

SURFACE IMPOUNDMENT ASSESSMENT

IN

AMERICAN SAMOA, THE NORTHERN MARIANAS AND  
THE TRUST TERRITORY OF THE PACIFIC ISLANDS

DECEMBER 1979

FINAL REPORT

GROUND WATER PROTECTION BRANCH  
OFFICE OF DRINKING WATER  
U. S. ENVIRONMENTAL PROTECTION AGENCY

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BY

E. W. RAMSEY, CONTRACTOR  
Contract Number 68-01-5152

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PREPARED FOR

GROUND WATER PROTECTION BRANCH  
OFFICE OF DRINKING WATER  
U. S. ENVIRONMENTAL PROTECTION AGENCY

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*NOTE: SOME MAPS WERE TOO LARGE TO INCLUDE IN THE REPORT, BUT SKETCHES WERE BEING PREPARED BY HQ (HAWAII)*

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## PREFACE

Preparation for this Surface Impoundment Assessment (SIA) was commenced during the Spring, 1979.

A visit was made to the Washington office of the Trust Territory of the Pacific Islands where statistical, and descriptive literature were obtained, from Mr. Hayden, along with names and addresses of Territorial Governors.

Two visits were made to U. S. Geological Survey offices, Reston, Virginia, where water resources and surface waste impoundments were discussed with, among others, Joshua I. Tracey, Jr. and Gerry Meyer. The library was searched for writings on water resources, geohydrology and surface impoundments. None on a list of maps which had been compiled could be purchased over-the-counter. Maps on only a few parts of the Unit (Pelau, Mariana Islands, Truk and American Samoa) were available.

Maps and remote sensing images, suitable for the SIA were sought, without success, from:

1. EPA Environmental Photographic Interpretation Center,  
Warrenton, Virginia
2. U. S. Geological Survey, Reston, Virginia
3. U. S. Geological Survey, San Francisco, California
4. EPA, Region IX, San Francisco, California
5. TTPI office, San Francisco, California
6. U. S. Geological Survey, Menlo Park, California
7. U. S. Army Corp of Engineers, Fort Shafter, Honolulu, Hawaii
8. U. S. Navy, OINC (Lt. Daley), Kolonia, Ponape
9. U. S. Navy, Naval Facility Engineering Command, Pearl Harbor,  
Hawaii
10. Metcalf and Eddy Pacific, Incorporated, Honolulu, Hawaii
11. EPA Pacific Islands Contact Office, Federal Building,  
Honolulu, Hawaii
12. Defense Mapping Agency: Topo Center (AMS), Washington,  
D. C., 20315
13. National Geographic Society, Washington, D. C.

However, at U. S. Geological Survey offices, Federal Building, Honolulu, Ben L. Jones, Charles Ewart III and associates supplied good topographic and development maps of Palau, Truk, Saigon and Tinian. Also Water Resources Investigations 29-75 and 78-01, USGS pp 403-H and USGS Open File Report 77-739.

Appreciation is extended to W. E. Forest and H. T. Hopkins, Water Resources Division, USGS, Richmond, Virginia for requesting writings from the USGS Library, Reston, for study in the Richmond WRD office by the contractor.

Appreciation and thanks are extended to Messers Lyle Silka, Ted Swearingen and Frank P. Ragonese, Office of Water, Washington, D. C. and to Norman Lovelace, Albert Brody, Beverly A. Reed, Theodore E. Durst, José Kou and the librarians of the Region IX staff for thoughtfulness and assistance.

On Yap, the first stop, at Colonia, the office of Harold O. Temme, District Land Management Officer, TTPI, was visited, and Charles D. Jordan, District Planning Officer was conferred with. Members of the TTPI were met (8 June 1979) at a formal session of the Board and they kindly gave attention to a brief description of the SIA in progress. Nachsa Siren, Executive Officer, was present.

On Koror, Palau, Tokiwo Sumang, Area Sanitarian, was conferred with in his office, and the District Planning office was visited where a copy of an aerial photograph of Koror was examined.

On Saipan, information and assistance were provided by Donna Scheuring in the office of Nachsa Siren, Executive Officer, the TTPI on Environmental Protection Board. They assisted in obtaining leave to land on Kwajalein for SIA purposes.

John Pangelinan, Department of Public Works of the Northern Mariana Islands, described the public water supply system which includes 28 water supply wells, 2 springs, and rain catchments. George Chan, Chief Sanitarian, assisted in obtaining copy of laws, provided insight into the protection of water supplies, and conducted a trip to Tinian in search of surface waste impoundments. Mr. Pete A. Tenoria, Executive

Director, Marianas Public Land Corporation, provided discussion of ground water from the perspective of land management practices, especially zoning.

On Moen, Truk Islands, Nachsa Siren kindly guided observations of water wells, water distribution system, sewage treatment plant and used-oil dump pit in solid waste landfill beside the causeway. Also, he arranged boat transportation to Dublon and Fefan Islands, guided by Sikaret Loren, Chief Sanitarian. Vincent W. McGurl, District Planning Officer, was visited, and also Mr. Peterson, Public Works Officer, whose assistant confirmed that used crankcase oil from diesel-engined electricity plant was dumped, and sometimes burned, in the pit to which reference is made above. A local leader on Fefan was conferred with.

At the hospital, Kolonia, on Ponape, a discussion of SIA matters was had with Carl Dennis, Area Sanitarian, and Misia Amin, Chief Sanitarian. The Division of Lands and Surveys Office and Marvin Gilbert, Planner at the Planning Office, were visited. Naval Lt. Daley, Officer In Charge of Construction (OINC), was visited at his office near the electricity-generating plant.

Scott C. Kvandall, P. E., of Barrett, Harris and Associates, Inc., Consulting Engineers, Guam, described, at Kolonia, the public sewage (hospital and school) oxidation system at Lelu on Kosrae. Since Kosrae was not actually visited, Mr. Nena, Chief Sanitarian, and other local officials were not interviewed, and local observations were not made.

A conference was had with Scott H. Stege, and an associate, of the TTPI-Kwajalein Liaison office, Marshalls Islands District. William F. Beierle, Construction Engineer, Logistics Support, Huntsville Missile Project, advised concerning water supply and impoundments. On Ebeye Atol, Public Works Officer Y. L. Ching advised concerning impoundments, and Lawrence Andrews, Marshall Islands District Representative, was consulted.

On Majuro Atol, Bujen Jacob, Chief Sanitarian, provided transportation



and accompanied a search for impoundments.

On Tutuila Island, Territory of American Samoa, a conference was held with Dr. Nofo Saliga, Dr. Tofiga Liaiga and T. M. Vaivai in the Department of Public Health and with Titi Fa'aiuaso, Environmental Sanitarian, at the Johnson Hospital. Dr. Lauvao of the Hospital Staff, guided to a fish waste ("slop") surface impoundment, furnishing transportation. Pati Faiai, Special Assistant to the Governor and head of the Environmental Quality Division, Al Sundquist, P. E., Office of Public Water Supply, and S. R. (Dan) Morris, Deputy Director, Department of Public Works, furnished information and advise. To all those named above, appreciation is extended.

On return to Hawaii, geohydrology and water supply in the Unit were discussed, at the U. S. Geological Survey Office, with Charles Ewart, III, Dan Davis and Benjamin L. Jones, District Chief, Water Resources Division. A telephone conversation was had with Melvin Waki, Naval Facility Engineering Command, Pearl Harbor. No maps were available.

In search of copy of early engineering reports, Metcalf and Eddy Pacific Incorporated, was visited.

A short conversation was had, 12 July 1979, with Vicki H. Tsuhaka in the EPA Pacific Islands Contact Office, Federal Building.

Two visits were made to the Hawaii State Library where a librarian assisted, to no avail, in search in Federal Information Processing System (FIPS) codes for "Identification of Facilities", blocks 6-8, Form No. OMB-158-378004.

#### DISCLAIMER

This document is a preliminary draft. It has not been formally released by EPA and should not at this stage be construed to represent Agency policy. It is being circulated for comment on its technical accuracy and policy implications.

## EXECUTIVE SUMMARY

### Chapter 1.

The Surface Impoundment Assessment (SIA) program for the Trust Territory of the Pacific Islands, the Northern Marianas and American Samoa (The Unit) includes research on the geohydrology of areas of the Unit, formulation of a plan of action, attendance at the National meeting on the Surface Impoundment Assessment (Dallas, Texas, April, 1979) and visits to principal islands of the Unit to witness and describe conditions and confer with appropriate governmental administrative officials.

During the SIA, 7 sites were found and 8 impoundments were assessed; 5 sites were municipal, and two were industrial. Five municipal and 3 industrial impoundments were assessed and SIA forms were filled out and submitted (Appendix C, page 27). However, one municipal site on Kosrae at Tofol included 3 impoundments for which only one each of SIA forms I and II were prepared. Therefore, 10 impoundments were located (Table 1, page 15).

No parts of the Unit had specific programs for protecting ground water from wastes in surface impoundments. However, pursuant to TTPI PL 4C-78, Water Quality Standards have been promulgated, Part 6.1 of which deals specifically with "fresh ground water". No current programs of protecting ground water from wastes in surface impoundments was found in TTPI Districts nor in Northern Mariana Islands. On Tutuila Island, American Samoa, non-periodic monitoring of pumpage from public supply wells is carried out by the Department of Public Works at Utehi.

No clear position was noted to be assumed by any Unit governmental agency with respect to surface waste impoundments and their production of contaminants to ground water. A few Departments of Health and Departments of Public Works are aware of potential hazard to quality of ground water from wastes in surface impoundments. None appear to have plans for dealing with surface impoundments. The concept of the SIA was new to most and no specific plans or recommendations were found.

While few Health Department or Public Works Department officials presented conclusions and recommendations with respect to surface waste impoundments, they agree and anticipate that the SIA should be productive of information and action to deal with the potential problem where it exists. Mr. George Chan, Department of Health, Northern Marianas, said there should be more cooperation and less simple announcement that regulations formulated by the U. S. government agencies were in effect.

In other words, in none of the Unit areas was there an existing or proposed program dealing with surface waste impoundments as they might affect quality of ground water. Only in American Samoa was there expressed awareness that such impoundments might be transmitting contamination to ground water. On Moen, Truk, spills of insecticide in old bomb craters had raised the question, but no record of investigation was available, although Metcalf and Eddy Pacific, Incorporated has made a survey and plan for a drinking water distribution system using supply from wells and surface sources.

#### SIA/RCRA

This Unit SIA data and information will facilitate RCRA Subtitles C and D programs in restricted ways only. By means of this report, management of open dump disposal of hazardous and non-hazardous wastes can contribute to gradual discontinuance. Locations and agency references can be used. The small number of surface waste impoundments cited will allow intelligent scoping of implementation and mechanics of the two pertinent RCRA subtitles.

#### FEDERAL IMPACT

No evidence was found in the Unit that Federal legislation has negatively or positively impacted efforts to deal with surface waste impoundments. Unit/Federal efforts practically are non-existent, partly because, as a result of the relatively small volume of wastes produced, needs for such efforts seldom are perceived.

The opinion was heard in Northern Mariana Islands that, instead of attempting to deal with surface waste impoundments, more Federal money should be made available for sewage collection, treatment and disposal. The biggest present threat to the quality of ground water on Saipan is from intrusion of marine water into pumped aquifers.

With respect to the Northern Mariana Islands, personnel of Department of Public Works and of Department of Health are aware of the threat to ground-water quality by surface waste impoundments. It jointly (TTPI officials, Saipan) is recommended that appropriate Environmental Protection Agency (EPA) personnel work with them to develop feasible regulation, by legislation, or by agency regulation, of surface impoundments which receive waste, and which might/would contaminate ground water.

## IDENTIFICATION OF PROJECT AND PARTIAL CONCEPT

This SIA was performed under Contract No. 68-01-5152 of March 1979, Project No. WA 79-A154. Mr. Lyle Silka is Project Officer, and Mr. Frank Ragonese is Negotiator.

