

Clean Water Action Plan for Guam

Unified Watershed Assessment



September 15, 1998

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Unified Watershed Assessment

Introduction

In his 1998 State of the Union Address, President Clinton announced a major new Clean Water Initiative to speed the restoration of our nation's waters. This initiative aims to achieve clean waters by encouraging federal and nonfederal agencies, other organizations and interested citizens to work in a collaborative manner to restore our highest priority watersheds. In October 1997, Vice President Gore directed the Department of Agriculture (USDA) and the Environmental Protection Agency (USEPA) to work with other federal agencies and the public to prepare the action plan that would form the foundation for this collective effort. The plan was completed in May 1998; it is called the Clean Water Action Plan (CWAP). The federal government is committed to contributing its technical and financial resources to the implementation of the plan, but only to those states, territories and tribes that meet the Plan's requirements and time lines.

Guam has responded to this federal initiative, and has committed itself to restoring and protecting our waters by working with the CWAP process. We created an interagency work group in June 1998, to design a CWAP for Guam. Guam's CWAP work group worked quickly and after less than two months of effort, released its first required draft CWAP document, the Unified Watershed Assessment, for public review and comment. The Assessment described the action plan, the process and the draft watershed decisions made by Guam's work group to respond to the CWAP challenge.

After the close of the public comment period, Guam's CWAP work group finalized the Unified Watershed Assessment. The group obtained the formal endorsement of the Assessment by the Guam Environmental Protection Agency's (GEPA) Board of Directors. GEPA and the Guam Natural Resources Conservation Service (NRCS) then jointly transmitted the final Assessment to the headquarters' offices of the USEPA and the NRCS consistent with the CWAP process guidelines several days before the final deadline.

The Clean Water Action Plan Requirements

The first requirement of the CWAP is to complete the Unified Watershed Assessment. The purpose of the Assessment is to produce a clear understanding of which watersheds are to be targeted for restoration in what general order. It sets the stage for successful watershed restoration. To complete the Assessment, the CWAP requires:

- I. The formation of a working committee comprising representatives of appropriate agencies, organizations and the public;
- II. A map with watersheds delineated;
- III. Watersheds categorized by how well each attains its water quality or other natural resource goals, and;
- IV. A schedule for addressing those watersheds which are not fully attaining their water quality or natural resource goals.

National guidance requires a draft Assessment to be released in early August for a 30-day public review and comment period, and a final product to be submitted to USEPA and USDA by October 1, 1998. The October deadline was firm; USEPA clearly indicated that it would not provide federal funding for restoration work under this initiative to those states, territories or tribes that failed to meet this deadline.

Proposals for funding watershed restoration work, starting with the highest priority watersheds identified by states, tribes and territories in their Unified Watershed Assessments, will be solicited by USEPA and USDA sometime during 1999. Each watershed proposal is to include elements such as measurable project goals, identification of the sources of water pollution and their individual contributions, restoration actions planned, monitoring and evaluation plans, funding sources, and a process for public involvement.

Guam's Response to the Clean Water Action Plan Opportunity

I. The formation of a Clean Water Action Work Group for Guam

On May 13, 1998, USDA called a meeting of government agencies and interested public on Guam to discuss the CWAP initiative. On June 23, 1998, the Water Planning Committee, an existing interagency committee which included USDA, held a meeting and added the CWAP to the Committee's agenda items. The committee decided to create a CWAP work group and to assign GEPA as its leader.

Guam's CWAP work group was made up of representatives from the following agencies and interested organizations:

- C Anderson Air Force Base
- C Bureau of Planning
- C Commander U.S. Naval Forces, Marianas
- C Guam Department of Agriculture
- C Guam Department of Commerce
- C GEPA
- C Southern Soil & Water Conservation District
- C University of Guam - Water Energy Research Institute
- C University of Guam - College of Agriculture and Life Sciences
- C USDA - NRCS
- C U.S. Navy Public Works Center, Guam

The highest priority of the work group was to complete a draft Unified Watershed Assessment, submit the draft to the public for a 30-day review and comment period, and still meet the October 1, 1998 deadline. It relied heavily on national guidance to complete the required Assessment components, each of which is described in more detail, below.

