IV. GROUND WATER MONITORING AND ASSESSMENT

This section describes Guam's ground water monitoring and protection programs, ground water quality, ground water contamination sources, and ground water - surface water interactions.

A. Overview of Ground Water Contamination Sources

1.0 Hydrogeology

Guam is comprised of two sub-equally sized hydrogeologic provinces. In the southern half of the island, fresh groundwater occurs in weathered volcanic rock of low permeability, unconsolidated sediments within river drainages, and along the eastern coast's fringing limestone formations. 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.

The northern half of the island is comprised of a limestone plateau bounded on the west, north and east by near-vertical cliffs and fringing reefs and on the south by the Adelup Fault that stretches from Adelup to Pago Bay. Groundwater in northern Guam is contained within the aquifer termed the "Northern Guam Lens" (NGL). This aquifer was 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 Tertiary to Pleistocene (Tracey, 1962). The carbonate rock sequence has been significantly altered by tectonic and geochemical processes that have resulted in the formation of multiple stages of porosity and permeability. 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.

Guam's northern limestone plateau was deposited subaqueously because of down faulting along the Adelup fault and is underlain by nearly impermeable volcanic rock that is exposed at the surface in southern Guam. The limestone plateau reaches thicknesses of approximately 1000 feet and extends below sea level over most of its extent. As a result, sea water has intruded into the island producing a layer of saltwater that overlies the volcanic rocks and extends into the limestone plateau. Guam's fresh groundwater is contained in a modified Ghyben-Herzberg lens system underlying most of northern Guam, having been formed by infiltrating rainfall that collected on top of the denser

saltwater. The NGL has been estimated to be capable of supplying 60 million gallons per day (60 MGD) of fresh water (Camp, Dresser, and McKee, 1982). The aquifer is divided into six basins, containing 47 management zones (Camp, Dresser and McKee, 1982). The Yigo-Tumon basin, the largest of the six basins in the NGL, produces about half of the total groundwater production. This abundance of water results in a developed and populated area (Habana, Heitz, and Valerio, 2022).

The NGL has been formed from surface recharge in northern Guam percolating through soils to the underlying limestone where it accumulates in a lens, which "floats" on and displaces the denser seawater. Analysis of the Dynamic Responses of the Northern Guam Lens Aquifer to Sea Level Change and Recharge (Wuerch, Cruz and Olson, 2007) has documented the dynamics of freshwater lens response to short- and long-term recharge events. The study was designed to more clearly define the percentage of recharge that remains in storage within the NGL and is available for production as drinking water. The moderate to high permeability of the limestone permits the ready flow of fresh water toward areas of discharge along the coast. The mixing of fresh and saltwater at the base of the lens produces a transition zone in which groundwater becomes progressively more saline downward and seaward.

Groundwater that occurs in the manner described above is called *"basal"* groundwater, and results in a water table that rarely exceeds approximately ten feet elevation. Most groundwater in the NGL is present under these conditions. Where infiltrating precipitation encounters the volcanic basement at elevations greater than approximately ten feet, the resulting groundwater rests upon the impermeable volcanic rock and *"parabasal"* conditions exist. Groundwater under these conditions can be produced without significant threat of saltwater intrusion. The NGL is the selected aquifer for this assessment due to the abundance of excellent drinking water it contains, the large demand placed on the water from this unit, and its obvious vulnerability.

2.0 Sources of Ground Water Contamination

The following table identifies ten contaminant sources representing the greatest threats to Guam's ground water quality. They include animal feedlots, fertilizer applications, pesticide applications, underground storage tanks, landfills, septic systems/cesspools, hazardous waste generators, fuel pipelines and sewer lines, saltwater intrusion, and urban runoff.

The two most common factors considered in the selection of these contaminant sources were human health and/or environmental risk (toxicity) and location of the sources relative to drinking water sources. The common contaminant in six of the ten sources was "nitrate". A recent inspection revealed that 80 GWA entry points have traces of dieldrin

with 3 production wells over EPA's "acceptable risk" range. (Source: GEPA SDW Program)

Table 27. SOURCES-GROUNDWATER CONTAMINATION

Contaminant Source	Ten Highest-Priority Sources (√)	Factors Considered in Selecting a Contaminant Source	Contaminants
Agricultural Activities			
Agricultural chemical facilities			
Animal feedlots	√	A,C,D	E,J
Drainage wells			
Fertilizer applications	√	A,C,D	E
Irrigation practices			
Pesticide applications	√	A,C,D, **F**	A,B
On-farm agricultural mixing and loading procedures			
Land application of manure (unregulated)			
Storage and Treatment Activities			
Land application (regulated or permitted			
Material stockpiles			
Storage tanks (underground)	√	A,C,D,E	D
Surface impoundments			
Waste piles			
Waste tailings			
Disposal Activities			
Deep injection wells			
Landfills	√	A,C,D,E	A,B,C,D,E,H,M
Septic systems	√	A,C,D	E,J,K,L
Shallow injection wells			
Other			
hazardous waste generators	√	A,C,E	C
Hazardous waste sites			
Large industrial facilities			
Material transfer operations			
Mining and mine drainage			
Pipelines and sewer lines	√	A,C,D	E,J,K,L
Salt storage and road salting			
Salt water intrusion	√	E,F	G
Spills			
Transportation of materials			
Urban runoff	√	A,C,D,E	A,B,C,D,E
Small-scale manufacturing and repair shops			
Other sources (please specify)			

FACTORS

Factors used to select each of the contaminant sources. Denote factor by using corresponding letter (A-I). List in order of importance.
A. Human health and/or environmental risk (toxicity)
B. Size of the polulation at risk
C. Location of the sources relative to drinking water sources
D. Number and/or size of contaminant sources
E. Hydrologic sensitivity
F. State findings, other finding
G. Documented from mandtory reporting
H. Geographic distribution/occurrence
I. Other criteria (please add or describe in the narrative)

CONTAMINANTS

Contaminants/classes of contaminants considered to be associated with each source checked. Denote contaminants/classes of contaminants by corresponding letter (A-M).
A. Inorganic pesticides
B. Organic pesticides
C. Halogenated solvents
D. Petroleum compounds
E. Nitrate
F. Flouride
G. Salinity/brine
H. Metals
I. Radionuclides
J. Bacteria
K. Protozoa
L. Viruses
M. Other (please add or describe in the narrative)

GEPA used professional judgment to identify the highest priority contaminant sources for Guam.

2.1 "Protecting and Restoring Guam's Waters" – *water resources protection and restoration, and pollution prevention approach*

In September 1999 Guam EPA documented its overall approach for managing water resources on Guam. This document, entitled *"Protecting and Restoring Guam's Waters"*, identified the most significant threat to Guam's water quality as **development without adequate infrastructure support.** It further stated that such development "leads to a high density of septic systems over a high permeability substrate, an insufficient and poorly maintained sewage treatment system, erosion problems from poorly managed construction projects, over-pumping groundwater production wells, and groundwater impacts from inadequate environmental practices of poorly managed light industries."

This document identified its list of on-island sources of water pollutants which included:

- inadequate domestic wastewater treatment (sewage treatment plants and septic tanks/leaching fields) contributing to elevated levels of bacteria and nitrates in our groundwater;
- urban storm water runoff, particularly in the north, contributing to nutrients in Guam's near shore waters;
- unconfirmed sources contributing to elevated levels of TCE and TCA (solvents and degreasers), PCE (dry cleaners and degreasers); thallium (insecticides); and EDB (pesticides) in groundwater;
- aquaculture facilities and golf courses contributing to elevated nutrients and pesticide levels;
- accidental spills of pollutants and hazardous materials from sites with inadequate spill prevention control countermeasure plans;
- leaking above and underground storage tanks and associated pipelines;
- construction without adequate erosion and sediment control measures;
- wildfires, and off-road vehicle use, particularly evident in the south, causing excess siltation, turbidity and sedimentation;
- leachate from landfills and agricultural runoff;
- past activities on military sites;
- recreational watercraft, including jet-skis, which are damaging marine life; and
- inadequate enforcement.