Initial approach included literature and map research, and personal conference at the U. S. Geological Survey (USGS) offices and library, Reston, Virginia, at the USGS Water Resources Division office and library, Richmond, Virginia, and at EPA Region IX offices in San Francisco, where other Federal sources of maps were investigated.

## ACQUISITION OF MAPS

Acquisition of appropriate maps and aerial photographs of most areas of the Unit was unsatisfactory with respect to availability, type of map and uniformity of scale. It became apparent that very few maps or photographs were available anywhere. USGS at Reston, San Francisco, Menlo Park and Honolulu had very incomplete geologic and topographic maps of Unit areas. EPA Washington, Warrenton (Environmental Photographic Interpretation Center), San Francisco, Honolulu did not have suitable maps nor aerial photographs or other remote sensing reproductions. None were available at the University of Hawaii. TTPI Office, Washington, had no maps available. Metcalf and Eddy Pacific, Incorporated, Honolulu, could provide no maps, and no copy of a report on Moen, Truk water-supply project. U. S. Defense Mapping Agency provided only hydrographic maps (charts).

Letters were sent to request conferences with appropriate personnel in offices of the U. S. High Commissioner for the Trust Territories of the Pacific Islands, in offices of the Governor, American Samoa and in offices of the Governor, Northern Mariana Islands.

The TTPI Environmental Protection Board looks after environmental considerations and is a source of information and assistance. Office of the Board furnished a list of permits issued in the TTPI by EPA under the National Pollution Discharge Elimination System (NPDES). (Appendix B p,25) It was understood that NPDES permits had not been

issued in Northern Mariana Islands. A list of NPDES permits issued in American Samoa was obtained from the Division of Environmental Protection, Utuili, Island of Tutuila. (Appendix B, p.26) No listing of NPDES permits issued in the Unit was obtained from Region IX Enforcement Division, 31 May 1979.

Of the 2000 - plus islands in the Unit, 19 were given close scrutiny, and of these, 15 were examined in detail, including personal reconnaissance. Each of the 19 has significant population and development but assurances were confirmed that on 4 (Rota - Northern Mariana, and Olesaga, Tau and Ofu - American Samoa) no waste-receiving surface impoundments exist. On Kosrae, three oxidation ponds in series receive municipal waste. Inhabitants of numerous smaller areas (islands) of the Unit employ primitive methods of waste disposal, as well as of water supply. Human waste disposal is by privies (benjos) built over marine or tidal waters, by pits, or on land surface. Water supply is from shallow dug wells and from various systems of rain catchments, and reservoirs. On "high" volcanic islands, water from streams is piped to reservoirs at villages where distribution is by faucet from/at the reservoirs.

It is not intended in a partial concept of this report, to be didactic, nor repetitive, but to be brief, precise as possible without measured data, and in response to the first round approximation concept and prescribed format. Definitions are considered not to be needed herein: they are set forth amply in EPA Report 570/9-78-005. The hydrogeologic waste terms are considered to be common knowledge, and no glossary is provided.

Technical approach to accomplishment involved 10 Tasks, proposed procedure for each being written in response to a Request for Proposal. Under Task III, 9 Steps are prescribed.

#### PERSONNEL/PARTICIPANTS

This Unit SIA is unique, and differs in many comparisons with State SIAs with respect to magnitude and scope. The prescribed tasks were performed principally by the contractor and one technician/consultant.

The title of technician/consultant was used by agreement with the participant concerned because of appropriate qualifications as set forth in Resume, Susan Petty, Appendix D, p.28 . Qualifications include Bachelor of Science, Geology, graduation cum laude, Princeton University, 1973.

Contractor on this SIA graduated with BS, 1948, and with MA 1950, Geology, from the University of Virginia. Subsequently, Ground Water work was performed for 22 years for the Commonwealth of Virginia.



Analysis of data and information collected in the Unit indicates little or no present pollution impact of wastes from surface impoundments upon ground water. Reported occurrence of coliform bacteria in American Samoa well 67 might not derive from fish cannery waste ("slop") dumped in surface waste impoundment, less than 1,600 meters distant, but rather from people residing within short radius from the well.

Data of all kinds is scarce, or non-existent, and not amenable to significant statistical statements and relationships. Potential impact of surface waste impoundments upon ground water is of low order although it exists to a modified degree in many areas of the Unit.

It reasonably is certain that all surface wastes impoundments in the Unit were located and counted. This assumption is made because:

1. Areas of probable occurrence were searched thoroughly.
2. Health Officials, including sanitarians, in each District of the TTPI (except Kosrae), in Northern Mariana Islands and in American Samoa, were conferred with concerning existence of such impoundments on any/all areas (islands) of the Unit.
3. Gross area in which surface waste impoundments occur proportionately is small and amenable to thorough examination by personal viewing.

The only surface waste impoundment system subject to a modicum of operational procedure is the three oxidation lagoons in series, on Kosrae, which receive waste principally from a hospital and from a public school. It is understood that the Kosrae system, about 3 years old, receives little attention with respect to operation and maintenance. The bottom of the lowest of the three lagoons is at or near the elevation of mean sea level, and the outfall is into a small stream which flows a short distance into marine water of Lele Bay. (Personal communication, S. C. Kvandal, P. E.)

Data on shallow aquifers (water table aquifers) in the Unit are few and no strictly new data were collected. Information on such aquifers on Tutuila, American Samoa, is available in USGS Water Resources Investigation 29075 by C. B. Bentley. On southwestern Tutuila, there is an extensive shallow aquifer between the airport and Leone where mostly unconsolidated Leone Volcanics (Figure 1) form the rough-surfaced Tafuna-Leone Plain. Porous volcanics, including cinders, along with underlying beach sands, form a shallow aquifer in which ground water is highly susceptible to pollution from surface sources.

Specific data on shallow aquifers was not collected on the high-relief portions of the islands of volcanic origin. Fringing land areas of such islands typically composed of detritus from higher elevations, of beach deposits, or of coral limestone, and these occur in varying stratigraphic relationships to each other. Their widths between steep topography on volcanics and marine water typically are a few hundred or a few thousands of feet. Such areas usually are heavily vegetated. It is on such lands that largest developments have taken place and, where wastes are produced and collected, the greatest pollution threat to ground water occurs. On such fringing land on the southwestern corner of Moen, Truk, a hotel uses injection wells for disposal of domestic wastes.

Pollution of ground water due to wastes from surface impoundments was not identified within the Unit, nor were wastes from such sources known to pollute surface water in streams. Potential for such pollution conspicuously exists on Maen (Truk) where pesticide has been spilled in bomb craters and where public water supply pumps operate about 100 meters distant. Such potential exists also near Tafunafou (American Samoa, Tutuila Island) where wells in the good aquifer of the Tafuna-Leone plain are about 1600 meters from the fish cannery waste ("slop") dumped in a natural impoundment (internal drainage) area. If private wells should be constructed and pumped at nearby, (minimum of approximately 400 feet), new housing, pollution of ground water probably would spread in a plume from the impoundment toward such possible private wells.

Litigation, past or current, of cases of pollution of ground water from wastes in surface impoundments was not found in the Unit.

Results of letter contacts between the Department of Health, American Samoa, and the fish canneries, Pago Pago, were unsatisfactory to the Department. At no other place in the Unit was it found that a government agency had contacted an owner or operator of a surface waste impoundment from which ground water was polluted, or potentially might be polluted.

On Majuro Atol, Marshall Islands, direct ground-water pollution from land-surface deposits of human and animal feces is an apparent threat. It was the opinion of a substantial citizen and of a sanitarian that better enforcement of sanitation is needed.

In brief, instances of active pollution of ground water from waste impoundments were not found to occur in the Unit area. Although it is possible that some pollution occurrences might have been missed, thoroughness of investigation makes it probable that about 95% of existing surface waste impoundments were noted. (Table 1, page 15)

TABLE I

## SIA SURFACE WASTE IMPOUNDMENTS IN UNIT

	Sites	Impoundments	Assessed	Industrial	Municipal	Agricultural	Oil and Gas	Mining	Estimate of number of existing impoundments	Percentage of existing impoundments assessed	Waste impoundments monitored	Ground-water quality monitored	Reported pollution of ground water	Regulation of surface waste impoundments	Map Numbers (In pocket)
AMERICAN SAMOA															
Tutuila	4	5	5	2					5	100		x			2,3
Ofu	0														2,4
Olosega	0														2,4
Tau	0														2,4
NORTHERN MARIANAS															
Saipan	0														5
Tinian	0														6
Rota	0														7
TTPI															
Yap	0														8
Palau															9
Koror	1	1	1		1				1	100					9
Babel-thaup	0														9
Truk															10
Moen	1	1	1		1				1	100		x			10
Dublon	0														10
Fefan	0														10
Tol	0														
Ponape	0														11
Kosrae															
Tofol	1	3	1		3				3	100					12
Marshall Is.															
Kwajalein	0														13
Ebeye	0														
Majuro	0														14
TOTALS	7	10	8	2	7				10						

Programs in the Unit dealing specifically with surface impoundments practically are non-existent. Because of the EPA SIA, Unit governmental personnel have become more aware of the importance of regulating and monitoring. That awareness was quickened, apparently, by SIA procedures locally, (from which this report is derived), but results remain to be manifest.

#### IMPENDING CHANGE IN GOVERNMENT

Central (Saipan) and District governments of the Trust Territory of the Pacific Islands are in a state of flux, with the goal of arriving at self government, hopefully with close liaison with the United States. One alliance under consideration is a Congress of Micronesia, to be centered on Ponape. Northern Mariana islands are under independent government, although many United States agencies are functional there. American Samoa is established as a protectorate, operating on local revenues plus U. S. Congressional appropriations.

In the TTPI, the basic authority for sanitation and protection of ground water from wastes put into surface impoundments is from the central TTPI government, administered by the Environmental Protection Board (EPB), Saipan. It was not apparent in any District that specific regulations had been formulated and administered to provide such protection. However, EPA guidelines are in use on Yap to prevent ground-water pollution, but monitoring of ground-water quality is not continuous. On Moen, Truk, ground-water quality is monitored regularly at public supply wells. Stricter enforcement of such monitoring is thought to be needed.

In the Northern Mariana islands, no specific regulations were found to deal with surface waste impoundments that might pollute ground water, but the Health Department is reported to have called to task the Department of Public Works when coli count in well water was high. Such high counts were not from wastes put into surface impoundments. However, such action indicates effective monitoring of quality. Saipan

has a ground-water quality monitoring program, carried out by the Department of Health in compliance with provisions of the Safe Drinking Water Act.

In American Samoa, liaison was apparent between the Division of Environmental Protection, the Department of Public Works, and the Department of Health. Each knows what the other is doing with respect to protection of ground water from pollution. Well(s) production into public supply lines is monitored and reported. Also, Department of Health had sent letters to fish canneries concerning their dumping of waste ("slop") near Tafuna and south of Futiga, as mentioned in Chapter 6.

Monitoring efforts are made, therefore, by the Departments of Health in Northern Mariana Islands and in American Samoa, and on Yap and Moen, Truk.

Governmental surface waste impoundment programs relative to protection of ground water from pollution are not conspicuous, and are minimal in implementation and execution, at best.

In the 6 TTPI district centers waste management is by conventional sewage treatment plants, three of which (Moen - Truk, Koror - Palau and Colonia - Yap) were fully installed but not in operation. Each was near (at) marine water, into which outfalls were constructed. Thus no sewage waste-receiving surface impoundment is in use, and presumably no pollution of ground water resulted from such possible sources at the three places cited. The waste-receiving oxidation ponds on Kosrae were at or slightly above mean sea level, and effluent is into a small stream which flows into nearby marine water.

#### STAFFING-FUNDING OF PROGRAMS

It appears that certain resources are available for effective programs of regulation of surface waste impoundments in the Unit. Personnel to implement and enforce regulations are believed to be (apparently are) in office in each TTPI District, with the possible exception of Kosrae, not visited. Regulations promulgated by Central TTPI Government, Saipan, are in question because of changing

governmental relationships as between the Central TTPI Government and the several Districts which are trying to organize for independent governmental status.