II. A Watershed Map of Guam

Before initiating collaborative watershed restoration, it is necessary for all involved to be working from the same map, using the same watershed names, locations, and boundaries. Guam's CWAP work group approached this task by building on work recently completed by the NRCS (Appendix A).

Professionals in the water management field typically describe watersheds using hydrologic unit codes boundaries, which define surface water drainage areas. The national practice is to use 11 digit hydrologic units for watershed work. (The digits are a code for locating the watershed; the more digits, the more precise the location and the smaller the management area.) The consensus of the work group was to adopt the approach of the national 11 digit practice. But, because the 11 digit code is almost an area the size of Guam itself, the work group decided to use the geographically smaller areas defined by the 14 digit sub-watersheds as the most appropriate management unit on Guam. Norm Lovelace, EPA Region 9, and Lane Price, NRCS National Headquarters concurred on this decision. This decision resulted in Guam being divided into 20 sub-watersheds, described simply as "watersheds" for the purposes of this document (Appendix B).

III. Guam's Watersheds Organized by Category

The CWAP requires watersheds to be assessed using available data and other information and placed in one of four categories, consistent with national guidelines (Appendix C):

- C Category I - Watersheds needing restoration;
- C Category II - Watersheds needing preventive action to sustain water quality (i.e., meeting goals);
- C Category III - Watersheds with pristine conditions on public lands;
- C Category IV - Watersheds with insufficient data to make an assessment.

To assess and categorize the watersheds, Guam's CWAP work group members shared their collective knowledge using data sources such as Guam's Water Quality Report (305(b)), Guam's list of impaired waters (303(d)), and other existing watershed assessments. The work group placed twelve watersheds in Category I, after agreeing that these watersheds are experiencing some level of water quality and natural resource impairments. Due to insufficient data, the work group placed the remaining eight watersheds in Category IV. Based on input received during the public comment period, the group later moved one watershed from Category IV to I, resulting in a final tally of thirteen watersheds in Category I, and seven in Category IV.

IV. Guam's Watersheds Prioritized for Restoration Activity

The CWAP requires that all Category I watersheds be prioritized for restoration activities; the highest priorities are those specifically scheduled for attention during the 1999-2000 period. A preliminary long term schedule is to be developed for the remaining Category I watersheds.

Guam's CWAP work group tackled the difficult task of scheduling watersheds using the following criteria:

Assessment criteria

- C Public health impairment
- C Drinking water impairment
- C Coastal resource (e.g., coral reefs) and marine resource impairment
- C Threatened and endangered species habitat impairment
- C Degradation of biodiversity

Management criteria

- C High probability of success
- C Likelihood of future development
- C Planned restoration activities

The work group did not engage in a formal numerical ranking exercise to prioritize the watersheds. Instead, members shared their knowledge and perspectives about each watershed. During the discussions, the work group decided that addressing the drinking water impairment

criterion by protecting the Island's drinking waters was a high priority. Drawing on experience and best professional judgement, the work group selected three watersheds that contain key drinking water resources as its highest priority watersheds targeted for CWAP restoration in the 1999-2000 time period, the Northern, Ugum and Talofofu Watersheds. (See Appendices D & E for the schedule and watershed summaries, respectively.) The group decided to cluster the remaining Category I watersheds into a five year time period, from 2001-2006. The schedule for all but the highest priority watersheds on Guam should be considered preliminary and subject to reevaluation in years, 1999 and 2000, and beyond.

V. Public Review and Comment Period

On August 12, 1998, GEPA released the draft Unified Watershed Assessment to the public for its review and comment on all aspects of the information presented. GEPA advertised the public comment period twice in the Island's newspaper, on August 12, 1998, and September 7, 1998 (Appendix F). Guam's Unified Watershed Assessment was also highlighted during a radio talk show and in a television news clip.

The comment period closed on September 11, 1998. Three formal and several informal draft comments were received (Appendix G).

