.0	123.0	47	40.0	301	34.0	121.0
3	46.0	28.0	19.0	54.0	13.0	28.0	106.0	24	25.0	37	18.0	36.0
4	167.0	33.0	13.0	24.0	8.8	17.0	300.0	664	18.0	32	14.0	49.0
5	43.0	25.0	16.0	48.0	21.0	12.0	49.0	207	25.0	23	71.0	349.0
6	64.0	16.0	14.0	17.0	27.0	7.6	23.0	58	20.0	256	27.0	230.0
7	41.0	12.0	20.0	12.0	112.0	6.4	16.0	47	15.0	345	73.0	300.0
8	33.0	9.2	35.0	8.8	73.0	39.0	12.0	190	10.0	68	193.0	117.0
9	42.0	7.6	13.0	56.0	110.0	17.0	9.5	35	8.2	46	42.0	34.0
10	28.0	8.0	73.0	27.0	28.0	8.8	7.2	20	6.4	25	30.0	312.0
11	29.0	7.2	21.0	18.0	17.0	6.8	16.0	15	6.8	236	20.0	53.0
12	17.0	7.2	13.0	11.0	12.0	5.7	19.0	12	10.0	459	167.0	110.0
13	46.0	11.0	9.2	8.4	32.0	31.0	24.0	10	14.0	44	40.0	375.0
14	16.0	68.0	7.6	22.0	26.0	63.0	201.0	9	26.0	26	20.0	1,080.0
15	20.0	45.0	6.4	35.0	12.0	31.0	30.0	150	45.0	18	15.0	95.0
16	58.0	35.0	11.0	20.0	9.2	79.0	126.0	70	215.0	47	11.0	28.0
17	17.0	42.0	8.0	25.0	13.0	211.0	104.0	40	200.0	64	63.0	16.0
18	13.0	54.0	7.2	25.0	27.0	69.0	134.0	300	33.0	24	22.0	12.0
19	61.0	49.0	6.0	16.0	54.0	26.0	40.0	70	37.0	23	58.0	8.6
20	24.0	68.0	5.7	11.0	103.0	17.0	42.0	25	122.0	16	19.0	13.0
21	133.0	26.0	6.0	14.0	35.0	12.0	93.0	20	52.0	33	42.0	8.2
22	53.0	86.0	5.2	14.0	16.0	44.0	28.0	14	55.0	122	25.0	6.4
23	32.0	31.0	18.0	9.6	16.0	26.0	34.0	16	24.0	30	21.0	8.2
24	38.0	16.0	17.0	98.0	133.0	25.0	84.0	35	15.0	19	16.0	7.7
25	185.0	12.0	94.0	52.0	68.0	148.0	45.0	20	14.0	239	130.0	128.0
26	42.0	9.2	35.0	24.0	69.0	70.0	29.0	13	11.0	38	25.0	25.0
27	25.0	67.0	13.0	16.0	30.0	55.0	232.0	10	9.5	24	27.0	303.0
28	48.0	25.0	14.0	19.0	38.0	42.0	110.0	50	27.0	928	16.0	225.0
29	46.0	11.0	68.0	14.0	28.0	26.0	31.0	200	16.0	139	13.0	382.0
30	27.0	9.2	18.0	317.0	--------	205.0	134.0	500	16.0	147	52.0	410.0
31	79.0	--------	35.0	39.0	--------	62.0	--------	700	--------	726	80.0	--------
Total	1,796.0	870.6	719.3	1,375.8	1,167.0	1,635.3	2,312.7	3,631	1,175.9	4,574	1,490.0	5,178.1
Mean	57.9	29.0	23.2	44.4	40.2	52.8	77.1	117	39.2	148	48.1	173.0
Max	294.0	86.0	94.0	317.0	133.0	211.0	300.0	700	215.0	928	193.0	1,080.0
Min	13.0	7.2	5.2	8.4	8.8	5.7	7.2	9	6.4	16	11.0	6.4
Acre-feet	3,560.0	1,730.0	1,430.0	2,730.0	2,310.0	3,240.0	4,590.0	7,200	2,330.0	9,070	2,960.0	10,270.0

Notes:
Calendar year 1971: Total, 17,463.3; mean, 47.8; maximum, 348; minimum, 3.5; acre-feet, 34,640.
Water year 1972: Total, 25,925.7; mean, 70.8; maximum, 1,080; minimum, 5.2; acre-feet, 51,420.

PEAK DISCHARGE (BASE, 4,000 FT³/S, REVISED)

Date	Time	Gage height	Discharge
Oct. 2	1930	7.65	6,400
Jan. 30	0830	7.34	5,160
May 4	2230	7.38	5,320
May 18	[1] 2100	[2] 7.80	7,000
May 31	[1] 1300	8.04	8,200
July 28	1100	7.13	4,490
Sept. 14	0630	7.86	7,300
Sept. 30	1730	7.05	4,250

[1] Approximately.
[2] From floodmark in well.

Note: No gage-height record May 10 to June 7.

Caroline Islands, Island of Ponape

16897600 NANEPIL RIVER

Location.—Lat 6°55′11″ N., long 158°12′36″ E., on left bank 1.4 mi (2.3 km) northeast of Mount Tamatamansakir and 1.4 mi (2.3 km) southeast of Rekisau.

Drainage area.—2.93 mi² (7.59 km²).

Period of record.—March 1970 to current year.

Gage.—Water-stage recorder. Altitude of gage is 390 ft (119 m), from topographic map.

Extremes.—Current year: Maximum discharge, 5,400 ft³/s (153 m³/s) Apr. 27, gage height, 7.40 ft (2.256 m), from floodmark in well, from rating curve extended above 130 ft³/s (3.68 m³/s); minimum, 1.6 ft³/s (0.045 m³/s) Nov. 17–23, Feb. 6.

Period of record: Maximum discharge, 8,200 ft³/s (232 m³/s) May 31, 1972, gage height, 8.04 ft (2.451 m), from floodmark in well, from rating curve extended above 130 ft³/s (3.68 m³/s); minimum, 1.6 ft³/s (0.045 m³/s) Nov. 17–23, 1972, Feb. 6, 1973.

Remarks.—Records good except those above 200 ft³/s (5.66 m³/s), which are poor. No diversion above station.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1972 TO SEPTEMBER 1973

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept
1	75.0	8.6	185.0	9.0	14.0	288.0	4.5	137.0	21.0	20.0	8.3	10.0
2	117.0	48.0	51.0	7.2	6.2	122.0	4.0	299.0	59.0	15.0	10.0	11.0
3	49.0	14.0	18.0	11.0	3.4	68.0	2.8	136.0	26.0	10.0	11.0	14.0
4	27.0	9.0	11.0	21.0	2.8	38.0	6.6	94.0	222.0	20.0	8.3	24.0
5	27.0	7.2	8.6	15.0	2.2	19.0	6.9	45.0	54.0	150.0	16.0	14.0
6	27.0	5.8	6.9	11.0	1.6	12.0	158.0	20.0	19.0	40.0	10.0	193.0
7	102.0	7.2	9.4	11.0	17.0	9.4	85.0	16.0	27.0	20.0	46.0	28.0
8	62.0	10.0	16.0	8.6	14.0	14.0	218.0	14.0	24.0	15.0	38.0	23.0
9	23.0	6.2	23.0	11.0	26.0	47.0	404.0	42.0	13.0	10.0	56.0	27.0
10	14.0	4.5	18.0	7.6	13.0	102.0	103.0	91.0	47.0	10.0	23.0	16.0
11	11.0	3.4	11.0	6.9	54.0	28.0	28.0	71.0	187.0	11.0	39.0	50.0
12	8.3	2.2	26.0	5.5	24.0	29.0	228.0	59.0	138.0	104.0	23.0	43.0
13	7.6	3.4	16.0	3.4	9.4	44.0	168.0	28.0	129.0	32.0	28.0	17.0
14	6.6	8.0	9.4	5.5	6.6	15.0	477.0	14.0	554.0	18.0	29.0	39.0
15	6.2	5.0	7.2	10.0	5.8	10.0	37.0	70.0	44.0	12.0	153.0	99.0
16	7.6	2.8	27.0	14.0	6.2	16.0	20.0	56.0	20.0	11.0	118.0	53.0
17	8.0	2.2	24.0	29.0	5.0	12.0	95.0	19.0	16.0	9.7	27.0	79.0
18	14.0	1.6	56.0	23.0	2.8	9.7	41.0	41.0	11.0	66.0	83.0	51.0
19	8.3	1.6	54.0	13.0	3.4	115.0	100.0	21.0	10.0	21.0	72.0	80.0
20	19.0	1.6	109.0	8.6	6.9	17.0	50.0	14.0	9.7	11.0	68.0	38.0
21	12.0	1.6	28.0	6.6	3.4	12.0	30.0	14.0	11.0	30.0	93.0	18.0
22	7.6	1.6	21.0	4.5	6.2	16.0	20.0	40.0	12.0	29.0	80.0	14.0
23	6.2	4.3	14.0	8.0	9.0	11.0	15.0	18.0	35.0	12.0	38.0	10.0
24	4.5	5.5	14.0	11.0	7.2	7.6	10.0	14.0	22.0	39.0	19.0	12.0
25	4.0	5.8	10.0	9.0	7.2	8.0	15.0	20.0	19.0	69.0	14.0	38.0
26	5.0	16.0	203.0	5.5	171.0	10.0	100.0	27.0	43.0	30.0	124.0	22.0
27	134.0	63.0	39.0	10.0	95.0	6.6	375.0	101.0	108.0	78.0	61.0	26.0
28	16.0	125.0	69.0	7.6	78.0	8.0	48.0	49.0	150.0	28.0	212.0	99.0
29	46.0	29.0	19.0	5.0	-------	6.6	162.0	44.0	100.0	14.0	33.0	30.0
30	31.0	22.0	13.0	2.8	-------	5.8	46.0	72.0	40.0	16.0	18.0	16.0
31	13.0	-------	12.0	9.6	-------	8.0	-------	41.0	-------	12.0	14.0	-------
Total	898.9	426.1	1,128.5	310.9	601.3	1,114.7	3,057.8	1,727.0	2,170.7	962.7	1,572.6	1,194.0
Mean	29.0	14.2	36.4	10.0	21.5	36.0	102.0	55.7	72.4	31.1	50.7	39.8
Max	134.0	125.0	203.0	29.0	171.0	288.0	477.0	299.0	554.0	150.0	212.0	193.0
Min	4.0	1.6	6.9	2.8	1.6	5.8	2.8	14.0	9.7	9.7	8.3	10.0
Acre-feet	1,780.0	845.0	2,240.0	617.0	1,190.0	2,210.0	6,070.0	3,430.0	4,310.0	1,910.0	3,120.0	2,370.0

Notes:
Calendar year 1972: Total, 24,993.3; mean, 68.3; maximum, 1,080; minimum, 1.6; acre-feet, 49,570.
Water year 1973: Total, 15,165.2; mean, 41.5; maximum, 554; minimum 1.6; acre-feet, 30,080.
Peak discharge (base, 4,000 ft³/s). Apr. 27 (0730) 5,400 ft³/s (7.40 ft).

Caroline Islands, Island of ponape

16897600 NANEPIL RIVER

Location.—Lat 6°55′11″ N., long 158°12′36″ E., on left bank 1.4 mi (2.3 km) northeast of Mount Tamatamansakir and 1.4 (2.3 km) southeast of Rekisau.

Drainage area.—2.93 mi² (7.59 km²).

Period of record.—March 1970 to current year.

Gage.—Water-stage recorder. Altitude of gage is 390 ft (119 m) from topographic map.

Extremes.—Current year: Maximum discharge, 8,800 ft³/s (249 m³/s) July 11, gage height, 8.16 ft (2.487 m), from rating curve extended above 130 ft³/s (3.68 m³/s); minimum, 1.6 ft³/s (0.045 m³/s) Oct. 21, 22.

Period of record: Maximum discharge, 8,800 ft³/s (249 m³/s) July 11, 1974, gage height, 8.16 ft (2.487 m), from rating curve extended above 130 ft³/s (3.68 m³/s); minimum, 1.6 ft³/s (0.045 m³/s) Nov. 17–23, 1972, Feb. 6, Oct. 21, 22, 1973.

Remarks.—Records fair except those above 200 ft³/s (5.66 m³/s), which are poor. No diversion above station. Periodic determinations of water temperature for the water year 1974 are published in Part 2 of this report.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1973 TO SEPTEMBER 1974

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	47.0	28.0	6.0	98.0	49.0	9.8	24.0	34.0	159.0	24.0	33.0	16.0
2	20.0	21.0	5.2	29.0	161.0	16.0	130.0	54.0	105.0	15.0	49.0	12.0
3	12.0	21.0	7.1	160.0	43.0	52.0	64.0	30.0	45.0	13.0	42.0	9.0
4	9.7	31.0	13.0	30.0	72.0	91.0	29.0	30.0	156.0	56.0	81.0	19.0
5	12.0	35.0	78.0	15.0	400.0	50.0	34.0	18.0	266.0	34.0	32.0	12.0
6	105.0	391.0	27.0	187.0	44.0	23.0	53.0	16.0	51.0	38.0	38.0	21.0
7	29.0	30.0	21.0	88.0	50.0	52.0	37.0	17.0	27.0	19.0	28.0	16.0
8	36.0	23.0	16.0	32.0	126.0	135.0	42.0	14.0	34.0	18.0	370.0	9.7
9	22.0	16.0	45.0	16.0	25.0	38.0	51.0	18.0	94.0	77.0	227.0	29.0
10	200.0	11.0	74.3	11.0	67.0	160.0	280.0	30.0	29.0	143.0	54.0	151.0
11	30.0	8.7	19.0	8.3	25.0	224.0	58.0	130.0	68.0	370.0	49.0	51.0
12	14.0	14.0	100.0	6.4	30.0	46.0	81.0	62.0	31.0	41.0	38.0	91.0
13	11.0	13.0	37.0	5.2	14.0	26.0	123.0	130.0	21.0	19.0	227.0	34.0
14	9.0	33.0	26.0	4.3	14.0	19.0	37.0	77.0	31.0	200.0	44.0	16.0
15	8.3	16.0	127.0	3.8	11.0	118.0	114.0	37.0	23.0	70.0	22.0	185.0
16	14.0	59.0	132.0	3.2	7.1	107.0	234.0	45.0	14.0	32.0	16.0	33.0
17	9.0	25.0	25.0	2.8	15.0	260.0	34.0	61.0	18.0	84.0	72.0	14.0
18	8.6	46.0	150.0	16.0	152.0	24.0	21.0	32.0	14.0	40.0	27.0	29.0
19	7.2	21.0	38.0	31.0	105.0	23.0	82.0	18.0	17.0	76.0	14.0	17.0
20	4.0	34.0	25.0	11.0	64.0	15.0	97.0	16.0	61.0	43.0	12.0	11.0
21	2.2	21.0	202.0	67.0	36.0	10.0	43.0	16.0	20.0	25.0	10.0	10.0
22	66.0	119.0	39.0	49.0	101.0	8.6	46.0	44.0	16.0	16.0	8.6	9.7
23	221.0	22.0	52.0	27.0	39.0	32.0	154.0	38.0	13.0	170.0	8.3	18.0
24	40.0	16.0	71.0	16.0	85.0	21.0	43.0	77.0	27.0	37.0	8.6	12.0
25	70.0	11.0	127.0	9.0	20 0	13.0	28.0	61.0	20.0	18.0	8.6	113.0
26	28.0	9.0	115.0	198.0	12.0	39.0	62.0	58.0	38.0	12.0	12.0	24.0
27	155.0	25.0	36.0	25.0	32.0	20.0	34.0	26.0	32.0	24.0	10.0	12.0
28	93.0	15.0	16.0	15.0	12.0	20.0	25.0	49.0	46.0	53.0	10.0	11.0
29	251.0	9.4	23.0	10.0	-------	224.0	28.0	62.0	88.0	23.0	12.0	17.0
30	49.0	7.5	35.0	9.0	-------	32.0	96.0	60.0	41.0	60.0	352.0	10.0
31	96.0	-------	188.0	8.7	-------	17.0	-------	22.0	-------	34.0	32.0	-------
Total	1,679.0	1,131.6	1,875.3	1,191.7	1,811.1	1,925.4	2,184.0	1,382.0	1,605.0	1,884.0	1,947.1	1,012.4
Mean	54.2	37.7	60.5	38.4	64.7	62.1	72.8	44.6	53.5	60.8	62.8	33.7
Max	251.0	391.0	202.0	198.0	400.0	260.0	280.0	130.0	266.0	370.0	370.0	185.0
Min	2.2	7.5	5.2	2.8	7.1	8.6	21.0	14.0	13.0	12.0	8.3	9.0
Acre-feet	3,330.0	2,240.0	3,720.0	2,360.0	3,590.0	3,820.0	4,330.0	2,740.0	3,180.0	3,740.0	3,860.0	2,010.0

Notes:
Calendar year, 1973: Total, 17,397.6; mean, 47.7; maximum, 554, minimum, 1.6, acre-feet, 34,510.
Water year, 1974: Total, 19,628.6; mean, 53.8; maximum, 400; minimum, 2.2; acre-feet, 38,930.

PEAK DISCHARGE (BASE, 4,000 FT³/S)

Date	Time	Gage height	Discharge
Oct. 29	1230	7.04	4,220
Nov. 6	0600	8.04	8,200
July 11	0530	8.16	8,800

Caroline Islands, Island of Ponape

16897600 NANEPIL RIVER

Location.—Lat 6°55′11″ N., long 158°12′36″ E., on left bank 1.4 mi (2.3 km) northeast of Mount Tamatamansakir and 1.4 mi (2.3 km) southeast of Rekisau.

Drainage area.—2.93 mi² (7.59 km²).

Period of record.—March 1970 to current year.

Gage.—Water-stage recorder. Altitude of gage is 390 ft (119 m), from topographic map.

Average discharge.—5 years, 52.7 ft^3/s (1.492 m^3/s), 38,180 acre-ft/yr (47.1 hm^3/yr).

Extremes.—Current year: Maximum discharge, 6,720 ft^3/s (190 m^3/s) Oct. 12 (gage height, 7.73 ft or 2.356 m), from rating curve extended above 130 ft^3/s (3.68 m^3/s); minimum, 2.0 ft^3/s (0.057 m^3/s) Feb. 5, 6.

Period of record: Maximum discharge, 8,800 ft^3/s (249 m^3/s) July 11, 1974 (gage height, 8.16 ft or 2.487 m), from rating curve extended above 130 ft^3/s (3.68 m^3/s); minimum, 1.6 ft^3/s (0.045 m^3/s) Nov. 17-23, 1972, Feb. 6, Oct. 21, 22, 1973.

Remarks.—Records good except those above 200 ft^3/s (5.66 m^3/s), which are poor. No diversion above station. Periodic determinations of water temperature for the current year are published in Part 2 of this report.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1974 TO SEPTEMBER 1975

[Mean values]

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	8.1	79.0	42.0	211.0	5.0	11.0	7.2	90.0	13.0	15.0	21.0	6.3
2	73.0	63.0	56.0	77.0	4.7	266.0	5.2	57.0	70.0	11.0	13.0	4.9
3	17.0	21.0	21.0	43.0	2.8	49.0	6.8	20.0	26.0	67.0	30.0	142.0
4	22.0	14.0	20.0	70.0	2.3	28.0	5.5	12.0	18.0	75.0	40.0	31.0
5	168.0	13.0	44.0	50.0	2.2	14.0	4.8	96.0	64.0	198.0	54.0	53.0
6	106.0	12.0	69.0	25.0	3.1	11.0	4.0	187.0	36.0	21.0	30.0	20.0
7	34.0	12.0	31.0	72.0	3.1	25.0	115.0	47.0	55.0	17.0	20.0	11.0
8	120.0	115.0	38.0	29.0	10.0	19.0	27.0	90.0	71.0	43.0	22.0	9.0
9	38.0	51.0	39.0	16.0	3.9	18.0	11.0	45.0	28.0	27.0	71.0	7.7
10	35.0	14.0	324.0	13.0	2.6	11.0	11.0	99.0	15.0	13.0	50.0	78.0
11	27.0	10.0	128.0	9.3	6.2	28.0	31.0	35.0	10.0	11.0	34.0	68.0
12	331.0	164.0	61.0	16.0	6.2	39.0	16.0	20.0	94.0	16.0	135.0	38.0
13	188.0	144.0	121.0	13.0	4.7	381.0	9.3	16.0	70.0	120.0	28.0	19.0
14	36.0	55.0	150.0	9.9	12.0	58.0	50.0	21.0	194.0	42.0	42.0	34.0
15	20.0	58.0	134.0	9.8	11.0	191.0	250.0	116.0	74.0	100.0	69.0	45.0
16	16.0	32.0	57.0	8.2	5.5	160.0	31.0	79.0	27.0	63.0	140.0	14.0
17	154.0	28.0	39.0	6.6	7.6	51.0	44.0	23.0	16.0	120.0	26.0	83.0
18	23.0	19.0	26.0	5.7	15.0	40.0	22.0	39.0	168.0	137.0	20.0	93.0
19	14.0	14.0	27.0	5.2	9.5	17.0	15.0	16.0	37.0	36.0	21.0	21.0
20	94.0	72.0	17.0	12.0	8.6	13.0	21.0	102.0	34.0	38.0	13.0	13.0
21	37.0	36.0	21.0	12.0	7.1	15.0	12.0	79.0	104.0	21.0	38.0	12.0
22	33.0	20.0	22.0	11.0	4.7	55.0	10.0	28.0	63.0	48.0	14.0	61.0
23	185.0	15.0	28.0	7.1	3.6	35.0	25.0	15.0	165.0	16.0	11.0	30.0
24	173.0	113.0	37.0	5.0	3.9	14.0	36.0	11.0	54.0	29.0	9.3	127.0
25	98.0	54.0	20.0	4.1	283.0	9.8	395.0	23.0	32.0	20.0	8.2	52.0
26	32.0	30.0	42.0	3.6	30.0	7.8	56.0	148.0	41.0	17.0	7.0	57.0
27	18.0	50.0	36.0	3.3	69.0	6.8	69.0	122.0	65.0	14.0	5.5	36.0
28	15.0	186.0	17.0	3.3	19.0	10.0	33.0	45.0	48.0	12.0	5.2	42.0
29	21.0	39.0	12.0	3.3	-------	7.5	33.0	20.0	23.0	48.0	8.5	36.0
30	32.0	97.0	11.0	3.6	-------	5.5	34.0	40.0	23.0	32.0	27.0	37.0
31	47.0	-------	11.0	10.0	-------	10.0	-------	29.0	-------	19.0	9.8	-------
Total	2,215.1	1,630.0	1,701.0	768.0	546.3	1,606.4	1,389.8	1,770.0	1,738.0	1,446.0	1,022.5	1,280.9
Mean	71.5	54.3	54.9	24.8	19.5	51.8	46.3	57.1	57.9	46.6	33.0	42.7
maximum	331.0	186.0	324.0	211.0	283.0	381.0	395.0	187.0	194.0	198.0	140.0	142.0
Minimum	8.1	10.0	11.0	3.3	2.2	5.5	4.0	11.0	10.0	11.0	5.2	4.9
Acre-feet	4,390.0	3,230.0	3,370.0	1,520.0	1,080.0	3,190.0	2,760.0	3,510.0	3,450.0	2,870.0	2,030.0	2,540.0

Notes:

Calendar year 1974; Total, 20,488.8; mean, 56.1; maximum, 400; minimum, 28; acre-feet, 40,640.
Water year 1975: Total, 17,114; mean, 46.9; maximum, 395; minimum, 2.2; acre-feet, 33,950.
Peak discharge (base, 4,000 ft^3/s).—Oct. 12 (1930) 6,720 ft^3/s (7.73 ft).

Caroline Islands, Island of Ponape

16897600 NANEPIL RIVER

Location.—Lat 06°55′11″ N., long 158°12′36″ E., on left bank 1.4 mi (2.3 km) northeast of Mount Tamatamansakir and 1.4 mi (2.3 km) southeast of Rekisau.