Adequacy, therefore, of resources appears sufficient, with the possible exception of funding. Additional funding of governmental agency administration undoubtedly would promote prevention of pollution of ground water from surface waste impoundments. Such funding is estimated to be relatively small, and far from massive, but its allocation and application should be accompanied by strict, precise provisions that could not be diverted from the purpose of protection of ground water from pollution by wastes in surface impoundments, in surface streams nor from leaky sewer installations.

Existing programs in the TTPI Districts are estimated to have minor effects only on future Resource Conservation and Recovery Act (RCRA) programs.

#### SIA - RCRA

Potentially, information in this SIA report, and in offices of District Departments of Public Works can be valuable to RCRA Subtitle C and Subtitle D Programs. Local district health and public works agencies have locally generated maps and aerial photographs available to assist in location, and appraisal, of hydrogeological/topographical settings, but useful tabulations and analyses of systematically collected data from monitoring wastes in surface impoundments and of quality of ground water are not available except on Tutuila, American Samoa and Saipan, Northern Mariana Islands.

With respect to Subtitle D and surface waste impoundments, no 5-year solid waste plans have been made anywhere in the Unit, although some personnel interviewed were aware of the imminent opportunity to make such plans.

Future programs will depend upon stimuli of specific funding and of motivation of agencies concerned. It appears possible that this would be valuable to a RCRA program in the TTPI, as well as in American Samoa and in the Northern Mariana Islands.

No governments in the Unit are involved in Federal programs relative to surface waste impoundments, nor in programs relative to any surface impoundments. There appeared to be little awareness of quality of water in surface impoundments as such quality might affect quality of ground water. Possible exceptions are two natural impoundments, one on Saipan and one on Tinian. The former, Lake Susupe, receives no waste outfall, but is slightly salty and it receives a small amount of residential solid waste. Investigators have concluded that it has no effect on ground water in southeastern Saipan. On Tinian, a natural impoundment, Lake Marpo, is thought to produce pollution to water supply wells used only for agricultural irrigation. There is an occurrence of a small-radius plume ground-water pollution in a saturated, nearly static condition. The irrigation well is close (a few meters) to the impoundment which occupies areally low topography and which receives no waste outfall. No Federal nor local regulation is applied in any program which affects this situation.

As earlier referred to, the only subsurface injection of waste observed in the Unit was at a hotel on Moen, Ruk. No action there, nor planning, was under way with respect to the Safe Drinking Water Act (SDWA), nor with planning and land treatment (Sections 203 and 201, respectively, of USFL 92-127). Elsewhere in the Unit, no action was detected with respect to these programs.

It appears that governments in the Unit are emphasizing and are heavily occupied with reorganization in the direction of increased local autonomy, in which favorable relations with the United States would be incorporated.



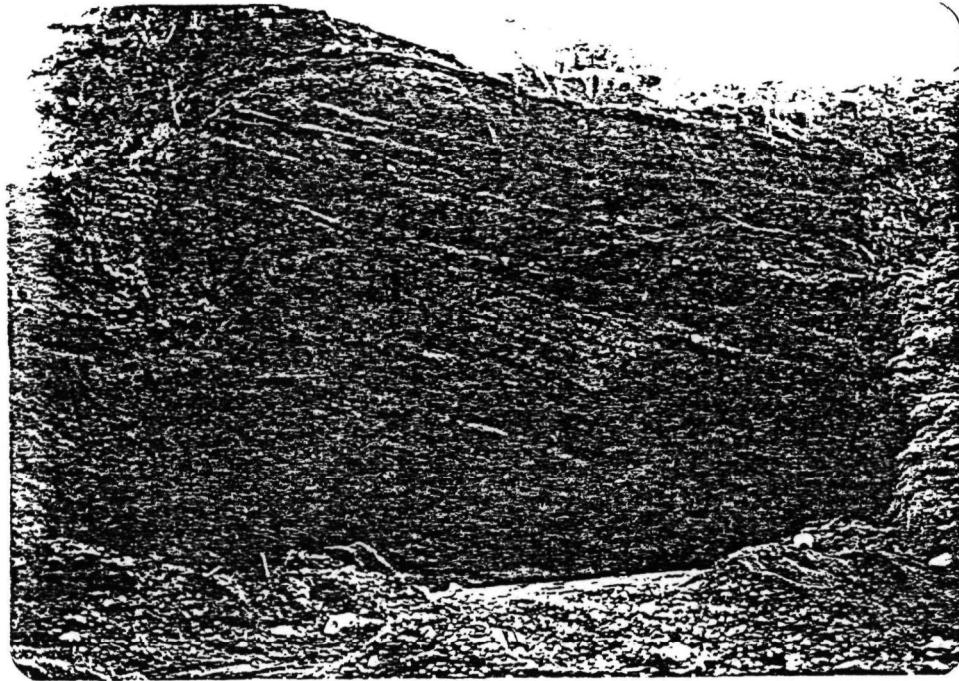


Figure 1. Tafuna volcanic cinders which occur in the Tafuna-Leone Plain aquifer, Tutuila. American Samoa.

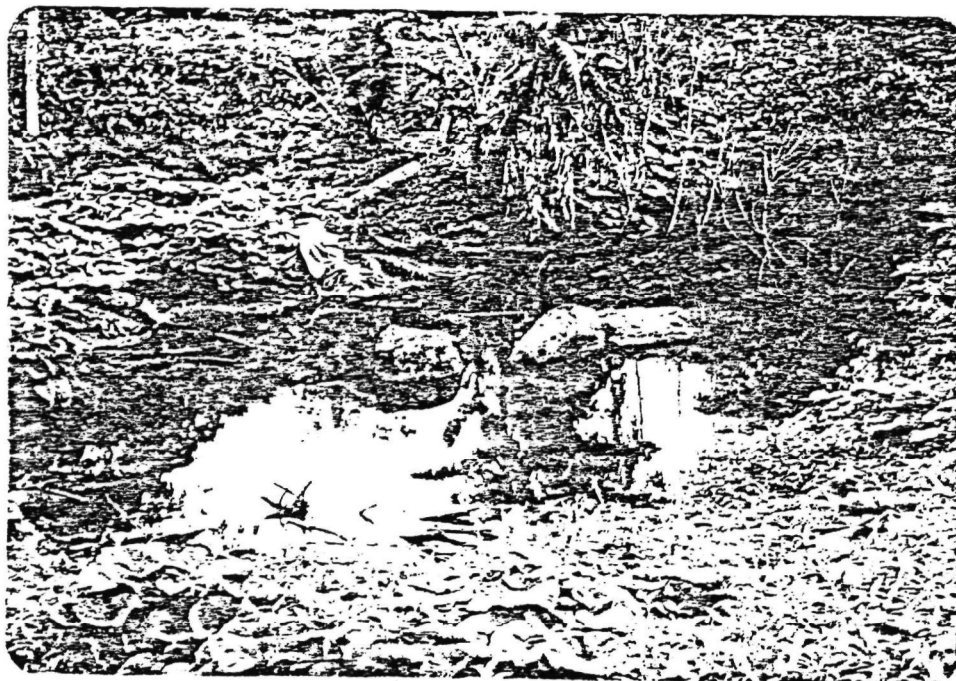


Figure 2. A small accumulation of leachate and surface runoff from municipal solid-waste landfill three-quarters of a mile south of Futiga, Tutuila. American Samoa.

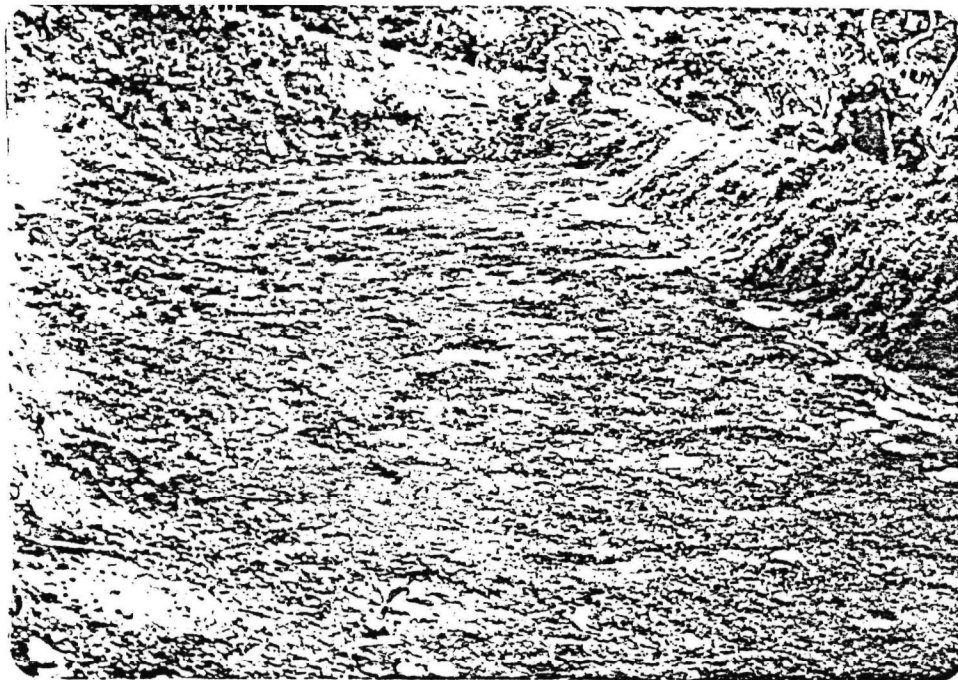


Figure 3. Surface Waste Impoundment, industrial fish cannery "slop" - abandoned, dry. On Matautuloa Peninsula, 280 feet above mean sea level, 1.3 miles south of Futiga. Runoff and seepage is to ocean, American Samoa.

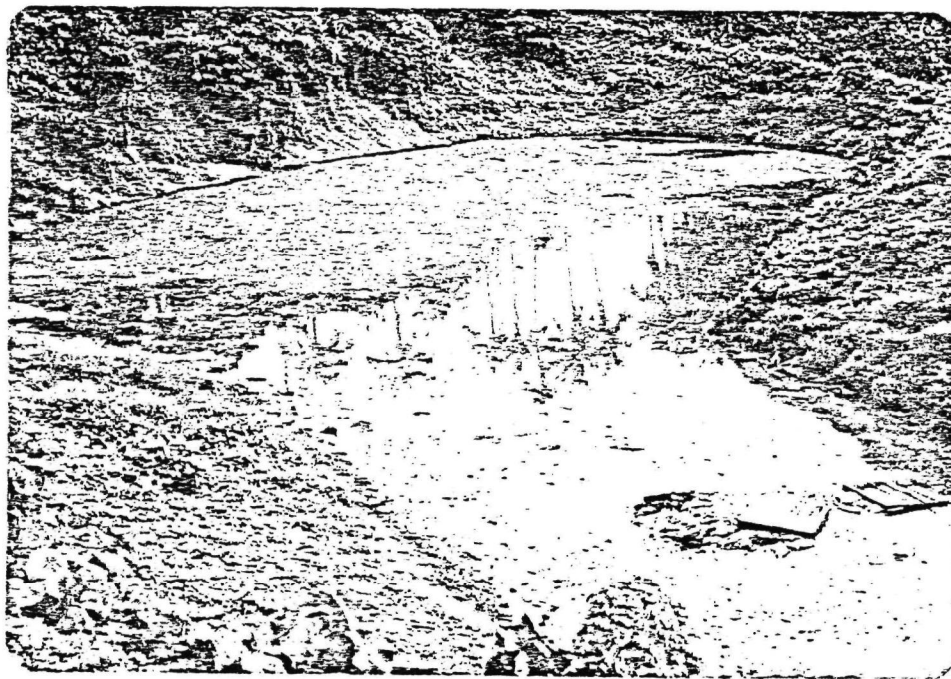


Figure 4. Site, waste and position is same as for Figure 3. Tutuila, American Samoa (Industrial).