VI. Submittal of the Unified Watershed Assessment

Guam's CWAP work group met shortly after the close of the comment period to discuss how to address the comments received and how to incorporate necessary changes into the final Assessment. The work group finalized the Unified Watershed Assessment and obtained the formal endorsement of the final product by the Water Planning Committee and by GEPA's Board of Directors. GEPA and the Guam NRCS then jointly transmitted the final Unified Watershed Assessment to the headquarter USEPA and NRCS offices shortly before the final October 1, 1998, deadline. All process, content and deadline requirements and guidelines associated with this federal initiative were satisfied.

Guam's Sub-Watershed Boundaries

Appendix A

Guam's Sub-Watershed Boundaries

Hydrologic unit boundaries define the area from which surface water drains to a point. (The Northern Guam sub-watershed is defined as the area that has no clearly defined drainage ways. It is composed of a shallow soil layer over permeable limestone, with little or no runoff.) Four levels of hydrologic unit boundaries (2-, 4-, 6-, and 8-digit) were developed by USGS in the 1970's for large drainage areas. NRCS has extended this 4 level system to delineate and digitize boundaries for smaller sized drainages. The new levels are called: watershed (11-digit) and sub-watersheds (14-digit). The 11-digit is typically 40,000 to 250,000 acres and the 14-digit is typically 10,000 to 40,000 acres, with a minimum of 3,000 acres. The NRCS Pacific Basin Area has proposed using the smaller 14 digit areas appropriate for islands. Details on the proposed designation are on file in the NRCS Pacific Basin Area office in a document called "Proposal for Designation of Hydrologic Units in the Pacific Basin".

An NRCS delineating and digitizing criteria document (NI 170-304) was originally distributed in 1992 and revised and redistributed (June 1995) as a working draft. The working draft continues to be updated and is available as the current NI 170-304 along with a summary of updates made since June 1995. You can link to this document through the following web site:

www.ftw.nrcs.usda.gov

The effort to delineate and digitize these 11 and 14 digit levels is handled through NRCS state offices (or the Pacific Basin Area office for Guam, the CNMI, American Samoa, Palau, and the FSM) in partnership with agencies and others interested in the effort. In early July, the modifications suggested by the Guam Unified Watershed Assessment Team were incorporated into the proposed 14-digit hydrologic unit map for Guam.

Watershed Map of Guam

Appendix B

Appendix B is located at the end of this document, but only
with hard copy versions of the UWA

List of Watersheds, with Hydrologic Codes

Appendix C

List of Watersheds with Hydrologic Codes.

Category	Restoration Year	Watershed	NRCS Number	Priority Ranking
1	FY 1999-2000	Northern	20100003-000-001	1
		Ugum	20100003-000-009	2
		Talofofa	20100003-000-011	3
1	FY 2001-2005	Agana	20100003-000-002	
		Agat	20100003-000-010	
		Apra	20100003-000-008	
		Asalonso	20100003-000-013	
		Geus	20100003-000-020	
		Inarajan	20100003-000-017	
		Pago	20100003-000-003	
		Togcha	20100003-000-007	
		Ylig	20100003-000-005	
		Piti/Asan	20100003-000-006	
4		Cetti	20100003-000-014	
		Dandan	20100003-000-015	
		Fonte	20100003-000-004	
		Manell	20100003-000-019	
		Talayag	20100003-000-012	
		Toguan	20100003-000-018	
		Umatac	20100003-000-016	

Unified Watershed Assessment Categories

Appendix D

Unified Watershed Assessment Categories

(taken from US EPA guidance)

Category 1: Watersheds Needing Restoration (i.e. those not meeting clean water and other natural resource goals), defined as:

- C nonattainment of national clean water goals (including exceedances of Guam's water quality standards, drinking water standards, etc.);
- C nonattainment of natural resource goals related to aquatic systems, including goals related to habitat, ecosystem health, and living resources;
- C other appropriate measures and indicators of degraded aquatic system conditions (e.g., wetland condition and current and historical loss rates, percent impervious surface, and other measures of aquatic habitat); and
- C decline in the condition of living and natural resources that are part of the aquatic system in the watershed (e.g., decline in the populations of rare and endangered aquatic species, decline in healthy populations of fish and shellfish, etc.).

Category II: Watersheds needing preventive action to sustain water quality and aquatic ecosystems.

Category III: Pristine or sensitive watersheds on public lands needing extra protection.