Drainage area.—2.93 mi² (7.59 km²).

Period of record.—March 1970 to current year.

Gage.—Water-stage recorder. Altitude of gage is 390 ft (119 m), from topographic map.

Remarks.—Records good. No diversion above station. Periodic determinations of water temperature for the current year are published on page 414 of this report.

Average discharge.—6 years, 54.6 ft³/s (1.546 m³/s), 39,560 acre-ft/yr (48.8 hm³/yr).

Extremes for period of record.—Maximum discharge, 8,820 ft³/s (250 m³/s) Aug. 4, 1976, gage height, 9.68 ft (2.950 m), from rating curve extended above 168 ft³/s (4.76 m³/s) on basis of slope-area measurement of gage height 9.68 ft (2.950 m); minimum, 1.6 ft³/s (0.045 m³/s) Nov. 17-23, 1972, Feb. 6, Oct. 21, 22, 1973.

Extremes for current year.—Peak discharges above base of 3,200 ft³/s (90.6 m³/s) revised, and maximum (*):

Date	Time	Discharge (ft³/s)	Discharge (m³/s)	Gage height (ft)	Gage height (m)
Aug. 2	0300	4,020	114	7.46	2.27
Aug. 4	1330	8,820	250	9.68	2.95
Sept. 8	1100	3,680	104	7.99	2.43

Note: Minimum discharge, 3.4 ft³/s (0.096 m³/s) Jan. 13.

Revisions.—The peak discharges and annual maximum (*) for water years 1970–75 have been revised as shown in the following table. They supersede figures published in the reports for 1970–75.

Water year	Date	Time	Discharge (ft³/s)	Discharge (m³/s)	Gage height (ft)	Gage height (m)
1970	Sept. 4, 1970	1100	3060	86.7	6.85	2.088
1971	Apr. 27, 1971	1100	3920	111.0	7.40	2.256
	July 22, 1971	0930	3660	104.0	7.24	2.207
1972	Oct. 2, 1971	1930	4320	122.0	7.65	2.332
	Jan. 30, 1972	0830	3820	108.0	7.34	2.237
	May 4, 1972	2230	3890	110.0	7.38	2.249
	May 18, 1972	[1] 2100	4580	130.0	[2] 7.80	2.377
	May 31, 1972	[1] 1300	5000	142.0	[2] 8.04	2.451
	July 28, 1972	1100	3490	98.8	7.13	2.173
1972	Sept. 14, 1972	0630	4680	133.0	7.86	2.396
	Sept. 30, 1972	1730	3360	95.2	7.05	2.149
1973	Apr. 27, 1973	0730	3920	111.0	7.40	2.256
1974	Oct. 29, 1973	1230	3350	94.9	[2] 7.04	2.146
	Nov. 6, 1973	0600	5000	142.0	8.04	2.451
	July 11, 1974	0530	5220	148.0	8.16	2.487
1975	Oct. 12, 1974	1930	4460	126.0	7.73	2.356

[1] About.
[2] Floodmark in well.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976

[Mean values]

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	55.0	274.0	79.0	27.0	12.0	157.0	140.0	9.0	22.0	7.6	55	20.0
2	41.0	43.0	26.0	14.0	73.0	66.0	93.0	24.0	13.0	22.0	565	14.0
3	30.0	20.0	153.0	10.0	109.0	42.0	34.0	205.0	241.0	8.4	510	36.0
4	19.0	42.0	188.0	8.7	16.0	18.0	16.0	54.0	51.0	5.9	698	31.0
5	106.0	106.0	161.0	6.4	10.0	11.0	14.0	56.0	30.0	7.8	76	21.0
6	108.0	47.0	55.0	5.4	7.3	7.8	11.0	102.0	196.0	13.0	69	160.0
7	34.0	66.0	27.0	5.0	5.7	6.4	8.1	175.0	35.0	11.0	46	94.0
8	18.0	24.0	241.0	4.5	5.2	5.2	15.0	31.0	42.0	7.8	144	511.0
9	45.0	14.0	64.0	4.2	5.2	5.2	42.0	17.0	158.0	16.0	61	46.0
10	40.0	13.0	93.0	4.0	7.0	7.0	79.0	59.0	173.0	274.0	30	28.0
11	168.0	12.0	75.0	4.2	6.7	21.0	53.0	209.0	31.0	223.0	30	91.0
12	36.0	107.0	103.0	3.8	26.0	183.0	[illegible].0	148.0	16.0	36.0	107	36.0
13	65.0	91.0	37.0	3.4	92.0	91.0	27.0	182.0	52.0	14.0	52	17.0
14	212.0	26.0	58.0	5.9	37.0	247.0	15.0	50.0	28.0	13.0	64	12.0
15	44.0	58.0	41.0	7.6	12.0	54.0	12.0	32.0	15.0	280.0	24	8.6
16	21.0	23.0	60.0	13.0	7.8	77.0	19.0	49.0	12.0	88.0	16	6.7
17	14.0	29.0	326.0	7.3	6.4	160.0	59.0	94.0	82.0	16.0	22	6.1
18	11.0	43.0	125.0	87.0	280.0	350.0	113.0	240.0	39.0	11.0	17	5.3
19	49.0	19.0	74.0	23.0	63.0	54.0	160.0	139.0	27.0	7.8	64	4.6
20	96.0	18.0	71.0	14.0	57.0	23.0	102.0	41.0	31.0	9.3	58	4.8
21	32.0	18.0	28.0	10.0	26.0	199.0	56.0	20.0	21.0	8.1	80	5.0
22	68.0	16.0	18.0	7.6	12.0	301.0	338.0	16.0	15.0	7.0	60	51.0
23	56.0	18.0	16.0	5.4	9.3	77.0	98.0	11.0	280.0	8.7	40	18.0
24	35.0	342.0	50.0	5.4	7.6	53.0	54.0	145.0	35.0	12.0	51	27.0
25	97.0	96.0	15.0	6.2	25.0	259.0	38.0	48.0	38.0	8.7	20	15.0
26	229.0	26.0	37.0	4.7	342.0	386.0	136.0	13.0	101.0	8.4	12	8.2
27	71.0	16.0	43.0	7.6	33.0	69.0	27.0	11.0	18.0	6.4	138	6.1
28	40.0	11.0	72.0	19.0	13.0	24.0	27.0	29.0	11.0	117.0	19	5.3
29	18.0	8.5	24.0	27.0	16.0	41.0	16.0	17.0	7.8	109.0	21	6.1
30	19.0	8.0	503.0	36.0	--------	112.0	12.0	32.0	8.7	141.0	13	4.8
31	29.0	--------	118.0	20.0	--------	76.0	--------	22.0	--------	81.0	14	--------
Total	1,906.0	1,634.5	2,981.0	407.3	1,322.2	3,182.6	1,861.1	2,280.0	1,829.5	1,578.9	3,176	1,299.6
Mean	61.5	54.5	96.2	13.1	45.6	103.0	62.0	73.5	61.0	50.9	102	43.3
Maximum	229.0	342.0	503.0	87.0	342.0	386.0	338.0	240.0	280.0	280.0	698	511.0
Minimum	11.0	8.0	15.0	3.4	5.2	5.2	8.1	9.0	7.8	5.9	12	4.6
Acre-feet	3,780.0	3,240.0	5,910.0	808.0	2,620.0	6,310.0	3,690.0	4,520.0	3,630.0	3,130.0	6,300	2,580.0

Notes:
Calendar year 1975: Total, 18,089.4; mean, 49.6; maximum, 503; minimum, 2.2; acre-feet, 35,880.
Water year 1976: Total, 23,458.7; mean, 64.1; maximum, 698; minimum, 3.4; acre-feet, 46,530.

Caroline Islands, Island of Ponape

16897600 NANEPIL RIVER

Location.—Lat 06°55′11″ N., long 158°12′36″ E., on left bank 1.4 mi (2.3 km) northeast of Mount Tamatamansakir and 1.4 mi (2.3 km) southeast of Rekisau.

Drainage area.—2.93 mi ^{2} (7.59 km ^{2}).

Period of record.—March 1970 to current year.

Revised records.—WDR HI–76–1: 1970(M), 1971–72(P), 1973(M), 1974(P), 1975(M).

Gage.—Water-stage recorder. Altitude of gage is 390 ft (119 m), from topographic map.

Remarks.—Records good. No diversion above station. Periodic determinations of water temperature for the current year are published elsewhere in this report.

Average discharge.—7 years, 51.9 ft ^{3}/s (1.470 m ^{3}/s), 37,600 acre-ft/yr (46.4 hm ^{3}/yr).

Extremes for period of record.—Maximum discharge, 8,820 ft ^{3}/s (250 m ^{3}/s) Aug. 4, 1976, gage height, 9.68 ft (2.950 m), from rating curve extended above 168 ft ^{3}/s (4.76 m ^{3}/s) on basis of slope-area measurement at gage height 9.68 ft (2.950 m); minimum, 1.6 ft ^{3}/s (0.045 m ^{3}/s) Nov. 17–23, 1972, Feb. 6, Oct. 21, 22, 1973.

Extremes for current year.—Maximum discharge, 2,500 ft ^{3}/s (70.8 m ^{3}/s) Oct. 14, gage height, 7.36 ft (2.243 m), no peak above base of 3,200 ft ^{3}/s (90.6 m^3/s); minimum, 2.0 ft ^{3}/s (0.057 m ^{3}/s) Mar. 2, 3.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977

(Mean values)

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	10.0	37.0	54.0	6.4	11.0	2.6	15.0	26.0	20.0	29.0	30.0	39.0
2	5.8	34.0	59.0	6.0	5.8	2.2	11.0	146.0	129.0	16.0	18.0	25.0
3	4.1	89.0	26.0	5.0	4.5	2.6	21.0	39.0	62.0	42.0	26.0	17.0
4	3.7	70.0	39.0	4.5	3.7	8.4	11.0	20.0	39.0	40.0	18.0	12.0
5	4.4	26.0	20.0	4.1	3.4	3.7	16.0	23.0	21.0	22.0	13.0	15.0
6	3.0	18.0	14.0	3.9	3.0	2.4	43.0	15.0	14.0	52.0	16.0	73.0
7	3.4	18.0	9.7	5.2	3.0	16.0	20.0	116.0	9.4	59.0	13.0	67.0
8	24.0	67.0	7.8	6.2	2.8	38.0	12.0	73.0	9.0	44.0	71.0	24.0
9	12.0	21.0	6.0	11.0	10.0	41.0	10.0	211.0	7.9	55.0	90.0	15.0
10	6.4	17.0	6.0	116.0	4.5	58.0	7.8	64.0	11.0	77.0	51.0	10.0
11	6.1	29.0	6.4	13.0	3.7	48.0	7.0	28.0	18.0	28.0	56.0	8.3
12	9.9	88.0	9.1	7.5	5.7	22.0	5.7	17.0	27.0	28.0	28.0	7.9
13	21.0	33.0	6.7	6.7	3.7	12.0	4.7	69.0	53.0	30.0	47.0	13.0
14	275.0	25.0	7.5	5.0	3.2	113.0	3.9	27.0	23.0	36.0	30.0	13.0
15	28.0	120.0	220.0	95.0	7.0	59.0	3.9	34.0	15.0	34.0	19.0	13.0
16	32.0	43.0	260.0	36.0	3.9	29.0	8.5	18.0	25.0	18.0	18.0	56.0
17	107.0	30.0	30.0	61.0	3.0	14.0	6.2	12.0	23.0	13.0	16.0	17.0
18	42.0	76.0	14.0	29.0	3.0	12.0	36.0	9.8	28.0	16.0	15.0	15.0
19	110.0	27.0	12.0	14.0	2.4	9.4	28.0	7.2	14.0	17.0	65.0	10.0
20	34.0	33.0	27.0	16.0	2.6	7.0	52.0	35.0	12.0	9.4	41.0	14.0
21	79.0	90.0	19.0	13.0	2.6	5.7	122.0	31.0	60.0	45.0	67.0	85.0
22	32.0	19.0	60.0	7.8	2.3	4.7	36.0	39.0	31.0	52.0	36.0	30.0
23	67.0	48.0	181.0	6.2	2.4	4.3	433.0	46.0	61.0	22.0	19.0	17.0
24	31.0	102.0	152.0	5.2	6.4	3.9	150.0	25.0	71.0	60.0	38.0	14.0
25	20.0	24.0	111.0	4.5	6.7	3.6	223.0	23.0	24.0	31.0	52.0	9.4
26	58.0	14.0	32.0	4.1	5.2	4.1	61.0	75.0	22.0	32.0	60.0	78.0
27	194.0	112.0	21.0	3.6	3.4	3.6	25.0	30.0	25.0	27.0	30.0	27.0
28	46.0	168.0	27.0	3.4	3.9	189.0	17.0	27.0	17.0	34.0	56.0	15.0
29	19.0	33.0	15.0	16.0	-------	105.0	25.0	52.0	37.0	34.0	98.0	12.0
30	13.0	30.0	9.7	16.0	-------	125.0	36.0	55.0	59.0	60.0	115.0	11.0
31	96.0	-------	7.5	33.0	-------	39.0	-------	48.0	-------	38.0	87.0	-------
Total	1,396.8	1,541.0	1,469.4	564.3	122.8	988.2	1,460.7	1,441.0	967.3	1,100.4	1,339.0	762.6
Mean	45.1	51.4	47.4	18.2	4.39	31.9	48.7	46.5	32.2	35.5	43.2	25.4
Maximum	275.0	168.0	260.0	116.0	11.0	189.0	433.0	211.0	129.0	77.0	115.0	85.0
Minimum	3.0	14.0	6.0	3.4	2.3	2.2	3.9	7.2	7.9	9.4	13.0	7.9
Acre-feet	2,770.0	3,060.0	2,910.0	1,120.0	244.0	1,960.0	2,900.0	2,860.0	1,920.0	2,180.0	2,660.0	1,510.0

Notes:
Calendar year, 1976: Total, 21344.4; mean, 58.3; maximum, 698; minimum, 3.0; acre-feet, 42340.
Water year, 1977: Total, 13153.5; mean, 36.0; maximum, 433; minimum, 2.2; acre-feet, 26090.

Caroline Islands, Island of Ponape

16897900 LUI RIVER

Location.—Lat. 6°55′36″ N., long 158°12′55″ E., on right bank 300 ft upstream from right-bank tributary and 1.3 miles southeast of Rekisau.

Drainage area.—0.47 sq mi.

Period of record.—March to September 1970.

Gage.—Water-stage recorder. Altitude of gage is 270 ft (from topographic map).

Extremes.—Maximums and minimums (discharge in cubic feet per second, gage height in feet) March to September 1970.

Remarks.—Records fair except those for period of no gage-height record, which are poor. No diversion above station. Results of discharge measurements made on Feb. 18, 26, 1970 were 2.8 cfs and 0.48 cfs. respectively.

ANNUAL MAXIMUM DISCHARGE AND PEAK DISCHARGES ABOVE BASE (250 FT³/S), AND ANNUAL MINIMUM DISCHARGE

WATER YEAR 1970

Date	Time	Discharge	Gage height
Maximum:			
June 8. 1970	0500	272	3. 31
July 16, 1970	0730	298	3. 44
Minimum:			
Mar. 30 to Apr. 1, 1970		0. 26	

Note: Discharge determined from rating curve above 13 ft³/s.

DISCHARGE, IN CUBIC FEET PER SECOND, MARCH TO SEPTEMBER 1970

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1						0. 34	0. 34	0. 62	5. 8	4. 8	2	7
2						. 38	2. 4	5. 1	2. 8	5. 6	1. 3	4
3						. 38	1. 4	1. 9	1. 7	3. 1	5	2
4						. 38	. 51	. 92	1. 2	9. 7	4	10
5						. 51	. 47	3. 4	2	4. 4	3	5
6						. 62	8. 6	1. 9	16	2. 3	2. 5	3
7						. 92	21	1. 0	4. 6	3. 4	2	5
8						. 30	4. 0	2. 3	18	5. 2	3. 4	3
9						. 85	7. 1	9. 8	6. 0	2. 8	7. 1	2
10						24	2. 8	10	4. 4	2. 1	10	20
11						6. 3	6. 0	2. 3	11	2. 6	5	10
12						1. 5	9. 7	1. 2	9. 4	5	5	7
13						. 78	3. 1	3	8. 7	2. 4	14	4
14						. 55	2. 3	1. 2	6. 9	1. 5	5. 6	2. 5
15						. 51	1. 1	3	3. 7	1. 2	3	2
16						. 42	. 70	7	6. 9	24	1. 8	1. 5
17						. 38	. 78	7	20	3. 2	2	. 8
18						. 38	1. 2	4	6. 6	1. 8	2	1
19						. 34	. 62	2. 5	2. 5	5. 5	15	2
20						. 47	. 47	22	2. 3	4	6	1. 5
21						. 51	2. 9	7. 2	1. 8	3. 8	18	1
22						. 62	2. 4	3	3. 7	1. 9	7	1. 8
23						1. 2	3. 2	2	13	1. 5	20	6
24						. 62	9. 2	2. 4	4	2	5	8
25						2. 5	7. 6	3	7. 8	7. 6	3	4
26						. 92	19	2. 6	6. 8	3	1. 8	10
27						. 42	3. 7	1. 2	10	2	1. 2	11
28						. 85	1. 8	14	4	1. 5	6	5. 5
29						. 38	1. 2	6. 3	4	1. 2	10	15
30						. 30	. 92	17	7. 5	1	15	7. 5
31						. 30	-------	3. 7	-------	1. 2	10	-------
Total						48. 93	126. 51	152. 54	203. 1	121. 3	196. 7	163. 10
Mean						1. 58	4. 22	4. 92	6. 77	3. 91	6. 35	5. 44
Maximum						24	21	22	20	24	20	20
Minimum						. 30	. 34	. 62	1. 2	1	1. 2	. 80
Acre-feet						97	251	303	403	241	390	324

Note: No gage height record Aug. 15 to Sept. 26.

Caroline Islands, Island of Ponape

16897900 LUI RIVER

Location.—Lat 6°55′36″ N., long 158°12′55″ E., on right bank 300 ft upstream from right-bank tributary and 1.3 miles southeast of Rekisau.

Drainage area.—0.47 sq mi.

Period of record.—March 1970 to current year.

Gage.—Water-stage recorder. Altitude of gage is 270 ft (from topographic map).

Extremes.—Current year: Maximum discharge, 806 cfs July 17 (gage height, 5.24 ft), from rating curve extended above 13 cfs; minimum, 0.42 cfs Jan. 24, 25.

Period of record: Maximum discharge, 806 cfs July 17, 1971 (gage height, 5.24 ft), from rating curve extended above 13 cfs; minimum, 0.26 cfs Mar. 30 to Apr. 1, 1970.

Remarks.—Records good except those for period of no gage-height record and those above 50 cfs, which are poor. No diversion above station. Records of chemical analyses for the water year 1971 are published in Part 2 of this report.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	11	4	4.5	20	1.3	2.3	2.4	3.1	3.8	4.6	8.1	3
2	12	10	4	26	1.6	4.2	5.6	3.8	2.8	3.1	7.2	5.3
3	10	7	2.3	10	2.5	13	4	23	2.6	4.2	3.4	4.5
4	16	4	26	6.3	.92	15	3.6	11	5.1	3.1	2.8	3.7
5	4.8	3.5	12	4.4	.92	3.6	2.5	16	8.1	1.5	2.6	4.5
6	3.1	4	6.6	5.4	1	6.6	7.5	14	3.8	6.6	6.8	5.5
7	4.8	5	3.2	30	.78	3.1	3	5.4	10	9	14	3.5
8	3.3	8	2.3	6	.92	20	3.2	9.1	8.7	4.8	2.8	2
9	17	5	1.9	7.8	1.9	4.6	1.4	3.6	7.5	3.1	1.7	1.3
10	6	4	6.1	3.7	5	2.5	1	6.7	17	6.2	3.9	1
11	5	3	16	2.4	14	3.7	2.3	4.6	5	6.6	2.8	.85
12	3.5	8	4.2	1.9	4.8	13	7.2	6.1	3.6	4.4	1.7	.70
13	4.5	5	3.1	1.4	2.4	5	1.9	3.8	24	4.4	1.7	.70
14	12	4	7	1.2	1.3	9	2.1	8.1	9	14	20	.55
15	8	2.5	6	1.1	11	34	1.2	3.2	6	6.9	7.8	1
16	12	5	3.4	.85	5.4	16	2.1	2.3	4.8	5.2	5.6	2
17	6.5	3	2.1	.78	4	32	6.7	1.5	8.3	67	2.8	.90
18	5.5	2.5	6.9	1.2	1.8	14	14	1.3	5.2	7.5	3.6	.60
19	4	2	6.9	1.3	4.6	3.8	5.6	1.1	19	3.4	3.4	2.5
20	7	1.7	6.3	1.1	2.5	2.5	5.6	2.8	6.9	6	2.3	1.5
21	4.5	1.5	5.6	2.3	4.7	2	3	5.8	6.3	5.4	8.1	5
22	3	3	3.7	.85	2.3	9.7	3.4	9.9	11	31	4	2
23	5.4	2	4.8	.70	1.2	3.8	9.6	18	7.8	7.4	2	1.8
24	2.8	5.5	3.7	.51	4.2	2.6	5.8	37	5.8	5.8	1.3	4.8
25	4	4	5.2	.51	9.1	1.5	23	5	3.1	2.6	5.3	2.4
26	5.5	3	14	.70	8.3	1.2	13	2.8	5	3.1	1.9	1.3
27	3	3	4	.62	7.4	1.2	29	3.1	3.4	15	1.2	7
28	2.3	2	2.3	1.1	3.8	3.6	7.2	4	1.9	5.4	1.1	12
29	6	2	3.1	1.2	-------	6.8	4.4	6.6	1.5	2.6	1.3	5.6
30	4.5	2.5	1.9	2.2	-------	5.4	4.2	6.6	3.9	1.8	20	10
31	7	-------	2.3	6.2	-------	2.6	-------	8.1	-------	2.6	9.9	-------
Total	204.0	119.7	181.4	149.72	109.64	248.3	185.5	237.4	210.9	254.3	161.1	97.50
Mean	6.58	3.99	5.85	4.83	3.92	8.01	6.18	7.66	7.03	8.20	5.20	3.25
Maximum	17	10	26	30	14	34	29	37	24	67	20	12
Minimum	2.3	1.5	1.9	.51	.78	1.2	1.0	1.1	1.5	1.5	1.1	.55
Acre-feet	405	237	360	297	217	493	368	471	418	504	320	193

Note: Water year 1971 · Total, 2,159.46; mean, 5.92; maximum, 67; minimum, 0.51; acre-feet, 4,280.

PEAK DISCHARGE (BASE, 250 FT³/S)

Date	Time	Gage height	Discharge
Mar. 15	2300	3.88	395
Apr. 27	1130	4.30	510
May 24	0030	3.86	390
July 17	1600	5.24	806
July 22	0930	4.84	672

Note: No gage height record Oct. 24 to Dec. 2.

Caroline Islands, Island of Ponape

16897900 LUI RIVER

Location.—Lat 6°55′36″ N., long 158°12′55″ E., on right bank 300 ft upstream from right-bank tributary and 1.3 miles southeast of Rekisau.

Drainage area.—0.47 sq mi.

Period of record.—March 1970 to current year.

Gage.—Water-stage recorder. Altitude of gage is 270 ft (from topographic map).

Extremes.—Current year: Maximum discharge, 970 cfs May 4 (gage height, 5.64 ft), from rating curve extended above 13 cfs; minimum, 0.47 cfs Jan. 23.

Period of record: Maximum discharge, 970 cfs May 4, 1972 (gage height, 5.64 ft), from rating curve extended above 13 cfs; minimum, 0.26 cfs Mar. 30 to Apr. 1, 1970.