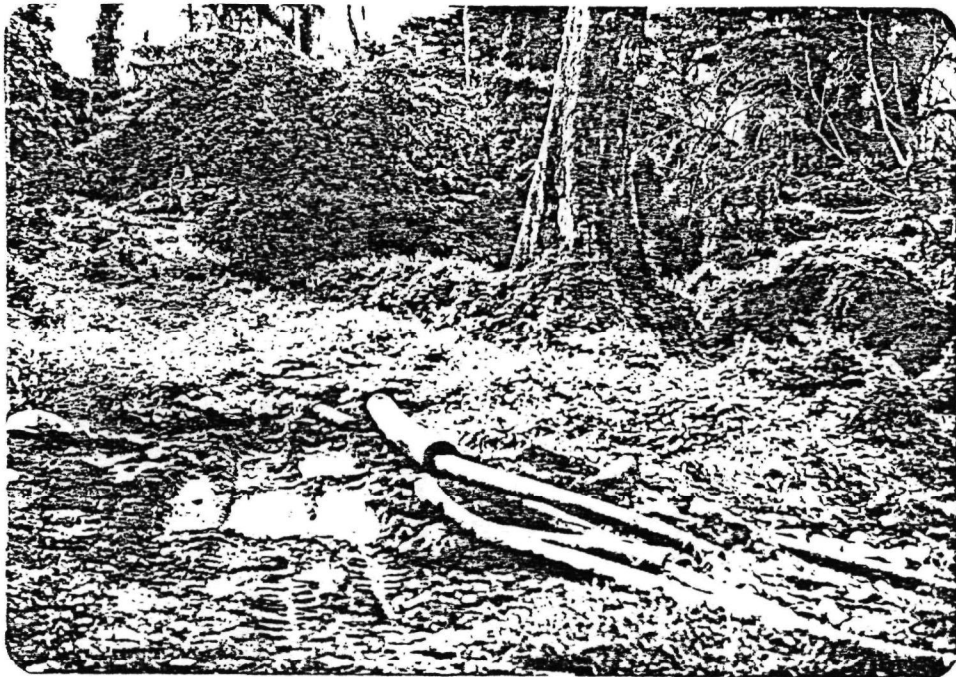


Figure 5. Pipe where industrial fish cannery "slop" is drained from truck tank to low-relief, shallow, natural surface waste impoundment. On Tafuna-Leone Plain about 2 miles west southwest of Pago Pago Airport Terminal.



Figure 6. Pipe outlet into the large industrial surface waste impoundment of Figure 5. Tutuila, American Samoa.





Figure 7. Looking northeastward. Vine-covered natural depression, about 50 meters by 330 meters, into which industrial fish cannery "slop" is dumped, seasonally. Position is same as for Figure 5.

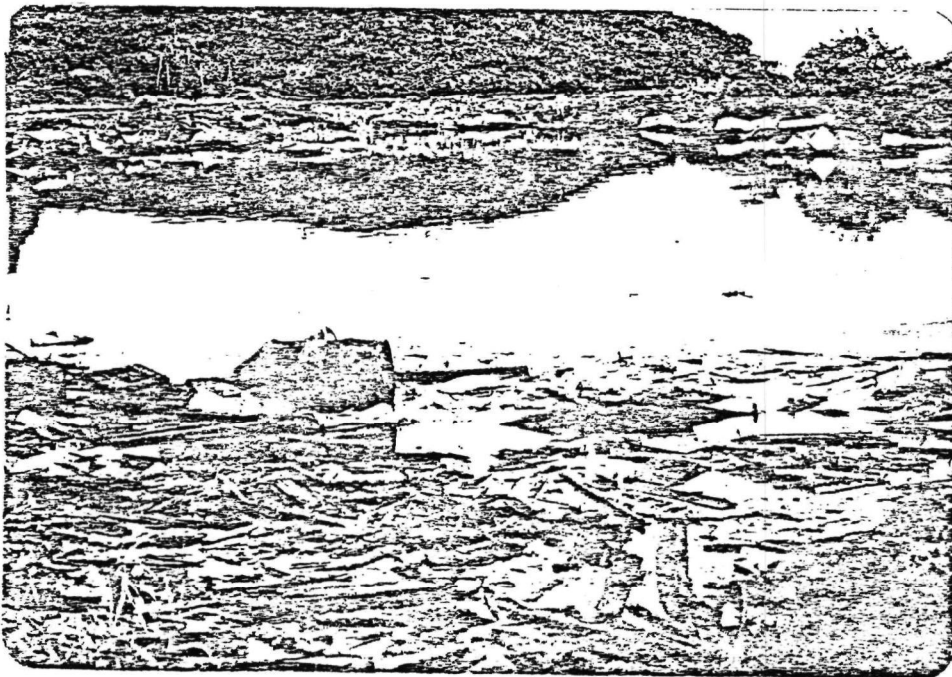


Figure 8. Leachate/runoff impounded at municipal solid waste landfill. Looking southward at Tafananai. Bottom is near mean sea level. American Samoa.

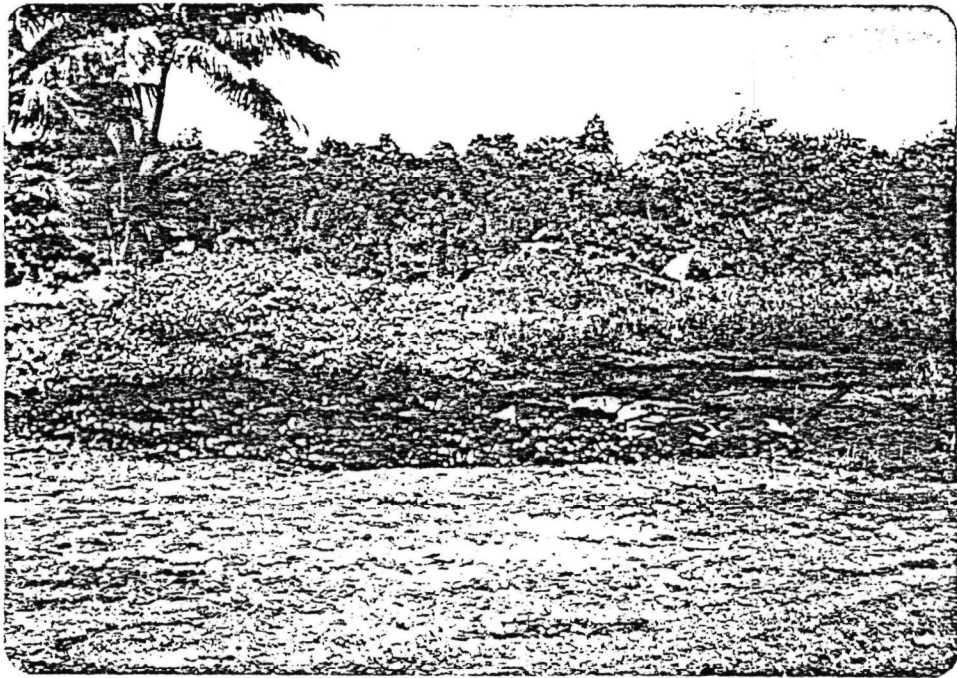


Figure 9. Municipal waste oil pit in solid waste landfill in mango swamp, west side of Causeway Road, about 230 meters southwest of Well 17, south of Mwan. It is not a potential pollution threat to ground-water quality. Moen-Truk.

TRUST TERRITORY OF THE PACIFIC ISLANDS      *Office of the High Commissioner, Saipan*

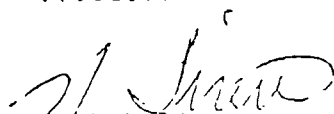
TO : Acting Director, Office of Planning & Statistics      DATE: Feb. 8, 1979

FROM : Executive Officer, T.T. Environmental Protection Board

SUBJECT: NPDES Permits Issued in the Trust Territory

According to our records, the following NPDES permits have been issued in the Trust Territory:

<u>NPDES Number</u>	<u>PROJECT</u>
TT0110035	Kwajalein Missile Range, Domestic Waste Discharges
TT0020231	Dillingham Corp. of Micronesia, Asphaltic Concrete Batch Facility, Saipan
TT0020273	ESA Hotel, Discharge of Treated Domestic Wastewater from an Evaporation Lagoon into Chamorro Bay, Yap
TT0020176	Van Camp Sea Food Co., Discharge into Malakal Harbor, Palau
TT0020001	Moen Wastewater Facility
TT0020036	Ebeye Wastewater Facility
TT0020044	Colonia Wastewater Facility
TT0020061	Koror Wastewater Facility
TT0020052	Kolonia Wastewater Facility
TT0020168	Yap High School
TT0020184	Power Barge Impedance (GNMI)
TT0020192	Tofol Wastewater Facility
TT0020095	Palau Mobil Bulk Plant
TT0020150	Yap Mobil Bulk Plant
TT0020141	Truk Mobil Bulk Plant
TT0020109	Ponape Mobil Bulk Plant
TT0020087	Majuro Mobil Bulk Plant
TT0020079	Ebeye Mobil Bulk Plant
TT0020125	Saipan Mobil Bulk Plant
TT0020133	Tinian Mobil Bulk Plant
TT0020117	Rota Mobil Bulk Plant

  
Nachsa Siren

(This memorandum was obtained, 12 June 1979, from office of Executive Officer, T.T. Environmental Protection Board.)

## AMERICAN SAMOA

NPDES PERMITS                      per Environmental Quality Division  
9 July 1979

## NPDES Number

AS0020010                      Tafuna Waste Water System  
American Samoa Government

AS0020001                      Utulei Waste Water System  
American Samoa Government

AS0000019                      Star Kist Samoa, Inc.  
Pago Pago (not at Tafuna dump)

AS0000027                      Van Camp Samoa, Inc.  
Pago Pago (not at Tafuna dump)

## U S EPA SIA FORMS - SERIAL NUMBERS

## TTPI and American Samoa

	<u>Section I</u>	<u>Section II</u>
Koror, Palau	007517	184135
Moan, Iruk	007516	184184
Tofol, Kosrae	009671	184163
Tafunafou, Tutuila American Samoa	007515	184183
Futiga, Tutuila American Samoa	007514	184182
Futiga, Tutuila Site 3, Imp't 1 American Samoa	007513	184180
Futiga, Tutuila Site 3, Imp't 2 American Samoa	007513	184181
Tafanana (Pago Pago) American Samoa	007502	184179



## U S EPA SIA FORMS - SERIAL NUMBERS

## TTPI and American Samoa

	<u>Section I</u>	<u>Section II</u>
Koror, Palau	007517	184135
Moen, Truk	007516	184184
Tofol, Kosrae	009671	184163
Tafunafou, Tutuila American Samoa	007515	184183
Futiga, Tutuila American Samoa	007514	184182
Futiga, Tutuila Site 3, Imp't 1 American Samoa	007513	184180
Futiga, Tutuila Site 3, Imp't 2 American Samoa	007513	184181
Tafananai (Pago Pago) American Samoa	007502	184179

## RÉSUMÉ

Name : Susan Pettv  
 Address : 3279 Winam Ave.  
 Honolulu, Hawaii 96813  
 Telephone: Home: 808-737-1135 Office: 808-948-7865  
 Birthdate: February 21, 1951

Education

<u>Dates of attendance</u>	<u>Institution</u>	<u>Degree attained</u>
Sept., 1976 - Aug. 1978	University of Hawaii	MS (expected 1978)
Sept. , 1969 - June 1973	Princeton University Princeton, New Jersey	BS Geology, 1973
June 6, 1971 - July 30, 1971	Yellowstone Bighorn Research Association - Field Camp	
Dec., 1971 - June 1972	West Indies Laboratory Fairleigh Dickinson U. St. Croix, U.S.V.I.	