Category IV: Watersheds with insufficient data to make an assessment.

A Summary Description of Delineated Watersheds

Appendix E

NORTHERN WATERSHED (NRCS 000-001)
CATEGORY-1, PRIORITY-1

HYDROGEOLOGIC SETTING AND AQUIFER DESCRIPTION

Guam is comprised of two sub-equal-sized hydrogeologic provinces. In the southern half of the island, fresh groundwater occurs in volcanic rock of low permeability, unconsolidated sediments within river drainages and, along the eastern coast, fringing limestone outcrops. The water table in the southern province reaches elevations of hundreds of feet above sea level in the volcanic rock and unconsolidated sediments. Other than a few springs, groundwater production in southern Guam is restricted to the narrow fringing limestone along the eastern coast, where the water table rarely reaches elevations greater than a few feet above sea level. Brackish to saline groundwater occurs along the southern and western coasts of the southern province within fractured limestone, artificial fill, and unconsolidated marine and estuarine sediments.

In northern Guam, north of a line stretching approximately from Adelup to Pago Bay, groundwater is contained within the aquifer termed the "Northern Guam Lens" (NGL). This aquifer has been designated a "principal source aquifer" in 1978 by the U.S. Environmental Protection Agency, and is essentially the groundwater source for the island. The aquifer is contained within a fractured carbonate complex ranging in age from the Tertiary to the Pleistocene (Tracey, 1962). The carbonate rock sequence has been significantly altered by tectonic and geochemical processes which has resulted in the formation of multiple stages of porosity development. The resulting aquifer is therefore comprised of primary porosity and dissolution features of varying scale, both of which have been modified and/or enhanced by fracturing.

The NGL has been formed from recharge from rainfall in northern Guam percolating through surface soils to the underlying cavernous limestone where it accumulates in a lens which "floats" on and displaces the denser sea water. Recharge increases the volume of the fresh water lens and lowers the elevation of the fresh/sea water interface. The moderate to high permeability of the limestone permits the flow of fresh water toward areas of discharge along the coast. Mixing of the two water types produces a transition zone in which groundwater becomes progressively more saline downward and seaward. Groundwater which occurs in this manner is called "basal" groundwater, and results in a water table which rarely exceeds approximately five feet elevation; most groundwater in the NGL is present under these conditions. Parabasal groundwater, on the other hand, is stored directly on volcanic basement rock and can normally be pumped without threat of saltwater intrusion. Parabasal water may be perched as high as 60 feet elevation, but ordinarily exists between 6 and 12 feet.

SUMMARY OF GROUNDWATER QUALITY

During the last three years, three chemicals [TCE, PCE, and ethylene dibromide (EDB)] have caused production wells to come into violation of the Safe Drinking Water Standards. TCE is found in solvents and degreasing agents. Guam Water Works Authority's NAS-1 well came into violation for high levels of TCE in March 1995, and was shut down. A granulated activated carbon filter was installed at the well head and was placed in operation in August 1997 to remediate the groundwater.

PCE is used in dry cleaning operations and is also found in degreasing agents. In 1996, the Air Force's Tumon Maui well came into violation of the Safe Drinking Water Standards when PCE was detected above the Maximum Concentration Level (MCL) of 5 ug/l, with concentrations of 10.8 ug/l in October 1995, 8.58 ug/l in November 1995, and 8.0 ug/l in December 1995. The well was shut off until an air stripper was installed in January 1997 to remediate the groundwater.

EDB is found in fumigants, pesticides, and leaded gasoline. However EPA suspended the use of EDB fumigant in 1983. In 1996, water samples from Guam Water Work's well F-8 exceeded the EDB MCL of 0.05 ug/l with concentrations of 0.13 ug/l and 0.11 ug/l in May 1996, 0.12 ug/l in June 1996, and 0.11 ug/l and 0.10 ug/l in September 1996. Well F-8 was shut down in October 1996. Carbon filtration is being installed at the well head for remediation.

Concentrations of nitrates have recently raised concerns among groundwater experts. Although drinking water standards for nitrates have not been exceeded, concentrations have indicated increases over time in groundwater management zones in populated areas of the island.