Remarks.—Records fair. No diversion above station.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1971 TO SEPTEMBER 1972

Day	October	November	December	January	February	March	April	May	June	July	August	September
1	5.4	3.1	3	19	1.7	12	13	5.8	6.9	4.6	13	18.0
2	36	2	5.2	15	1.3	13	4.2	4.6	8	13.0	5.2	11.0
3	7.5	2.8	1.9	6.7	.92	3.2	7.5	2.3	4	3.8	2.8	3.2
4	5.7	2.3	1.2	3.1	.78	1.9	32	138.0	2.4	3.4	2.0	3.8
5	7.5	1.9	1.2	3.7	.92	1.2	6.6	20.0	4.6	2.1	7.9	30.0
6	11	1.3	1.1	1.5	1.8	1	3	6.3	2.1	19.0	3.2	9.5
7	3.8	1.7	2.1	1	16	.85	1.9	8.4	1.8	25.0	9.2	17.0
8	4.8	1.3	3	.78	8.7	4.7	1.3	9.2	1.2	9.8	13	9.8
9	3.2	.85	1.1	10	14	1.7	1.1	4.0	1	5.8	4.8	4.0
10	2.6	1.2	4	3.8	3.2	.92	.85	2.4	.85	3.0	3.1	30.0
11	3.2	.85	1.5	1.7	1.7	.85	1.7	1.9	3.2	21.0	2.4	5.4
12	1.9	.62	1.2	1	1.2	.70	1.2	1.8	2.5	45.0	13	4.6
13	7.6	1.2	.92	.78	1.8	2.8	3.1	2.3	2.1	4.8	5.4	40.0
14	2.5	7.4	.85	1.8	1.9	8	8.4	1.9	1.9	3.0	2.8	77.0
15	2.4	5.3	1	3.2	1.1	2.6	3.4	20.0	4	1.9	1.7	9.0
16	8.7	3.2	1.3	1.5	.85	7.3	5.8	9.9	7	3.4	1.4	4.0
17	3.1	2.6	1	1.5	.85	24	5.6	5.6	14	5.4	8.8	2.6
18	1.8	4	.85	2.4	2.1	8.7	5.3	23.0	4	2.6	3.7	1.9
19	11	4	.78	1.4	3.8	3.6	3.7	7.5	13	2.4	2.3	1.4
20	2.8	9	.85	.85	13	2	4.6	3.0	12	1.4	1.5	2.1
21	8.8	7	.78	1	5.4	1.5	5.6	2.8	6	1.8	4.3	1.3
22	7.2	10	.70	.78	2	2.6	3.2	1.8	4	11.0	3.6	1.2
23	4.6	4	1.2	.55	1.3	3	3.4	3.8	2.3	4.0	2	1.3
24	6	2.5	1	10	22	2.5	6.8	6.8	1.4	2.1	1.2	1.2
25	20	2	9.2	4.6	6.9	4.2	4.4	2.5	1.2	13.0	4	11.0
26	6.6	1.7	4.8	2.1	9.9	3.8	2.6	1.3	.92	4.6	2	3.7
27	3	8	1.7	1.2	4	4.8	36	1.2	.85	2.6	2	11.0
28	2	4	1.4	.92	4.2	3	8.7	12.0	4.4	73.0	1.2	13.0
29	1.7	2	3.8	1.2	2.5	2.1	3.2	28.0	1.9	15.0	.85	27.0
30	2.4	1.4	1.2	34	-------	11	7.8	49.0	2.4	15.0	3.8	30.0
31	6.6	-------	1.1	4	-------	6.3	-------	59.0	-------	64.0	6	-------
Total	201.4	99.22	60.93	141.06	135.82	145.82	195.95	446.1	121.92	386.5	138.15	385.0
Mean	6.50	3.31	1.97	4.55	4.68	4.70	6.53	14.4	4.06	12.5	4.46	12.8
Maximum	36	10	9.2	34	22	24	36	138.0	14	73.0	13	77.0
Minimum	1.7	.62	.70	.55	.78	.70	.85	1.2	.85	1.4	.85	1.2
Acre-feet	399	197	121	280	269	289	389	885.0	242	767.0	274	764.0

Notes:
Calendar year 1971: Total, 2,015.91; mean, 5.52; maximum, 67; minimum, 0.51; acre-feet 4,000.
Water year 1972: Total, 2,457.87; mean, 6.72; maximum, 138; minimum, 0.55; acre-feet, 4,880.

PEAK DISCHARGE (BASE, 500 FT ^{3}/s REVISED)

Date	Time	Gage height	Discharge
Oct. 2	2100	4.88	684
Apr. 27	1530	4.67	621
May 4	1700	5.64	970
May 31	1330	5.20	790
July 28	1000	4.46	558
Sept. 10	0400	4.46	558
Sept. 14	0600	4.64	612

Caroline Islands, Island of Ponape

I6897900 LUI RIVER

Location.—Lat 6°55′36″ N., long 158°12′55″ E., on right bank 300 ft (91 m) upstream from right-bank tributary and 1.3 mi (2.1 km) southeast of Rekisau.
Drainage area.—0.47 mi^2 (1.22 km^2).
Period of record.—March 1970 to current year.
Gage.—Water-stage recorder. Altitude of gage is 270 ft (82 m), from topographic map.
Extremes.—Current year: Maximum discharge, 516 ft ^{3}/s (14.6 m ^{3}/s) June 14, gage height, 4.32 ft (1.317 m), from rating curve extended above 37 ft ^{3}/s (1.05 m ^{3}/s); minimum, 0.13 ft ^{3}/s) (0.004 m^3/s) Feb. 2–4.
Period of record: Maximum discharge, 970 ft ^{3}/s (27.5 m ^{3}/s) May 4, 1972, gage height, 5.64 ft, from rating curve extended above 37 ft ^{2}/s (1.05 m ^{3}/s); minimum, 0.13 ft ^{3}/s (0.004 m ^{3}/s) Feb. 2–4, 1973.
Remarks.—Records good. No diversion above station.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1972 TO SEPTEMBER 1973

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	7.6	0.80	14	0.41	0.47	12	0.29	18	2.5	1.9	0.73	1.3
2	13	2.6	6.7	.35	.18	18	.35	31	3.1	1.3	.66	1.9
3	6.4	1.1	2.3	.47	.13	7	.35	8.1	2.1	1.2	.66	1.6
4	2.4	.73	1	.80	.18	3.7	.35	11	17	1.9	.60	2.3
5	2.5	.60	.73	.60	.23	1.5	.60	8.4	5.5	13	1.1	1.4
6	2.3	.53	.66	.41	.41	.73	7.4	3.6	2.6	3.4	.66	21.0
7	12	.60	.60	.41	.88	.53	7	2.8	5.7	2	3.7	3.7
8	5.5	.80	.53	.41	.47	.47	21	2.5	3.2	1.3	3.7	3.2
9	2.4	.60	.60	.60	.47	1.1	39	4.8	1.8	1	7	3.8
10	1.5	.41	.60	.35	.41	6.6	7.8	8.4	3.7	.96	2.5	2.6
11	1.1	.41	.47	.35	1.9	1.9	3.1	12	9.8	1.3	2.6	7.8
12	.96	.35	.35	.23	.96	1	12	6.4	12	1.9	1.9	4.8
13	.80	.35	.29	.23	.41	1.5	17	3.4	13	2	7	2.1
14	.74	.80	.23	.35	.23	.60	36	1.9	58	1.1	4.7	3.4
15	.73	.35	.23	.47	.41	.41	5	26	6.1	.73	15	4.2
16	.80	.29	.35	.60	.29	.80	3.1	12	3.4	.66	10	4.2
17	.66	.23	.53	1.2	.23	.53	8.2	3.7	4	.73	2.8	8.1
18	.66	.23	1.7	1	.23	.35	5.3	4.2	2.3	8.5	9.9	4.6
19	.53	.18	2.1	.47	.29	1.9	5.7	3	2.6	2.8	6.3	10.0
20	1.5	.23	6.2	.29	.29	.73	5	2	2.1	1.2	6.3	4.0
21	.88	.23	2.1	.23	.29	.47	3.0	1.7	1.9	1.7	12	2.5
22	.60	.20	1.2	.18	.35	.80	1.5	3.8	2	3.2	4.4	2.3
23	.47	.23	2.3	.23	.35	.41	1	2.5	5.2	1.2	3.1	1.7
24	.41	.29	1.5	.29	.35	.35	.73	2.1	3.6	4.8	2.1	2.5
25	.41	.47	.66	.23	.41	.47	1.2	3	2.6	4.2	1.8	8.9
26	53	1.1	12	.23	3.8	.47	6.8	4	6.1	2.5	13	4.8
27	5.6	7	3	.23	3.4	.29	41	6.1	7.8	2.1	8.4	7.7
28	1	12	2.6	.23	3.6	.35	5.5	5.5	16	1.7	23	16.0
29	3	3.2	1	.23	-------	.35	12	6.4	7.6	.96	4.4	5.0
30	3.4	2.5	.73	.23	-------	.29	4.2	9.8	3.2	1	2.5	2.5
31	1.2	-------	.53	.79	-------	.35	-------	4.8	-------	1	2	-------
Total	82.57	39.41	67.79	13.10	21.62	74.95	272.47	22.9	216.5	73.24	164.51	149.9
Mean	2.66	1.31	2.19	.42	.77	2.42	9.08	7.19	7.22	2.36	5.31	5.0
Maximum	13	12	14	1.2	3.8	21	41	31	58	13	23	21.0
Mimimum	.41	.18	.23	.18	.13	.29	.29	1.7	1.8	.66	.60	1.3
Acre-feet	164	78	134	26	43	149	540	442	429	145	326	297.0

Notes:
Calender year 1972: Total, 2,286.09; mean 6.25; maximum 138; minimum 0.18; acre-feet, 4,530.
Water year 1973: Total, 1,398.96; mean 3.83; maximum, 58; mimimum 0.13; Acre-feet, 2,770.
Peak discharge (base, 500 ft ^{3}/s).—June 14 (0900) 516 ft ^{3}/s (4.32 ft).

Caroline Islands, Island of Ponape

16897900 LUI RIVER

Location.—Lat 6°55′36″ N., long 158°12′55″ E., on right bank 300 ft (91 m) upstream from right-bank tributary and 1.3 mi (2.1 km) southeast of Rekisau.

Drainage area.—0.47 mi^2 (1.22 km^2).

Period of record.—March 1970 to current year.

Gage.—Water-stage recorder. Altitude of gage is 270 ft (82 m) from topographic map.

Extremes.—Current year: Maximum discharge, 766 ft^3/s (21.7 m^3/s) July 11, gage height, 5.13 ft (1.564 m), from rating curve extended above 37 ft^3/s (1.05 m^3/s); minimum, 0.35 ft^3/s (0.010 m^3/s) Jan. 16.

Period of record: Maximum discharge, 970 ft^3/s (27.5 m^3/s) May 4, 1972, gage height, 5.64 ft, from rating curve extended above 37 ft^3/s (1.05 m^3/s); minimum, 0.13 ft^3/s (0.004 m^3/s) Feb. 2–4, 1973.

Remarks.—Records fair. No diversion above station. Periodic determinations of water temperature for the water year 1974 are published in Part 2 of this report.

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DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1973 TO SEPTEMBER 1974

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sept.
1	2	4.8	0.47	8.9	3.4	1.7	2.5	3	12	5	5.7	2.3
2	2.3	3.1	.47	3.2	11	1.9	7	4.8	12	3.5	8.1	1.5
3	2	3	.53	13	4.6	2.5	5.9	3.1	5.3	2.5	5.7	.96
4	1.2	3	.80	3.8	3.1	6.7	3	3	16	7	10	1.1
5	4.2	2.1	6.1	2.3	34	7.3	3.4	1.4	23	6.0	5.3	.96
6	12	33	3.2	12	5.5	3.2	3	1	9.8	5	5.7	1.9
7	4.8	4	1.3	5.7	6.7	6.7	5.7	.96	5.5	3.5	4.2	1.5
8	3.1	3.7	1.2	2.8	10	12	6.1	.80	5	3	15	.96
9	3	2.1	9.1	1.5	3.1	4	5.3	1	12	15	21	.73
10	30	1.4	10	1.2	7.6	15	29	2.1	5.7	12	6.4	33
11	4.2	1	3.8	.80	7	37	7.3	12	.89	58	14	8.7
12	2.3	3.5	10	.73	6.4	5.7	9	5.3	5.5	7	5.9	14
13	1.5	1.7	3.4	.60	2.5	2.8	13	17	3.7	3.8	28	4.8
14	1.2	4	3.6	.47	1.7	2	5.9	13	4.8	23	5.7	2
15	1	3	16	.47	1.5	21	15	5	3.7	9	3.4	15
16	3.4	3.8	12	.41	1	11	10	4.2	2.4	5.5	2.4	4.6
17	1.7	3.2	3.4	.41	2.3	17	3.8	9	2.6	3.7	6.7	2.1
18	1.3	5.7	9.4	1.3	13	4.2	2.8	4.2	3.8	3.2	3.4	3.2
19	1.1	4.8	4.4	3.4	9	5	6.8	2.4	4	5	2.1	2.3
20	.80	5.3	3	.80	6.1	2.5	9.5	2	6.9	7	1.8	1.5
21	.66	2.6	12	5	4.4	1.3	7	2.1	3.7	5.7	1.3	1.4
22	7.4	7.7	4.2	6	11	.88	5.3	5.3	3.7	3.6	1	1.5
23	26	2.5	5.9	4	5.5	1.7	8.7	3.8	3	26	.96	2.4
24	7.3	1.7	5.7	2.4	5.3	1.2	3.6	8.1	6.4	6.1	.96	.9
25	9.8	1.1	5.9	.96	2.4	.73	2.3	8.7	6.1	3.4	.96	12
26	4.8	1.9	9.8	4.2	1.5	1.1	5.5	4	19	2.3	1.5	4.2
27	13	2.3	4.2	2.4	8.7	1.8	4.4	2.5	5.5	3.4	1.1	2.1
28	14	1.9	2.4	1.5	2.5	2.3	3.2	9.9	6.2	3.7	1.7	1.5
29	49	.80	2.3	1	--------	17	3.4	15	15	3.9	1.4	2.1
30	9	.53	5	.96	--------	4.4	8.9	7.3	7	6.9	17	1.2
31	7.6	--------	13	.96	--------	2	--------	3.6	--------	5.9	4.6	--------
Total	231.66	119.23	172.57	93.17	180.8	203.61	206.3	165.56	228.2	258.6	192.98	133.41
Mean	7.47	3.97	5.57	3.01	6.46	6.57	6.88	5.34	7.61	8.34	6.23	4.45
Maximum	49	33	16	13	34	37	29	17	23	58	28	33
Minimum	.66	.53	.47	.41	1.0	.73	2.3	.80	2.4	2.3	.96	.73
Acre-feet	459	236	342	185	359	404	409	328	453	513	383	265

Notes:
Calandar year 1973: Total, 1,732.65; mean 4.75; maximum 58; minimum 0. 13; acre-feet 3,440.
Water year 1974: Total, 2,186,09; mean, 5.99; maximum 58; minimum, 0.41; acre-feet, 4,340.

PEAK DISCHARGE (BASE, 500 FT³/S)

Date	Time	Gage height	Discharge
Oct. 29	1230	4. 74	642
Nov. 6	0630	4. 47	561
Mar. 11	1200	4. 44	552
July 11	0500	5. 13	766
Sept. 10	0930	4. 37	531

Caroline Islands, Island of Ponape

16897900 LUI RIVER

Location.—Lat 6°55′36″ N., long 158°12′55″ E., on right bank 300 ft (91 m) upstream from right-bank tributary and 1.3 mi (2.1 km) southeast of Rekisau.
Drainage area.—0.47 mi² (1.22 km²).
Period of record.—March 1970 to current year.
Gage.—Water-stage recorder. Altitude of gage is 270 ft (82 m), from topographic map.
Average discharge.—5 years, 5.40 ft³/s (0.153 m³/s), 3,910 acre-ft/yr (4.82 hm³/yr).
Extremes.—Current year: Maximum discharge, 422 ft³/s (12.0 m³/s) Nov. 15 (gage height, 3.97 ft or 1.210 m), from rating curve extended above 37 ft³/s (1.05 m³/s); mimimum, 0.18 ft ³/s (0. 005 m³/s) Jan. 30, Feb. 10–22.
Period of record: Maximum discharge, 970 ft³/s (27.5 m³/s) May 4, 1972 (gage height, 5.64 ft or 1.719 m), from rating curve extended above 37 ft³/s (1.05 m³/s); minimum, 0.13 ft³/s (0.0004 m³/s) Feb. 2–4, 1973.
Remarks.—Records fair. No diversion above station. Periodic determinations of water temperature for the current year are published in Part 2 of this report.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1974 TO SEPTEMBER 1975, MEAN VALUES

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0.98	8	4.4	15	0.29	0.47	0.35	7.9	1.7	2.4	3.6	0.88
2	2.8	7	4	8	.35	27	.35	6.1	7.2	2	1.9	.66
3	1.3	2	2.3	6	.29	5.3	.53	2.4	4	9.8	2.6	10
4	1.7	1.6	2.5	5	.29	1.9	.35	1.4	2.5	6.4	2.6	4
5	13	1.3	3.6	4	.23	.80	.23	6.9	6.1	27	5	6.5
6	12	1.7	7.6	3	.23	.53	.18	23	4.8	3.4	3.8	3.1
7	4.6	1.7	2.8	2.5	.23	.47	4	6.1	7	2.4	3.4	1.8
8	13	8.1	3.8	2.2	.23	1	.80	8.4	9	3.1	3.2	1.2
9	6.1	5.9	3.8	1.4	.23	1.1	.41	5.3	3.6	3	8.7	1.1
10	5.9	1.9	32	1.1	.18	.60	.47	11	2.0	1.7	7.3	4.7
11	3	1.2	15	.80	.18	1.5	1.9	5	1.3	2.1	3.6	7.5
12	24	19	5.7	.80	.18	1.3	1.5	2.8	10	2.3	8.8	2.8
13	15	18	10	.73	.18	11	.66	2	7.8	24	3.6	1.8
14	4.4	7.3	10	.73	.18	3.6	4.7	3.2	14	5	5.1	2.1
15	2.4	23	11	.60	.18	7.6	16	14	7.6	9	5.6	3.2
16	2.3	6.4	5.7	.53	.18	4.6	3.6	8.4	6.4	8.6	11	1.3
17	9	4.8	4.4	.47	.18	3.6	3.4	3.4	3.8	15	3.7	5.7
18	3.4	3.6	3.1	.41	.18	2.8	2.3	4	18	17	2.6	10
19	1.9	2.1	3.4	.41	.18	1.8	1.3	2.1	5.5	4.8	2.4	2.8
20	2.6	4.3	2.1	.47	.29	1.3	2.1	7.9	5.5	5.9	1.7	1.8
21	3.1	5.4	3	.53	.18	1.8	1	10	11	3.4	3.6	1.8
22	1.9	2.6	1.8	.41	.23	4.6	.88	3.8	9.3	3.8	1.7	11
23	19	1.8	1.8	.35	.23	3.6	1.7	2.1	15	2.3	1.2	5.5
24	12	8.3	2.8	.29	.35	1.4	8.6	1.8	7.8	3	1	2.6
25	9.8	3.2	1.7	.23	9.1	.88	46	3.6	5.7	2.5	1.2	6.1
26	3.7	2.3	5.3	.23	1.9	.60	5.9	5.6	8.6	2.5	.96	4.8
27	2.3	3.1	4	.23	6.1	.53	2.8	9.8	7.0	1.8	.66	4.2
28	1.5	35	1.7	.23	1.3	.96	1.8	4.4	5.7	1.5	.60	6.4
29	2.4	4.8	1.1	.23	--------	.66	5.5	2.6	3.1	1.3	.88	6.4
30	5.9	7.3	1.3	.18	--------	.47	3.8	3.8	2.6	1.9	4	5
31	4	--------	1.9	.53	--------	.60	--------	3.2	--------	1.5	1.5	--------
Total	194.96	202.7	163.6	57.59	23.85	94.37	123.11	182.0	203.6	180.4	107.50	126.74
Mean	6.29	6.76	5.28	1.86	.85	3.04	4.10	5.87	6.79	5.82	3.47	4.22
Maximum	24	35	32	15	9.1	27	46	23	18	27	11	11
Minimum	.96	1.2	1.1	.18	.18	.47	.18	1.4	1.3	1.3	.60	.66
Acre-feet	387	402	325	114	47	187	244	361	404	358	213	251

Notes:
Calendar year 1974: Total, 2,223.89; mean, 6.09; maximum, 58; minimum, 0.41; acre-feet, 4,410.
Water year 1975: Total, 1,660.42; mean, 4.55; maximum, 46; minimum, 0·18; acre-feet, 3,290.
Peak discharge (base, 500 ft³/s). No peak above base.

Caroline Islands, Island of Ponape

16897900 LUI RIVER

Location.—Lat 06°55'36" N., long 158°12'55" E., on right bank 300 ft (91 m) upstream from right-bank tributary and 1.3 mi (2.1 km) southeast of Rekisau.

Drainage area.—0.47 mi² (1.22 km²).

Period of record.—March 1970 to current year.

Gage.—Water-stage recorder. Altitude of gage is 270 ft (82 m), from topographic map.

Remarks.—Records good. No diversion above station. Periodic determinations of water temperature for the current year are published on page 414 of this report.

Average discharge.—6 years, 5.73 ft³/s (0.162 m³/s), 4,150 acre-ft/yr (5.12 hm³/yr).

Extremes for period of record.—Maximum discharge, 1,190 ft³/s (33.7 m³/s) Aug. 4, 1976, gage height, 5.92 ft (1.804 m), from rating curve extended above 37 ft³/s (1.05 m³/s), on basis of slope-area measurement at gage height 5.92 ft (1.804 m); minimum, 0.13 ft³/s (0.004 m³/s) Feb. 2–4, 1973.