The only difference between these two lists (of sources of water pollutants) was "salt water intrusion".

2.2 Guam Hydrologic Survey and Comprehensive Water Monitoring Program 2023 Annual Report (October 2023)[1]

[1] Prepared by Dr. Nathan C. Habana, GHS Program Advisor; Mary Clare Snaer, CWMP Research Assistant; Dr. Blaž Miklavič, GHS Operations Manager; Dr. Ross Miller, WERI Interim Director. Water & Environmental Research

a. Contamination issues of concern to Guam's groundwater resources.

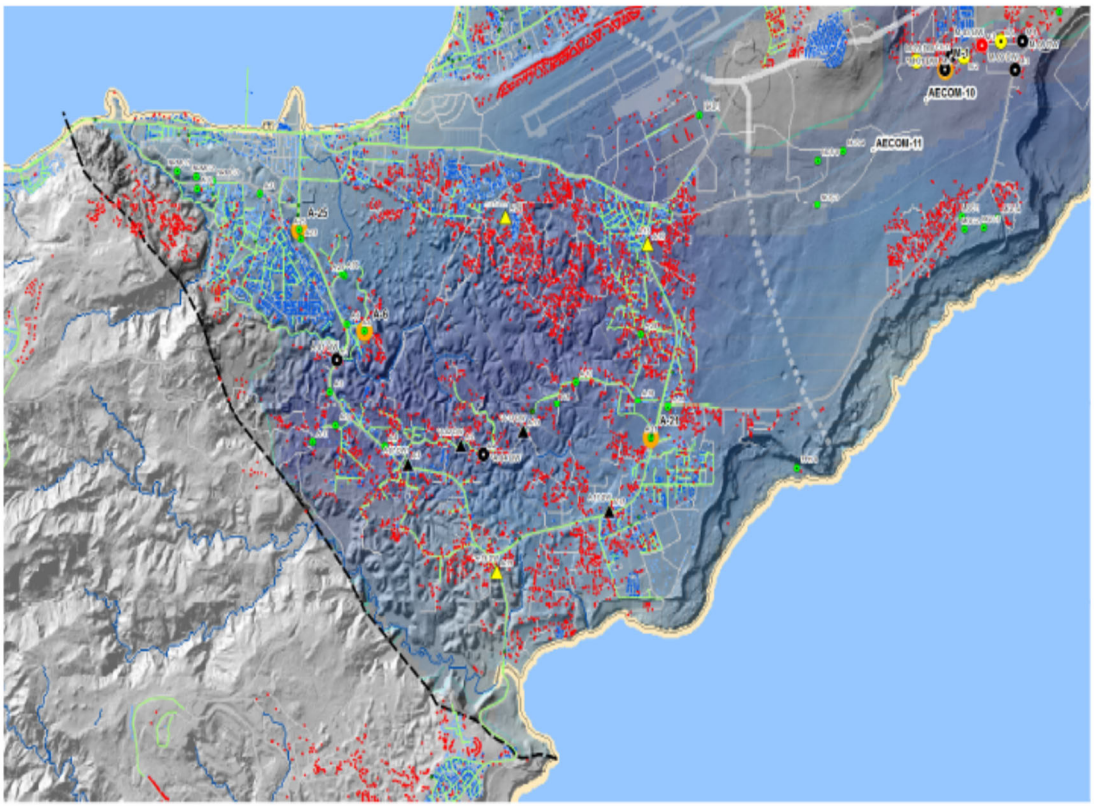
- *Contamination, one of three main reasons for production wells shut down*
  Four production wells have been taken offline due to exceeding maximum contaminant levels (MCL) and health advisory levels. - Chlordane: Well M-14, Yigo-Tumon, basal zone (since 1983) - PCE: Well A-28, Hagatna, basal zone (since 2006) - PFOS: Well A-23, A-25, Hagatna, pare-basal zone (since 2017).
- *Potential PFAs contamination sites*
  Recent UCMR3[2] results reveal three Guam Waterworks Authority (GWA) production wells to be contaminated with perfluorooctanesulfonic acid (PFOS). One of these wells (NAS-1) is located inside of the former Naval Air Station at Tiyan, in the village of Barrigada. PFOS concentrations found in this well to-date range from 67-110 ng/L. The two other wells (A-23 and A-25) are in Hagåtña, one of the oldest villages on Guam. PFOS concentrations determined in both wells to date are consistently above 70 ng/L with maximum levels occasionally exceeding 400 ng/L in well A-25. Both wells are currently offline. Ongoing PFOS source studies have so far identified four potential contamination sites based on historical records and favorable hydrogeological properties of the surrounding area. These sites include: 1) a defective wastewater pump station that leaked millions of gallons of wastewater into the Chaot River over a 25-year period, 2) Agana swamp which drains the Chaot River and where chronic illegal dumping has occurred since WWII, 3) neighboring ponding basins that direct stormwater into the underlying aquifer, and 4) a nearby air flight crash site. Soil/sediment samples were retrieved for analyses of PFOS and other five unregulated perfluoralkyl substances (PFAS) from 22 sampling sites overall. 4.8 ug/Kg of PFOS was detected with the highest level among all sampling sites at one of ponding basins near the Well A-25. 28.29 ug/Kg of six PFASs (sum) was the highest near the GWA wastewater pump station.

Institute of the Western Pacific, University of Guam. (https://www.guamhydrologicsurvey.uog.edu)

[2] The 1996 amendments to the Safe Drinking Water Act (SDWA) require that once every five years, the U.S. Environmental Protection Agency (EPA) issue a new list of no more than 30 unregulated contaminants to be monitored by public water systems (PWSs). The Unregulated Contaminant Monitoring Rule (UCMR) provides EPA and other interested parties with scientifically valid data on the occurrence of contaminants in drinking water. These data serve as a primary source of occurrence and exposure information that the agency uses to develop regulatory decisions. The final rule "Revisions to the Unregulated Contaminant Monitoring Rule (UCMR 3) for Public Water Systems" was published in the Federal Register on May 2, 2012 (77 FR 26072). UCMR 3 monitoring took place from 2013-2015 and included monitoring for 28 chemicals and two viruses.

- *NGLA Maps: Wastewater Sources and Production Well Nitrates*
  By far the most important tool for successfully locating sites for new wells that will deliver abundant high-quality water from the Northern Guam Lens Aquifer is an accurate and precise map of the aquifer's subsurface structure and hydrologic components. Other ideas have emerged to further improve the mapping of the NGLA --- such as the layover of the wastewater system.

  Development over the NGLA is a concern of possible wastewater contamination. The aquifer's water resource in a durable karst plateau provides an economic access for development, but the residential and business wastewater discharged above it may be a threat to the freshwater resource. Increased and dense development must be assessed as it may intensify wastewater discharge. The NGLA map and the layover of the wastewater system provides a useful assessment tool for contaminant transport. The map may also be used to determine prioritization of sewer systems. The wastewater system map over the NGLA map helps planners strategize future development and reduce wastewater contamination.



NGLA wells and wastewater system

A fundamental surface hydrologic map of the NGL has been produced by WERI and is available on the Guam Hydrologic Survey website. This new high-resolution digital elevation based hydrologic map improves surface analysis capabilities thus improving groundwater protection strategies. It aids in the assessment and determination of development strategies toward water source protection and can reveal potentially vulnerable areas for production wells.

Four interactive web-based hydrologic map applications are now available on the Guam Hydrologic Survey website. The WERI Web MApps of the NGL include surface hydrology, nitrate-N and sources, northern Guam terrain , and an overall NGL map. Together, these maps can be used to develop successful strategies for management of new development over the NGL as well as long term strategies to manage and mitigate development impacts over the aquifer.