The central and perimeter (outside the designated groundwater protection zone) regions of the Northern Watersheds are designated G-1 and G-2 by Guam Water Quality Standards, protective of drinking water use. Discharge of pollutants into G-1 waters are prohibited; discharges of pollutants into G-2 waters are allowed provided they receive treatment to the degree necessary to protect underlying G-1 groundwater from any contaminants.

The surface waters of the watershed are designated as S-1 and S-2, depending on the location. Both S-1 and S-2 designations fully protect recreational uses, including swimming, and all stages of aquatic life. An S-1 designation is more stringent in that no pollutants are allowed to be discharged into S-1 waters. Waters designated as S-1 are to be kept free of substances or pollutants that may impact water quality. The marine waters are designated primarily as M-1, with a portion of the western coastline designated as M-2. Both designations fully protect recreation and marine aquatic life.

The designation of marine waters as M-2 in the vicinity of Tanguisson Beach Park located on the western coast of central Guam is of particular interest. In 1991, three people died after consuming seaweed, *Gracilaria tsudae*, collected from the beach. Therefore since 1991, there has been a standing fish/seaweed consumption advisory for that particular beach. The exact source has not been identified and a no harvesting advisory remains in effect. The fact that the advisory is not always heeded highlights the need for a solution to this problem.

CERCLA SITES WHICH OVERLIE THE NGL

There are two CERCLA sites which overlie the NGL: Andersen Air Force Base (AAFB) and Tiyan (the former Naval Air Station, Agana). Andersen Air Force Base was listed on the National Priority List (NPL) in October, 1992. Groundwater beneath the site has been investigated in accordance with the Federal Facility Agreement (FFA) since that time. Prior to NPL listing, groundwater was investigated under the Department of Defense, Installation Restoration Program (DoD, IRP) beginning in 1986. Groundwater beneath Tiyan has been investigated since 1986 under the DoD, IRP.

There are also several sites that are currently being investigated under the Navy's IR Program. These sites include the Harmon Annex Print Shop Leach Field, the Navy Construction Battalion Landfill, and the Nimitz Golf Course Landfill. The Harmon Annex site is currently in the Site Investigation stage and no groundwater monitoring has been performed to date. The site will ultimately be transferred to GovGuam under the 1995 base realignment and closure process. A Screening Site Investigation has been completed at the Nimitz Golf Course Landfill, but no groundwater monitoring has been performed to date. The CB Landfill is currently under site mitigation that includes placement of a non-permeable cap as a presumptive remedy under the CERCLA process. Groundwater contaminants have been detected, and hydraulic communication between the site and a downgradient freshwater pond (which is used for swimming and shrimp harvesting) has been established. The final Record of Decision (ROD) for the site is currently under evaluation.

AAFB

Groundwater contamination in the form of Trichloroethene (TCE) and Perchloroethene (PCE) has been detected beneath sections of AAFB in production wells as early as 1976. Groundwater monitoring of production and monitoring wells under the DoD, IRP and the FFA has detected additional contamination in the form of fuel components, volatile organic compounds (VOCs), and metals. Groundwater beneath one area of the base, The MARBO Annex, in which VOC contamination was first detected in 1976, is currently being remediated through well head treatment and air stripping. A Record of Decision is currently being finalized for this area in accordance with the FFA. Groundwater beneath the remainder of the base is still under investigation.

TIYAN

Groundwater contamination beneath Tiyan has been detected in the form of TCE and PCE. One production well (NAS-1) exists on the former base and a water sample collected in January 1991 exceeded the MCL for TCE. Subsequent groundwater sampling of monitoring wells under the DoD, IRP has shown the presence of an extensive area of contamination of PCE and TCE. Contamination in NAS-1 is currently being remediated through well head treatment by the use of a granulated activated carbon filter. Groundwater beneath the remainder of the former base is still under investigation.

TUMON SUBBASIN

The area which drains into Tumon Bay has been delineated in Appendix A as the Tumon/Yigo subbasin (as defined by the Yigo Subbasin in the 1982 Northern Guam Lens Study) of the Northern Watershed because of several reasons. Most importantly, the Tumon Bay area has experienced phenomenal growth for the past 20 years in response to the tourism industry. This has led to increased impacts to the highly used recreational waters of the bay in terms of urban runoff producing non-point source pollution in the form of sedimentation and bacteriological parameters. Bacteriological impacts to Tumon Bay, a primary recreational marine beach, have been reported in the Guam Water Quality Report to Congress (1998) and has resulted in four swimming and harvesting advisories being issued in 1997.