Extremes for current year.—Peak discharges above base of 500 ft³/s (14.2 m³/s) and maximum (*):

Date	Time	Discharge		Gage height	
		Cubic feet per second	Cubic meters per second	Feet	Meters
Oct. 11	1500	583	16.5	4.39	1.338
Dec. 17	1200	839	23.8	5.12	1.561
Aug. 4	1330	1190	33.7	5.92	1.804
Sept. 8	1300	767	21.7	4.93	1.503

Note: Minimum discharge, 0.38 ft³/s (0.011 m³/s) Jan. 23–26, Feb. 8, 9.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976, MEAN VALUES

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	4.7	29	5.3	4.6	0.97	7.4	8.3	2	3.1	1.7	4.9	5.8
2	8	6.8	5.5	2.8	8	7	14	2.3	1.8	2.8	52	3.5
3	6.7	3.3	18	2.1	7.1	6.7	6.5	18	22	1.6	48	3.5
4	4	4.7	15	1.6	1.8	2.8	3.4	7	8.7	1	69	3.8
5	22	8.8	17	1.2	.97	1.6	2.4	5.9	3.7	.97	8.7	3.1
6	19	5.4	6.1	.97	.66	1.1	4.7	8.1	15	1.1	9.3	23
7	5.4	3.6	4	.81	.54	.89	3.2	14	5.3	1.1	5	13
8	2.7	2.3	22	.73	.43	.81	2.7	4.6	23	.89	18	93
9	3.7	1.7	6.9	.66	.38	.97	5.1	3	8.1	1.2	7.8	8.8
10	5.4	1.6	8.6	.60	.60	.97	11	5.1	4.8	23	3.7	4.7
11	29	1.6	7.1	.54	.60	1.5	9.2	23	2.7	18	4.4	5.7
12	5.7	14	9	.48	2.8	7.7	6.3	15	3.1	5.5	8.5	5.9
13	4.2	14	6.7	.48	6.3	5.6	3.5	24	3.6	2.4	7.1	2.9
14	25	5.5	7.2	.54	3.9	12	2,6	7	2.3	1.8	9.8	2
15	5.8	5.5	6.2	.60	1.3	9.6	2.5	8.1	1.8	32	4.1	1.4
16	3.2	3.1	6.3	.73	.73	17	3.3	6.4	1.6	9	2.4	1.1
17	2.3	2.8	50	.54	.66	8.1	9.6	13	3.7	3.1	3.5	1
18	2.2	4.9	16	6.2	22	35	12	27	12	2	2.8	.97
19	8.6	2.5	11	3	6.7	5.3	16	14	5	1.5	6.3	.81
20	7.5	3.2	11	1.3	2.9	2.9	11	6.4	5.7	1.3	7	.73
21	3.4	2.4	4.8	.97	1.7	25	8	4.8	4.8	1.3	7.8	.73
22	10	2.2	3.2	.60	1.1	25	37	3.3	3.8	1.2	3.2	6.2
23	4.6	2.1	4	.43	.89	8.5	14	2.3	16	1	8.8	2.7
24	6.4	43	3.6	.48	.73	5.8	7.3	10	4.2	.90	14	15
25	4.8	13	2.3	.48	1.6	23	5.9	6.4	3.3	.80	3.5	5
26	51	3.8	4.7	.43	26	44	9.4	2.5	12	.70	2.3	2.8
27	9.4	2.4	6	.81	4.7	9.8	3.4	1.8	3	.65	18	1.4
28	6.3	1.7	11	1.7	2.1	4.5	3.9	2.7	2	12	4.4	1.2
29	3.2	1.3	4.6	2.8	3.5	6.8	3.3	2.5	1.4	4.5	6.8	2
30	3.5	1.2	49	2.2	--------	14	2.7	1.8	3.7	2.9	3.7	1.6
31	8.1	--------	16	1.6	--------	7.4	--------	2.4	--------	6.7	3.7	--------
Total	285.8	197.4	348.1	42.98	111.66	308.74	232.2	254.4	191.2	144.61	358.5	223.34
Mean	9.22	6.58	11.2	1.39	3.85	9.96	7.74	8.21	6.37	4.66	11.6	7.44
Maximum	51	43	50	6.2	26	44	37	27	23	32	69	93
Minimum	2.2	1.2	2.3	.43	.38	.81	2.4	1.8	1.4	.65	2.3	.73
Acre-feet	567	392	690	85	221	612	461	505	379	287	711	443

Notes:
Calendar year 1975: Total, 1,930.46; mean, 5.29; maximum, 51; minimum, 0.18; acre-feet, 3,830.
Water year 1976: Total, 2,698.93; mean, 7.37; maximum, 93; minimum, 0.38; acre-feet, 5,350.

Caroline Islands, Island of ponape

16897900 LUI RIVER

Location.—Lat 06°55′36″ N., long 158°12′55″ E., on right bapk 300 ft (91 m) upstream from right-bank tributary and 1.3 mi (2.1 km) southeast of Rekisau.

Drainage area.—0.47 mi² (1.22 km²).

Period of record.—March 1970 to current year.

Gage.—Water recorder. Altitude of gage is 270 ft (82 m), from topographic map.

Remarks.—Records fair. No diversion above station. Periodic determinations of water temperature for the current year are published elsewhere in this report.

Average discharge.—7 years, 5.59 ft³/s (0.158 m³/s), 4,050 acre-ft/yr (4.99 hm³/yr).

Extremes for period of record.—Maximum discharge, 1,190 ft³/s (33.7 m³/s) Aug. 4, 1976, gage height, 5.92 ft (1.704 m), from rating curve extended above 37 ft³/s (1.05 m³/s), on basis of slope-area measurement at gage height 5.92 ft (1.804 m); minimum, 0.13 ft³/s (0.004 m³/s) Feb. 2–4, 1973.

Extremes for current year.—Peak discharges above base of 500 ft³/s (14.2 m³/s) and maximum (*).

Date	Time	Discharge		Gage height	
		Cubic feet per second	Cubic meters per second	Feet	Meters
Oct. 14	0700	505	14.3	4.13	1.259
Oct. 19	1200	668	18.9	4.65	1.417
Dec. 16	1200	644	18.2	4.58	1.396
Apr. 23	2300	505	14.3	4.13	1.259

Note: Minimum discharge, 0.21 ft³/s (0.006 m³/s) Mar. 22–25, Apr. 15.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977, MEAN VALUES

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	1.5	4.9	6	1.1	0.50	0.34	1.6	1.9	2.3	2.4	4.2	4.4
2	1.1	3.9	8	.97	.40	.34	.97	24	16	1.4	2.4	2.8
3	.73	11	4.5	.81	.38	.29	1.3	5.2	6.1	3.5	2.1	2.1
4	.66	7.8	6	.81	.38	.34	.73	2.2	5.3	3.6	1.7	1.7
5	.60	4	3.8	.73	.38	.25	.97	2.4	2.3	2.6	1.4	1.8
6	.54	2.9	2.5	.66	.38	.25	4.2	1.5	1.4	5	1.3	14
7	.43	4.2	1.7	.73	.38	.66	1.7	14	.97	13	1.1	9
8	.54	18	1.4	.66	.38	.89	.81	13	1.1	9	9	3.4
9	.66	4.7	1.1	.73	.43	1.7	.60	44	1.1	11	5	2
10	.43	5.3	1	3.5	.38	4.8	.43	11	1.6	8	4.3	1.4
11	.43	4.7	1	.89	.43	3.5	.34	4	1.4	4	7	1.1
12	.89	7.4	.97	.66	.43	1.1	.29	2.3	2.3	2.8	3.4	.89
13	1.1	4.8	.81	.60	.38	.48	.29	12	9.1	4.5	2.8	1.6
14	45	5.6	.73	.48	.38	5.8	.25	4.3	3.3	5.7	3	1.1
15	3.6	25	23	7.5	.48	8	.21	2.5	2	4.6	2.2	1
16	3.1	6.7	49	3	.43	2.4	.29	1.6	3.8	2.3	2.6	10
17	13	6	5	4	.43	.89	.29	1.2	3.6	1.5	1.6	2.3
18	4.3	9.5	2.5	2.8	.43	.73	.79	1.7	2.3	2.3	1.5	2.3
19	33	4.5	2.4	2	.43	.48	1	.99	1.4	3.7	4.9	1.5
20	6.1	3.3	4.4	2	.43	.34	7.4	3.6	1	1.6	5.9	1.7
21	12	25	2.8	1.5	.38	.29	25	3.2	5.5	1.5	5.7	8.4
22	5.9	3.8	6.6	1	.34	.29	5.1	9.2	2.8	5.1	4.6	3.7
23	8.3	6.6	19	.80	.34	.25	87	7.5	7	2.5	2.2	1.6
24	6.1	15	23	.60	.34	.21	40	3.3	12	10	5	1.3
25	4.1	3.6	11	.50	.54	.29	20	2.6	3.2	5	2.6	.89
26	9.2	2.2	5	.40	.29	.29	7.2	7.7	2.3	7	3.1	2
27	18	9.5	3.9	.35	.34	.38	2.9	4.0	2.6	6	2.1	1.4
28	6.1	23	3.1	.30	.34	18	2.2	2.5	1.6	8	2.8	.97
29	3.6	5.7	2.1	.70	-------	14	2.1	9.5	4.6	4	19	.97
30	2.7	5.5	1.4	1	-------	20	2.6	7.8	5.9	9	24	.81
31	4.6	-------	1.1	1	-------	5.3	-------	5.3	-------	5	13	-------
Total	198.31	244.1	204.81	42.78	11.15	92.88	218.56	215.99	115.87	155.6	151.5	88.13
Mean	6.40	8.14	6.61	1.38	.40	3	7.29	6.97	3.86	5.02	4.89	2.94
Maximum	45	25	49	7.5	.54	20	87	44	16	13	24	14
Minimum	.43	2.2	.73	.30	.29	.21	.21	.99	.97	1.4	1.1	.81
Acre-feet	393	484	406	85	22	184	434	428	230	309	301	175

Notes:
Calendar year, 1976: Total, 2,514.85; mean, 6.87; maximum, 93; minimum, 0.38; acre-feet, 4,990.
Water year, 1977: Total, 1,739.68; mean, 4.77; maximum, 87; minimum, 0.21; acre-feet, 3,450.

Caroline Islands, Island of Ponape

16898200 LUI RIVER AT MOUTH

Location.—Lat 6°57′07″ N., long 158°13′16″ E., on right bank 0.4 mile upstream from mouth and 1.3 miles west of Tolenot Peak.
Drainage area.—2.06 sq mi.
Period of record.—March to September 1970.
Gage.—Water-stage recorder. Altitude of gage is 40 ft (from topographic map).
Extremes.—Maximums and minimums (discharge in cubic feet per second, gage height in feet) March to September.
Remarks.—Records fair. No diversion above station. Result of discharge measurement made Feb. 14, 1970, 4.8 cfs.

ANNUAL MAXIMUM DISCHARGE AND PEAK DISCHARGES ABOVE BASE (1,200 FT³/S), AND ANNUAL MINIMUM DISCHARGE

Date	Time	Discharge	Gage height
Maximum:			
June 17, 1970	0200	1,280	4.14
Aug. 21, 1970	1430	1,260	4.12
Minimum:			
Mar. 6, 1970		3.0	-------

Note: Discharge determined from rating cure extended above 92 ft³/s.

DISCHARGE, IN CUBIC FEET PER SECOND, MARCH TO SEPTEMBER 1970

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1						3.7	3.6	6.2	25.0	24.0	11.0	28.0
2						3.5	7.9	13.0	16.0	26.0	8.7	20.0
3						3.4	6.1	7.9	12.0	18.0	19.0	15.0
4						3.3	4.0	5.6	9.8	30.0	20.0	16.0
5						3.3	5.0	9.8	9.5	20.0	21.0	19.0
6						3.2	25.0	7.3	42.0	14.0	15.0	14.0
7						4.1	100.0	5.3	18.0	18.0	11.0	14.0
8						3.3	15.0	7.1	84.0	24.0	12.0	11.0
9						5.0	25.0	30.0	27.0	15.0	39.0	8.5
10						114.0	12.0	30.0	20.0	13.0	33.0	105.0
11						31.0	35.0	12.0	41.0	14.0	27.0	40.0
12						11.0	40.0	7.3	40.0	24.0	22.0	57.0
13						7.1	25.0	9.5	40.0	15.0	46.0	27.0
14						5.9	12.0	7.1	32.0	10.0	22.0	16.0
15						5.1	9.0	8.1	22.0	8.9	15.0	14.0
16						4.7	7.0	22.0	29.0	138.0	12.0	12.0
17						4.2	6.5	23.0	113.0	20.0	9.3	9.1
18						4.1	10.0	21.0	27.0	14.0	9.1	9.3
19						3.9	7.0	16.0	17.0	19.0	36.0	8.5
20						3.9	6.5	94.0	15.0	15.0	29.0	8.1
21						3.7	14.0	37.0	12.0	15.0	102.0	6.8
22						3.5	12.0	19.0	13.0	9.3	34.0	6.6
23						4.8	12.0	14.0	49.0	8.3	117.0	20.0
24						4.9	27.0	15.0	19.0	8.5	27.0	27.0
25						7.1	27.0	18.0	32.0	16.0	18.0	18.0
26						5.3	68.0	15.0	27.0	11.0	14.0	56.0
27						4.3	18.0	10.0	64.0	8.7	11.0	48.0
28						5.6	12.0	52.0	27.0	8.3	20.0	35.0
29						4.5	8.9	34.0	22.0	6.8	18.0	53.0
30						4.0	7.3	68.0	32.0	5.6	65.0	41.0
31						3.7	----	21.0	----	6.4	35.0	----
Total						279.1	567.8	685.2	936.3	583.8	878.1	762.9
Mean						9.0	18.9	22.1	31.2	18.8	28.3	25.4
Maximum						114.0	100.0	94.0	113.0	138.0	117.0	105.0
Minimum						3.2	3.6	5.3	9.5	5.6	8.7	6.6
Acre-feet						554.0	1,130.0	1,360.0	1,860.0	1,160.0	1,740.0	1,510.0

Caroline Islands, Island of Ponape

16898200 LUI RIVER AT MOUTH

Location.—Lat 6°57′07″ N., long 158°13′16″ E., on right bank 0.4 mile upstream from mouth and 1.3 miles west of Tolenot Peak.

Drainage area.—2.06 sq mi.

Period of record.—March 1970 to current year.

Gage.—Water-stage recorder. Altitude of gage is 40 ft (from topographic map).

Extremes.—Current year: Maximum discharge, 7,440 cfs July 17 (gage height, 7.92 ft), from rating curve extended above 92 cfs; minimum, 4.5 cfs Feb. 8.

Period of record: Maximum discharge, 7,440 cfs July 17, 1971 (gage height, 7.92 ft), from rating curve extended above 92 cfs; minimum, 3.0 cfs Mar. 6, 1970.

Remarks.—Records fair except those above 200 cfs, which are poor. No diversion above station. Records of chemical analyses for the water year 1971 are published in Part 2 of this report.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	55.0	20.0	22.0	125.0	6.6	14.0	12.0	18.0	19.0	20.0	33.0	18.0
2	58.0	62.0	19.0	179.0	6.4	18.0	23.0	19.0	15.0	16.0	36.0	27.0
3	48.0	35.0	12.0	71.0	8.7	51.0	20.0	102.0	13.0	19.0	20.0	23.0
4	114.0	21.0	200.0	35.0	5.5	79.0	20.0	48.0	17.0	18.0	15.0	19.0
5	27.0	19.0	84.0	23.0	5.3	21.0	16.0	77.0	30.0	12.0	13.0	20.0
6	19.0	21.0	40.0	27.0	5.5	23.0	29.0	61.0	18.0	36.0	20.0	21.0
7	20.0	27.0	22.0	287.0	5.1	15.0	15.0	24.0	82.0	45.0	69.0	14.0
8	25.0	53.0	16.0	37.0	5.0	69.0	16.0	29.0	47.0	29.0	16.0	9.8
9	123.0	29.0	15.0	42.0	7.0	23.0	10.0	17.0	37.0	18.0	11.0	8.0
10	32.0	18.0	30.0	21.0	11.0	15.0	7.4	26.0	107.0	25.0	14.0	7.0
11	28.0	17.0	63.0	16.0	51.0	15.0	12.0	21.0	28.0	31.0	12.0	6.3
12	20.0	54.0	22.0	13.0	18.0	69.0	36.0	24.0	21.0	27.0	8.8	5.7
13	24.0	24.0	17.0	11.0	12.0	23.0	12.0	19.0	170.0	28.0	8.8	5.5
14	84.0	21.0	43.0	9.1	8.7	39.0	12.0	33.0	47.0	80.0	112.0	5.1
15	48.0	15.0	28.0	7.9	35.0	280.0	8.5	18.0	29.0	35.0	43.0	6.5
16	82.0	24.0	18.0	7.1	20.0	133.0	9.5	13.0	24.0	26.0	26.0	9.6
17	41.0	16.0	14.0	6.4	16.0	201.0	26.0	10.0	33.0	597.0	15.0	6.0
18	30.0	15.0	23.0	7.0	10.0	69.0	32.0	8.5	26.0	45.0	16.0	5.3
19	22.0	12.0	30.0	8.5	16.0	25.0	19.0	7.4	70.0	22.0	16.0	11.0
20	48.0	9.8	26.0	6.8	12.0	18.0	23.0	11.0	31.0	26.0	13.0	8.2
21	27.0	9.3	24.0	8.9	18.0	16.0	15.0	21.0	33.0	23.0	60.0	23.0
22	20.0	15.0	18.0	5.7	12.0	87.0	18.0	50.0	73.0	136.0	24.0	9.5
23	23.0	11.0	19.0	5.5	8.3	24.0	51.0	245.0	41.0	29.0	13.0	9.7
24	16.0	31.0	16.0	5.0	15.0	16.0	30.0	204.0	31.0	27.0	12.0	20.0
25	19.0	20.0	30.0	5.0	35.0	12.0	133.0	29.0	21.0	18.0	30.0	10.0
26	27.0	16.0	89.0	5.2	35.0	9.5	68.0	18.0	31.0	17.0	13.0	7.7
27	16.0	15.0	24.0	5.2	36.0	9.3	227.0	20.0	23.0	99.0	9.8	18.0
28	12.0	11.0	16.0	5.5	20.0	16.0	39.0	22.0	15.0	29.0	8.2	54.0
29	36.0	11.0	16.0	5.7	-------	31.0	26.0	29.0	12.0	18.0	9.2	30.0
30	29.0	12.0	13.0	6.7	-------	28.0	26.0	30.0	23.0	13.0	108.0	35.0
31	48.0	-------	12.0	18.0	-------	16.0	-------	32.0	-------	15.0	64.0	-------
Total	1,221.0	664.1	1,021.0	1,016.2	44.1	1,468.8	991.4	1,285.9	1,167.0	1,579.0	868.8	452.9
Mean	39.4	22.1	32.9	32.8	15.9	47.4	33.0	41.5	38.9	50.9	28.0	15.1
Maximum	123.0	62.0	200.0	287.0	51.0	280.0	227.0	245.0	170.0	597.0	112.0	54.0
Minimum	12.0	9.3	12.0	5.0	5.0	9.3	7.4	7.4	12.0	12.0	8.2	5.1
AC-FT	2,420.0	1,320.0	2,030.0	2,020.0	881.0	2,910.0	1,970.0	2,550.0	2,310.0	3,130.0	1,720.0	898.0

Note: Water year 1971: Total, 12,180.2; mean 33.4; maximum, 597; minimum, 5.0; acre-feet, 24,160.

PEAK DISCHARGE (BASE, 1,200 FT³/s)

Date	Time	Gage height	Discharge
Mar. 15	2230	5.74	3,310
Apr. 27	1200	5.66	3,190
May 23	2300	5.20	2,520
July 17	1530	7.92	7,440
July 22	0930	4.82	2,020

Caroline Islands, Island of Ponape

16898200 LUI RIVER AT MOUTH

Location.—Lat 6°57′07″ N., long 158°13′16″ E., on right bank 0.4 mile upstream from mouth and 1.3 miles west of Tolenot Peak.

Drainage area.—2.06 sq mi.

Period of record.—March 1970 to current year.

Gage.—Water-stage recorder. Altitude of gage is 40 ft (from topographic map).

Extremes.—Current year: Maximum discharge, 4,280 cfs May 4 (gage height, 6.34 ft), from rating curve extended above 92 cfs; minimum, 4.1 cfs Dec. 22.

Period of record: Maximum discharge, 7,440 cfs July 17, 1971 (gage height, 7.92 ft), from rating curve extended above 92 cfs; minimum, 3.0 cfs Mar. 6, 1970.

Remarks.—Records fair. No diversion above station.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1971 TO SEPTEMBER 1972

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	24.0	14.0	17	94.0	9.8	64.0	41.0	21.0	40.0	19.0	58.0	98.0
2	312.0	12.0	23	60.0	8.0	76.0	16.0	20.0	35.0	43.0	26.0	55.0
3	41.0	12.0	12	46.0	7.0	19.0	29.0	12.0	20.0	20.0	17.0	18.0
4	31.0	12.0	8.8	18.0	6.2	13.0	219.0	528.0	13.0	15.0	12.0	17.0
5	35.0	10.0	7.6	17.0	6.0	10.0	33.0	149.0	18.0	11.0	38.0	175.0
6	55.0	8.2	7.1	10.0	8.5	8.0	16.0	31.0	11.0	95.0	18.0	40.0
7	23.0	9.8	8.0	7.7	45.0	7.1	11.0	77.0	9.6	151.0	50.0	88.0
8	29.0	8.8	10	6.8	36.0	14.0	8.8	33.0	8.1	58.0	73.0	47.0
9	18.0	7.1	6.4	48.0	88.0	8.0	7.4	20.0	7.4	33.0	25.0	20.0
10	14.0	8.0	13	19.0	18.0	6.5	6.5	14.0	6.7	19.0	18.0	174.0
11	16.0	7.1	7.6	10.0	11.0	6.1	7.4	12.0	12.0	141.0	14.0	25.0
12	11.0	6.3	6.4	7.8	8.8	5.5	7.0	12.0	9.0	340.0	57.0	22.0
13	32.0	6.6	5.7	6.8	8.8	8.6	9.8	10.0	8.1	30.0	24.0	211.0
14	14.0	33.0	5.4	7.1	8.8	32.0	47.0	8.7	8.1	18.0	15.0	664.0
15	12.0	21.0	5.4	12.0	6.6	12.0	17.0	112.0	11.0	12.0	11.0	60.0
16	40.0	21.0	5.8	8.5	6.1	28.0	24.0	46.0	18.0	15.0	9.6	23.0
17	16.0	15.0	5.2	7.8	5.7	64.0	21.0	26.0	58.0	24.0	44.0	15.0
18	12.0	18.0	4.9	8.0	7.6	42.0	15.0	211.0	17.0	14.0	19.0	11.0
19	88.0	18.0	4.7	7.0	15.0	20.0	13.0	49.0	55.0	14.0	12.0	9.4
20	16.0	43.0	4.7	5.7	54.0	13.0	14.0	17.0	73.0	10.0	9.8	10.0
21	31.0	31.0	4.6	5.7	23.0	9.8	20.0	15.0	30.0	11.0	19.0	8.3
22	29.0	46.0	4.2	5.6	10.0	10.0	13.0	11.0	19.0	39.0	17.0	7.4
23	19.0	22.0	4.8	4.9	7.8	11.0	11.0	15.0	13.0	18.0	11.0	7.4
24	23.0	13.0	4.8	32.0	111.0	9.0	21.0	22.0	9.4	12.0	8.5	7.3
25	104.0	11.0	24	13.0	33.0	13.0	19.0	11.0	8.3	54.0	14.0	31.0
26	34.0	11.0	15	8.2	48.0	10.0	13.0	8.9	7.5	21.0	8.5	12.0
27	26.0	39.0	6.8	6.5	19.0	13.0	310.0	8.7	6.8	14.0	8.1	32.0
28	16.0	20.0	6.4	5.7	18.0	9.8	48.0	45.0	12.0	586.0	7.1	42.0
29	13.0	12.0	13	5.7	13.0	7.7	19.0	207.0	8.0	69.0	6.3	117.0
30	13.0	9.8	6.8	122.0	--------	53.0	29.0	466.0	8.5	63.0	11.0	175.0
31	24.0	--------	6.8	19.0	--------	26.0	--------	474.0	--------	435.0	17.0	-------
Total	1,171.0	505.7	265.9	635.5	647.7	629.1	1,065.9	2,692.3	560.5	2,404.0	677.9	2,221.8
Mean	37.8	16.9	8.58	20.5	22.3	20.3	35.5	86.8	18.7	77.5	21.9	74.1
Max	312.0	46.0	24	122.0	111.0	76.0	310.0	528.0	73.0	586.0	73.0	664.0
Min	11.0	6.3	4.2	4.9	5.7	5.5	6.5	8.7	6.7	10.0	6.3	7.3
Acre-feet	2,320.0	1,000.0	527	1,260.0	1,280.0	1,250.0	2,110.0	5,340.0	1,110.0	4,770.0	1,340.0	4,410.0

Note:
Calendar year 1971: Total, 11,216.7; mean, 30.7; maximum, 597; minimum, 4.2; acre-feet, 22,250.
Water year 1972: Total, 13,477.3; mean, 36.8; maximum, 664; minimum, 4.2; acre-feet, 26,730.

PEAK DISCHARGE

[Base, 3,000 ft³/s, revised]

Date	Time	Gage height	Discharge
Oct. 2	2000	5.65	3,180
Apr. 27	1600	6.24	4,080
May 4	2300	6.34	4,280
May 31	1300	5.98	3,670
July 28	1000	5.60	3,100
Sept. 14	0600	5.76	3,340

Caroline Islands, Island of Ponape

16898200 LUI RIVER AT MOUTH

Location.—Lat 6°57′07″ N., long 158°13′16″ E., on right bank 0.4 mi (0.6 km) upstream from mouth and 1.3 mi (2.1 km) west of Tolenot Peak.