Serving as a starting point for a living and updating data document, the next phase in updating these maps include further refinements such as delineating tributary watersheds, defining runoff paths within fill areas, and identifying true sinkholes in fill areas (Habana, Heitz, and Valerio, 2022).

b. Comprehensive Water Monitoring Programs (CWMP)

In 1998, the CWMP was made a permanent part of WERI's program when Governor Gutierrez signed PL 24-161 and PL 24-247. This resulted in the refurbishment of the deep monitoring wells and a renewed program of water resource monitoring on Guam. The intent of PL 24-161 was to restore, and then to expand, as needed, the discontinued monitoring program to help Guam manage and safeguard all of its freshwater resources, now and in the future. Under PL 24-161, WERI/UOG and the USGS entered a memorandum of understanding to administer and fund this program on a 50/50 cost-sharing basis.

The CWMP program collects pertinent hydrologic data and applies analysis and interpretation. The analysis and interpretation are conducted in research projects that will contribute to the status our water resources and new findings. The CWMP program is organized into two components, the monitoring program and data analysis research.

1) Monitoring (observation) Program - USGS-WERI continues to work as a team in collecting well hydrologic information. WERI and GWA established cooperation in a Memorandum of Understanding, where GWA shares the monthly water production report and quarterly well water

chloride concentration data. Wastewater-N data is now being logged in two production wells in the Yigo area. Additional monitoring program activities are described in the annual report.

2) Data Analysis Research – Relevant projects described in the annual report include:

- Salinity patterns and trends in the NGLA - This project focused on processing, visualization and analysis of the patterns and trends of salinity from drinking wells in the Northern Guam Lens Aquifer (NGLA). Water quality data is available from GWA. GIS is utilized to process and analyze the salinity data, and to locate wells with water quality problems with salinity. Since high levels of salinity in drinking water pose risks to man's health, it is crucial to locate wells with problems with salinity and archive those wells in a format that permits rapid visualization of spatial and temporal trends of salinity in the wells in the study area using the state-of-art GIS technology. Figures on page 32 of the 2019 annual report indicate wells with salinity problems and the salinity distribution the in the first quarter of 2001.
- N-data collection: Phase II - The Northern Guam Lens Aquifer (NGLA) is Guam's primary source of freshwater for potable use. This porous limestone formation currently provides approximately 90% of the island's municipal water supply. Aggressive production of groundwater has grown to 45 million gallons per day (mgd). With water demand rising and concerns over water quality increasing, proper management of this freshwater source has become critical to the welfare of the island's increasing population of residents and tourists. Preliminary inquiries have suggested that contaminants from anthropogenic sources are showing up in the NGLA. Much more baseline data of contaminant concentrations is needed to determine if the problem is greater in zones with sewer collection lines, or in zones that rely on household septic tanks.

  Nitrate concentrations across the NGL aquifer have risen over the past four decades in nearly 60% of the 146 wells. The continuous rise in at least 44% of the wells indicate that there are widely disturbed sources of nitrate that have, and continue, to contribute steady-to-increasing amounts of nitrate in the aquifer. Since patterns of spatial variations and trends in nitrate concentrations are complex, their relationships to the locations and histories of sewer lines and septic tanks are subjects of ongoing or future research (Habana, Bulaklak, and Jenson, 2020).

It is essential that these issues be studied before actions are taken to extend sewer collection lines or even build new wastewater treatment plants in Northern Guam. In addition, the effectiveness of septic tanks is also an issue of concern.

A groundwater solute transport model was created to simulate wastewater contaminant transport and to aid in visualizing the potential impact on the production wells in the NGL. A study using this model was performed using the Swamp Road area due to a substantial number of wells and non-sewered homes as well as future plans to develop a line of housing. The model suggested that using septic systems in a dense lot configuration can be intense and may increase nitrate concentration in nearby wells. A comprehensive technical report and the calibration of the entire Yigo-Tumon basin is in preparation (Bautista, Caasi, Wood, and Habana, 2023).

As an alternative to traditional septic tanks, consideration is increasingly given to use of single-family prefabricated, packaged treatment units. It is considered that these units could serve to reduce the potential of contamination reaching the water table.

Objectives: The objectives of this project are: (a) Data acquisition and literature review of wastewater-N and groundwater-N cycle transformation triggers, and study of groundwater contaminant transport. (b) Analysis of spatial time-series wastewater-N data at sites with rainfall and other possible influences such as pH, ORP, sewage discharge events, etc. (c) Translation/interpretation of analysis such as increasing/decreasing trends, averages, and spatial distribution. (d) Suggest/recommend development strategies to improve wastewater management.

B. Overview of Guam's Ground Water Protection Program

Guam EPA manages different environmental programs which serve to protect ground water resources. Most programs are fully established but undergo continuous revision based on changes in statutes or regulations or to maintain effective control measures. The table below summarizes the status of ground water protection programs in Guam. Related information is available at **www.epa.guam.gov** and **https://weri.uog.edu/**

Information about Guam's key ground water protection programs are presented in the following.

1.0 Northern Guam Lens Study

It has been long recognized that the NGL supply needed protection and on April 26, 1978, the groundwater lens in northern Guam was defined as a "sole source aquifer," by the EPA Administrator under Section 1424(e) of the Safe Drinking Water Act (SDWA), Federal Register citation 43FR17867.

Table 28. SUMMARY OF STATE GROUND WATER PROTECTION PROGRAMS

Programs or Activities	Check (√)	Implementation Status	Responsible Agency
Active SARA title III Program			
Ambient ground water monitoring system			
Aquifer vulnerability assessment			
Aquifer mapping	√	Continuing efforts	GEPA, WERI
Aquifer characterization	√	Continuing efforts	GEPA, WERI
Comprehensive data management system	√	Continuing efforts	WERI
EPA-endorsed Core Comprehensive State Ground Water Protection Program (CSGWPP)			
Ground water discharge permits			
Ground water Best Management Practices	√	Continuing efforts	GEPA
Ground water legislation	√	Continuing efforts	GEPA, GWA
Ground water classification	√	fully established	GEPA
Ground water quality standards	√	fully established	GEPA
Interagency coordination for ground water protection initiatives	√	Continuing efforts	GEPA*, GWA, JOINT REGION
Nonpoint source controls	√	Continuing efforts	GEPA
Pesticide State Management Plan	√	Continuing efforts	GEPA
Pollution Prevention Program	√	Continuing efforts	GEPA
Resource Conservation and Recovery Act (RCRA) Primacy	√	fully established	GEPA
Source Water Assessment Program			
State Superfund	√	Continuing efforts	GEPA
State RCRA Program incorporating more stringent requirements than RCRA Primacy	√	fully established	GEPA
State septic system regulations	√	fully established	GEPA*
Underground storage tank installation requirements			
Underground Storage Tank Remediation Fund			
Underground Storage Tank Permit Program	√	fully established	GEPA
Underground Injection Control Program	√	fully established	GEPA
Vulnerability assessment for drinking water wellhead protection	√	Continuing efforts	GEPA, GWA
Well abandonment regulations	√	fully established	GEPA
Wellhead Protection Program (EPA-approved)	√	fully established	GEPA
Well installation regulations	√	fully established	GEPA
Other programs or activities (please specify)			
Watershed Planning Committee activities	√	Continuing efforts	GEPA*

* Multiple agencies involved

To properly protect this "sole source aquifer", it was necessary to define the range or extent of the aquifer, the types of protection and/or controls needed, and the type of management system needed to monitor, control, develop, and protect this resource.

In 1979 Guam EPA initiated the Northern Guam Lens Study (NGLS), which was completed in December 1982. This study sufficiently defined the range or extent of the aquifer, and the types of protection and/or controls needed. It also outlined the framework necessary for Guam EPA to implement the type of management system needed to monitor, control, develop, and protect this resource. This 40-year-old study is still in use.

The Northern Lens Study concluded the following:

a. The aquifer and its recharge areas cover almost the entire northern half of the island and are divided into six major sub-basins based on the volcanic subsurface topography. These sub-basins are further divided into 47 management zones, which could provide an estimated sustainable yield of 59 million gallons a day.

b. The lens contains very high-quality water but needs to be protected against both contamination from percolation of surface pollution through the very permeable soils and salt-water intrusion due to over-pumping of the lens.

c. The management system defines the necessary data to be collected, construction practices, the operation and maintenance practices needing modification, and the 2)required legislative and legal measures that should be developed to properly implement the program.