The area has also been delineated as a subbasin because the bay serves as a discharge area for a significant portion of the NGL, much of which is under urban and light industrial usage. Although the actual extent of the NGL which discharges to Tumon Bay has not yet been defined, water samples collected from coastal springs have contained concentrations of certain pesticides and chlorinated solvents which have also been detected in groundwater samples from the NGL. In particular, the previously mentioned Tumon Maui well which taps a portion of the Tumon Sub-Watershed has been determined to have been impacted by PCE. Although it should be noted that the concentrations of organic chemicals measured in spring water samples have not exceeded drinking water MCLs, the ground-, surface, and marine waters of the Tumon Sub-Watershed are designated as G-1, S-1, and M-1, respectively. Waters protected under these designations are to be kept free of substances and pollutants that may impact water quality. Recreational activities and marine aquatic life are to be fully protected.

The Ugum Watershed is located in southern Guam and covers an area of approximately 19 square kilometers (7.3 square miles). The Ugum Watershed includes the Bubulao and Ugum River systems and their tributaries, and stretches from the top of Mount Bolanos to the mouth of the Ugum River where it meets the Talofofu River about 0.8 kilometer from the coast (Ugum Watershed Best Management Practices, Demonstration Project, March 1998).

The Ugum River was dammed in 1992 to provide a 2 million gallons per day drinking water source from runoff and spring discharge from the watershed. The Ugum River Treatment Plant was installed at the dam site and was designed to process 4 million gallons of water per day (Barrett Consulting Group, 1994, Surface Water Development Study. Prepared for the Public Utility Agency of Guam, 2 Volumes, Agana, Guam).

During the Ugum Watershed Resource Assessment (1995) erosion rates within this watershed were estimated at 5.5 tons per acre per year. This rate of erosion causes siltation of the river and dam impoundment and limits the amount of drinking water production from this source. The erosion rate increases during the year in the dry season with the occurrence of grass fires that burn uncontrollably (see Table E-1, U.S. Department of Agriculture - Forest Service and Soil Conservation Service, 1989, Guam River Basin Study). Erosion rates are also increased with the unauthorized use of off-road vehicular activities in the watershed. Poorly maintained and operated agricultural plots also lead to higher erosion rates, with the likelihood of nutrient loading from fertilizers, and contamination from pesticide and herbicide use. Soils of the watershed are characterized as slow to moderate permeability making runoff from high intensity storms highly erosive (Young, F., 1988, Soil Survey of the Territory of Guam, U.S. Department of Agriculture Soil Conservation Service, U.S. Government Printing Office, Washington D.C.).

Also, increased runoff and associated sedimentation of the river impact down stream aquatic ecosystems. It is widely believed that the principle cause for coral mortality on Guam is increased sedimentation. This applies to runoff from the Ugum Watershed to the marine environment. Although the Ugum River does not discharge directly to the marine environment, it is tributary to the Talofofu River approximately one half of a mile from Talofofu Bay. Sediment and bacteriological impacts from the two watersheds therefore co-mingle. The effects of this co-mingling are apparent in the bacteriological impacts to a primary recreational marine beach (Talofofu Beach) as reported in the Guam Water Quality Report to Congress (1998), Federal Water Pollution Control Act Section 305 (b). In fact Talofofu Beach had the largest number of advisories issued for any beach on Guam (36) in 1997.

Guam's water quality standards designate the upper and lower portions of the watershed as S-1 and S-2, respectively. Both S-1 and S-2 designations fully protect recreational uses, including swimming, and all stages of marine life. An S-1 designation is more stringent in that no pollutants are allowed to be discharged into S-1 waters. Waters designated as S-1 are to be kept free of substances or pollutants that may impact water quality.

Table E-1. Guam Fire Statistics (1979-1998) Uqum, Talofofu and Southern Guam Watershed Areas.