Drainage area.—2.06 mi² (5.34 km²).

Period of record.—March 1970 to current year.

Gage.—Water-stage recorder. Altitude of gage is 40 ft (12 m), from topographic map.

Extremes.—Current year: Maximum discharge, 4,440 ft³/s (126 m³/s) June 14, gage height, 6.42 ft (1.957 m), from rating curve extended above 92 ft³/s (2.61 m³/s); minimum, 0.26 ft³/s (0.007 m³/s) Jan. 20, when gate in dam 500 ft (152 m) upstream was closed.

Period of record: Maximum discharge, 7,440 ft³/s (211 m³/s) July 17, 1971, gage height, 7.92 ft (2.414 m), from rating curve extended above 92 ft³/s (2.61 m³/s); minimum, 0.26 ft³/s (0.007 m³/s) Jan. 20, 1973.

Remarks.—Records good except those above 150 ft³/s (4.25 m³/s), which are poor. No diversion above station.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1972 TO SEPTEMBER 1973

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	36.0	5.2	55	3.6	3.0	57	1.0	85.0	12.0	12.0	5.2	8.7
2	56.0	9.0	30	3.4	1.5	58	.94	205.0	12.0	9.4	4.9	8.9
3	30.0	5.7	12	3.5	1.3	20	.86	35.0	9.6	8.9	4.6	8.0
4	17.0	5.0	8.3	3.9	1.2	9.4	.70	45.0	77.0	10.0	4.5	9.2
5	13.0	4.7	7.0	3.4	1.2	6.4	.94	39.0	31.0	54.0	5.2	7.5
6	11.0	4.3	6.0	3.0	1.2	4.5	13	18.0	14.0	17.0	3.5	82.0
7	48.0	4.7	5.7	2.9	2.9	3.6	16	12.0	22.0	12.0	9.4	18.0
8	22.0	5.0	5.2	2.7	2.5	3.1	58	11.0	15.0	9.2	13.0	15.0
9	12.0	4.0	5.2	2.9	2.2	4.3	184	18.0	10.0	8.3	22.0	18.0
10	9.6	3.8	4.7	2.6	2.0	13	32	25.0	13.0	7.4	9.8	12.0
11	8.3	3.6	4.5	2.5	4.6	6.3	12	44.0	33.0	8.9	9.2	32.0
12	7.4	3.5	4.0	2.3	3.8	4.6	72	23.0	52.0	8.6	8.0	22.0
13	6.8	3.2	3.6	2.2	2.2	4.9	74	15.0	58.0	9.0	17.0	12.0
14	6.1	4.3	3.4	2.3	1.8	3.5	254	9.8	467.0	9.4	11.0	13.0
15	5.7	3.2	3.2	2.9	1.8	2.7	25	150.0	35.0	7.0	64.0	16.0
16	6.0	3.0	3.5	3.4	1.8	3.1	16	76.0	19.0	6.4	41.0	15.0
17	5.6	2.9	3.5	4.2	1.5	2.6	32	22.0	22.0	6.8	15.0	25.0
18	5.0	2.6	5.9	4.0	1.3	2.2	22	24.0	14.0	50.0	39.0	22.0
19	4.9	2.6	6.0	3.1	1.3	5.3	24	17.0	16.0	9.0	29.0	39.0
20	7.7	2.6	15	2.5	1.6	3.4	25	12.0	13.0	6.7	30.0	24.0
21	5.9	2.7	7.5	2.3	1.3	2.9	14	9.8	14.0	6.8	42.0	14.0
22	5.0	2.9	5.9	2.2	1.4	2.9	9.2	13.0	11.0	9.4	19.0	11.0
23	4.5	2.9	6.3	2.2	1.3	2.0	7.7	11.0	13.0	6.6	13.0	9.0
24	4.3	3.0	5.7	2.3	1.1	1.7	6.6	9.4	12.0	24.0	9.8	11.0
25	4.0	3.4	4.3	2.3	1.0	2.0	7.1	10.0	11.0	12.0	8.7	35.0
26	4.7	5.7	22	1.9	3.8	2.2	18	11.0	25.0	8.5	30.0	19.0
27	15.0	21	8.5	1.9	8.0	1.5	247	17.0	41.0	8.7	31.0	26.0
28	5.9	43	8.3	1.7	4.3	1.6	26	17.0	55.0	8.1	98.0	90.0
29	11.0	12	5.7	1.3	-------	1.3	62	20.0	30.0	6.7	23.0	31.0
30	11.0	9.2	4.7	1.3	-------	1.2	18	30.0	17.0	6.6	14.0	16.0
31	6.4	-------	4.2	1.6	-------	1.1	-------	20.0	-------	6.3	11.0	-------
Total	395.8	188.7	274.8	82.3	62.9	238.3	1,279.04	1,054.0	1,173.6	373.7	644.8	669.3
Mean	12.8	6.29	8.86	2.65	2.25	7.69	42.6	34.0	39.1	12.1	20.8	22.3
Maximum	56.0	43	55	4.2	8.0	58	254	205.0	467.0	54.0	98.0	90.0
Minimum	4.0	2.6	3.2	1.3	1.0	1.1	.70	9.4	9.6	6.3	3.5	7.5
Acre-feet	785.0	374	545	163	125	473	2,540	2,090.0	2,330.0	741.0	1,280.0	1,330.0

Notes:
Calendar year 1972: Total, 12,394; mean, 33.9; maximum, 664; minimum, 2.6; acre-feet, 24,580.
Water year 1973: Total, 6,437.24; mean, 17.6; maximum, 467; minimum, 0.70; acre-feet 12,770.
Peak discharge (base, 3,000 ft³/s); June 14 (0930) 4,400 ft³/s (6.42 ft).

Caroline Islands, Island of Ponape

16898200 LUI RIVER AT MOUTH

Location.—Lat 6°57′07″ N., long 158°13′16″ E., on right bank 0.4 mi (0.6 km) upstream from mouth and 1.3 mi (2.1 km) west of Tolenot Peak.

Drainage area.—2.06 mi² (5.34 km²).

Period of record.—March 1970 to current year.

Gage.—Water-stage recorder. Altitude of gage is 40 ft (12 m) from topographic map.

Extremes.—Current year: Maximum discharge, 4,000 ft³/s (113 m³/s) Mar. 11, gage height, 6.20 ft (1.890 m), from rating curve extended above 92 ft³/s (2.61 m³/s); minimum, p.62 ft³/s (0.018 m³/s) Jan. 20, when gate in dam 500 ft (152 m) upstream was closed.

Period of record: Maximum discharge, 7,440 ft³/s (211 m³/s) July 17, 1971, gage height, 7.92 ft (2.414 m), from rating curve extended above 92 ft³/s (2.61 m³/s); minimum, 0.26 ft³/s (0.007 m³/s) Jan. 20, 1973.

Remarks.—Records fair. During dry periods, water is diverted from dam, 500 ft upstream, to Tawannu River pump-station pool for domestic use in Kolonia. Periodic determinations of water temperature for the water year 1974 are published in Part 2 of this report.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1973 TO SEPTEMBER 1974

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	14.0	30.0	5.6	39.0	11.0	12.0	13.0	19.0	50.0	24.0	16.0	9.8
2	11.0	20.0	5.0	19.0	30.0	10.0	22.0	22.0	54.0	17.0	35.0	7.8
3	10.0	17.0	4.9	52.0	16.0	10.0	19.0	15.0	24.0	14.0	25.0	6.7
4	8.4	16.0	5.5	24.0	12.0	20.0	13.0	14.0	58.0	35.0	41.0	6.0
5	56.0	15.0	23.0	15.0	240.0	24.0	14.0	10.0	116.0	31.0	25.0	5.3
6	55.0	188.0	14.0	35.0	32.0	13.0	12.0	8.4	49.0	28.0	29.0	7.4
7	19.0	26.0	9.5	27.0	25.0	21.0	20.0	8.0	30.0	17.0	21.0	7.0
8	14.0	20.0	9.8	19.0	50.0	48.0	26.0	7.6	24.0	17.0	66.0	5.5
9	11.0	14.0	32.0	11.0	18.0	19.0	25.0	7.6	52.0	64.0	87.0	4.7
10	126.0	11.0	46.0	9.2	30.0	50.0	320.0	8.4	28.0	48.0	34.0	80.0
11	24.0	8.8	17.0	7.8	31.0	305.0	43.0	53.0	40.0	360.0	83.0	21.0
12	14.0	15.0	33.0	6.7	30.0	37.0	34.0	20.0	25.0	34.0	34.0	60.0
13	10.0	10.0	19.0	5.8	15.0	21.0	56.0	64.0	17.0	21.0	153.0	22.0
14	8.4	21.0	15.0	5.2	11.0	16.0	35.0	64.0	19.0	197.0	33.0	12.0
15	7.6	14.0	60.0	4.7	9.2	113.0	80.0	25.0	16.0	36.0	20.0	43.0
16	12.0	13.0	67.0	4.3	7.6	61.0	60.0	20.0	12.0	25.0	14.0	18.0
17	8.0	11.0	20.0	4.0	10.0	73.0	24.0	26.0	11.0	17.0	21.0	11.0
18	6.5	20.0	40.0	6.8	36.0	23.0	16.0	17.0	14.0	17.0	15.0	14.0
19	6.0	20.0	27.0	15.0	33.0	26.0	28.0	12.0	17.0	19.0	10.0	11.0
20	5.0	21.0	18.0	6.7	27.0	17.0	41.0	10.0	27.0	49.0	8.8	8.6
21	4.3	13.0	42.0	11.0	17.0	12.0	29.0	9.0	16.0	28.0	7.8	8.0
22	17.0	36.0	24.0	19.0	39.0	10.0	23.0	16.0	15.0	20.0	6.7	8.2
23	129.0	16.0	24.0	14.0	24.0	11.0	32.0	14.0	15.0	76.0	6.2	10.0
24	36.0	11.0	20.0	11.0	24.0	9.8	17.0	31.0	27.0	27.0	6.5	8.4
25	39.0	9.5	21.0	7.8	13.0	7.8	14.0	41.0	26.0	16.0	6.2	24.0
26	23.0	7.6	43.0	14.0	11.0	8.4	27.0	21.0	63.0	12.0	7.2	14.0
27	59.0	14.0	23.0	10.0	38.0	9.2	23.0	14.0	26.0	12.0	6.5	9.0
28	79.0	9.5	15.0	8.4	15.0	8.6	17.0	68.0	27.0	14.0	6.4	7.8
29	290.0	7.2	12.0	6.5	-------	66.0	15.0	80.0	105.0	12.0	6.7	9.2
30	46.0	6.2	15.0	5.8	-------	23.0	58.0	41.0	36.0	20.0	46.0	6.7
31	34.0	-------	44.0	5.5	-------	13.0	-------	22.0	-------	19.0	17.0	-------
Total	1,182.2	640.8	754.3	430.2	854.8	1,097.8	1,156.0	788.0	1,039.0	1,326.0	894.0	466.1
Mean	38.1	21.4	24.3	13.9	30.5	35.4	38.5	25.4	34.6	42.8	28.8	15.5
Max	290.0	188.0	67.0	52.0	240.0	305.0	320.0	80.0	116.0	360.0	153.0	80.0
Min	4.3	6.2	4.9	4.0	7.6	7.8	12.0	7.6	11.0	12.0	6.2	4.7
Acre-feet	2,340.0	1,270.0	1,500.0	853.0	1,700.0	2,180.0	2,290.0	1,560.0	2,060.0	2,630.0	1,770.0	925.0

Notes:
Calendar year 1973: Total, 8,155.24; mean, 22.3; maximum, 467; minimum, 0.70; acre-feet, 16,180.
Water year 1974: Total, 10,629.2; mean, 29.1; maximum, 360; minimum, 4; acre-feet, 21,080.

PEAK DISCHARGE

[Base, 3,000 ft³/s]

Date	Time	Gage height	Discharge
Oct 29	1300	6.12	3,880
Mar. 11	1300	6.20	4,000
July 11	0500	6.04	3,760

Caroline Islands, Island of Ponape

16898200 RIVER LUI AT MOUTH

Location.—Lat 6°57′07″ N., long 158°13′16″ E., on right bank 0.4 mi (0.6 km) upstream from mouth and 1.3 mi (2.1 km) west of Tolenot Peak.

Drainage area.—2.06 mi² (5.34 km²).

Period of record.—March 1970 to current year.

Gage.—Water-stage recorder. Altitude of gage is 40 ft (12 m), from topograhphic map.

Average discharge.—5 years, 27.9 ft³/s (0.790 m³/s), 20,210 acre-ft/yr (24.9 hm³/yr).

Extremes.—Current year: Maximum discharge, 1,760 ft³/s (49.8 m³/s) Nov. 15 (gage height, 4.60 ft or 1.402 m), from rating curve extended above 92 ft³/s (2.61 m³/s); minimum, 0.38 ft³/s (0.011 m³/s) Feb. 24.

Period of record: Maximum discharge, 7,440 ft³/s (211 m³/s) July 17, 1971 (gage height, 7.92 ft or 2.414 m), from rating curve extended above 92 ft³/s (2.61 m³/s); minimum, 0.26 ft³/s (0.007 m³/s) Jan. 20, 1973.

Remarks.—Records good except those above 100 ft³/s (2.83 m³/s), which are fair. During dry periods, water is diverted from dam, 500 ft (152 m) upstream, to Tawannu River pump-station pool for domestic use in Kolonia. Periodic determinations of water temperature for the current year are published in Part 2 of this report.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1974 TO SEPTEMBER 1975, MEAN VALUES

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	6.0	40.0	29.0	73.0	2.5	4.9	3.2	48.0	8.2	15.0	6.8	5.0
2	8.6	39.0	21.0	44.0	2.3	123.0	3.6	38.0	24.0	14.0	6.1	4.3
3	6.3	19.0	14.0	29.0	2.0	22.0	2.3	16.0	16.0	30.0	8.7	26.0
4	6.5	13.0	13.0	19.0	1.8	9.4	2.3	11.0	11.0	67.0	8.7	14.0
5	39.0	11.0	17.0	16.0	1.7	6.4	2.3	25.0	22.0	120.0	20.0	22.0
6	44.0	13.0	28.0	12.0	2.7	6.3	1.5	145.0	18.0	20.0	16.0	13.0
7	19.0	12.0	15.0	20.0	1.8	5.2	50.0	34.0	23.0	14.0	15.0	9.1
8	60.0	26.0	21.0	12.0	1.8	4.9	14.0	36.0	34.0	18.0	13.0	7.3
9	27.0	29.0	18.0	8.8	1.6	5.4	8.0	28.0	16.0	13.0	34.0	7.1
10	30.0	12.0	189.0	7.4	1.6	4.3	6.1	44.0	11.0	9.1	28.0	14.0
11	17.0	9.8	77.0	6.5	1.7	5.0	6.8	26.0	8.9	8.4	15.0	16.0
12	71.0	110.0	32.0	6.2	1.3	5.3	6.6	17.0	47.0	10.0	29.0	9.1
13	71.0	160.0	36.0	5.6	1.5	200.0	4.7	12.0	34.0	135.0	14.0	7.3
14	24.0	49.0	39.0	5.5	1.4	29.0	15.0	14.0	60.0	22.0	20.0	7.0
15	15.0	144.0	51.0	4.9	1.2	82.0	77.0	46.0	38.0	29.0	20.0	9.1
16	12.0	43.0	28.0	4.5	.86	58.0	18.0	41.0	25.0	45.0	40.0	6.3
17	35.0	25.0	23.0	4.0	.86	20.0	15.0	18.0	16.0	84.0	16.0	13.0
18	18.0	20.0	17.0	3.8	1.9	14.0	10.0	17.0	77.0	59.0	13.0	30.0
19	12.0	14.0	16.0	3.4	1	9.4	8.0	11.0	30.0	22.0	10.0	13.0
20	19.0	19.0	12.0	3.4	1	11.0	10.0	23.0	23.0	25.0	8.7	9.6
21	18.0	28.0	12.0	3.5	.62	11.0	6.7	42.0	40.0	16.0	12.0	8.9
22	13.0	16.0	9.0	3.2	.50	16.0	5.9	18.0	34.0	17.0	8.7	50.0
23	94.0	12.0	8.6	2.9	.46	15.0	6.4	12.0	58.0	12.0	7.1	24.0
24	48.0	28.0	10.0	2.6	.58	8.2	30.0	9.6	44.0	12.0	6.7	15.0
25	49.0	14.0	7.8	2.4	25	6.3	257.0	12.0	31.0	9.6	6.3	22.0
26	24.0	11.0	15.0	2.2	8.6	5.3	30.0	16.0	44.0	8.7	5.9	20.0
27	15.0	13.0	12.0	2.0	14	4.6	15.0	33.0	44.0	8.0	5.0	17.0
28	12.0	220.0	7.6	2.0	5.5	4.9	10.0	16.0	31.0	7.3	4.9	26.0
29	14.0	29.0	6.2	1.9	-------	4.3	23.0	11.0	18.0	7.0	5.3	29.0
30	22.0	56.0	6.3	1.8	-------	3.5	22.0	13.0	18.0	6.3	10.0	24.0
31	22.0	-------	6.1	2.9	-------	4.3	-------	13.0	-------	6.4	6.3	-------
Total	869.4	1,234.8	796.6	316.4	87.78	708.9	670.4	845.6	904.1	869.8	420.2	478.1
Mean	28.0	41.2	25.7	10.2	3.14	22.9	22.3	27.3	30.1	28.1	13.6	15.9
Max	94.0	220.0	189.0	73.0	25	200.0	257.0	145.0	77.0	135.0	40.0	50.0
Min	6.0	9.8	6.1	1.8	.46	3.5	1.5	9.6	8.2	6.3	4.9	4.3
Acre-feet	1,720.0	2,450.0	1,580.0	628.0	174	1,410.0	1,330.0	1,680.0	1,790.0	1,730.0	833.0	948.0

Notes:
Calendar year 1974: Total, 10,952.70; mean, 30; maximum 360; minimum, 4; acre-feet, 21,720.
Water year 1975: Total, 8,202.08; mean, 22.5; maximum, 257; minimum, 0.46; acre-feet, 16,270.
Peak discharge (base, 3,000 ft³/s). No peak above base.

Caroline Islands, Island of Ponape

16898200 LUI RIVER AT MOUTH

Location.—Lat 06°57′07″ N., long 158°13′16″ E., on right bank 0.4 mi (0.6 km) upstream from mouth and 1.3 mi (2.1 km) west of Tolenot Peak.

Drainage area.—2.06 mi² (5.34 km²).

Period of record.—March 1970 to current year.

Gage.—Water-stage recorder. Altitude of gage is 40 ft (12 m), from topographic map.

Remarks.—Records good. During dry periods, water is diverted from dam, 500 ft (152 m) upstream, to Tawannu River pump-station pool for domestic use in Kolonia. Periodic determination of water temperature for the current year are published on page 415 of this report.

Average discharge.—6 years, 27.4 ft³/s (0.776 m³/s), 19,850 acre-ft/yr (24.5 hm³/yr).

Extremes for period of record.—Maximum discharge, 6,360 ft³/s (180 m³/s) Aug. 4, 1976, gage height, 8.91 ft (2.716 m), from rating curve extended above 288 ft³/s (8.16 m³/s) on basis of slope-area measurement at gage height 8.91 ft (2.716 m); minimum, 0.26 ft³/s (0.007 m³/s) Jan. 20, 1973, during short regulation of flow.

Extremes for current year.—Peak discharges above base of 2000 ft ^{3}/s (56.6 m ^{3}/s) revised, and maximum (*):

Date	Time	Discharge		Gage height	
		Cubic feet per second	Cubic meters per second	Feet	Meters
Dec. 17	1200	2,280	64.6	5.93	1.807
Aug. 4	1400	6,360	180.0	8.91	2.716
Sept. 8	1230	2,600	73.6	6.23	1.899

Note: Minimum discharge, 0.55 ft ^{3}/s (0.016 m ^{3}/s) Mar. 9, during short regulation of flow.

Revisions.—The peak discharges and annual maximum (*) for water years 1970–75 have been revised and, revised daily discharges, in cubic feet per second, for high-water periods in these years, are given below. These figures supersede those published in the reports for 1970–75.

Water year	Date	Time	Discharge		Gage height	
			Cubic feet per second	Cubic meters per second	Feet	Meters
1970	June 17, 1970	0200	804	22.8	4.14	1.262
	Aug. 21, 1970	1430	792	22.4	4.12	1.256
1971	Mar. 15, 1971	2230	2,090	59.2	5.74	1.750
	Apr. 27, 1971	1200	2,010	56.9	5.66	1.725
	May 23, 1971	2300	1,580	44.7	5.20	1.585
	July 17, 1971	1530	4,790	136.0	7.92	2.414
	July 22, 1971	0930	1,270	36.0	4.82	1.469
1972	Oct. 2, 1971	2000	2,000	56.6	5.65	1.722
	Apr. 27, 1972	1600	2,610	73.9	6.24	1.902
	May 4, 1972	2300	2,720	77.0	6.34	1.932
	May 31, 1972	1300	2,330	66.0	5.98	1.823
	July 28, 1972	1000	1,950	55.2	5.60	1,707
	Sept. 14, 1972	0600	2,110	59.8	5.76	1.756
1973	June 14, 1973	0930	2,810	79.6	6.42	1.957
1974	Oct. 29, 1973	1300	2,480	70.2	6.12	1.865
	Mar. 11, 1974	1300	2,570	72.8	6.20	1.890
	July 11, 1974	0500	2,390	67.7	6.04	1.841
1975	Nov. 15, 1974	1845	1,100	31.2	4.60	1.402

Date	Discharge cubic feet per second
1971:	
July 17	374
July 22	106
Oct. 2	204
Oct. 25	87
1972:	
Apr. 4	155
Apr. 27	209
May 4	330
May 5	117
May 15	91
May 18	150
May 29	148
May 30	289
May 31	293
July 7	115
July 11	109
July 12	220
July 28	368
July 31	271
Sept. 5	128
Sept. 10	128
Sept. 13	150
Sept. 14	427
Sept. 29	94
Sept. 30	128

Date	Discharge cubic feet per second
1973:	
Apr. 9	134
Apr. 14	176
Apr. 27	172
May 2	148
May 15	116
June 14	289
Oct. 10	101
Oct. 23	102
Oct. 29	193
1974:	
Mar. 11	201
Mar. 15	93
Apr. 10	209
July 11	230
July 14	141
Nov. 12	91
Nov. 13	120
Nov. 15	111
Nov. 28	156
1975:	
Mar. 2	99
Mar. 13	143
Apr. 25	177

Month	Total	Mean	Maximum	Minimum	Runoff in (acre-feet)
July 1971	1,326	42.8	374	12	2,630
Water year 1971	11,927.2	32.7	374	5.0	23,660
October 1971	1,046	33.7	204	11	2,070
Calendar year 1971	10,838.7	29.7	374	4.2	21,500
April 1972	900.9	30.3	209	6.5	1,790
May 1972	1,963.3	63.3	330	8.7	3,890
July 1972	1,834	59.2	368	10	3,640
September 1972	1,760.8	58.7	427	7.3	3,490
Water year 1972	11,427.3	31.2	427	4.2	22,670
Calendar year 1972	10,469.0	28.6	427	2.6	20,770
April 1973	1,076.04	35.9	176	.70	2,130
May 1973	963.0	31.1	148	9.4	1,910
June 1973	995.6	33.2	289	9.6	1,970
Water year 1973	5,965.24	16.3	289	.70	11,830
October 1973	1,033.2	33.3	193	4.3	2,050
Calendar year 1973	7,534.24	20.6	289	.70	14,940
March 1974	973.8	31.4	201	7.8	1,930
April 1974	1,045	34.8	209	12	2,070
July 1974	1,140	36.8	230	12	2,260
Water year 1974	10,059.2	27.6	230	4.0	19,950
November 1974	1,078.8	36.0	156	9.8	2,140
Calendar year 1974	10,375.7	28.4	230	4.0	20,580
March 1975	627.9	20.3	143	3.5	1,250
April 1975	590.4	19.7	177	1.5	1,179
Water year 1975	7,885.08	21.6	177	.46	15,640