1.1 Other Aquifer Related Studies[3]

Other studies of the NGL aquifer include:

- Mink (BCG, 1992) Update to the 1982 study;
- Department of Defense Installation Restoration Program project studies relevant to the aquifer 1) Dye Traces (Barner, 1997) 2) WERI Aquifer Modeling in the 1990's and early 2000s (Contractor and Srivastva-1990; Contractor and Jenson -2000; and Jocson et al.- 2002);
- USGS "Groundwater Availability Study for Guam" (Gingerich and Jenson, 2010) where five component projects were undertaken in collaboration with WERI. 1) NGLA Database Report 2) Aquifer Recharge Report (Johnson, 2012) 3) Field study of regional hydraulic conductivity (Rotzoll et al., 2013) 4) Update of the Aquifer Basement Map (Vann et al., 2014) 5) Three-Dimensional Numerical Model of the NGL aquifer (Gingerich and Jenson, 2010).

[3] The Northern Guam Lens Aquifer Database. Viviana M. Bendixson, John W. Jenson, Nathan C. Habana. Technical Report No. 141, 2nd Edition, October 2014, p. 5.

2.0 Ground Water Legislation, Statutes, Rules, and/or Regulations

The statutory authority for water resources management programs falls under the provisions of 10 GCA, Chapter 46 (Water Resources Conservation Act). This and other pertinent regulations can be found on the Guam EPA website www.epa.guam.gov under the REGULATIONS or LAWS tab.

Public Law 24-247 (August 1998) established the Guam Hydrologic Survey (GHS) as a permanent program to be created and administered by WERI. Among the five points detailed as the mission of the GHS, the program is to locate, inventory, and evaluate all hydrologic data pertaining to Guam and consolidate the data into a single computer-based data library form which information can be easily accessed and retrieved.

The Northern Guam Lens Aquifer Database is a comprehensive centralized database containing information on custodianship, function, operational status, and the geographical hydrological, engineering, and geological attributes of each well installed in northern Guam for which records could be found. The database is integrated with current ArcGIS® geospatial information visualization tools. Developed in support of the 2010-2013 "Guam Groundwater Availability Study" led by the USGS's Pacific Islands Water Science Center, with funding by the US Marine Corps, and in conjunction with the 2010 NavFacPac Exploratory Drilling Program on northern Guam, its integration into WERI's GHS Program will keep it up to date and make it permanently and readily accessible to professional and scientific users.[4] (Visit: **www.guamhydrologicsurvey.uog.edu**)

3.0. Wellhead Protection Program

Provisions for wellhead protection were adopted as part of the reauthorization of the Safe Drinking Water Act (SDWA), signed into law in June 1986. The legislation established a nationwide program to encourage states to develop systematic and comprehensive programs within their jurisdiction. Such programs were intended to protect water supply wells and well fields from all sources of anthropogenic contamination.

Water Resource Development and Operating Regulations were adopted on January 25, 1985 and amended August 2, 1990.
(www.guamcourts.org/CompilerofLaws/GAR/22GAR/22GAR002-7a.pdf)
Section 7130. Wellhead Protection for Public Water Supply Well contains regulations intended to safeguard the public health, safety, and welfare by providing established standards.

A draft report on Guam's drinking water assessment entitled "Guam Drinking Water Source Assessment and Protection Program and Wellhead Protection Plan" listed the

[4] Ibid. p. iii.

overall vulnerability ranking of GWA's drinking water supply wells to contamination, from high risk to moderate to low risk. Of the 122 wells, 77 are considered high risk, 39 moderate risk, and 6 low risk. GWA intends to address these high-risk wells through its Capital Improvement Plan. A Wellhead Protection Plan was completed which provides management strategies for GWA to continue and improve protection of wells.[5]

4.0 Underground Injection Control (UIC) Well and UIC Permitting Program

The only type of injection well in Guam is the Class V well used primarily for drainage of storm water runoff. All injection wells in Guam have been issued permits and are inspected annually.

At present, there are five hundred eight (508) permitted wells. A general breakdown of well-ownership is as follows:

PERMITTE	# of WELLS
Andersen Air Force Base (USAF)	105
Guam International Airport Authority (GovGuam)	28
Department of Public Works (GovGuam)	48
Agana Shopping Center	28
Guam Memorial Hospital Authority (GovGuam)	13
Lotte Hotel	20
Atkins Kroll (Toyota)	10
Hyatt Regency Hotel	47
Westin Resort	18
Pioneer Westpac Plaza	10
Mobil Guam	15
Summer Towers Apartments	11
Other permittees (with <10 UIC systems)	60
TOTAL	**508**

The Guam EPA Water Resources Management Program conducts annual compliance inspections to

- verify if the site or location of injection wells conform with its operating permit requirements and conditions;
- assure adequate maintenance of the wells to prevent groundwater contamination; and
- identify discrepancies or deficiencies between the inspected well and its permitted requirements and conditions.

A UIC permit is required for anyone who has constructed a well, used primarily for drainage of storm water runoff. The permit provides a means of tracking all injection

[5] June 29, 2015. Guam Office of Public Accountability, GWA FY 2014 Financial Highlights, p.1.

wells and insuring, through inspection, that such wells are properly maintained. Recent concern has developed over the proliferation and extensive use by commercial establishments to contain stormwater runoff within its boundaries. These drainage systems, because of their configuration and purpose, are now considered injection wells requiring a UIC permit.

4.1 Underground Injection Control Monitoring

Guam EPA's UIC program has a Permit-driven water quality monitoring requirement for UIC well/system owners. As of this reporting period, permitted UIC well owners are operating a total of 516 individual wells/systems located over the northern Guam lens.

The UIC well/system owners are required to perform water quality monitoring sampling semiannually on 19 chemicals. The owners are required to grab the first set of samples during the first significant rainfall between the months of April and July which represents the end of the dry season and the onset of the rainy season. This sampling event is scheduled during this period as a way of capturing the illusive *first flush.* The second set of samples is grabbed between the months of October and December which are the last three months of the rainy season. The 19 chemicals of concern and their respective MCLs are listed in **Table 29 below**.

Table 29. UIC Sampling Parameters

	Chemical	MCL (mg/l)		Chemical	MCL (mg/l)
1.	MBAS	0.5	**11.**	Lead	0.015
2.	Oil and Grease*	N/D	**12.**	Benzene	0.005
3.	NO_3-N	10.0	**13.**	Ethylbenzene	0.7
4.	Endrin	0.002	**14.**	Xylene	10.0
5.	Lindane	0.0002	**15.**	Toluene	1.0
6.	Toxaphene	0.003	**16.**	Boron	5.0
7.	2, 4-D**	0.07	**17.**	COD	50.0
8.	2, 4, 5 -TP Silvex***	0.05	**18.**	pH	6.5-8.5
9.	Heptachlor	0.0004	**19.**	MTBE	0.02
10.	Methoxychlor	0.04			

* Not Detected using 0.05 ppm MDL ** 2,4 - Dichlorophenoxyacetic Acid
*** 2,4,5 - Trichlorophenoxy Propioacid Silvex
MCLs are based on the most current Guam Water Quality Standards.

5.0 Ground Water Assessment Monitoring

An ambient groundwater monitoring system has been established for Guam groundwater under Guam EPA. Pump rates and chloride and nitrate sampling are among a set of key annual inspection and testing parameters of all production wells currently being

monitored. The Agency reports a total of 194 production wells owned as follows: GWA-121; Private – 40; Navy-14; and AAFB-19.