Year	Number of Fires	Acres Burned
1979	370	6,572
1980	350	2,972
1981	427	5,964
1982	354	5,431
1983	620	9,208
1984	354	1,271
1985	215	966
1986	231	1,122
1987	921	8,800
1988	436	10,263
1989	191	2,331
1990	110	800
1991	318	1,338
1992	558	5,686
1993	693	2,341
1994	152	221
1995	427	4,862
1996	174	500
1997	344	844
1998	800	9,000

Data Source: Guam Fire Department, Navy Federal Fire Department and Guam Forestry's Fire Protection Section.

Data Base: Guam Forestry Division

TALOFOFO WATERSHED (000-009)
CATEGORY 1, PRIORITY 3

The Talofofu River Watershed is the largest watershed on the island. The watershed is comprised of two sub-basins, an upper and a lower drainage area. The 23 square mile watershed is partially regulated at the upper end of the drainage by the Fena Reservoir, which also acts as a sediment trap and diversion for the island's drinking water supply (WERI UOG, 1998, verbal communication). The flow from the Fena drainage is controlled at the spillway by the amount of pumpage from the reservoir and storage within Fena Lake. All flow thereafter is otherwise affected by the combined flow of the Maagas and the Tolaeyuus or Lost Rivers. The lower Talofofu "sub-watershed" is comprised of deeply weathered volcanic derived sediments with thicker sections of alluvial deposits near the lower sections (USGS Hydrology of Guam, Ward, Hoffard, and Davis, 1985). The long-term average discharge of the Talofofu is about 50 cubic feet per second (Shade, 1983, USGS Reconnaissance Study of Stream Sedimentation). The watershed is comprised of grass covered hills and barren "Badlands", which drop into densely vegetated jungle ravines and gullies. The Talofofu Valley is a wide flat river bottom, with jungle or wetland vegetation throughout. Dense jungle covers much of the adjacent hill sides. Sections of the bottom land are used for agriculture.

Where the river discharges to Talofofu Bay, and in the adjacent estuary, recreational activities in the form of fishing, swimming, and river cruises occur. Impacts from the Talofofu Watershed to Talofofu Bay occur regularly in the form of concentrations of bacteria which exceed USEPA standards for primary recreational marine beaches (Guam Water Quality Report to Congress 1998, Federal Water Pollution Control Act Section 305 (b)). In fact Talofofu Beach had the largest number of advisories issued for any of Guam's beaches (36) in 1997. Guam EPA uses the enterococci standard as the indicator species for bacteriological quality of primary recreational marine beaches.

The Fena River sub-watershed is a river reach in the western sector of the Talofofu drainage area. It is comprised of the Imong, Almagosa, and Maulap Rivers. Total drainage area of the dam spillway is 5.9 square miles. It is a relatively hilly to very steep, undeveloped watershed, except for the Navy's munitions storage area. The western part is a limestone karst terrain with a very thin granular clayey cover. Sediment influx to the reservoir has reached levels whereby the Navy has contracted with the Division of Forestry and Soil Conservation, Guam Department of Agriculture to reforest portions of the watershed which drain into the reservoir.

Guam's Water Quality Standards designate the upper, lower, and southeastern portions of the watershed as S-1, S-2, and S-3, respectively. Both S-1 and S-2 designations fully protect recreational uses, including swimming, and all stages of aquatic life. An S-1 designation is more stringent in that no pollutants are allowed to be discharged into S-1 waters. Waters designated as S-1 are to be kept free of substances or pollutants that may impact water quality. An S-3 designation is the lowest designated use for Guam. Limited body contact only, is protected and aquatic life is to be maintained, rather than fully protected. The marine waters into which the Talofofu waters are discharged are designated as M-2, which is fully protective of recreation and marine aquatic life.

PRIORITY WATERSHEDS FY 2001-2005
(000-002,3,5,6,7,8,10,13,17,and 20)
CATEGORY-1

This group of watersheds share the common characteristic of experiencing impacts to the marine environment. Marine impacts from this group of watersheds are in the form of exceedences of Guam Water Quality Standards for biological parameters (Guam Water Quality Report to Congress, 1998, Federal Water Pollution Control Act Section 305 (b)). Coastal impacts have also resulted from high sedimentation loads during periods of high runoff. These impacts are most pronounced in areas used most heavily for recreational activities (Agana, Pago, Ylig, Togcha, Agat, and Inarajan Watersheds). Pago Watershed is of additional concern because it serves as a recharge area to the northern aquifer.