Employment History

<u>Dates of employment</u>	<u>Employer</u>	<u>Position</u>
Dec., 1977 - Aug., 1978	University of Hawaii Water Resources Research Center	Research Assistant
Sept., 1977 - Nov., 1977	University of Hawaii Hawaii Institute of Geophysics	Research Assistant
Sept., 1976 - Aug., 1977	University of Hawaii	Teaching Assistant
Jan. 27, 1974 - Jan. 27, 1975	Delaware Geological Survey University of Delaware Newark, Delaware	Lead Project Geologist
August, 1974 - Jan. 1975	Self-employed	Shoreline Erosion Consultant
August, 1973 - August, 1974	Environmental Concern, Inc. St. Michaels, Maryland	Geological Consultant on shoreline erosion
May 22 - July 30, 1973	Princeton University and The National Endowment for the Humanities	Research Associate
Nov., 1970 - May, 1973	Department of Geology Princeton University Princeton, New Jersey	Research Assistant

### Research and Publications

Nov., 1970 - Dec., 1971, 'Hydrology and Geochemistry of the New Jersey Pine Barrens', presented at 1972 meeting of the Geological Society of America, Washington, D.C., by H. M. Kelsey and D.J.J. Kinsman. Included calculations of hydrologic budget for several basins in the N.J. Pine Barrens using both standard techniques and mass balancing of ionic concentrations.

Dec., 1971 - Sept., 1972, 'The role of melobesinoid algae in the production of high magnesian calcite fine fraction of sediments in St. Croix, U.S.V.I. Two unpublished Junior Papers, Princeton University.

Sept., 1972 - June 1973, 'The Hydrology and Sedimentary History of the Rock Ridge Lake Drainage Basin, Denville, New Jersey,' Unpublished Senior Thesis, Princeton University.

J. C. Ogden, Editor, An Ecological Study of Tague Bay Reef, St. Croix, U.S.V.I., Publication of the West Indies Laboratory, No. 1, 1972.

G. R. Petty, and Susan Petty, 'The Site of the Battle of Malden: A study using geological methods.', Spaeculum: The Journal of the Medieval Historical Society, Sept., 1976.

Susan Petty, 'A Mathematical Model of Clogging in Waste Water Injection Wells.' Masters Thesis, University of Hawaii, 1978.

### Awards

Cum Laude graduate, Princeton, 1973

Tony Conway Memorial Fellowship for Undergraduate Research  
June, 1971 and June, 1973

### Special Skills and Qualifications

Certified SCUBA diver.

Skilled in all phases of water quality analysis, including use of atomic absorption spectrometer.

Familiar with standard methods of soil analysis.

Fluent in German.

Familiar with several computer programming languages and their applications including Fortran IV, PL-1, and COBOL.

## APPENDIX

## SELECTED BIBLIOGRAPHY

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- Silka, Lyle R., and Ted L. Swearingen, "A Manual for Evaluating Contamination Potential of Surface Impoundments," U. S. EPA 570/9-78-003, 1978.
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- U. S. Army, Far Eastern Command, "Mariana Islands - Geology - Tinian," U. S. G. S. Library, Reston, 203.5 (940) fUn 3mt.
- U. S. Army, Far Eastern Command, "Mariana Islands - Geology - Saipan," U. S. G. S. Library, Reston, 203.5 (940) fUn 3ms.
- U. S. Army, Far Eastern Commands, "Truk Islands - Geology," U. S. G. S. Library, Reston, 203.5 (940) fUn 33.
- U. S. Army, Far Eastern Commands, "Caroline Islands - Geology - Yap Islands," U. S. G. S. Library, Reston, 203.5 (940) fUn 3my.
- van der Brug, O., "Trust Territory of the Pacific Islands Water Supply," U. S. G. S. Library, Reston (200) Jn 3wt.
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STANDARDS OF WATER QUALITY  
FOR THE WATERS OF THE  
TRUST TERRITORY OF THE PACIFIC ISLANDS

(Release No. 17-73)

PART 1                    GENERAL PROVISIONS

1.1.                    Under and by virtue of the provisions of Public Law 40-78 (61 Stat. 50 et seq.) of the Trust Territory, these Regulations and any further Amendments, and any other applicable laws, the following Water Quality Standards are hereby promulgated:

PART 2                    POLICY

2.1.                    It is the policy of the Trust Territory of the Pacific Islands that:

(a)                    All sewage and all wastes prior to discharge will receive the best practicable treatment or control unless it can be demonstrated that a lesser degree of treatment or control will provide water quality commensurate with the uses of waters of the Territory, and

(b)                    Waters whose existing quality is better than the established standards as of the date on which such standards become effective will be maintained at their existing high quality. These and other waters of the Territory will not be lowered in quality unless and until it has been affirmatively demonstrated to the Environmental Protection Board or its designee, and the Administrator of the Environmental Protection Agency that such change is justifiable as a result of necessary economic or social development and will not interfere with or become injurious to any assigned uses made of, or presently possible, in such waters. Any industrial, public or private project or development which would constitute a new source of pollution or an increased source of pollution to high quality waters will be required, as part of the initial project design, to provide the highest and best degree of waste treatment available under existing technology.

(c)                    No direct discharges of sewage or other wastes from other than natural causes, treated or untreated, will be permitted into fresh surface waters, or fresh ground waters of the Territory.

(d)                    Discharge of any hazardous substances such as pesticides, herbicides, etc., into any waters of the Territory is prohibited.

PART 3                    DEFINITIONS

(a)                    "Near-shore waters" means: (1) All coastal waters lying within a defined reef area; (2) All coastal waters of a depth of less than ten fathoms; (3) All coastal waters greater than ten fathoms up to 1,000 feet off-shore where there is no defined reef area.

- (b) "Off-shore waters" means all coastal waters beyond the limits defined for "near-shore waters".
- (c) "Coastal waters" includes "near-shore waters", "off-shore waters", and those brackish, fresh and salt waters that are subject to the ebb and flow of the tide.
- (d) "Best practicable treatment or control" is defined herein as not less than: (1) Treatment in accordance with national guidelines for discharge into off-shore waters - provided evaluation of water current patterns demonstrates the effluent will not be brought back to the beach or near-shore waters; (2) Secondary treatment for discharge into "near-shore waters" provided that such discharge will not be made in areas which are primary contact waters for recreational purposes or will not be made into areas of unique value into which it has been determined no waste water effluent is acceptable; (3) Disinfection comminuter -- acceptable only on emergency basis (period 3-6 months) with special approval of the Director of Health Services or the Chairman of the Environmental Protection Board.
- (e) "Receiving water" is that stream, aquifer, or body of water receiving a discharge in any physical form.
- (f) "Standards of Water Quality" is herein defined to be synonymous with the meaning of "water quality criteria" as defined in the Federal Water Pollution Control Act, as amended.
- (g) "Primary contact waters for recreational purposes" are those waters where such activities as swimming, wading, water skiing, surfing, and other activities occur and in which there is prolonged and intimate contact with the water involving considerable risk of ingesting water in quantities sufficient to pose a significant health hazard.

#### PART 4 CLASSIFICATION

The following water classifications, according to recognized beneficial uses, are hereby designated (order of listing is not intended to imply relative rank of importance):

- 4.1 Public or Domestic Water Supply
- 4.2 Industrial Water Supply
- 4.3 Agricultural Water Supply
- 4.4 Propagation of Fish and Other Aquatic Life and Wildlife
- 4.5 Special classes - (a) Waters reserved for conservation of native marine biota; (b) Shellfish propagation; (c) Commercial and sports fishing; (d) Esthetic enjoyment; (e) Recreation; (f) Special Class - Primary Water Contact
- 4.6 Navigation, including harbors, small boat harbors, marinas and waters adjacent to piers and docks.

5.1 The following shall apply to all waters of the Trust Territory at all times:

- (a) Free from visible floating materials, oils, grease, scum, foam, and other floating matter attributable to sewage, industrial wastes, or other wastes.
  - (b) Free from materials attributable to sewage, industrial wastes, or other wastes that will produce visible turbidity or settle to form deposits.
  - (c) Free from materials attributable to sewage, industrial wastes or other wastes that will produce color, odor, or taste, either of itself or in combination, or in the biota.
  - (d) Free from substances and conditions or combination thereof attributable to sewage, industrial wastes, or other wastes that will induce undesirable aquatic life.
  - (e) Free from substances and conditions or combinations thereof attributable to sewage, industrial wastes, or other wastes toxic or irritant to humans, animals, plants and aquatic life.
- In addition to the above "Five Freedoms", the following criteria shall also apply at all times to waters for each of the following classifications:

#### PART 6 PUBLIC OR DOMESTIC WATER SUPPLY

6.1 There shall be no discharge of sewage, industrial wastes, or other wastes into waters designated for public or domestic water supply. To the extent that such discharges are now occurring and such discharges reach surface waters, fecal coliforms shall not exceed an arithmetic mean of 20/100 ml in any thirty-day period. Fresh ground waters designated for public or domestic water supply shall be protected and preserved so that they will meet PHS Drinking Water Standards.

6.2 Treated surface waters used for public or domestic water supply shall meet the recommendations of the Public Health Service Drinking Water Standards.

6.3 Temperature from other than natural causes shall not exceed 85° F, and there shall not be more than 5°F increase nor more than a 1.0°F hourly temperature variation due to thermal discharges or reservoir manipulation.

6.4 Ammonia nitrogen shall be less than 0.01 mg/l as N.

6.5 Dissolved oxygen in surface waters shall not be reduced from natural conditions.

6.6 pH shall be within 0.1 pH units of that natural to the water.

6.7 Total phosphorus in surface waters shall be less than 0.025 mg/l.

6.8 Carbon chloroform extract shall be less than 0.025 mg/l.

6.9 Methylene blue active substances shall be virtually absent.

6.10 Pesticides, herbicides, and phenols shall be absent.

## PART 7 RECREATION

7.1 The fecal coliform limit in primary contact waters shall not exceed a log mean of 200/100 ml nor exceed 400/100 ml in more than 10 percent of samples during any thirty-day period.

7.2 The pH range shall be 7.0 to 8.3.

7.3 Visibility shall not be reduced by more than 10 percent of natural values as measured by Secchi disc.

7.4 Temperature shall not exceed 85° due to influence of other than natural conditions.

## PART 8 PROPAGATION OF FISH AND OTHER AQUATIC LIFE

8.1. Temperature shall not deviate from natural conditions by more than 1.5°F, nor hourly deviate by more than 1.0°F.

8.2 Dissolved oxygen shall be greater than 6.0 mg/l unless reduced by natural causes.

8.3 pH shall be within 0.1 pH unit of the natural value.

8.4 In shellfish areas, coliform concentrations shall comply with Public Health Service Shellfish Standards in its latest revision.

8.5 The naturally occurring ratio of the concentrations of nitrogen to phosphorus will be maintained in all waters.

## PART 9 NAVIGATION

9.1 pH shall not be less than 7.0 nor more than 8.5 nor shall the influence of these waters, where they connect with waters of other uses, cause a change in the natural pH of more than 0.1 pH unit.

9.2 The free CO<sub>2</sub> shall not exceed 20 mg/l except where due to natural causes.

## PART 10 ADDITIONAL REQUIREMENTS

10.1 In multiple-classification areas or where different values for the same parameter are involved, the most stringent criterion will apply.



10.2 DO shall not be less than 6 mg/l in all saline surface waters from other than natural causes.

10.3 Fecal coliform limits shall not exceed 2000/100 ml at any time or at any place.

10.4 The concentration of radioactivity shall not: (a) exceed 1/30 of the MPC (Maximum Permissible Concentration in water) values given for continuous occupational exposure in the National Bureau of Standards Handbook No. 69 as revised;  
(b) exceed the current Public Health Service Drinking Water Standards for waters used for public or domestic supplies;  
(c) result in accumulations of radioactivity in edible plants and animals that present a hazard to consumers;  
(d) be harmful to aquatic life.

Since human exposure to any ionizing radiation is undesirable the concentration of radioactivity in natural waters will be maintained at the lowest practicable level.