WERI and the water resource monitoring program for the NGLA[6]

The water resource monitoring program for the Northern Guam Lens Aquifer (NGLA), designated a Sole Source Aquifer in 1978 by the U.S. EPA, had been established in the 1950s by the USGS. However, in the 1990s, this program was forced to downsize when funding from the local government could not be met, which resulted in data disruption to deep well monitoring for saltwater intrusion in the north and stream gage data in the south. In 1998 the Comprehensive Water Monitoring Program (Guam Public Law 24-161) became a permanent program of the Water and Environmental Research Institute (WERI) of the Western Pacific and resulted in the refurbishment of the deep monitoring wells and a renewed program of water resource monitoring on Guam. In the same year, the Guam Hydrologic Survey (Guam Public Law 24-247) was made a permanent program, administered by WERI, to develop an inter-agency cooperation for gathering and publicly providing water and environmental information. Current withdrawals from production wells estimate to 40 Mgal/d. Over the next decade, population growth, inclusive of the proposed military forces relocation, projects a production increase as much as 25 percent. Increased withdrawals, in the long-term, were modeled to result in a decline in water levels and a rise in the freshwater-saltwater transition zone. To assist with water-resource management, an inter-agency framework for information sharing and decision making has been established with a Memorandum of Understanding, signed in 2010, under the Monitoring System Expansion and Rehabilitation Program. 7 new deep monitoring wells have been drilled, and rehabilitation has begun on 12 existing monitoring wells which has expanded groundwater monitoring to include four NGLA sub-basins in addition to the two NGLA sub-basins (Habana, Snaer, Miklavič, and Miller, 2023).

As partners in the island's technical/scientific experts group, WERI and the USGS will assume data collection, analyses, and reporting, to provide best practices for sustainable management.

The general list of Indicators for groundwater monitoring is listed below. (See list in **Table C5, Appendix C.**)

- General water chemistry (chlorides, nitrates)
- Organic and Inorganic Constituents
- Physical Parameters (Water Level, Yields)

[6] Guam Water Resources Monitoring Program, Groundwater Week, Exhibits Workshop Summit, National Groundwater Association, Las Vegas, Nevada. Bautista, K., Jenson, J.W., Habana, N.C., Kim, Y.S. 2018

6.0 Man-Made Impoundment Monitoring[7]

The Man-Made Impoundment Monitoring Plan primarily evaluates chemical data sampled from man-made impoundments very much like the UIC plan and focuses on surface impoundment impacts to groundwater. **Table 30** presents the locations and a proposed schedule for surface impoundment (i.e. ponding basins) sampling. It is proposed that this monitoring program be extended to include the surface impoundments of Southern Guam that affect surface water quality of receiving streams and other water bodies.

Table 30. Man-Made Impoundment Area WQM Schedule.

Cycle	SIA Name	Site No.	Location	Cycle Sampling Year	Plus One Site Each from Other Four Cycles
I	GHURA 501	43	Behind Dededo Transfer Station	Year 1	Year 2
	Potts Junction	12	Rte 9; 500 Feet West of Well HGC-3	Year 1	Year 3
	Marianas Terrace	36A	Gayinero Street, Yigo	Year 1	Year 4
	Airport road Extension	72A	Route 10A (South Side)	Year 1	Year 5
II	GHURA 502	20	Route 3 (Astumbo Gardens)	Year 2	Year 1
	Ypaopao Estates	42B	Behind PUAG Pump Station	Year 2	Year 3
	Hatsuho Golf Course	12E	Route 3 (Near Club House)	Year 2	Year 4
	Harmon Sinkhole	71	Route 10A (Near Hotel Mai'Ana)	Year 2	Year 5
III	Agana Hts. Injection Wells	79	F. Xavier Dr./Salamon Dr., Agana Hts.	Year 3	Year 1
	Guam Community College	76A	Sesame Street, Mangilao	Year 3	Year 2
	GHURA 503	15	Route 3 (Fern Terrace)	Year 3	Year 4
	Guam Intl. Airport Terminal	72	Route 10A (Across Airport Parking Lot)	Year 3	Year 5
IV	Barrigada 76 Gas Station	74	Route 10 & Route 8 Intersection	Year 4	Year 1
	GHURA 35	48B	Near Northern Public Health Center	Year 4	Year 2
	Macheche Subdivision	55A	Macheche Avenue, Dededo	Year 4	Year 3
	GHURA 505	41	Atsadas Street, Yigo	Year 4	Year 5
V	Sinajana Baseball Field	79B	Chalan Guma' Yuus, Sinajana	Year 5	Year 1
	Latte Heights	56A	Gardenia Ave. & Carnation Ave.	Year 5	Year 2
	GHURA 506	38	Near Simon Sanchez High School	Year 5	Year 3
	Dededo Public Park	47A	Rte. 1 & Ysengsong Rd. Intersection	Year 5	Year 4

[7] Suspended program. No laboratory capacity to sustain program.

C. Summary of Ground Water Contamination Sources

The top ten contaminant sources presenting the greatest threat to Guam's ground water quality were identified on page 3. Guam EPA includes the following narrative on major contaminant sources and groundwater locations most at risk on Guam.

1.0 Septic Systems[8]

Septic systems are currently in use throughout Guam for wastewater collection and disposal in the areas not sewered. It is estimated that 41% of the island residents use individual wastewater disposal systems (IWDS) as reflected in GWA's customer count list.

There are parts of Guam that are more sensitive to the effects of septic systems than other parts of the island. The Northern Region and the northern portion of the Central Region are located over an aquifer in an area of limestone formations that provides an environment for the septic-treated wastewater to filter down to the island's groundwater source.[9] In this area, rainwater and water from other sources percolate through the limestone aquifer rapidly. Any pollutants, such as nitrates resulting from septic system wastewater treatment, eventually make their way to the aquifer.

GWA's customer count shows that approximately 42% of all the septic systems on island are located in the Northern Region (Dededo, Yigo and Mangilao) and approximately 44% are located in the Central Region (Agana, Sinajana, Mongmong-Toto-Maite, Agana Heights, Tamuning, Barrigada, Chalan Pago – Ordot, Yona, Asan, Piti, and Santa Rita). Approximately 13% of the island's septic systems are located in the southern region of Guam.

See page 8 for the narrative about WERI's *N-Data Collection: Phase II Project* which proposes to conduct research on spatial and temporal trends in levels of contaminants in Guam's groundwater, as well as the need for continuous baseline studies on levels of nitrogenous compounds, etc. with respect to time and location. It also proposes to address the need for evaluation of innovative wastewater treatment units as alternatives to conventional septic tanks for individual homes, commercial buildings, or hotels.

2.0 CERCLA[10] Sites Overlying the NGL

[8] Volume 3, Chapter 6: Septic Systems & Unsewered Areas. October 2006 Final Water Resources Master Plan
[9] PUAG's Rural Island-wide Wastewater Facilities Plan delineates Guam regions as Northern, Central and Southern.
[10] EPA website

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, was enacted by Congress on December 11, 1980. This law created a tax on the chemical and petroleum industries and provided broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. Over five years, $1.6 billion was collected and the tax went to a trust fund for cleaning up abandoned or uncontrolled hazardous waste sites. CERCLA:

- established prohibitions and requirements concerning closed and abandoned hazardous waste sites;
- provided for liability of persons responsible for releases of hazardous waste at these sites; and
- established a trust fund to provide for cleanup when no responsible party could be identified.

The law authorizes two kinds of response actions:

- Short-term removals, where actions may be taken to address releases or threatened releases requiring prompt response.
- Long-term remedial response actions, that permanently and significantly reduce the dangers associated with releases or threats of releases of hazardous substances that are serious, but not immediately life threatening. These actions can be conducted only at sites listed on EPA's National Priorities List (NPL).

CERCLA also enabled the revision of the National Contingency Plan (NCP). The NCP provided the guidelines and procedures needed to respond to releases and threatened releases of hazardous substances, pollutants, or contaminants. The NCP also established the NPL.

There are CERCLA sites, which overlie the NGL: Andersen Air Force Base (AAFB), Tiyan (the former Naval Air Station, Agana), and the Navy Construction Battalion (CB) Landfill.

2.1 AAFB

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.

Initial Actions: Closure of the main base landfill in accordance with the requirements of the Resource Conservation and Recovery Act (RCRA) finished in 1994. Landfill closure included the construction of a cover over the landfill.