DISCHARGE. IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976 MEAN VALUES

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	21.0	89.0	18.0	26	6.8	20.0	35.0	12.0	13.0	11.0	21.0	26.0
2	30.0	31.0	21.0	17	26.0	18.0	55.0	11.0	10.0	12.0	155.0	18.0
3	31.0	19.0	51.0	13	22.0	20.0	33.0	39.0	136.0	8.9	220.0	19.0
4	24.0	26.0	57.0	11	9.5	11.0	18.0	32.0	46.0	7.4	710.0	18
5	103.0	37.0	76.0	9.1	6.8	8.5	13.0	26.0	24.0	7.4	50.0	14.0
6	95.0	28.0	32.0	8.0	5.6	6.8	27.0	33.0	70.0	8.3	47.0	106.0
7	33.0	18.0	20.0	7.0	4.9	6.0	18.0	62.0	29.0	7.8	28.0	61.0
8	19.0	13.0	90.0	6.2	4.4	5.3	14.0	25.0	20.0	6.2	79.0	446.0
9	18.0	11.0	33.0	5.6	4.3	5.5	16.0	16.0	119.0	6.2	43.0	45.0
10	26.0	11.0	32.0	5.2	4.3	5.6	37.0	26.0	51.0	76.0	20.0	24.0
11	85.0	11.0	30.0	5.0	4.0	6.3	31.0	111.0	28.0	80.0	19.0	25.0
12	32.0	31.0	41.0	4.7	11.0	16.0	26.0	73.0	18.0	31.0	31.0	24.0
13	24.0	61.0	33.0	4.6	17.0	12.0	17.0	130.0	19.0	14.0	34.0	14.0
14	109.0	26.0	32.0	4.7	13.0	23.0	12.0	46.0	17.0	11.0	44.0	11.0
15	31.0	28.0	30.0	4.6	7.0	24.0	12.0	47.0	13.0	119.0	23.0	9.5
16	19.0	19.0	30.0	4.0	5.3	47.0	15.0	31.0	11.0	67.0	15.0	8.5
17	14.0	14.0	215.0	3.7	4.7	24.0	30.0	57.0	13.0	19.0	17.0	7.8
18	13.0	19.0	76.0	17	85.0	148.0	34.0	160.0	111.0	13.0	15.0	7.0
19	29.0	13.0	51.0	9.7	28.0	25.0	65.0	85.0	20.0	11.0	36.0	6.3
20	30.0	13.0	49.0	6.2	15.0	13.0	52.0	36.0	24.0	9.3	30.0	5.8
21	18.0	12.0	26.0	5.0	10.0	104.0	38.0	43.0	21.0	8.1	28.0	5.3
22	37.0	13.0	18.0	4.1	8.0	130.0	196.0	24.0	18.0	7.2	15.0	18.0
23	21.0	12.0	17.0	3.5	6.8	36.0	58.0	16.0	51.0	11.0	26.0	11.0
24	21.0	153.0	16.0	3.4	6.0	23.0	35.0	26.0	23.0	9.3	87.0	141.0
25	19.0	69.0	12.0	3.5	7.0	110.0	29.0	32.0	19.0	7.4	24.0	25.0
26	187.0	25.0	16.0	3.2	106.0	226.0	41.0	12.0	50.0	6.5	14.0	14.0
27	40.0	17.0	26.0	5.0	23.0	55.0	21.0	10.0	18.0	6.2	83.0	9.7
28	30.0	12.0	36.0	5.6	12.0	23.0	18.0	12.0	13.0	22.0	25.0	9.3
29	18.0	11.0	21.0	13	13.0	29.0	20.0	13.0	11.0	31.0	28.0	9.5
30	18.0	9.3	229.0	9.5	-------	67.0	18.0	11.0	16.0	16.0	19.0	8.5
31	28.0	-------	102.0	8.9	-------	33.0	-------	11.0	-------	23.0	16.0	-------
Total	1,223.0	851.3	1,536.0	237.0	476.4	1,281.0	1,034.0	1,268.0	1,041.0	673.2	2,002.0	1,147.2
Mean	39.5	28.4	49.5	7.65	16.4	41.3	34.5	40.9	34.7	21.7	64.6	38.2
Max	187.0	153.0	229.0	26	106.0	226.0	196.0	160.0	136.0	119.0	710.0	446.0
Min	13.0	9.3	12.0	3.2	4.0	5.3	12.0	10.0	10.0	6.2	14.0	5.3
Acre-feet	2,430.0	1,690.0	3,050.0	470	945.0	2,540.0	2,050.0	2,520.0	2,060.0	1,340.0	3,970.0	2,280.0

Notes:
Calendar year 1975: Total 8 750.58; mean 24; maximum 177; minimum, 046; acre-feet 17,360.
Water year 1976: Total, 12,770.10; mean, 34.9; maximum, 710, minimum, 3.2; acre-feet, 25,330.

Caroline Islands, Island of Ponape

16898200 LUI RIVER AT MOUTH

Location.—Lat 06°57′07″ N., long 158°13′16″ E., on right bank 0.4 mi (0.6 km) upstream from mouth and 1.3 mi (2.1 km) west of Tolenot Peak.
Drainage area.—2.06 mi² (5.34 km²).
Period of record.—March 1970 to current year.
Revised records.—WDR HI–76–1: 1970(P), 1971–75.
Gage.—Water-stage recorder. Altitude of gage is 40 ft (12 m), from topographic map.
Remarks.—Records good. During dry periods, water is diverted from dam, 500 ft (152 m) upstream, to Tawannu River pump-station pool for domestic use in Kolonia. Periodic determinations of water temperature for the current year are published elsewhere in this report.
Average discharge.—7 years, 26.5 ft³/s (0.750 m³/s), 19,200 acre-ft/yr (23.7 hm³/yr).
Extremes for period of record.—Maximum discharge, 6,360 ft³/s (180 m³/s) Aug. 4, 1976, gage height, 8.91 ft (2.716 m) from rating curve extended above 288 ft³/s (8.16 m³/s) on basis of slope-area measurement at gage height 8.91 ft (2.716 m); minimum, 0.26 ft³/2 (0.007 m³/s) Jan. 20, 1973, during short regulation of flow.
Extremes for current year.—Maximum discharge, 2,060 ft³/s (58.3 m³/s) Nov. 21, gage height, 5.71 ft (1.740 m), no other peak above base of 2,000 ft³/s (56.6 m³/s) minimum, 0.55 ft³/s (0.016 m³/s) Jan. 9, during short regulation of flow.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977, MEAN VALUES

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	9.4	20.0	28.0	6.8	3.3	1.1	8.9	9.1	19.0	16.0	20.0	24.0
2	7.2	18.0	41.0	6.0	2.5	1.2	6.3	90.0	51.0	12.0	16.0	17.0
3	6.0	40.0	21.0	5.5	2.3	1.2	7.2	27.0	30.0	15.0	16.0	13.0
4	5.8	44.0	26.0	5.6	2.2	1.5	5.2	14.0	26.0	16.0	12.0	11.0
5	5.3	19.0	17.0	5.0	2.1	1.2	5.2	11.0	16.0	12.0	10.0	10.0
6	4.7	15.0	12.0	4.4	2.0	1.1	8.9	9.1	12.0	22.0	8.9	51.0
7	4.3	19.0	9.8	4.3	2.0	2.6	6.5	41.0	9.6	54.0	8.1	38.0
8	4.5	79.0	8.5	4.3	1.9	2.8	4.5	62.0	8.5	41.0	26.0	19.0
9	4.5	24.0	7.2	4.0	2.3	3.5	3.8	201.0	7.6	52.0	41.0	13.0
10	4.1	22.0	6.8	9.4	1.9	8.3	3.3	62.0	8.5	36.0	27.0	10.0
11	3.8	23.0	6.3	4.7	2.0	6.8	3.0	24.0	8.3	20.0	33.0	8.7
12	6.0	35.0	6.0	4.0	2.1	3.7	2.8	15.0	10.0	17.0	22.0	8.3
13	6.2	23.0	5.7	3.4	1.7	2.3	2.5	58.0	31.0	20.0	16.0	9.5
14	201.0	29.0	5.0	3.2	1.7	11	2.3	25.0	17.0	24.0	14.0	7.8
15	21.0	115.0	59.0	19	1.8	21	2.2	18.0	11.0	19.0	15.0	8.5
16	16.0	31.0	161.0	11	1.6	7.4	2.1	12.0	17.0	13.0	16.0	51.0
17	47.0	27.0	25.0	12	1.5	4.1	2.1	9.8	15.0	10.0	12.0	14.0
18	20.0	39.0	14.0	8.3	1.5	3.3	2.4	10.0	13.0	10.0	11.0	13.0
19	95.0	23.0	16.0	5.5	1.4	2.6	2.9	8.0	10.0	14.0	16.0	10.0
20	41.0	30.0	21.0	6.3	1.4	2.2	15.0	13.0	8.7	8.7	24.0	9.5
21	42.0	210.0	14.0	5.3	1.3	2.0	76.0	12.0	15.0	8.0	18.0	22.0
22	28.0	23.0	21.0	4.1	1.3	1.8	21.0	45.0	12.0	15.0	18.0	14.0
23	36.0	23.0	56.0	3.5	1.3	1.7	349.0	40.0	29.0	9.8	11.0	9.7
24	36.0	52.0	95.0	3.3	1.3	1.6	210.0	21.0	48.0	39.0	13.0	8.3
25	26.0	19.0	52.0	3.0	1.9	1.5	66.0	16.0	19.0	20.0	11.0	7.0
26	48.0	13.0	26.0	2.8	1.7	1.5	32.0	32.0	16.0	25.0	16.0	8.0
27	66.0	47.0	19.0	2.5	1.3	1.4	16.0	23.0	14.0	21.0	12.0	7.4
28	29.0	113.0	15.0	2.5	1.3	67	11.0	19.0	11.0	27.0	12.0	6.3
29	20.0	32.0	11.0	3.0	-------	56	10.0	40.0	24.0	19.0	46.0	6.2
30	15.0	28.0	9.1	4.4	-------	56	10.0	56.0	28.0	34.0	102.0	5.5
31	20.0	-------	8.0	4.1	-------	22	-------	39.0	-------	23.0	62.0	-------
Total	878.8	1,235.0	821.9	171.2	50.6	301.4	898.1	1,062.0	545.2	672.5	685.0	440.7
Mean	28.3	41.2	26.5	5.52	1.81	9.72	29.9	34.3	18.2	21.7	22.1	14.7
Max	201.0	210.0	161.0	19	3.3	67	349.0	201.0	51.0	54.0	102.0	51.0
Min	3.8	13.0	5.0	2.5	1.3	1.1	2.1	8.0	7.6	8.0	8.1	5.5
Acre/feet	1,740.0	2,450.0	1,630.0	340	100	598	1,780.0	1,110.0	1,080.0	1,330.0	1,360.0	874.0

Notes:
Calendar year 1976; Total, 12,095.5; mean, 33, maximum, 710; minimum, 3.2; acre-feet, 23,990.
Water year 1977; Total 7,762.4; mean, 21.3; maximum, 349; minimum, 1.1; acre-feet, 15,400.

Caroline Islands, Island of Ponape

16898300 TAWANNU RIVER

Location.—Lat 6°56′57″ N., long 158°12′50″ E., on left bank 1.3 miles northeast of Rekisau and 1.8 miles west of Tolenot Peak.

Drainage area—1.00 sq mi.

Period of record.—March to September 1970.

Gage.—Water-stage recorder and concrete control. Altitude of gage is 110 ft (from topographic map).

Extremes.—Water year 1970: Maximum discharge, 357 cfs Aug. 21 (gage height, 2.99 ft), from rating curve extended above 76 cfs; minimum, 0.10 cfs Apr. 1.

Remarks.—Records fair. During periods, up to 360,000 gal per day is diverted 100 ft above station for domestic use in Kolonia. Results of discharge measurements made on Feb. 14, 22, 1970 were 0.78 cfs and 1.9 cfs respectively.

DISCHARGE, IN CUBIC FEET PER SECOND, MARCH TO SEPTEMBER 1970

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1						0.92	0.15	2.3	9.7	9.7	3.0	10
2						.80	.35	3.9	6.3	11	2.6	8.9
3						.68	.40	2.7	5.1	8.1	7.7	6.0
4						.50	.40	1.8	4.0	9.7	8.9	5.8
5						.45	2.0	3.0	3.8	7.7	8.9	6.0
6						.40	15	2.4	14.0	5.8	7.3	4.8
7						.50	40	1.8	8.9	6.5	5.8	4.6
8						.35	8.0	1.9	22.0	9.3	5.1	3.8
9						1.0	10	9.9	10.0	6.0	16.0	3.0
10						39	5.0	16	7.3	5.1	17.0	26
11						18	15	5.8	20.0	5.3	15.0	17
12						5.5	20	4.0	17.0	8.9	11.0	24
13						3.5	10	4.0	18.0	5.8	19.0	12
14						2.6	5.0	3.1	14.0	4.3	11.0	7.3
15						2.2	3.6	3.8	9.3	3.7	7.7	5.3
16						1.7	2.2	11	10.0	47	5.8	4.3
17						1.2	2.5	14	36.0	9.7	4.6	3.3
18						1.2	4.0	13	11.0	6.0	4.1	3.1
19						1.0	2.2	10	7.7	5.5	9.3	3.0
20						.98	2.0	34	6.0	4.8	10.0	3.1
21						.92	3.4	16	4.8	4.3	38.0	2.4
22						.74	3.1	8.1	4.6	3.0	14.0	2.3
23						.92	2.7	6.0	17.0	2.6	38.0	7.3
24						.86	3.8	6.3	8.1	2.3	12.0	9.3
25						1.4	5.8	7.7	12.0	3.3	7.7	6.5
26						1.1	17	6.9	10.0	3.4	6.0	17
27						.74	6.5	4.8	23.0	2.5	4.6	16
28						.80	4.8	34	12.0	2.4	4.8	12
29						.50	3.7	15	9.7	1.9	7.7	14
30						.40	2.7	16	13.0	1.5	25.0	14
31						.30	-------	8.5	-------	1.9	11.0	-------
Total						86.16	200.70	277.7	354.3	208.6	348.6	262.1
Mean						2.78	6.68	8.96	11.8	6.73	11.2	8.74
Max						39	40	34	36.0	47	34.0	26
Min						.30	.15	1.8	3.8	1.5	2.6	2.3
Acres-feet						171	398	551	703.0	414	691.0	520

Caroline Islands, Island of Ponape

16898300 TAWANNU RIVER

Location.—Lat 6°56′57″ N., long 158°12′50″ E., on left bank 1.3 miles northeast of Rekisau and 1.8 miles west of Tolenot Peak.

Drainage area.—1.00 sq mi.

Period of record.—March 1970 to current year.

Gage.—Water-stage recorder and concrete control. Altitude of gage is 110 ft (from topographic map).

Extremes.—Current year: Maximum discharge, 1,550 cfs July 17 (gage height, 5.58 ft), from rating curve extended above 76 cfs; minimum, 0.81 cfs Jan. 30.

Period of record: Maximum discharge, 1,550 cfs July 17, 1971 (gage height, 5.58 ft), from rating curve extended above 76 cfs; minimum, 0.10 Apr. 1, 1970.

Remarks.—Records good except those above 150 cfs, which are fair. During dry periods, up to 360,000 gal per day is diverted 100 ft above station for domestic use in Kolonia.

DISCHARGE IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	15.0	8.9	8.5	51	1.8	5.6	4.5	7.8	7.8	7.4	16	6.7
2	20.0	28	5.5	55	1.6	6.4	7.0	7.8	6.7	5.8	9.2	13
3	18.0	15	4.1	29	1.9	18.0	7.0	32.0	6.4	7.4	6.0	8.1
4	34.0	8.9	65.0	14	1.3	31.0	12.0	20.0	5.6	8.4	4.2	7.0
5	11.0	8.1	28.0	9.3	1.2	9.5	7.8	31.0	14.0	5.6	3.6	7.0
6	7.7	9.3	18.0	8.1	1.4	7.0	9.2	29.0	8.8	13.0	3.7	7.0
7	7.7	11	11.0	82	1.4	5.3	6.0	12.0	26.0	1.0	11	5.6
8	9.3	21	6.9	17	1.2	22.0	5.6	15.0	24.0	11.0	4.2	4.7
9	47.0	12	5.8	20	1.6	8.8	4.0	7.8	16.0	6.7	3.6	3.7
10	14.0	7.7	8.9	9.7	2.4	5.8	3.6	9.2	39.0	8.1	3.3	2.9
11	12.0	7.3	19.0	6.5	13	5.3	5.3	8.1	13.0	10.0	3.2	2.3
12	8.9	18	8.9	5.5	6.4	30.0	13.0	9.2	8.4	7.8	2.7	1.9
13	8.9	9.3	6.3	4.1	4.2	11.0	5.6	7.4	38.0	8.1	2.8	1.6
14	30.0	6.9	13.0	3.1	3.5	14.0	5.1	12.0	21.0	25.0	35	1.3
15	19.0	5.5	10.0	2.7	11	65.0	3.8	7.0	12.0	14.0	16	1.6
16	35.0	5.8	6.5	2.4	8.8	57.0	3.6	5.6	8.8	8.8	7.8	2.6
17	20.0	5.3	5.3	2.1	6.7	70.0	7.0	4.2	12.0	233.0	5.1	1.7
18	12.0	4.8	6.5	2.2	4.7	20.0	11.0	3.6	9.5	22.0	4.9	1.2
19	9.3	4.3	12.0	2.8	5.6	10.0	7.0	2.9	17.0	8.8	5.1	1.9
20	15.0	3.4	10.0	1.7	4.9	7.4	7.4	3.3	10.0	8.4	4.7	3.2
21	9.7	3.7	8.1	2.3	6.4	6.0	5.8	6.4	13.0	7.8	23	8.8
22	6.9	4.8	6.3	1.6	4.5	26.0	5.8	20.0	31.0	32.0	8.8	4.5
23	9.3	3.8	6.3	1.4	3.4	8.4	16.0	50.0	16.0	11.0	5.3	4.5
24	6.3	12	5.3	1.2	4.7	5.8	19.0	65.0	13.0	10.0	4.7	8.8
25	7.7	6.5	15.0	.98	11	4.5	36.0	13.0	8.8	7.0	11	4.9
26	9.7	5.3	33.0	1.0	13	3.7	45.0	6.9	14.0	5.6	5.1	3.4
27	6.0	4.8	10.0	1.0	13	3.3	71.0	11.0	9.5	24.0	4.5	4.5
28	5.1	3.7	6.9	.92	8.1	5.3	16.0	11.0	6.4	11.0	3.5	19
29	16.0	3.1	5.8	.98	-------	9.0	10.0	11.0	5.6	6.0	3.3	9.5
30	13.0	3.8	4.8	.98	-------	10.0	8.8	12.0	11.0	4.9	34	10
31	16.0	-------	3.8	3.7	-------	5.8	-------	12.0	-------	7.3	22	-------
Total	459.5	252.0	364.5	344.26	148.7	496.9	368.9	452.2	432.3	564.9	277.3	162.9
Mean	14.8	8.40	11.8	11.1	5.31	16.0	12.3	14.6	14.4	18.2	8.95	5.43
Max	47.0	28	65.0	82	13	70.0	71.0	65.0	39.0	233.0	35	19
Min	5.1	3.1	3.8	.92	1.2	3.3	3.6	2.9	5.6	4.9	2.7	1.2
Acre-feet	911.0	500	723.0	683	295	986.0	732.0	897.0	857.0	1,120.0	550	323

Note: Water year 1971: Total, 4,324.36; mean, 11.8; maximum, 233; minimum, 0.92; acre-feet, 8,580.

PEAK DISCHARGE (BASE, 300 ft³/s)

Date	Time	Gage height	Discharge
Mar. 15	2300	4.01	724
Apr. 27	0900	4.00	720
May 23	2300	3.36	471
July 17	1530	5.58	1,550

Caroline Islands, Island of Ponape

16898300 TAWANNU RIVER

Location.—Lat 6°56′57″ N., long 158°12′50″ E., on left bank 1.3 miles northeast of Rekisua and 1.8 miles west of Tolenot Peak.

Drainage area.—1.00 sq mi.

Period of record.—March 1970 to current year.

Gage.—Water-stage recorder and concrete control. Altitude of gage is 110 ft (from topographic map).

Extremes.—Current year: Maximum discharge, 1,090 cfs Apr. 27 (gage height, 4.78 ft), from rating curve extended above 76 cfs; minimum, 0.12 cfs Dec. 22–25.

Period of record: Maximum discharge, 1,550 cfs July 17, 1971 (gage height, 5.58 ft), from rating curve extended above 76 cfs; minimum, 0.10 cfs Apr. 1, 1970.

Remarks.—Records fair. During dry periods, up to 360,000 gal per day is diverted 100 ft above station for domestic use in Kolonia.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1971 TO SEPTEMBER 1972

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	8.4	5.6	5.8	29	3.0	22	11.0	6.0	17	8.3	22	36.0
2	67.0	5.6	6.4	23	2.3	28	5.1	6.0	11	19.0	11	24.0
3	22.0	5.6	5.1	19	1.8	7.8	18.0	3.6	7.4	8.4	6.7	8.1
4	17.0	7.8	4.9	7.4	1.4	5.3	40.0	114.0	6.0	5.6	4.9	6.0
5	16.0	6.0	3.8	5.6	1.2	4.5	11.0	55.0	7.0	3.8	9.5	64.0
6	19.0	5.8	2.8	3.8	1.6	3.2	5.8	12.0	4.7	26.0	5.8	13.0
7	9.5	6.4	3.4	2.7	11	2.6	4.7	32.0	3.7	38.0	12	26.0
8	13.0	6.0	4.0	2.2	15	3.9	3.2	11.0	3.0	24.0	21	23.0
9	7.8	4.9	2.6	11	36	2.9	2.6	7.4	2.4	15.0	9.5	8.1
10	6.7	5.6	4.9	5.3	6.7	2.2	2.2	5.3	2.1	8.1	6.4	58.0
11	7.4	4.5	3.1	3.7	4.7	1.9	2.0	4.7	2.8	48.0	5.3	8.8
12	5.8	3.0	2.1	3.0	3.4	1.4	2.1	3.5	2.6	119.0	30	8.1
13	9.5	2.5	1.4	2.5	2.7	1.9	2.0	3.2	2.5	14.0	11	52.0
14	6.0	15	1.2	2.3	2.6	8.8	15.0	2.5	2.6	7.8	6.7	162.0
15	5.8	8.8	1.0	3.3	1.9	3.7	5.6	44	3.0	5.3	4.9	22.0
16	13.0	8.1	1.1	3	1.5	12	6.0	25.0	2.4	5.6	3.7	8.1
17	6.4	7.4	1.2	2.5	1.3	17	5.8	12.0	8.6	8.4	32	5.3
18	11.0	6.4	1.1	2.2	1.6	14	4.2	58.0	3.8	4.9	9.2	3.8
19	30.0	6.7	.81	1.6	2.3	7.0	3.6	27.0	6.7	4.5	5.3	3.1
20	6.4	12	.60	1.2	5.2	4.7	4.2	8.4	30	3.5	4.2	3.5
21	8.4	8.8	.48	.81	4.7	3.6	6.7	6.7	11	3.6	3.8	2.8
22	9.2	10	.24	1.2	2.8	3.2	3.4	4.7	6.4	11.0	3.8	2.3
23	6.7	8.8	.30	.67	2.2	3.3	3.1	4.2	4.5	5.6	3.4	1.9
24	7.0	5.1	.36	4.2	26	2.8	6.0	7.0	3.4	4.0	2.7	1.7
25	33.0	4.7	2.9	3.1	11	3.8	4.0	4.5	2.5	15.0	2.7	5.5
26	14.0	4.7	2.7	2.0	14	2.7	3.3	3.2	2.3	7.0	2.0	3.4
27	10.0	13	1.3	1.3	6.7	3.0	102.0	3.0	1.9	4.9	1.7	7.0
28	6.7	7.4	1.0	.88	6.0	2.6	23.0	14.0	3.3	161.0	1.6	11.0
29	5.8	4.9	3.8	.60	4.9	2.0	7.8	59.0	2.3	24.0	1.2	21.0
30	5.6	4.7	1.5	20	--------	22	7.8	116.0	2.3	48.0	12	43.0
31	7.4	--------	1.4	4.7	--------	10	-------	121.0	--------	127.0	7.6	--------
Total	401.5	296.0	72.49	173.76	185.5	213.8	321.2	783.9	169.2	788.3	263.6	642.5
Mean	13.0	6.87	2.34	5.61	6.40	6.90	10.7	25.3	5.64	25.4	8.50	21.4
Max	67.0	15	6.4	29	36	28	102.0	121.0	30,0	161.0	32.0	162.0
Min	5.6	2.5	.24	.60	1.2	1.4	2.0	2.5	1.9	3.5	1.2	1.7
Acre-feet	796.0	409	144	345	368	424	637.0	1,550.0	336.0	1,560.0	523.0	1,270.0

Notes:
Calendar year 1971: Total, 3,928.35; mean, 10.8; maximum, 233; minimum, 0.24; acre-feet, 7,790.
Water year 1972: Total, 4,221.75; mean, 11.5; maximum, 162; minimum, 0.24; acre-feet, 8,370.