## PART 11 WATER USES - IDENTIFICATION OF WATER FOR BENEFICIAL USES

11.1 Fresh Water. The topography and geology of the six administrative districts in the Trust Territory vary. The "low islands" of Majuro are composed of low, sandy platforms. Saipan is basically limestone and low sandy areas; Truk, Ponape, Palau and Yap are of volcanic origin. In the "low islands" of Majuro, Saipan, and similar areas there are no rivers. Rainfall readily percolates through the porous coralline limestone formations to form fresh water lenses - the major sources of water supply for these islands. On the high volcanic islands in Ponape, Truk, Palau and Yap the soils are impermeable, resulting in numerous rivers, streams and a natural lake in Palau. Water supplies are obtained from these streams or springs.

Realizing the expanding need for fresh, palatable water, and the unique water sources for the various islands, it is necessary to classify all fresh surface and ground waters for public and domestic water supply purposes, propagation of fish and aquatic life, esthetic enjoyment and recreation. Other beneficial uses for these waters are industrial and agricultural water supplies.

11.2 Near-shore Waters. All near-shore waters shall be protected for industrial water supplies; propagation of fish and other aquatic life (including waters reserved for conservation of native marine biota, shellfish propagation, and commercial and sport fishing), esthetic enjoyment and recreation. Unless otherwise specified, the following near-shore waters shall be protected for navigation (seafaring vessels and small craft), in addition to uses listed above. Malakal Harbor (Palau) Tomil Harbor (Yap),

Tanarag Harbor (Saipan), Ororon Harbor (Truk), Ponape Harbor (Ponape), and Majuro Harbor, immediately adjacent to the dock. (Refer to Figures A, B, C, D, E and F respectively). All other waters in, around, and adjacent to docks and piers not listed above shall be protected for small boats navigation.

To the extent that most of the lagoons in the district centers are highly polluted, fishing, wading or swimming in waters reserved for recreation and also known to be polluted shall be prohibited until such time that they have been brought in compliance with quality standards. All possible efforts shall be made via news media and other means to inform the people of the condition of these waters.

11.3 Off-shore Waters. In recognition of the multiple uses (industrial water supply, propagation of fish and other aquatic life and wildlife, esthetic enjoyment, recreation, and navigation) made of off-shore waters, the risks of occasional ingestion by humans, and need for protection to the maximum extent feasible for all uses, the most stringent standards of those previously described shall apply to these waters.

11.4 Waters for Other Purposes. For precautionary measures against accidental ingestion of pathogens or chemicals attributed to sewage discharge, fishing, or swimming within close proximity of any sewage outfall inside a lagoon or inner reef is prohibited.

## PART 12      A PLAN FOR IMPLEMENTATION AND ENFORCEMENT OF WATER QUALITY STANDARDS

12.1 Existing Waste Water Discharge. Discharge of raw sewage originating from housing, hospitals and other institutions into the lagoons is common throughout the Trust Territory. A pollution abatement inventory (Table I) contains a list of sources of these discharges, types of waste, present treatment, if any, and additional treatment needed, the date when additional treatment is required to bring the waste discharge in compliance with applicable water quality standards. Any new treatment facility shall provide for not less than best practicable treatment or control consistent with the policies as herein provided.

12.2 Septic Tanks, Cesspools and Privies. Regulations for location and construction of these facilities are being promulgated.

12.3 Waste from Vessels and Marinas. Regulations for control of waste discharges from commercial and private vessels and from naval and other military vessels will be promulgated by the Trust Territory Environmental Protection Board and enacted before Fiscal Year ending 1973. These regulations will be based on no discharge within the territorial requirements.

12.4 Erosion and Other Surface Drainage. Erosion could be a serious problem in the "high" islands due to volcanic nature of the soil and the rugged topograph. The problem is compounded by drainage from construction sites. There is no program for control of erosion. During heavy rainfall, considerable damage could be inflicted on reefs, lagoons and estuarine biota.

The Board will coordinate with the Land Conservation Division within the Department of Resources and the Department of Public Works, to develop a program and adopt regulations before Fiscal Year ending 1973 to prevent erosion.

12.5 Nutrients. Problems associated with nutrients in the lagoons have not been observed. The fact that the necessary conditions for algae growth (sunlight, relatively constant temperatures, and shallow lagoons) exist year-round in the Territory, an introduction of a sufficient amount of nutrients into these lagoons could induce eutrophic conditions. With proper locations of sewer outfalls supported by scientific study, i.e., current, depth, and wind data, this problem could be prevented or minimized.

12.6 Pesticides and Herbicides. Regulations for the controlled use of pesticides and herbicides is partially covered under Public Health Regulation Chapter 14. Necessary amendments will be made as needed.

12.7 Pollution from Diffused Sources. Soon after a sewer system has been put in operation in the District Centers, a sanitary survey program of all diffused sources of pollution or contamination will be initiated to identify each source of pollution, and its control. This program will continue as long as any such pollution or contamination is known to exist.

## PART 13 WATER MONITORING AND SURVEILLANCE PROGRAM

13.1 The Water Quality Surveillance Program for the Territory will consist of periodic inspections of treatment plants, monitoring and sampling both surface and near-shore waters and investigations in response to complaints. The Chief, Division of Environmental Health within the Department of Health Services, shall be responsible for administration of this program for the EPS. The division shall establish cooperative support from other departments and agencies, both local and Federal, to assist in performing these activities.

13.2 Monitoring programs shall include bacteriological, chemical, physical, and biological examinations. Laboratory examinations of these parameters shall be required in all areas of waste discharges or outfalls to assure compliance with the standards. Each sewage treatment

plant should be provided facilities for its own physical, chemical and bacteriological examination. Due to the considerable distance between the district centers and the Headquarters Office, special effort will be made to coordinate sampling and handling procedures, analytical techniques, and reporting. The Environmental Protection Board staff shall be responsible for training of district staff on these procedures and evaluations of performance.

# MAP 1

CONCEPTUAL DESIGN ASSESSMENT  
IN  
AMERICAN SAMOA, THE NORTHERN MARIANAS AND  
THE TRUST TERRITORY OF THE PACIFIC ISLANDS

Project No.: WA 79-6154  
Contract No. 68-01-5152

DRAFT FINAL REPORT  
DECEMBER 1979

GROUND WATER PROTECTION BRANCH  
OFFICE OF DRAINING WATER  
U. S. ENVIRONMENTAL PROTECTION AGENCY

## TRUST TERRITORY of the PACIFIC ISLANDS

MARIANA, CAROLINE AND MARSHALL ISLANDS

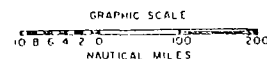
TOTAL ISLAND POPULATION ----- 80,980

97 INHABITED ATOLLS AND SEPARATE ISLANDS

OCEAN AREA APPROX 3,000,000 SQ. MILES

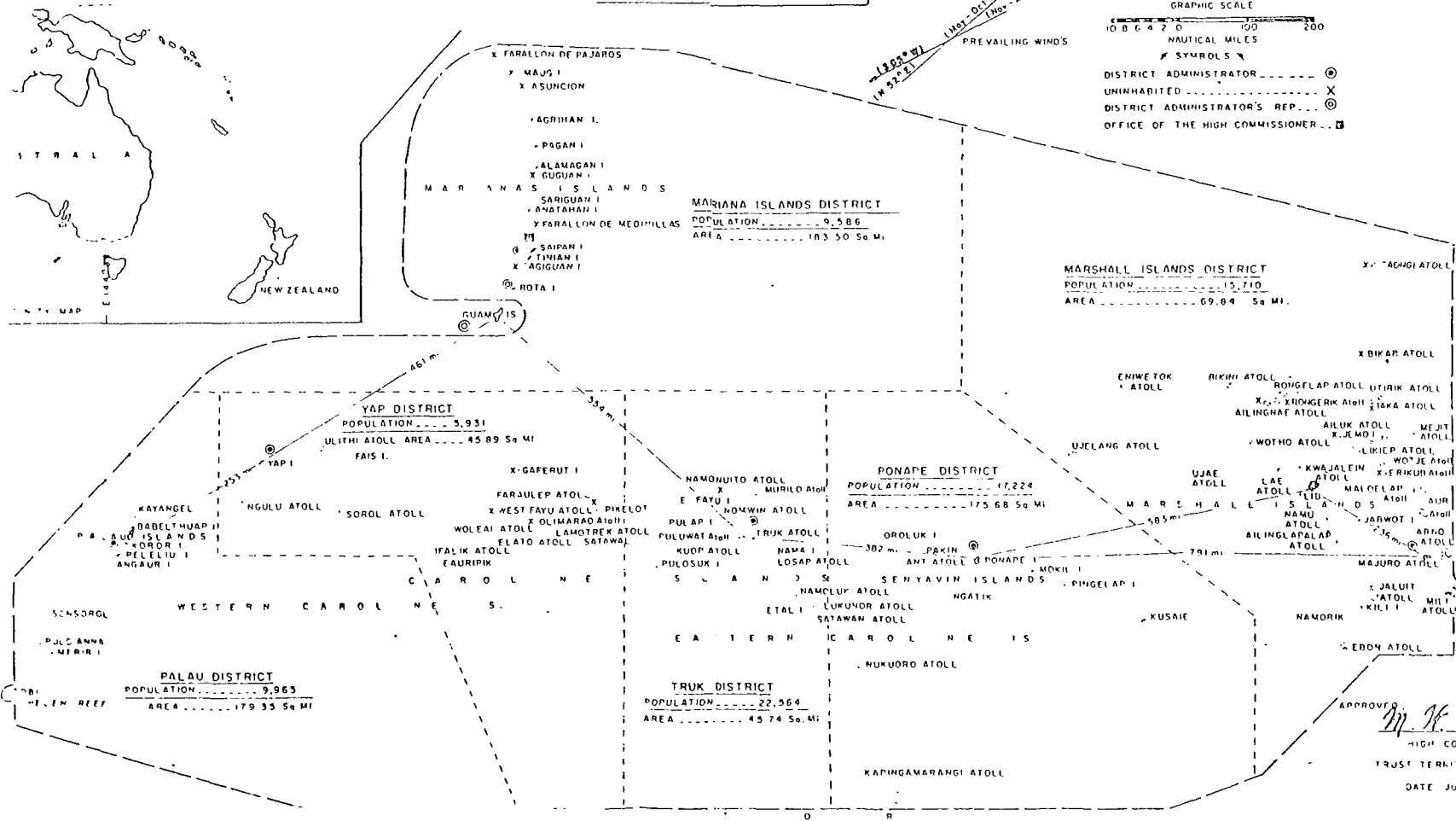
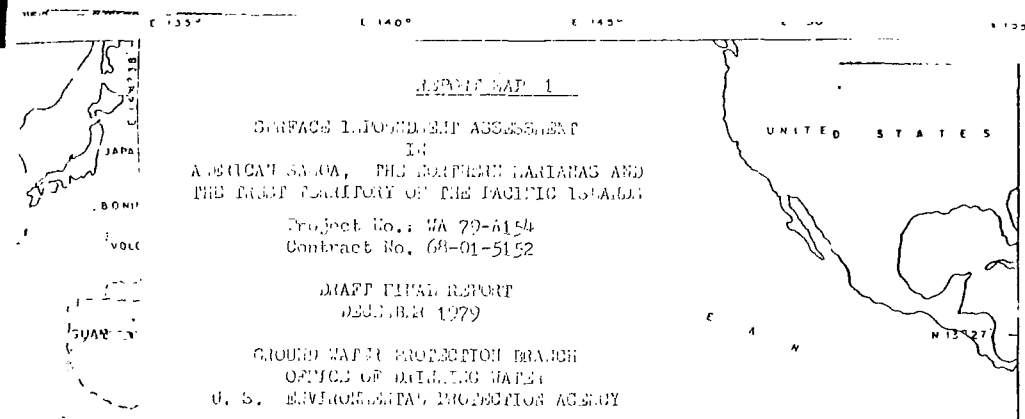
LAND AREA ----- 700 SQ MILES

2,141 ISLANDS



SYMBOLS

DISTRICT ADMINISTRATOR ..... (C)  
UNINHABITED ..... (X)  
DISTRICT ADMINISTRATOR'S REP. .... (C)  
OFFICE OF THE HIGH COMMISSIONER .... (H)