Long-Term Cleanup: The Main Base Operable Unit, Northwest Field Operable Unit and the Site-Wide Operable Unit encompasses the entire Andersen Air Force Base property. The Main Base contains active runways, bulk fuel storage facilities, housing areas, and the majority of the operations and administrative structures and functions. Northwest Field is home to Rapid Engineer Deployable Heavy Operations Repair Squadron Engineer facilities and operations. The three operable units include seventy-one (71) out of the eighty-one (81) IRP sites and 18 MRP sites. Only seven (7) IRP sites and eleven (11) MRP sites remain under investigation and remedial cleanup.

For active information about AAFB as a superfund site go to https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.Cleanup&id=0902825#Status

2.1.1 AAFB Main Base TCE Groundwater Contamination - Building 18006

Building 18006 has been operational since the 1960's. AAFB started looking at this site after its status was converted from an Area of Concern (AOC) to an Installation Restoration (IR) site in the beginning of CY 2005. This was done to access funding to start an investigation into whether Building 18006 may be contributing to the groundwater TCE contamination. In fiscal year 2008, AAFB began the Remedial Investigation (RI) and feasibility study (FS) proposed plans for Building 18006.

Selected Remedy[11]

The USN is managing remediation of contamination at the Site-Wide OU in accordance with CERCLA as required by the Defense Environmental Restoration Program (DERP). The USN and the United States Environmental Protection Agency (USEPA) have jointly selected the remedy for the site, and Guam Environmental Protection Agency (Guam EPA) has concurred with the selected remedy, under the guidelines established in the Federal Facilities Agreement (FFA) signed in February 1993 by representatives of USEPA Region IX, Guam EPA, and the United States Air Force (USAF) (USEPA et al., 1993).

The USN selected *Long-Term Groundwater Monitoring with Contingency for Wellhead Treatment* as the preferred alternative for Site 54. The major components of this selected remedy are as follows:

- Long-term groundwater monitoring and assessment to monitor plume stability and evaluate contaminant trends within the groundwater contaminant plume
- Land Use Controls (LUCs): LUCs shall be implemented through the Base Master

[11] Record of Decision for Site 54 Site-Wide Operable Unit Andersen Air Force Base, Guam. August 2015. Indefinite Delivery/Indefinite Quantity Contract Number N40192-11-D-5001, CTO 0026

Plan and the Guam EPA's Wellhead Protection Program. As part of its Wellhead Protection Program, Guam EPA limits the location of newly installed wells (must be at least 1,000 feet from existing wells) and requires that any new well be sampled prior to being connected to the water supply system. If sampling at a newly installed well indicates that TCE/PCE is present, the USN will evaluate the need to install and operate wellhead treatment whenever levels exceed one half of the respective maximum contaminant level (MCL). LUCs will be maintained until the concentrations of hazardous substances in the groundwater are at such levels to allow for unrestricted use and exposure.

- Contingency for Wellhead Treatment: at potential future water production wells within the extent of the PCE and TCE plume. Upon TCE or PCE concentrations exceeding half of the MCL, the USN will perform additional sampling and analysis to determine if the concentration is likely to approach the MCL (5 μg/L). If statistical significance is found, the well will continue to be monitored for potential exceedance of the MCL. If PCE or TCE concentrations exceed the MCL, wellhead treatment will be applied to the affected well.
- A technical impracticability (TI) waiver to waive the requirement to achieve Federal and Territory of Guam drinking water maximum contaminant levels (MCLs) for tetrachloroethene (PCE) and trichloroethene (TCE) in the aquifer where concentrations exceed the MCLs. The TI waiver is necessary because it is not practicable or feasible from an engineering and technological perspective to remediate the dissolved-phase PCE and TCE in the aquifer within a reasonable time frame.
- Regular reporting and five-year regulatory reviews to assess the effectiveness of the remedy.

The selected remedy for Site 54 addresses the principal threats posed by the site through implementation of wellhead treatment, if needed, to treat contaminated groundwater at potential future production wellhead(s), thereby preventing potential future exposure to contaminated groundwater. Successful implementation of the selected remedy at Site 54 would effectively mitigate all unacceptable risks to human receptors at the site and render the site suitable for unrestricted use. Monitoring at the site would be performed regularly to determine whether contaminant concentrations in the groundwater have attenuated to levels that would allow the removal of the wellhead treatment contingency.

2.1.2 Air Force Marbo Groundwater Impacted by TCE and PCE

The MARBO Operable Unit is located several miles south-southeast of the Main Base and covers 2,342 acres. The final remedy for soils included removing some hazardous soils off-island and removing other, less hazardous soils to the Main Base landfill. Ground water

is contaminated with trichloroethylene, a degreasing solvent. The remedy, selected in 1998, is monitored natural attenuation. Long-term monitoring has shown that the contaminants at the bottom of the aquifer, directly over the saltwater zone, are not decreasing, so the Air Force and EPA re-evaluated the remedy in 2014 and proposed a waiver for technical impracticability. Because cleaning the aquifer directly over the saltwater interface would cause upwelling of salt water into the drinking water portion of the aquifer, there is no practical way to implement a remedy. Thus, the remedy update included institutional controls prohibiting the pumping of ground water in the deep plume area, long-term groundwater monitoring and contingencies for well-head treatment.

2.2. Tiyan – former NAS Agana

Groundwater beneath Tiyan has been investigated since 1986 under the Department of Defense Installation Restoration Program. 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 Base Realignment and Closure (BRAC) program has shown the presence of an extensive area of contamination of PCE and TCE.

In July 1993, the BRAC Commission recommended closure of Naval Air Station (NAS) Agana. The installation was closed on March 31, 1995.

All cleanup work on BRAC sites is complete and the sites are in long-term management (Action conducted after cleanup to monitor effectiveness of the remedy and ensure site restrictions remain in place). All former NAS Agana property has been transferred, except for the Agana Power Plant.

Contamination in NAS-1 is currently being remediated through wellhead treatment through activated carbon filtration.

2.3 Construction Battalion Landfill – IRP Long-term Management Site

In 1998, a soil and synthetic liner system was completed. The site is now in long-term management. Annual inspections and cover maintenance are ongoing, and five-year review results will be published in 2014.[12]

3.0 Other CERCLA Sites

There are several CERCLA sites located in the Southern Guam hydrogeologic province

[12] Fact Sheet 5: Navy's Guam Environmental Restoration Program – Site Status Update , February 2014

not over the NGL: the Ordot Dump and numerous sites belonging to the Navy.

3.1. Ordot Dump[13]

The 23-acre Ordot Landfill site was Guam's primary landfill for industrial and municipal waste near Ordot and Chalan Pago. Site investigations revealed leachate flowing from the site to the Lonfit River. EPA deferred cleanup to EPA's Water Program in 1998.

The Ordot Dump was in operation, beginning in the 1940s until August 31, 2011, polluting the Lonfit River in violation of the Clean Water Act. Working in conjunction with the United States Environmental Protection Agency (USEPA), the Guam Environmental Protection Agency (EPA), the Ordot Mayor's Office, and the people who live in the immediate vicinity of the Ordot Dump, the Receiver, (Gershman, Brickner & Bratton, Inc. (GBB), solid waste management consultants, appointed on March 17, 2008 as Receiver by the District Court of Guam to achieve the government's compliance with the Clean Water Act as set forth in the Consent Decree) oversaw the design of an approved plan that met all of the legal and environmental requirements of the Federal and Territorial Governments.

A plan developed by the Receiver, USEPA and Guam EPA, provided the legally required 30 year post-closure care of this facility. Such care included monitoring groundwater, leachate collection and control, methane gas collection and control, and financial assurance that the money would be available to carry out these activities. Leachate, which had been leaking out of the Ordot Dump and polluting the Lonfit River, is now being captured and diverted to a wastewater treatment facility for proper treatment. From January 30, 2015, to March 10, 2016, 8 million gallons of leachate has been directed away from the Lonfit River to the waste water treatment plant. The environmental closure of the Ordot Dump also captures harmful methane gas, a greenhouse gas that contributes to climate change. From September 14, 2015, through March 9, 2016, 12,539 metric tons of methane has been captured and properly disposed, rather than escaping into the atmosphere. This is the equivalent of the carbon produced by 2,640 passenger vehicles per year.