PRIORITY WATERSHEDS FY 2006 - 2010
(000-004, 012, 014, 015, 016, 018, 019)
CATEGORY 4

These watersheds are considered Category 4 because of the paucity of data related to the physical conditions present and the presence or absence of any impacts to groundwater or surface water sources, or the marine environment. The general remoteness and removal from population centers of these watersheds has resulted in a data gap which needs to be filled in order to fully address the condition of all Guam's watersheds.

Clean Water Action Plan Newspaper Advertisements

Appendix F

(Copies of advertisements inserted here)

Comments Received and Responses to Comments

Appendix G

Department of Agriculture

The information presented by the Department in its comment letter asserts that the Piti/Asan Watershed should be moved from Category IV, watersheds with insufficient data to make an assessment, to Category I, watersheds needing restoration. The letter documents numerous environmental studies which have been carried out by a variety of organizations and which have generated considerable data. The letter is persuasive. The Piti/Asan Watershed is moved to Category I.

The letter addressed the assessment and management criteria that the CWAP work group used to prioritize watersheds for restoration activities. The work group has decided not to add the Piti/Asan Watershed to the set of highest priority Category I watersheds scheduled for 1999-2000 restoration actions. Implementing effective restoration efforts on the highest priority Northern, Talofofu and Ugum Watersheds, will be sufficiently demanding. To add the Piti/Asan Watershed to this set would dilute the focus of the CWAP initiative and undermine our chances of success. The information presented in letter, however, is excellent, and will be very useful when the remaining Category I waters are prioritized.

Mr. Jeffrey Pleadwell

The Water Planning Committee wishes to thank Mr. Pleadwell for his concerns expressed in his letter dated September 13, 1998. It has been obvious for quite some time to anyone who frequents the location of the Togcha River that a strong odor is present in the area during certain times of the year. Over the years, both the treatment plant mentioned in Mr. Pleadwell's letter and the CCP golf course have been investigated by the Guam EPA as to their respective roles in contributing to the cause of the foul odor. To this point no definitive answers have been arrived at with regard to the degree of complicity of either source.

Mr. Pleadwell's letter discusses some interesting observations and presents a very reasonable explanation of the odor in terms of the possible source, transport and distribution mechanisms, and ultimate fate of the root cause. Currently, the Guam Waterworks Authority has issued a bid proposal for services to construct a system which will allow for the proper treatment effluent from the Baza Gardens Sewage Treatment Plant such that fecal coliform count and residual chlorine content meet regulatory requirements.

In 1998, the Environmental Monitoring and Analytical Services (EMAS) Division of Guam EPA has been responsible for water quality monitoring at the Togcha Complex. During six weeks of sampling, 243 samples were collected at four Togcha River sampling sites and 386 samples were collected at six sites on the Togcha Reef Flat. All results from these sampling events will be presented in the 1998 EMAS Fourth Quarterly Report.

USEPA Region IX

We appreciate the favorable comments provided in this memo, and the help provided by Region IX during this phase of the CWAP.

**Directory of Guam's Water Planning Committee
and
Clean Water Action Group**

Appendix H

Water Planning Committee Distribution List

<u>Organization, Name</u>	<u>Phone</u>	<u>Fax</u>	<u>E-Mail</u>
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Comnav Marianas			
Leslie Morton	339-8279	339-4363	
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Water Environment Research Institute			
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Guam Waterworks Authority			
Bert Johnston	479-7805	479-7879	
Department of Commerce			
Richard Carandang	475-0332	477-9031	
Bureau of Planning			
Francis Damian	475-9665	477-1812	
CALS - Univ. of Guam			
Frank Cruz	735-2091	734-5600	
Department of Land Management			
James Cruz	475-5212	477-0883	
Department of Agriculture			
Ed Camacho	735-3967	734-6570	
Department of the Air Force			
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