APPROVED  
*M. H. Goring*  
HIGH COMMISSIONER  
TRUST TERRITORY OF THE PACIFIC ISLANDS  
DATE JULY 1962

SURFACE IMPOUNDMENT ASSESSMENT  
IN  
AMERICAN SAMOA, THE NORTHERN MARIANAS AND  
THE TRUST TERRITORY OF THE PACIFIC ISLANDS

Project No.: WA 79-A154  
Contract No. 68-01-5152

DRAFT FINAL REPORT  
DECEMBER 1979

GROUND WATER PROTECTION BRANCH  
OFFICE OF DRINKING WATER  
U. S. ENVIRONMENTAL PROTECTION AGENCY

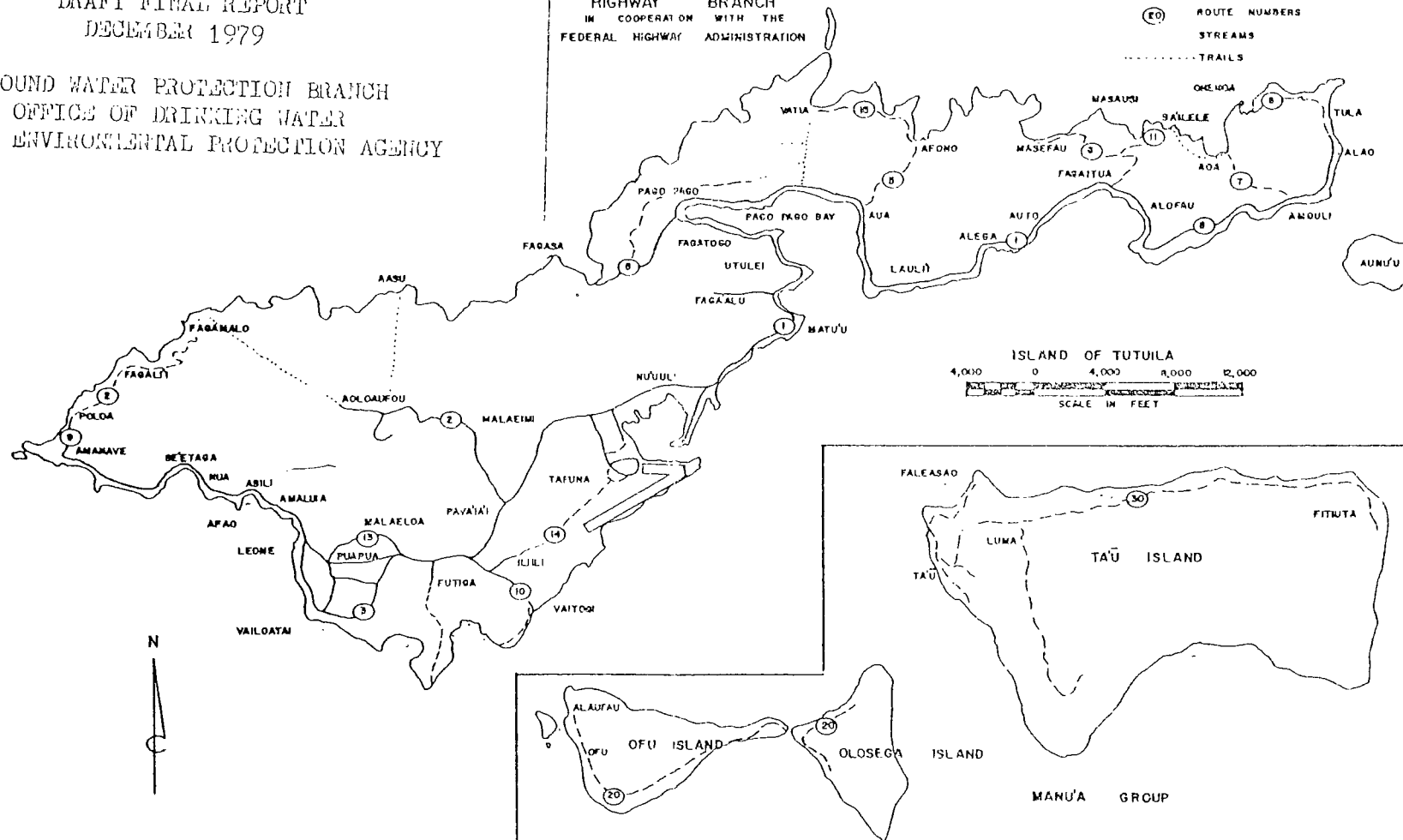
GENERAL HIGHWAY SYSTEM MAP  
FOR THE ISLAND OF

# AMERICAN SAMOA

PREPARED BY THE  
DEPARTMENT OF AMERICAN SAMOA  
DEPARTMENT OF PUBLIC WORKS  
HIGHWAY BRANCH  
IN COOPERATION WITH THE  
FEDERAL HIGHWAY ADMINISTRATION

## LEGEND

- PAVED ROADS
- - - UNPAVED ROADS
- (10) ROUTE NUMBERS
- STREAMS
- ..... TRAILS



APRIL 1977

Yap

CONTRACT, INTERIM AND FINAL REPORT  
ON  
AMERICAN SA-VA, AND AMERICAN SA-VA-2  
AND BRITISH TERRITORY OF THE PACIFIC ISLANDS

SA-VA-2, SA-VA-2, SA-VA-2

Project No. SA 79-4114  
Contract No. 68-01-1159

MAST HEAD REPORT  
NO. 177

GROUND WATER INVESTIGATION DIVISION  
OFFICE OF MILITARY WATER  
U. S. ENVIRONMENTAL PROTECTION AGENCY

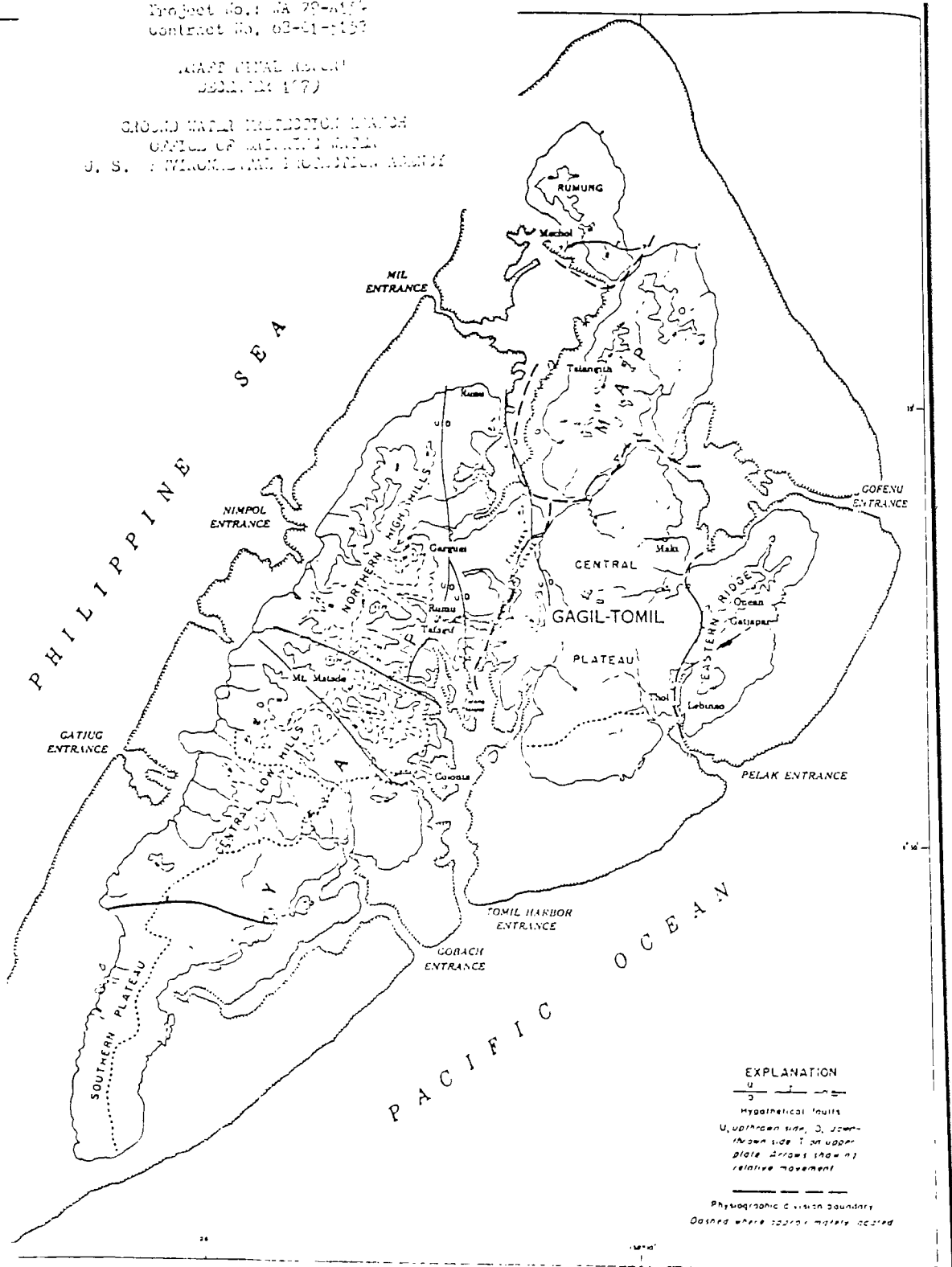


Figure 7. Physiographic Divisions, and Hypothetical Faults based upon topographic trends.

U. S. ENVIRONMENTAL PROTECTION AGENCY



REPORT MAP 12

SURFACE IMPACTMENT ASSESSMENT  
IN  
AMERICAN SAMOA, THE NORTHERN MARIANAS AND  
THE TRUST TERRITORY OF THE PACIFIC ISLANDS

Project No.: WA 79-A154  
Contract No. 68-C1-5152

DRAFT FINAL REPORT  
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GROUND WATER PROTECTION BRANCH  
OFFICE OF DRINKING WATER  
U. S. ENVIRONMENTAL PROTECTION AGENCY