PEAK DISCHARGE (BASE, 600 FT³/S, REVISED)

Date	Time	Gage height	Discharge
April 27	1600	4.78	1,090
May 4	2300	4.75	1,080
May 18	2100	----------	[1] 620
May 31	1300	----------	[1] 600
July 28	1030	----------	[1] 700

[1] Approximately.

Caroline Islands, Island of Ponape

16898300 TAWANNU RIVER

Location.—Lat 6°56′57″ N., Long 158°12′50″ E., on left bank 1.3 mi (2.1 km) northeast of Rekisau and 1.8 mi (2.9 km) west of Tolenot Peak.

Drainage area.—1.00 mi² (2.59 km²).

Period of record.—March 1970 to current year.

Gage.—Water-stage recorder and concrete control. Altitude of gage is 110 ft. (34 m), from topographic map.

Extremes.—Current year: Maximum discharge, about 1,000 ft³/s (28.3 m³/s) June 14, gage height, about 4.5 ft. (1.37 m), from rating curve extended above 76 ft³/s (2.15 m³/s); no flow for many days.

Period of record: Maximum discharge, 1,550 ft³/s (43.9 m³/s) July 17, 1971, gage height, 5.58 ft (1.701 m), from rating curve extended above 76 ft³/s (2.15 m³/s); no flow for many days during January and February 1973.

Remarks.—Records fair. During dry periods, up to 360,000 gal per day (1,368 m³/day) is diverted 100 ft (30 m) above station for domestic use in Kolonia.

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DISCHARGE IN CUBIC FEET PER SECOND WATER YEAR OCTOBER 1972 TO SEPTEMBER 1973

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	15	0.95	20	0.60	0.50	10	0.10	31.0	5.0	6.0	.84	3.5
2	19	3.4	9.7	.50	.30	14	.05	52.0	5.8	4.8	.80	3.1
3	11	1.3	3.8	.45	.10	8.7	.03	15.0	4.5	3.5	.75	2.7
4	6.9	.98	2.7	.40	.05	3.0	.02	20.0	26.0	4.2	.70	3.0
5	4.8	.83	2.3	.35	.03	1.5	.05	12.0	12.0	38	.80	2.2
6	3.3	1.8	1.9	.30	.02	1.0	4.0	7.8	6.9	8.1	.60	21
7	13	3.4	1.8	.25	.40	.75	2.3	6.0	8.1	6.0	1.5	6.6
8	8.1	1.5	1.6	.20	.30	.60	12	5.0	6.6	5.0	4.1	5.5
9	4.5	1.4	1.6	.20	.25	1.0	52	4.5	4.8	3.5	9.2	6.0
10	3.0	1.3	1.2	.15	.20	2.6	15	7.8	5.5	2.2	3.3	4.5
11	2.8	1.2	1.0	.10	1.0	2.1	6.0	11.0	16.0	3.4	2.9	12
12	2.5	1.1	.70	.05	.75	1.0	17	6.9	22.0	2.7	2.4	8.1
13	2.3	1.0	.50	.03	.25	1.0	25	5.5	21.0	2.7	3.0	4.8
14	2.1	1.5	.40	.02	.20	.80	72	3.8	134.0	4.2	1.9	5.2
15	2.0	1.1	.30	.01	.15	.60	12	28.0	15.0	2.5	20	5.2
16	2.1	1.0	.40	.05	.10	.60	7.2	21.0	9.7	1.8	14	4.2
17	1.9	.90	.40	.10	.05	.60	11	8.7	11.0	1.7	6.6	8.4
18	1.4	.80	2.0	.03	.03	.50	10	10.0	7.2	2.1	12	7.5
19	1.3	.80	2.0	.01	.01	1.0	9.7	8.1	8.1	2.1	10	12
20	2.6	.75	5.4	0	.02	.55	11	5.8	7.2	1.3	9.0	7.8
21	1.6	.80	1.1	0	.01	.40	7.5	4.8	7.8	.88	18	5.2
22	1.2	.90	.75	0	.01	.35	5.0	4.2	5.8	2.0	9.0	4.0
23	.91	1.0	.80	0	.01	.30	3.5	4.0	6.3	1.0	6.6	2.5
24	.80	1.0	.75	0	0	.25	2.4	3.3	5.8	2.3	5.0	2.7
25	.70	1.2	.70	0	0	.30	2.7	3.1	6.3	2.2	3.4	11
26	1.5	2.0	5.5	0	.70	.30	8.3	3.5	10.0	1.6	8.1	6.0
27	6.0	8.1	2.4	0	1.0	.25	69	5.2	15.0	1.4	17	7.3
28	1.5	15	2.1	0	.50	.25	12	6.6	18.0	1.2	47	39
29	4.0	5.0	1.0	0	-------	.20	22	6.0	11.0	1.1	9.7	14
30	4.0	2.4	.80	0	-------	.15	8.7	9.7	8.1	1.1	6.0	8.1
31	2.3	-------	.70	0	-------	.10	-------	7.2	-------	.97	5.0	-------
Total	134.11	64.41	76.30	3.80	6.94	54.75	407.55	327.5	430.5	121.55	239.19	233.1
Mean	4.33	2.15	2.46	.12	.25	1.77	13.6	10.6	14.4	3.92	7.72	7.77
Max	19	15	20	.60	1.0	14	72	52.0	134.0	38	47	39
Min	.70	.75	.30	0	0	.10	.02	3.1	4.5	.88	.60	2.2
AC-FT	266	128	151	7.5	14	109	808	650.0	854.0	241	474	462

Notes:
Calendar year 1972: Total 3,816.58; mean, 10.4; maximum, 162; minimum, 0.30; acre-feet, 7,570.
Water year 1973: Total 2,099.70; mean, 5.75; maximum, 134; minimum, 0; acre-feet, 4,160.
Peak discharge (base, 600 ft ^{3}s).—June 14 (0900) about 1,000 ft ^{3}s (about 4.5 ft).

Caroline Islands, Island of Ponape

16898300 TAWANNU RIVER

Location.—Lat 6°56′57″ N., long 158°12′50″ E., on left bank 1.3 mi (2.1 km) northeast of Rekisau and 1.8 mi (2.9 km) west of Tolenot Peak.

Drainage area.—1.00 mi^2 (2.59 km^2).

Period of record.—March 1970 to current year.

Gage.—Water-stage recorder and concrete control. Altitude of gage is 110 ft. (34 m) from topographic map.

Extremes.—Current year: Maximum discharge, 1,600 ft^3/s (30.0 m^3/s) Mar. 11, gage height, 4.72 ft (1.439 m), from rating curve extended above 76 ft^3/s (2.15 m^3/s); minimum, 0.18 ft^3/s (0.005 m^3/s) Oct. 21.

Period of record: Maximum discharge, 1,550 ft^3/s (43.9 m^3/s) July 17, 1971, gage height, 5.58 ft (1.701 m), from rating curve extended above 76 ft^3/s (2.15 m^3/s); no flow for many days during January and February 1973.

Remarks.—Records fair. During dry periods, water from Lui River is pumped to the gage pool to augment the water supply and up to 360,000 gallons per day (1,368 m^3/day) is then diverted 100 ft (30 m) above station for domestic use in Kolonia. Periodic determinations of water temperature for the water year 1974 are published in Part 2 of this report.

DISCHARGE IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1973 TO SEPTEMBER 1974

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	6.0	12	1.1	14	2.2	5.2	3.3	5.6	34.0	9.9	5.0	2.2
2	4.2	8.1	.82	6.6	4.5	4.2	7.1	6.7	29.0	7.1	14	1.8
3	2.8	7.2	.62	21	3.8	3.5	6.7	47.	12.0	5.2	7.5	1.1
4	2.3	7.2	.75	8.4	3.5	8.2	5.0	4.2	40.0	18.0	11	1.3
5	3.0	8.1	6.4	5.5	90.0	8.2	6.3	3.0	50.0	13.0	6.0	.68
6	15	46	2.9	9.0	14.0	4.5	4.7	2.8	20.0	9.9	6.0	2.0
7	6.0	9.0	1.5	8.4	9.0	6.3	7.1	2.7	10.0	6.3	5.6	2.0
8	4.8	6.9	2.0	5.8	24.0	15.0	12.0	2.4	8.0	6.0	16	1.2
9	3.0	4.8	10	3.8	7.9	6.7	11.0	2.2	30.0	27.0	26	.53
10	42	3.1	11	2.9	11.0	18.0	115.0	2.1	10.0	21.0	13	12
11	9.4	2.4	5.2	1.9	11.0	91.0	24.0	20	12.0	85.0	36	4.7
12	5.8	3.0	10	1.8	11.0	18.0	14.0	5.2	10.0	14.0	15	18
13	4.2	2.5	6.3	1.5	6.0	9.0	30.0	20	8.0	8.2	64	8.2
14	2.8	6.0	4.2	1.2	4.0	6.7	17.0	23	7.0	42.0	14	4.5
15	2.2	4.2	16	.70	3.5	31.0	32.0	9.9	6.3	14.0	8.2	13
16	2.8	3.1	23	.62	2.8	26.0	32.0	7.1	4.2	8.6	5.6	6.3
17	1.8	2.4	7.2	.75	3.3	37.0	12.0	7.5	3.8	6.7	6.7	4.2
18	1.3	4.8	14	2.1	8.6	10.0	8.2	5.6	4.7	5.0	5.2	5.2
19	.88	6.3	9.7	4.7	9.9	9.0	7.5	4.0	7.1	5.2	4.0	4.5
20	.57	6.0	6.9	1.7	8.2	6.3	13.0	3.0	12.0	42.0	2.8	3.3
21	.30	3.8	15	1.8	4.7	4.5	9.0	2.8	6.7	11.0	2.5	3.3
22	1.1	9.4	8.4	3.5	11.0	3.5	7.9	4.0	5.6	7.9	2.2	3.0
23	38	5.2	7.2	3.0	7.9	4.0	9.4	3.5	6.3	21.0	2.1	3.5
24	14	3.8	6.9	2.8	7.9	3.5	7.9	7.5	13.0	9.4	2.2	2.8
25	16	2.4	6.6	2.1	4.7	3.0	5.2	15	7.9	5.6	2.2	4.7
26	8.7	2.1	14	2.4	3.8	3.8	8.0	7.9	28.0	4.7	1.5	4.2
27	30	3.3	7.5	2.5	35.0	3.5	6.0	5.2	10.0	4.5	.92	2.8
28	26	2.1	5.0	2.0	7.9	3.3	4.5	32	12.0	4.7	1.3	2.5
29	66	1.6	3.5	1.4	-------	27.0	4.5	33	41.0	4.2	1.5	2.5
30	17	1.3	4.0	1.4	-------	8.2	20.0	19	17.0	5.2	10	1.4
31	11	-------	12	1.3	-------	5.0	-------	10	-------	7.1	3.8	-------
Total	348.95	188.1	229.69	126.57	321.1	393.1	450.3	281.6	465.6	439.4	301.82	127.41
Mean	11.3	6.27	7.41	4.08	11.5	12.7	15.0	9.08	15.5	14.2	9.74	4.25
Max	66	46	23	21	90.0	91.0	115.0	33	50.0	85.0	64	18
Min	.30	1.3	.62	.62	2.2	3.0	3.3	2.1	3.8	4.2	.92	.53
Acre feet	692	373	456	251	637.0	780.0	893.0	559	924.0	872	599.0	253

Notes:
Calendar year 1973: Total, 2,591.62; mean, 7.10; maximum, 134; minimum, 0; acre-feet, 5,140.
Water year 1974: Total, 3,673.64; mean, 10.1; maximum, 115; minimum, 0.30; acre-feet, 7,290.

PEAK DISCHARGE (BASE, 600 FT³/S)

Date	Time	Gage height	Discharge
Oct. 29	1300	[1] 3.8	[1] 640
March 11	1200	4.72	1,060
July 11	0630	[1] 4.5	[1] 950

[1] Approximately.

Caroline Islands, Island of Ponape

16898300 TAWANNU RIVER

Location.—Lat 6°56′57″ N., long 158°12′50″ E., on left bank 1.3 mi (2.1 km) northeast of Rekisau and 1.8 mi (2.9 km) west of Tolenot Peak.

Drainage area.—1.00 mi² (2.59 km²).

Period of record.—March 1970 to December 1974 (discontinued as a continuous-record station; converted to a partial-record station).

Gage.—Water-stage recorder and concrete control. Altitude of gage is 110 ft (34 m), from topographic map.

Extremes.—Maximum discharge during period, 336 ft³/s (9.52 m³/s) Nov. 15 (gage height, 2.92 ft or 0.890 m), from rating curve extended above 76 ft³/s (2.15 m³/s); minimum, about 1.0 ft³/s (0.028 m³/s) Oct. 3.

Period of record: Maximum discharge, 1,550 ft³/s (43.9 m³/s) July 17, 1971 (gage height, 5.58 ft or 1.701 m), from rating curve extended above 76 ft³/s); no flow for many days during January and February 1973.

Remarks.—Records fair. During dry periods, water from Lui River is pumped to the gage pool to augment the water supply and up to 360,000 gallons per day (1,368 m³/day) is then diverted 100 ft (30 m) above station for domestic use in Kolonia. Periodic determinations of water temperature for the current year are published in Part 2 of this report.

DISCHARGE, IN CUBIC FEET PER SECOND, OCTOBER TO DECEMBER 1974, MEAN VALUES

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0.92	14.0	13.0									
2	1.3	14.0	10.0									
3	1.1	6.7	7.5				[1] 0.28		[1] 4.9			
4	1.2	4.0	6.3		[1] 0.10	[1] 3.7						
5	8.2	3.5	7.1									
6	16	4.0	9.9									
7	4.7	3.3	6.7									
8	17	7.9	7.9									
9	6.7	6.3	8.2									
10	9.9	3.5	66.0									
11	4.7	2.8	25.0									
12	12	31.0	14.0									
13	31	62.0	15.0					[1] 3.5				
14	7.9	13.0	14.0				[1] 2.5					
15	5.2	42.0	24.0									
16	5.2	14.0	11.0									
17	10	9.0	7.9						[1] 5.8			
18	6.0	6.0	7.5		[1] .77	[1] 5.8				[1] 14		
19	3.8	4.5	6.0									
20	3.8	6.7	4.7									
21	4.2	14.0	4.5									
22	3.3	7.1	4.2	[1] 0.67								
23	39	4.5	4.5									
24	11	6.7	4.2									
25	14	4.7	3.3									
26	6.7	4.2	4.7									
27	4.7	4.2	4.2									
28	3.8	74.0	3.0									
29	4.0	14.0	2.7				[1] 5.8					
30	5.0	20.0	2.8						[1] 10.0			
31	5.2	------	6.4									
Total	257.52	416.6	320.2									
Mean	8.31	13.9	10.3									
Max	39	74.0	66.0									
Min	.92	2.8	2.7									
Acre-feet	511	826.0	635.0									

[1] Result of discharge measurement.

Note. Peak discharge (base, 600 ft³/s)—No peak above base.

Caroline Islands, Island of Ponape

16898600 LUPWOR RIVER

Location—Lat 6°54′15″ N., long 159°09′45″ E., on left bank about 300 ft (91 m) upstream from 50–ft (15 m) waterfall, 1.8 mi (2.9 km) above mouth, and 2.1 mi (3.4 km) west of Mount Tamatamansakir.

Drainage area.—1.12 mi² (2.90 km²).

Period of record.—September 1972 to current year.

Gage.—Water-stage recorder. Altitude of gage is 100 ft (30 m), from topographic map.

Extremes.—September 1972: Maximum discharge, 1,370 ft³/s (38.8 m³/s) Sept. 14, gage height, 6.13 ft (1.868 m), from rating curve extended above 11 ft³/s (0.31 m³/s); minimum, 1.2 ft³/s (0.034 m³/s) Sept. 25.

Current year: Maximum discharge, 1,180 ft³/s (33.4 m³/s) Apr. 27, gage height, 5.92 ft (1.804 m), from rating curve extend above 11 ft³/s (0.31 m³/s); minimum, 0.40 ft³/s (0.011 m³/s) Feb. 18, 19.

Period of record: Maximum discharge, 1,370 ft³/s (38.8 m³/s) Sept. 14, 1972, gage height, 6.13 ft (1.868 m), from rating curve extended above 11 ft³/s (0.31 m³/s); minimum, 0.40 ft³/s (0.011 m³/s) Feb. 18, 19, 1973.

Remarks—Records fair except those above 50 ft³/s (1.42 m³/s) and those for period of no gage-height record, which are poor.

DISCHARGE MEASUREMENTS MADE PRIOR TO BEGINNING OF CONTINUOUS DISCHARGE RECORD

Date	Discharge cubic feet per second
1972:	
June 8	2.8
June 20	2.8
July 5	5.0
July 13	13.0
Aug. 11	4.3
Aug. 29	3.8

DISCHARGE, IN CUBIC FEET PER SECOND, SEPTEMBER 1972

Day	Sept.	Day	Sept.	Day	Sept.	Day	Sept.	Day	Sept.	Day	Sept.
1	31.0	6	16.0	11	7.8	16	6.4	21	2.0	26	5.1
2	18.0	7	24.0	12	18.0	17	4.5	22	1.7	27	42.0
3	8.0	8	19.0	13	34.0	18	3.6	23	1.6	28	29.0
4	7.8	9	8.2	14	158.0	19	2.8	24	1.5	29	32.0
5	48.0	10	45.0	15	12.0	20	2.7	25	26.0	30	68.0

Total	683.7
Mean	22.8
Maximum	158
Minimum	1.5
Acre-feet	1,360

DISCHARGE IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1972 TO SEPTEMBER 1973

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	11	2.0	17	1.4	1.1	31	0.81	21	2.9	3.2	1.3	2.5
2	19	3.8	4.2	1.2	.69	15	.77	49	6.0	2.8	1.5	3.5
3	9.0	2.4	1.8	1.5	.61	6.5	.79	12	3.6	2.8	1.3	3.0
4	6.5	1.6	1.4	1.8	.65	2.6	.90	17	23.0	3.3	1.1	4.0
5	5.4	1.4	1.1	1.6	.65	1.4	.85	10	10.0	5.6	1.6	2.3
6	4.9	1.2	1.0	1.4	.69	1.1	3.1	6.4	5.9	3.4	1.2	30
7	10	1.4	1.0	1.2	1.2	.85	5.0	5.3	5.1	2.7	3.8	7.0
8	6.7	1.5	1.0	1.2	1.0	.85	19	4.2	4.2	2.4	3.5	6.0
9	4.5	1.3	1.1	1.2	.95	2.2	54	5.4	3.2	2.3	10	7.0
10	3.4	1.2	1.0	1.0	.85	6.0	10	7.3	4.9	2.2	5.0	5.0
11	2.9	1.2	.90	1.0	2.2	1.9	4.6	9.8	22.0	2.5	5.0	13
12	2.4	1.0	.95	.90	1.2	2.4	15	9.0	20.0	4.0	3.0	8.0
13	2.1	1.0	.90	.85	.77	3.4	21	5.6	23.0	4.0	14	4.0
14	1.9	1.2	.81	.95	.65	1.6	72	4.1	89.0	2.0	8.0	6.0
15	1.8	1.0	.73	1.1	.61	1.2	8.6	9.0	12.0	1.5	25	7.0
16	2.0	.90	.85	1.3	.53	2.0	5.1	6.4	6.8	1.3	20	7.0
17	1.8	.85	.85	1.8	.53	1.4	11	4.4	5.3	1.2	5.0	15
18	1.9	.81	1.9	2.1	.49	1.3	6.5	6.0	4.0	15	20	8.0
19	1.5	.77	2.0	1.2	.45	4.0	6.8	4.8	3.8	5.0	10	16
20	1.5	.77	6.1	1.0	.57	1.8	6.8	4.0	3.9	2.5	10	7.0
21	1.4	.66	2.6	1.0	.49	1.4	5.1	3.4	3.1	3.5	20	5.0
22	1.2	.57	2.4	.95	.57	1.5	3.3	5.4	2.8	5.0	8.0	4.0
23	1.0	.69	2.7	1.0	.57	1.3	2.9	3.6	4.4	2.5	6.0	3.5
24	1.0	.61	2.6	1.2	.49	1.2	2.7	3.1	4.0	7.0	4.0	5.0
25	.95	.65	2.7	1.1	.45	1.3	3.7	3.0	3.0	7.4	3.5	15
26	.90	1.2	21	.90	6.2	1.5	12	3.6	8.0	3.3	25	8.0
27	9.6	2.5	3.7	.85	7.5	1.3	70	8.6	10.0	4.2	15	13
28	2.0	8.3	3.7	.81	7.0	1.3	10	4.6	20.0	3.3	40	30
29	3.9	2.6	1.9	.77	-------	1.1	24	5.3	8.0	2.4	8.0	9.0
30	3.1	1.8	1.7	.73	-------	1.0	8.8	5.9	4.9	2.3	5.0	5.0
31	2.0	-------	1.6	.81	-------	1.0	-------	4.4	-------	1.9	4.0	-------
Total	127.25	46.88	93.19	35.82	39.66	102.40	395.12	251.6	326.8	112.5	288.8	258.8
Mean	4.10	1.56	3.01	1.16	1.42	3.30	13.2	8.12	10.9	3.63	9.32	8.63
Max	19	8.3	21	2.1	7.5	31	72	49	89.0	15	40	30
Min	.90	.57	.73	.73	.45	.85	.77	3.0	2.8	1.2	1.1	2.3
Acre-feet	252	93	185	71	79	203	784	499	648.0	223	573	513

Notes:
Water year 1973: Total, 2,078.82; mean, 5.7; maximum, 89; minimum, 0.45; acre-feet, 4,120.
Peak discharge (base, 900 ft³/s). Apr. 27 (0730) 1,180 ft³/s (5.92 ft).
Peak discharge (base, 900 ft³/s). Sept. 14 (0630) 1.370 ft³/s (6.13 ft); Sept. 25 (1300) 993 ft³/s (5.69 ft.)
Note: No gage-height record Aug. 8 to Sept. 30.

Caroline Islands, Island of Ponape

16898600 LUPWOR RIVER

Location.—Lat 6°54′15″ N., long 158°09′45″ E., on left bank about 300 ft (91 m) upstream from 50-ft (15 m) waterfall, 1.8 mi (2.9 km) above mouth, and 2.1 mi (3.4 km) west of Mount Tamatamansakir.