On March 28, 2016, the District Court of Guam held a special Hearing that officially concluded the Environmental Closure of the Ordot Dump.

On April 29, 2019, the Court issued an Order partially ending the Receivership. Under the receivership, the Ordot Dump has been closed, and the Receiver installed the necessary systems to protect Guam's waters from this environmental hazard that had

[13] https://www.guamsolidwastereceiver.org/updates-done.shtml

plagued the island for decades. The Receiver built a modern solid waste system for the island which includes a compliant solid waste landfill, a recycling program and a household hazardous waste disposal center. (The Court authorized the Receiver to continue its work to complete the post-closure plan for the Ordot Dump.)

3.2 Navy's Guam Environmental Restoration Program Sites

The Environmental Restoration Program is organized into three programs based on the site type and location.

- Installation Restoration Program (IRP): The IRP addresses chemical at sites located on active Navy installations and property;
- Munitions Response Program (MRP): The MRP addresses cleanup at sites with munitions on active Navy installations and property;
- Base Realignment and Closure (BRAC) Program: The BRAC Program addresses chemicals on sites located on closed or transferring Navy installations and property.

Fact Sheet 5 dated February 2014 follows in the next few pages. It describes the status of each of the Navy's ERP sites on Guam.

D. Summary of Ground Water Quality

The overall ground water quality of the NGL is good, however, it is significantly vulnerable to contaminants, including chloride contamination induced from over pumping of water supply wells.

Recent studies of **Per/PolyFluoro-Alkyl Substances** (chemical compounds which contain fluorine to make them water, fire and/or stain resistant) have brought to light potentially adverse health effects of some chemicals in this group for a lifetime of exposure to humans. GWA has completed screening drinking water sources for these chemicals; and the levels at points of entry into the distribution system are reported in its 2023 Consumer Confidence Water Quality Report. While GWA has treatment systems in place at several production facilities , work is underway to design and construct additional treatment systems to address these contaminants in line with EPA's compliance schedule.

Dieldrin is a pesticide previously used for crops from the 1950's until 1970 and used in homes to control termites until 1989. Guam EPA is developing action levels that will require GWA to notify its customers when a specified level is exceeded. Work is ongoing to provide additional treatment at production sources where this compound may be of concern.

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. Information on lead in drinking water, testing methods and steps to minimize exposure is available from the Safe Drinking Water Hotline (1-800-426-4791) or <www.epa.gov/safewater/lead>.

These threats increase the NGL's contamination potential.

The preservation of the Northern Guam Lens Aquifer is a priority because of its designation as Guam's Sole Source Aquifer and because of the magnitude of incidences observed in which the levels of pollutants (Bacteria, Nutrients, Chlorides, and Toxic Contaminants) exceeded Guam Water Quality Standards. The Agency will facilitate assessment, planning, or pollution control activities necessary to improve water quality such that it complies with local standards.

E. Summary of Groundwater-Surface Water Interactions

Guam EPA has a growing awareness of ground water-surface water interactions and their contribution to water quality problems.

Another aspect of groundwater is spring discharge along the coast in the inter- and sub-tidal zones. These springs comprise the discharge of the NGL aquifer. A study completed in the early 2000's characterized the chemistry of discharge from selected springs into Tumon Bay. The study consisted of sampling eight Tumon Bay springs during four discrete sampling events. Total discharge estimated for the seven springs is 17 million gallons per day.

The two-year study consisted of four sample rounds (of eight springs along the Bay) during both the wet and dry seasons.

In 2020, Guam EPA received EPA technical assistance to support development of a TMDL for impaired parameters identified for Tumon Bay waters. This work included water, tissue and sediment sampling, review and analysis of data, development of maps using available GIS data, TMDL calculations, development of draft and final TMDL reports, and implementation recommendations. The concluding study identified two chemicals of concern for the TMDL: Dieldrin and Total Chlordane. A draft TMDL is under review and approval action by USEPA.

Navy's Guam Environmental Restoration Program

Site Status Update

Fact Sheet 5 — February 2014

INTRODUCTION

The purpose of the Navy's Environmental Restoration Program is to reduce risk to humans and the environment from historical activities at Navy properties. The Environmental Restoration Program is organized into three programs based on the site type and location as seen in the box to the right. This fact sheet provides a status for each of the Navy's Environmental Restoration Program sites in Guam. Additional information on the investigation and cleanup process followed at each site is included as

Navy Environmental Restoration Programs

Installation Restoration Program (IRP): The IRP addresses chemicals at sites located on active Navy installations and property.

Munitions Response Program (MRP): The MRP addresses cleanup at sites with munitions and explosives of concern and chemical contamination hazards from the past use of military munitions on active Navy installations and property.

Base Realignment and Closure (BRAC) Program: The BRAC Program addresses chemicals on sites located on closed or transferring Navy installations and property.

IRP SITES ON GUAM

The Navy began work on the Guam IRP in the 1980s. Currently, there are 19 active IRP sites on Guam; 5 are being investigated, 1 is in the cleanup phase, 11 are in long-term management, and 2 are planned for future actions.

IRP Investigation Sites:
2 Barrigada Bldg. 50 Landfill
3 Bldg. 27 Boiler Facility
4 Apra Harbor Parcel 7
5 Piti Power Plant UST 51
16 Apra Harbor Operable Units

IRP Cleanup Sites:
7 Old NSD Drum Storage Lot

IRP Long-Term Management Sites*:
1 Tear Gas Burial Site
6 Bldg. 3009
8 Lower Sasa Fuel Burning Pond
9 NEX Garage Septic Tank
10 Dry Cleaning Shop
11 Area Behind the SRF Fenceline
12 Orote Landfill
13 CB Landfill

IRP Planned Sites:
14 Camp Covington USTs 16, 19 and 20
15 NCTMS Barrigada UST 19

* 3 Electrical Utility Sites not shown

Fact Sheet 5

IRP Investigation Sites

2. Barrigada Bldg. 50 Landfill: Final Work Plan completed in August 2013. Field work scheduled for March 2014 to occur during dry season. Subsurface anomalies being investigated.

3. Building 27 Boiler Facility: The Remedial Investigation published in 2013 concluded no further action is required for this site. A Decision Document specifying this recommendation will be prepared in 2014.

4. Apra Harbor Parcel 7: The Phase II Remedial Investigation Report will be published in 2014. No further action is recommended for this site.

5. Piti Power Plant UST 51: Draft Work Plan scheduled for February 2014 for fuel contamination investigation.

16. Apra Harbor Operable Units: Sediment/biota study in inner and outer Apra Harbor. Draft Work Plan currently in review by regulatory agencies. Field work scheduled for Summer 2014, report to follow.

IRP Cleanup Sites

7. Old NSD Drum Storage Lot: Work Plan for waste removal and site investigation will be finalized in early 2014. Field work to follow.

IRP Long-Term Management Sites

1. Tear Gas Burial Site: No traces of tear gas were found but low levels of hydrocarbons were found in the soil. A Decision Document detailing Land Use Controls (LUCs) to limit future exposure to the soil was signed in 2012. Annual inspections are ongoing, five-year review results due in 2014.

6. Building 3009: Groundwater studies completed in 2012 found no impact to groundwater quality. The site entered Long-Term Management in 2013. Annual inspections are ongoing.

8. Lower Sasa Fuel Burning Pond: Fuel contaminated soil cleanup complete in 2007. Annual inspections are ongoing, and five-year review results will be published in 2014.

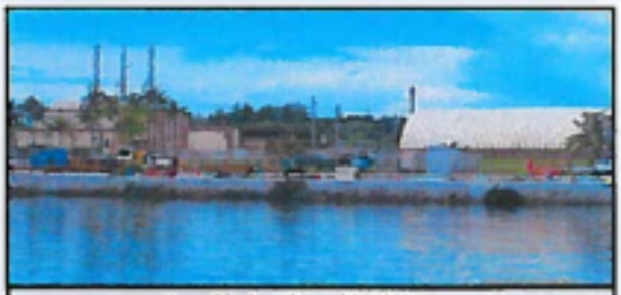
9. NEX Garage Septic Tank: The septic tank was cleaned and removed/sealed. Annual inspections are ongoing, and five-year review results will be published in 2014.