—○— SEWER LINE

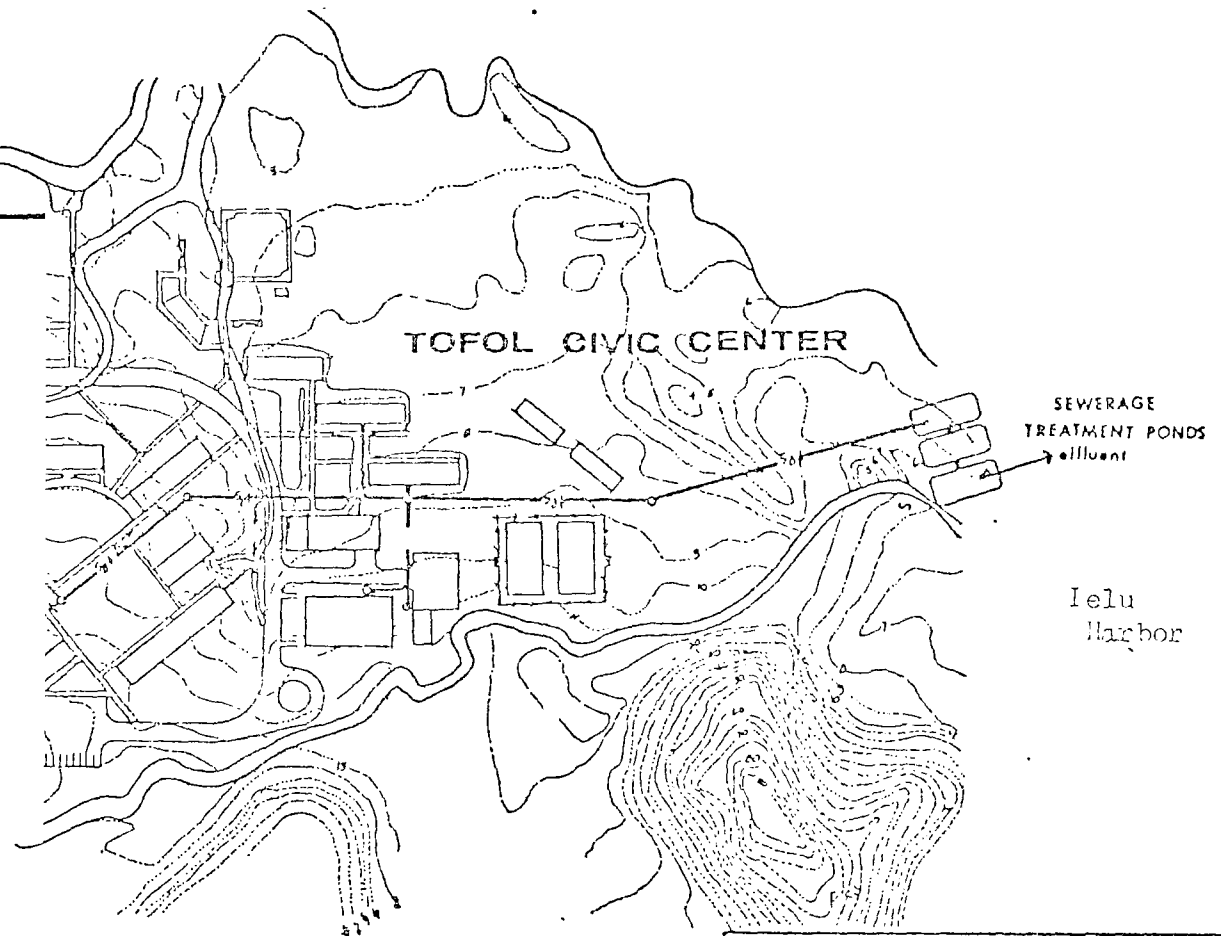


FIGURE IV - 23  
EXISTING SEWER SYSTEM  
TOFOL  
KOSRAE DISTRICT  
(From Facilities Plan)

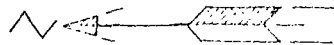


SURFACE IMPACT ASSESSMENT  
IN  
ATOLLAN NATION, THE NORTHERN MARSHAS AND  
THE EASTERN PART OF THE PACIFIC OCEAN

Project No.: WA 79-A154  
Contract No.: 69-01-5152

DRAFT FINAL REPORT  
DECEMBER 1979

GROUND WATER PROTECTION BOARD  
OFFICE OF DRINKING WATER  
U. S. ENVIRONMENTAL PROTECTION AGENCY



PACIFIC OCEAN

Hospital

ULIGA

Government Housing

Post Office  
Bank of America

53,800 PER SQ. MI.

25,000 PER SQ. MI.

44,800 PER SQ. MI.

50,800 PER SQ. MI.

Marshall Islands  
High School

51,216 PER SQ. MI.

DARBIT

MAIRO LACOGH

Antenna Field

Water Reservoir

23,500 PER SQ. MI.

12,000 PER SQ. MI.

Water Plant

Public Works

Western Bureau

19,000 PER SQ. MI.

04,000

Racee Plant

New Port Development

# PORT DEVELOPMENT PLAN AND USE/POPULATION DENSITY

District Planning Office  
Marshall Islands



REPORT MAP 12

SURFACE IMPONEMENT ASSESSMENT  
IN  
AMERICAN SAMOA, THE NORTHERN MARIANAS AND  
THE TRUST TERRITORY OF THE PACIFIC ISLANDS

Project No.: WA 72-A154  
Contract No. 68-C1-5152

DRAFT FINAL REPORT  
DECEMBER 1979

GROUND WATER PROTECTION BRANCH  
OFFICE OF DRINKING WATER  
U. S. ENVIRONMENTAL PROTECTION AGENCY

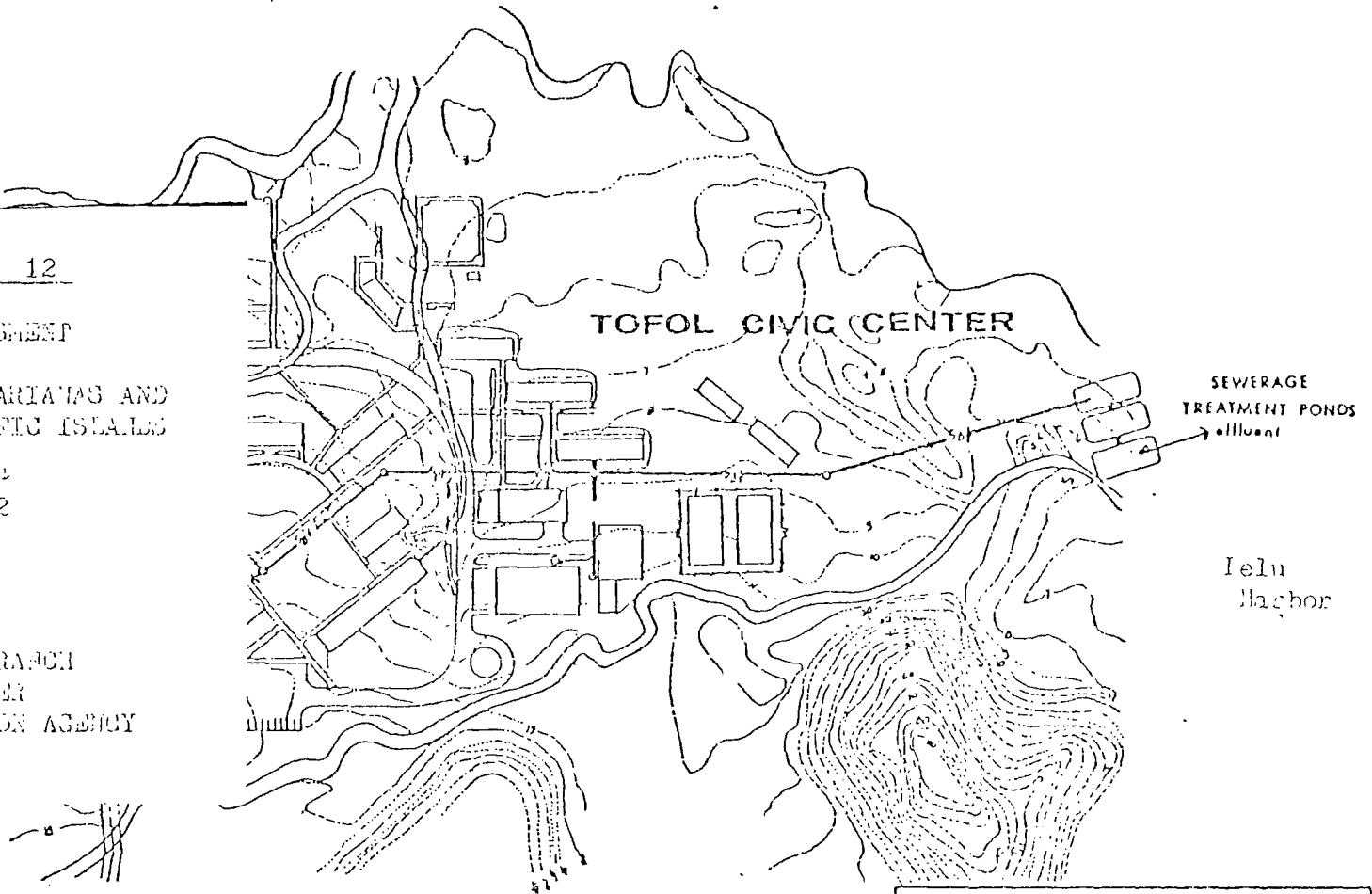


FIGURE IV - 23

EXISTING SEWER SYSTEM

TOFOF

KOSRAE DISTRICT  
(From Photolines Plan)

KWAJALEIN

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0  
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0REPORT MAP 13SURFACE IMPOUNDMENT ASSESSMENT  
INAMERICAN SAMOA, THE NORTHERN MARIANAS AND  
THE TRUST TERRITORY OF THE PACIFIC ISLANDS

Project No.: WA 79-A154

Contract No. 68-01-5152

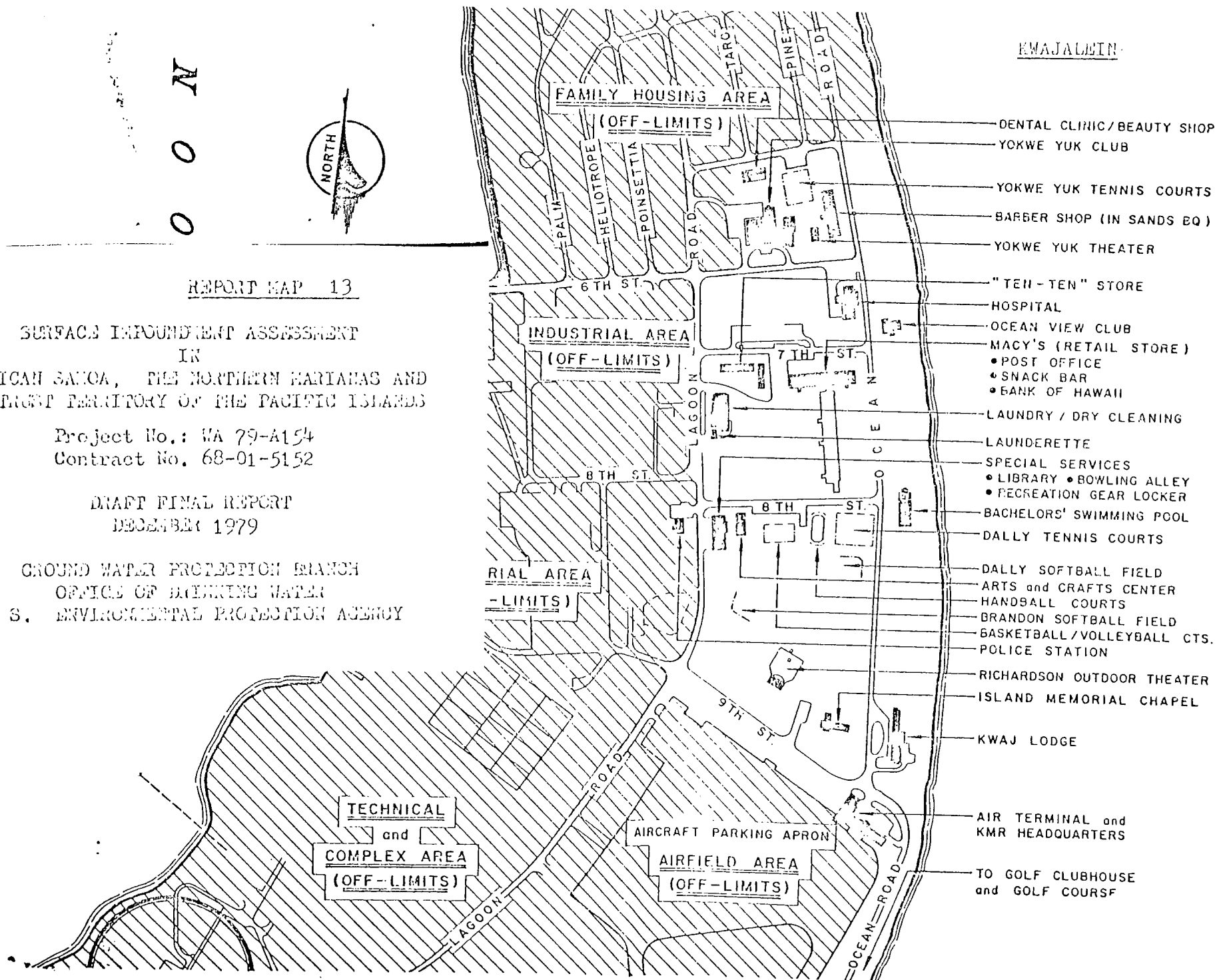
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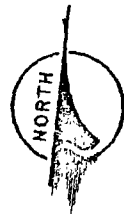
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SURFACE IMPROVEMENT ASSESSMENT  
IN

Project No.: WA 79-A154  
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