Drainage area.—1.12 mi² (2.90 km²).

Period of record.—September to current year.

Gage.—Water-stage recorder. Altitude of gage is 100 ft (30 m) from topographic map.

Extremes.—Current year: Maximum discharge, 1,770 ft³/s (50.1 m³/s) July 11, gage height, 6.53 ft (1.990 m), from rating curve extended above 11 ft³/s (p.31 m³/s); minimum, 1.0 ft³/s (0.028 m³/s) Dec. 2.

Period of record: Maximum discharge, 1,770 ft³/s (50.1 m³/s) July 11, 1974, gage height, 6.53 ft (1.990 m), from rating curve extended above 11 ft³/s (0.31 m³/s); minimum, 0.40 ft³/s (0.011 m³/s) Feb. 18, 19, 1973.

Remarks.—Records poor. Periodic determinations of water temperature for the water year 1974 are published in Part 2 of this report.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1973 TO SEPTEMBER 1974

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	8.0	4.6	1.2	10	6.2	2.3	4.8	5.9	12	5.9	5.4	4.9
2	4.5	3.8	1.2	6.0	18	2.4	12.0	6.4	11	4.6	7.0	3.8
3	3.0	3.2	1.2	15	8.0	9.5	9.5	4.6	6.5	3.7	5.9	3.0
4	2.5	5.0	2.0	6.0	8.2	13	5.6	3.9	16	8.2	9.8	3.3
5	5.0	6.0	8.0	4.0	55	9.0	5.7	2.9	34	6.8	6.0	2.9
6	15	50	4.0	20	9.2	5.0	7.6	2.5	12	6.0	6.0	4.1
7	6.0	8.0	3.5	9.0	9.0	6.7	7.4	2.5	5.7	4.2	16.0	3.9
8	6.5	5.0	3.0	6.0	14	11	7.6	2.0	5.0	3.4	58.0	2.6
9	4.0	4.0	7.0	4.0	6.7	6.0	7.2	1.9	9.0	5.4	34.0	4.6
10	30	3.5	9.0	3.2	10	8.6	39.0	2.6	4.9	4.5	11.0	21.0
11	10	3.0	4.0	2.7	6.2	21	11.0	8.4	8.2	198.0	8.2	6.7
12	5.0	4.5	10	2.2	6.7	8.0	11.0	8.0	4.5	10.0	9.0	8.4
13	3.0	3.0	5.0	2.0	4.2	6.4	15.0	9.2	4.5	6.4	27.0	6.2
14	2.5	6.0	3.0	1.8	3.6	5.1	7.4	9.2	5.6	32.0	8.2	4.8
15	2.0	2.0	12	1.6	2.9	32	12.0	6.0	4.5	9.8	5.9	18.0
16	4.5	5.4	14	1.6	2.4	14	12.0	5.3	3.1	6.8	5.4	7.0
17	2.5	3.5	5.0	1.4	3.3	33	6.9	6.1	3.3	15.0	12.0	4.8
18	1.7	6.0	15	2.5	13	7.4	5.9	5.1	3.2	11.0	6.5	6.7
19	1.5	4.0	7.0	5.0	12	5.3	27.0	3.8	2.8	6.5	5.1	6.2
20	1.2	5.0	5.0	2.5	7.4	4.2	21.0	3.3	5.1	5.0	5.7	5.1
21	1.1	4.0	20	7.0	5.4	3.4	8.2	3.1	3.9	4.2	4.4	4.5
22	3.9	13	7.0	6.0	10	2.8	6.8	4.9	3.0	3.4	3.4	3.7
23	25	5.0	8.0	4.5	6.5	4.5	18.0	4.6	4.0	24.0	2.9	3.9
24	5.9	3.5	9.0	3.5	8.4	3.7	8.0	10	5.0	7.8	2.6	3.4
25	9.7	3.0	12	2.4	4.8	3.3	6.2	7.2	4.4	4.9	2.7	16.0
26	5.1	2.5	11	19	3.7	8.6	12.0	4.9	6.4	3.8	2.9	6.0
27	8.9	4.0	6.0	6.8	4.5	5.1	6.8	4.0	5.4	4.4	2.4	4.1
28	12	3.0	4.0	4.4	2.8	4.0	5.1	5.6	9.2	5.6	3.2	3.7
29	64	2.0	4.0	3.2	-------	24	4.5	12	10	4.0	3.1	11.0
30	6.5	1.4	6.0	2.7	-------	6.7	10.0	9.2	7.8	11.0	50.0	4.4
31	11	-------	20	2.4	-------	4.2	-------	5.0	-------	5.7	7.0	-------
Total	271.5	176.9	227.1	168.4	252.1	280.2	320.8	170.0	220.0	432.0	336.7	188.7
Mean	8.76	5.90	7.33	5.43	9.00	9.04	10.7	5.48	7.33	13.9	10.9	6.29
Max	64	50	20	20	55	33	39.0	12	34	198.0	58.0	21
Min	1.1	1.4	1.2	1.4	2.4	2.3	4.5	1.9	2.8	3.4	2.4	2.6
Acre-feet	539	351	450	334	500	556	636.0	337	436	857.0	668.0	374

Notes:
Fiscal year 1973: Total, 2,487; mean, 6.81; maximum, 89; minimum, 0.45; acre-feet, 4,930.
Fiscal year 1974: Total, 3,044.4; mean, 8.34; maximum, 198; minimum, 1.1; acre-feet, 6.040.

PEAK DISCHARGE

[Base, 900 ft³/s]

Date	Time	Gage height	Discharge
Oct. 29	1230	5.76	1,050
Nov. 17	[1] 0630	5.78	1,060
Mar. 17	0200	6.31	1,550
July 11	0515	6.53	1,770

[1] Approximately.

Caroline Islands, Island of Ponape

16898600 LUPWOR RIVER

Location.—Lat 6°54′15″ N., long 158°09′45″ E., on left bank about 300 ft (91 m) upstream from 50-ft (15-m) waterfall, 1.8 mi (2.9 km) above mouth, and 2.1 mi (3.4 km) west of Mount Tamatamansakir.

Drainage area.—1.12 mi² (2.90 km²).

Period of record.—September 1972 to current year.

Gage.—Water-stage recorder. Altitude of gage is 100 ft (30 m), from topographic map.

Extremes.—Current year: Maximum discharge, 853 ft³/s (24.2m²/s) Oct. 12 (gage height, 5.49 ft or 1.673 m), from rating curve extended above 15 ft³/s (0.42 m³/s); minimum, 0.45 ft³/s (0.013 m³/s) Feb. 10, 22–24.

Period of record: Maximum discharge, 1,770 ft³/s (50.1 m³/s) July 11, 1974 (gage height, 6.53 ft or 1.990 m), from rating curve extended above 15 ft³/s (0.42 m³/s); minimum, 0.40 ft³/s (0.011 m³/s) Feb. 18, 19, 1973.

Remarks.—Records good except those above 30 ft³/s (0.85 m³/s), which are fair. Periodic determinations of water temperature for the current year are published in Part 2 of this report.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1974 TO SEPTEMBER 1975, MEAN VALUES

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	3.0	7.4	6.9	23	0.77	1.8	1.3	12	4.4	4.5	5.3	1.6
2	6.3	7.8	5.9	10	.77	30	1.1	10	8.5	3.6	4.2	1.4
3	5.1	4.6	4.5	8.0	.65	8.2	1.1	5.7	5.5	6.5	4.3	12
4	7.1	3.7	4.4	7.8	.65	4.9	1.0	4.2	4.5	23.0	4.3	5.6
5	17.0	3.2	5.3	7.6	.65	3.1	.89	11	8.4	50.0	5.6	9.3
6	16.0	2.6	10	5.9	.65	2.3	.82	26	6.6	7.1	4.9	5.2
7	8.0	2.4	5.9	12	.57	2.3	5.7	9.3	9.9	5.7	4.3	4.8
8	13.0	8.2	7.3	6.5	.77	2.7	2.9	13	10	6.7	4.3	4.0
9	8.0	6.4	6.7	4.8	.57	2.7	1.6	9.4	6.5	5.5	8.1	2.9
10	8.3	3.1	60	3.8	.53	1.9	1.6	13	4.9	3.9	6.1	6.6
11	6.7	2.6	23	3.1	1.3	3.8	3.7	8.2	3.9	3.4	5.6	11
12	46.0	20	9.5	3.1	.86	4.0	2.3	6.1	13	3.5	22	5.4
13	29.0	20	13	2.6	.65	29	1.5	5.1	11	27.0	7.3	5.1
14	7.3	12	15	2.3	.86	9.5	4.3	4.7	24	15.0	6.3	5.0
15	5.5	8.8	20	2.1	.86	18	24	17	12	21.0	9.6	6.1
16	4.7	7.0	10	1.8	.61	21	6.0	11	7.2	11.0	17	3.6
17	26.0	5.0	7.8	1.6	.61	9.6	6.3	5.9	5.5	14.0	7.1	7.0
18	5.7	4.0	6.2	1.5	.77	7.5	4.5	7.4	22	9.5	5.9	13
19	4.2	3.0	5.9	1.3	.69	5.1	3.6	4.7	8.4	9.2	5.4	5.4
20	43.0	7.0	4.5	2.5	.65	3.7	4.3	13	7.2	10.0	4.0	4.0
21	7.8	6.0	4.4	1.8	.57	4.0	2.8	12	15	6.7	5.3	3.4
22	5.3	4.0	3.4	1.4	.49	6.1	2.3	6.9	13	8.1	3.6	8.0
23	25.0	3.0	3.7	1.2	.49	5.0	3.6	5.2	24	5.2	3.1	6.1
24	9.0	12	4.0	1.1	.69	3.1	7.9	4.1	10	5.5	2.6	4.0
25	8.4	7.0	3.0	1.0	43	2.4	55	4.9	7.5	4.8	2.2	6.1
26	5.5	5.0	5.9	.95	4.8	2.1	9.3	24	8.0	4.3	2.0	6.0
27	4.3	6.0	5.6	.90	7.3	1.8	19	19	9.6	3.8	1.8	5.5
28	3.9	25	3.6	.90	3.0	2.1	8.2	9.0	8.0	3.2	1.6	6.4
29	4.0	7.0	2.8	.81	-------	1.7	6.5	6.0	5.7	18.0	1.9	6.4
30	5.2	9.0	2.3	.73	-------	1.4	6.2	7.6	5.5	8.0	4.0	6.1
31	6.2	-------	2.3	1.1	-------	1.7	-------	6.6	-------	5.6	2.1	-------
Total	354.5	222.8	272.8	123.19	74.78	212.5	199.31	302.0	289.7	313.3	171.8	177.0
Mean	11.4	7.43	8.80	3.97	2.67	6.85	6.64	9.74	9.66	10.1	5.54	5.90
Max	46.0	25	60	23	43	39	55	26	24	50.0	22	13
Min	3.0	2.4	2.3	.73	.49	1.4	.82	4.1	3.9	3.2	1.6	1.4
Acre-feet	703.0	442	541	244	148	421	395	599	575	621.0	341	351

Notes:
Calendar year 1974: total, 3,219; mean, 8.82; maximum, 198; minimum, 1.4; acre-feet, 6,380.
Transitional year 1975: total, 2,713.68; mean, 7.43; maximum, 60; minimum, 0.49; acre-feet, 5,380.
Peak discharge (base, 900 ft³/s). No peak above base.

Caroline Islands, Island of Ponape

16898600 LUXWOR RIVER

Location.—Lat 06°54′15″ N., long 158°09′45″ E., on left bank about 300 ft (91 m) upstream from 50-ft (15-m) waterfall, 1.8 mi (2.9 km) above mouth, and 2.1 mi (3.4 km) west of Mount Tamatamansakir.

Drainage area.—1.12 mi² (2.90 km²).

Period of record.—September 1972 to current year.

Gage.—Water-stage recorder. Altitude of gage is 100 ft (30 m), from topographic map.

Remarks.—Records good except those above 100 ft³/s (2.83 m³/s), which are fair. Periodic determinations of water temperature for the current year are published on page 415 of this report.

Extremes for period of record.—Maximum discharge, 3,090 ft³/s (87.5 m³/s) Aug. 4, 1976, gage height, 8.26 ft (2.518 m), from rating curve extended above 26 ft³/s (0.74 m³/s), on basis of estimate of peak flow; minimum, 0.40 ft³/s (0.011 m³/s) Feb. 18, 19, 1973.

Extremes for current year.—Peak discharges above base of 750 ft³/s (21.2 m³/s) revised, and maximum (*):

Date	Time	Discharge		Gage height	
		Cubic feet per second	Cubic meters per second	feet	Meters
Mar. 26	1700	1,030	29.2	5.74	1.750
Apr. 22	0700	1,701	48.4	6.47	1.972
June 9	1400	1,300	36.8	6.05	1.844
Aug. 2	0400	1,880	53.2	7.29	2.222
Aug. 4	1345	3,090	87.5	8.26	2.518
Sept. 8	1145	1,210	34.3	6.40	1.951

Note: Minimum discharge, 1.0 ft³/s (0.028 m³/s), Jan. 26.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976, MEAN VALUES

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept
1	7.1	54.0	5.9	8.2	1.8	23.0	17.0	3.5	7.2	3.3	14.0	8.2
2	7.0	16.0	4.4	6.2	7.1	11.0	14.0	3.4	5.3	4.9	207.0	4.9
3	5.8	8.5	22.0	4.9	13	9.3	9.0	11.0	21.0	3.0	143.0	11.0
4	4.9	7.9	27.0	3.7	3.7	5.6	6.3	6.2	10.0	2.5	282.0	8.2
5	13.0	29.0	15.0	2.8	2.2	4.1	7.3	6.8	7.4	2.8	20.0	5.5
6	10.0	18.0	9.2	2.5	1.8	3.3	5.6	10.0	28.0	2.3	15.0	53.0
7	7.0	29.0	7.3	2.2	1.5	2.7	4.2	25.0	8.6	2.2	9.3	27.0
8	5.1	9.0	39.0	1.9	1.4	2.2	3.9	7.8	9.0	1.9	37.0	162.0
9	5.9	6.3	13.0	1.7	1.3	2.0	6.1	5.9	41.0	2.5	13.0	17.0
10	5.2	5.3	15.0	1.6	1.4	1.9	8.2	13.0	50.0	43.0	7.5	10.0
11	12.0	4.3	10.0	1.6	1.3	2.3	7.7	21.0	11.0	33.0	8.0	11.0
12	6.1	9.5	15.0	1.4	2.2	17.0	6.0	23.0	7.4	8.7	45.0	9.5
13	7.2	9.3	11.0	1.3	9.8	17.0	4.6	36.0	10.0	5.4	11.0	6.2
14	30.0	5.0	11.0	1.8	5.6	38.0	3.8	10.0	7.2	4.4	12.0	4.8
15	11.0	6.0	8.0	1.6	2.5	11.0	3.3	7.2	5.7	56.0	8.8	3.9
16	6.6	4.5	8.4	2.7	1.8	10.0	3.5	7.7	4.5	18.0	6.0	3.2
17	5.2	4.5	70.0	1.4	1.5	9.5	6.5	14.0	14.0	7.0	8.2	2.8
18	4.4	5.7	23.0	8.7	34	63.0	15.0	41.0	9.4	5.3	6.4	2.5
19	9.2	3.9	13.0	3.4	15	9.6	19.0	37.0	6.9	4.1	9.8	2.2
20	16.0	3.6	11.0	2.2	12	6.5	15.0	12.0	14.0	3.7	10.0	2.0
21	6.3	3.2	7.4	2.1	6.3	19.0	10.0	7.8	7.5	3.2	12.0	1 9
22	8.3	3.1	6.2	1.6	4.2	44.0	129.0	5.9	5.6	3.0	6.2	16.0
23	10.0	3.3	5.4	1.2	3.1	16.0	17.0	4.7	52.0	3.1	13.0	8.2
24	27.0	51.0	8.4	1.2	2.5	12.0	11.0	13.0	13.0	4.7	25.0	4.9
25	21.0	15.0	5.0	1.1	3.8	56.0	8.2	8.1	11.0	3.8	8.0	3.7
26	21.0	6.4	6.7	1.0	39	91.0	13.0	6.3	19.0	3.0	5.8	2.8
27	12.0	4.9	6.5	1.2	8.0	17.0	7.3	4.9	6.9	2.5	25.0	2.2
28	9.1	3.8	10.0	1.8	4.6	8.6	6.8	6.4	5.3	44.0	6.9	4.0
29	6.2	3.0	5.7	2.5	4.0	8.2	5.3	4.5	4.3	21.0	6.2	3.1
30	5.9	2.6	98.0	2.8	--------	18.0	4.1	19.0	3.9	30.0	4.7	2.2
31	5.7	-------	17.0	2.5	--------	15.0	--------	7.0	--------	30.0	10.0	-------
Total	311.3	335.6	514.5	80.8	196.4	553.8	377.7	389.1	406.1	362.3	955.8	403.9
Mean	10.0	11.2	16.6	2.61	6.77	17.9	12.6	12.6	13.5	11.7	32.1	13.5
Max	30.0	54.0	98.0	8.7	39	91.0	129.0	41.0	42.0	56.0	282.0	162.0
Min	4.4	2.6	4.4	1.0	1.3	1.9	3.3	3.4	3.9	1.9	4.7	1.9
Acre-feet	617.0	666.0	1,020.0	160	390	1,100.0	749.0	772.0	805.0	719.0	1,980.0	801.0

Notes:

Calendar year 1975: Totals, 3,024.98; mean, 8.29; maximum, 8.98; minimum, 0.49; acre-feet 6,000.
Water year 1976: Total, 4,927.30; mean, 13.5; maximum 282; minimum, 1.0; acre-feet 9,770.

Caroline Islands, Island of Ponape

16898600 LUPWOR RIVER

Location.—Lat 06°54′15″ N., long 158°09′45″ E., on left bank about 300 ft (91 m) upstream from 50-ft (15-m) waterfall, 1.8 mi (2.9 km) above mouth, and 2.1 mi (3.4 km) west of Mount Tamatamansakir.

Drainage area.—1.12 mi ^{2} (2.90 km ^{2}).
Period of record.—September 1972 to current year.
Gage.—Water-stage recorder. Altitude of gage is 100 ft (30 m), from topographic map.
Remarks.—Records good except those above 100 ft ^{3}/s (2.83 m ^{3}/s), which are fair. Periodic determinations of water tempereture for the current year are published elsewhere in this report.
Average discharge.—5 years, 8.92 ft ^{3}/s (0.253 m ^{3}/s), 6,400 acre-ft/yr (7.97 hm ^{3}/yr).
Extremes for period of record.—Maximum discharge, 3,090 ft ^{3}/s (87.5 m ^{3}/s) Aug. 4, 1976, gage height, 8.26 ft (2.518 m), from rating curve extended above 26 ft ^{3}/s (0.74 m ^{3}/s), on basis of estimate of peak flow; minimum, 0.40 ft ^{3}/s (0.011 m ^{3}/s) Feb. 18, 19, 1973.
Extremes for current year.—Peak discharges above base of 750 ft ^{3}/s (21.2 m ^{3}/s) and maximum (*):

Date	Time	Discharge		Gage height	
		Cubic feet per second	Cubic meters per second	Feet	Meters
Dec. 16	1230	765	21.7	5.65	1.722
Apr. 24	0030	918	26.0	5.93	1.808
Apr. 25	1400	1,070	30.3	6.19	1.887

Note: Minimum discharge, 0.62 ft^3/s (0.018 m^3/s) Mar. 2, 3, 6, 7.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977, MEAN VALUES

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	2.8	10.0	12.0	2.3	1.9	.70	4.5	6.2	44	3.2	7.0	8.8
2	2.8	8.2	13.0	2.0	1.4	.66	3.4	37.0	42	4.0	6.0	11
3	2.1	21.0	7.7	1.9	1.3	.70	4.4	11.0	14	10	7.0	6.4
4	2.0	25.0	12.0	1.7	1.2	1.2	2.7	6.5	8.8	9.0	5.5	4.9
5	1.8	9.5	6.9	1.6	1.1	.82	2.7	5.5	6.0	5.2	4.1	5.7
6	1.6	6.7	4.9	1.5	1.1	.66	4.9	4.0	4.5	11	4.8	25
7	1.5	6.0	3.9	1.6	1.0	1.8	2.9	29.0	3.6	22	4.2	25
8	5.8	20.0	3.3	1.5	1.1	2.5	2.1	16.0	3.3	13	23.0	7.0
9	3.9	7.0	2.8	1.7	1.6	4.7	1.9	81.0	2.8	14	21.0	5.2
10	2.2	7.5	2.6	12	1.1	9.8	1.7	22.0	3.2	15	14.0	4.0
11	1.9	6.5	2.4	2.6	1.1	12	1.6	9.5	3.4	6.9	18.0	7.2
12	2.2	30.0	2.5	1.9	1.2	4.1	1.4	6.2	4.9	6.9	10.0	5.2
13	3.3	9.8	2.0	1.7	1.0	2.5	1.2	11.0	10	5.8	11.0	4.8
14	82.0	6.9	2.1	1.5	.98	10	1.2	6.0	5.4	5.8	23.0	4.1
15	6.9	29.0	39.0	17	1.2	10	1.1	28.0	3.7	5.7	9.3	3.9
16	6.0	11.0	106.0	6.2	.98	5.1	1.2	12.0	4.1	3.9	6.2	34
17	18.0	8.2	9.5	11	.94	3.1	1.1	7.0	3.6	3.1	5.2	6.5
18	9.8	12.0	5.7	5.5	.90	2.6	2.9	4.9	4.7	3.8	4.2	5.7
19	40.0	7.0	4.7	3.4	.82	2.0	2.0	3.6	3.1	3.6	9.8	4.5
20	11.0	25.0	4.4	3.7	.82	1.7	1.7	5.7	2.9	2.6	6.9	5.2
21	18.0	10.0	3.4	2.9	.78	1.5	4.4	5.5	10	17	11.0	33
22	8.2	6.5	6.0	2.2	.74	1.4	3.0	4.0	6.4	8.8	6.7	10
23	11.0	14.0	45.0	1.9	.98	1.3	77.0	7.7	12	4.9	4.7	5.7
24	6.7	31.0	46.0	1.7	1.3	1.2	75.0	4.8	16	13	4.0	5.1
25	4.8	7.5	36.0	1.6	1.5	1.1	85.0	4.0	6.4	8.2	27.0	3.9
26	6.9	5.5	11.0	1.5	.94	1.1	16.0	11.0	4.7	7.0	7.5	32
27	50.0	31.0	7.0	1.4	.78	1.1	7.7	5.4	4.5	5.7	5.4	8.2
28	15.0	50.0	5.5	1.3	.78	43	6.7	21.0	3.6	6.5	28.0	4.9
29	7.0	11.0	4.1	3.3	-------	33	7.0	18.0	4.0	9.5	52.0	5.2
30	5.2	10.0	3.2	2.9	-------	28	8.2	12.0	5.1	17	22.0	4.7
31	44.0	-------	2.6	2.8	-------	9.8	-------	6.5	-------	8.5	14.0	-------
Total	384.4	442.8	417.2	105.8	30.54	199.14	336.6	412.0	250.7	260.6	332.5	296.8
Mean	12.4	14.8	13.5	3.41	1.09	6.42	11.2	13.3	8.36	8.41	12.3	9.89
Max	82.0	50.0	106.0	17	1.9	43	85.0	81.0	44	22	52.0	34
Min	1.5	5.5	2.0	1.3	.74	.66	1.1	3.6	2.8	2.6	4.0	3.9
Acre-feet	762.0	878.0	828.0	210	61	395	668.0	817.0	497	517	759.0	589

Notes:
Calendar year 1976: Total, 5,010.30; mean, 13.7, maximum, 282; minimum, 1.0; acre-feet, 9,940.
Water year 1977: Total, 3,519.08; mean, 9.64, maximum, 106; miminum, 0.66; acre-feet, 6, 980.