10. Dry Cleaning Shop: Six underground storage tanks (USTs) and 2 concrete sumps were removed in April 1994. Annual inspections are ongoing, and five-year review results will be published in 2014.

11. Area Behind the SRF Fenceline: A vegetated soil cover was built on exposed sandblast grit/soil in 2007. Also, wetland shoreline restored. Annual inspections and cover maintenance are ongoing, and five-year review results will be published in 2014.

12. Orote Landfill: A seawall and vegetated soil cap were built in 2000, and fish sampling was completed in 2010. Annual inspections and cap and seawall maintenance are ongoing. The upgradient groundwater study was completed in 2013. Five-year review results are due in 2014.

13. CB Landfill: A soil/synthetic cover system was built in 1998. Annual inspections and cover maintenance are ongoing, and five-year review results will be published in 2014.



Apra Harbor Operable Units

Electrical Utility Sites (*3 Sites not shown on map): Barrigada Substation, Harmon Substation, and Piti Substation—Completed thermal treatment of PCB contaminated soil and excavation and off-island disposal of metal contaminated soil in June 2010. Annual inspections are ongoing, and five-year review results will be published in 2014.

IRP Planned Sites:

14. Camp Covington USTs 16, 19, and 20: Draft work plan scheduled for 2016 for fuel contamination investigation.

15. NCTMS Barrigada UST 19: Draft work plan scheduled for 2016 for fuel contamination investigation.

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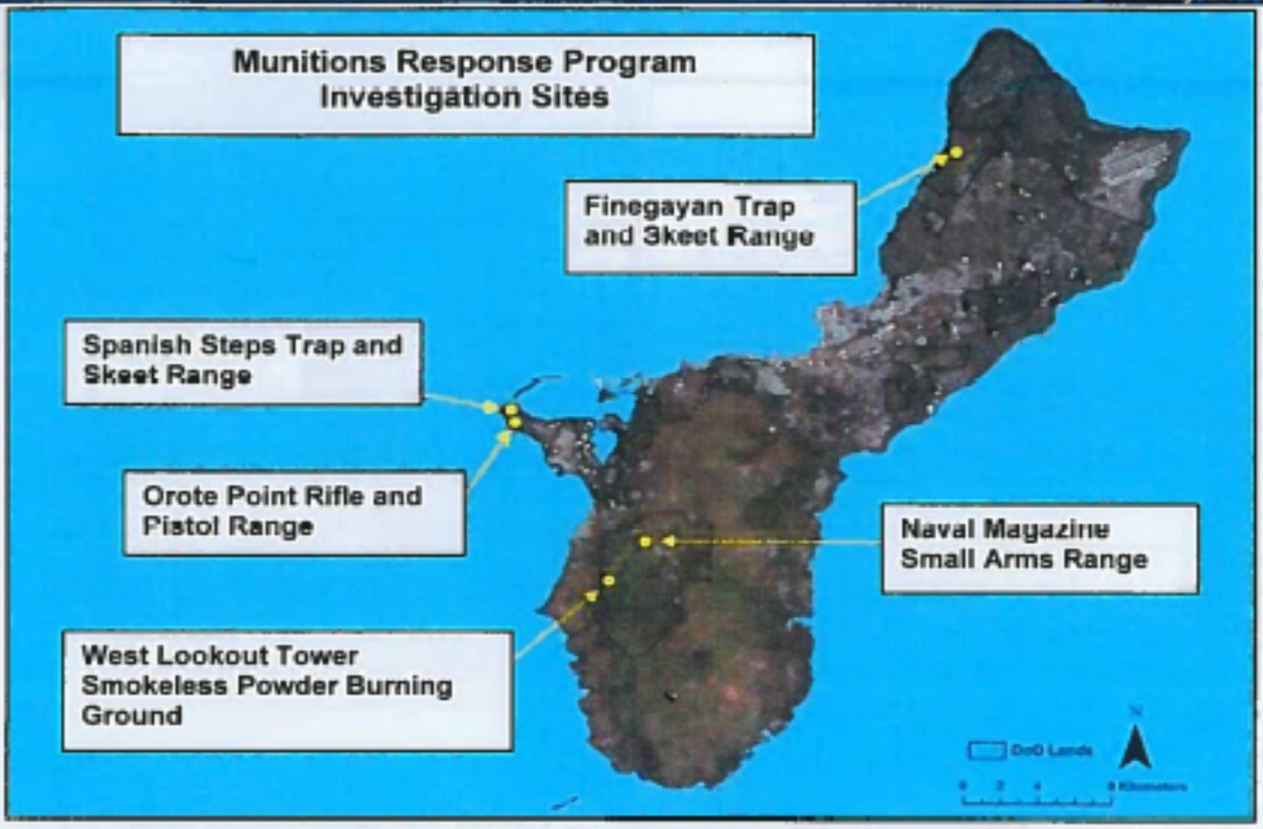
February 2014



MRP SITES ON GUAM

The Navy's MRP began in 2000. A Site Inspection was completed at each of the five MRP sites in 2010, and further study or investigation was recommended for all five sites.

Orote Point Rifle and Pistol Range: Remedial Investigation field work will be followed by a draft report in 2014 to address potential risk from levels of antimony, copper and lead in the soil.

Former Small Arms Firing Mound at Orote Point

Spanish Steps Trap and Skeet Range: Preparation of a Remedial Investigation Work Plan is scheduled for 2014 to address potential risk from levels of lead and polyaromatic hydrocarbons (PAHs) in the soil.

West Lookout Tower Smokeless Powder Burning Ground: Preparation of a Remedial Investigation Work Plan is scheduled for 2016 to address potential risk from levels of various metals in the soil.

Naval Magazine Small Arms Range: A Supplemental Risk Assessment is scheduled for 2014 to address the potential risk to human health from levels of copper and lead in the soil.

Finegayan Trap and Skeet Range (NCTMS): Remedial Investigation field work will be followed by a draft report in 2014 to address potential risk from levels of lead and polyaromatic hydrocarbons (PAHs) in the soil.

3

Fact Sheet 5 February 2014

BRAC SITES ON GUAM: All BRAC sites on Guam are in long-term management.

Site Name	Status Summary
Various former NAS Agana Land Use Control (LUC) Sites	LUCs have been implemented at 11 sites to ensure they remain restricted to industrial/ commercial reuse. Five-year review completed in June 2013.
Agana (Tiyan) Landfill (located at former NAS Agana)	A landfill cap was built over consolidated landfill waste in 2004. Annual inspections and cap maintenance ongoing; five-year review completed in June 2013.
Agana Power Plant	PCB cleanup at the site and drainage outfall areas completed 2005. Annual inspections ongoing; five-year review completed in 2013. Leased to Guam Power Authority.
Tamuning Telephone Exchange	Lead contaminated soil cleaned up in July 2001. Five-year review completed in June 2013.
Route 2A (Old WESTPAC Site)	PCB contaminated soil cleaned up in 2004. Five-year review completed in June 2013.

PUBLIC PARTICIPATION

The Navy encourages local community members to become involved in the environmental cleanup program on Guam. The easiest way is through participation on the Navy Guam Restoration Advisory Board (RAB). This is a group made up primarily of local community members who meet regularly to discuss environmental cleanup program plans and progress with representatives with the Navy, Guam EPA, and the U.S. EPA Region 9. Community members can participate in the RAB either by becoming an official RAB member or simply attend meetings as a member of the public.

FOR MORE INFORMATION

Copies of all official environmental program documents are available for review at the information repositories located at the Nieves M. Flores library in Hagatna or the University of Guam Robert F. Kennedy Memorial library.

If you are interested in RAB participation or want more information on the Navy Guam Environmental Restoration Program, please contact:

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