



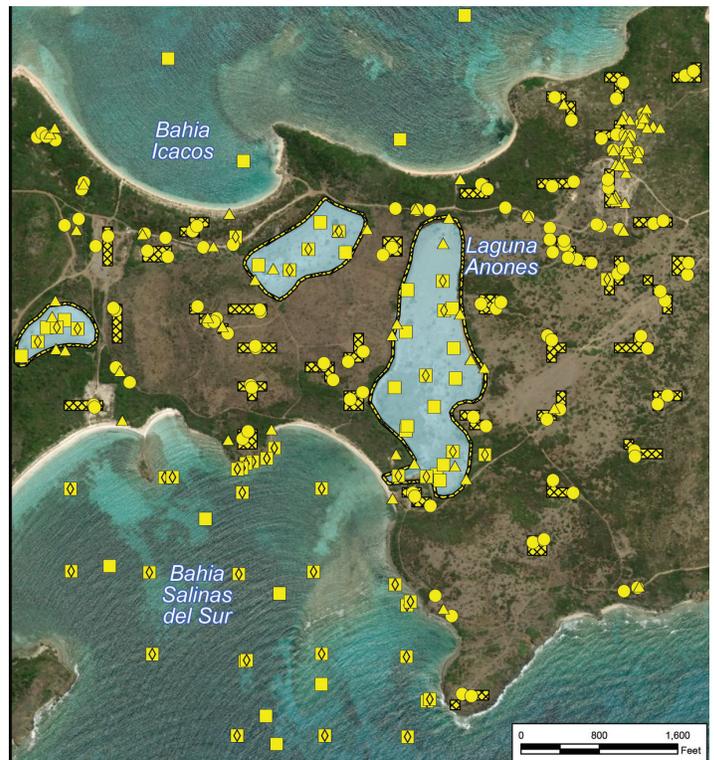
Munitions Constituents on Vieques

What are munitions constituents?

Munitions constituents are chemical contaminants associated with discarded or unexploded military munitions. The main categories of munitions constituents are explosive compounds, organic chemicals, and metals.

What samples have been collected on Vieques?

- The Navy has sampled Vieques soil, sediment, groundwater, and surface water for the presence of munitions constituents. During the past 20 years, over 1,500 samples have been collected. Sampling has been performed across the 18 munitions sites on land, but sampling is still ongoing in the underwater munitions areas.
- Samples were collected throughout the former Navy training areas, including target locations, gun positions, drainage ditches, lagoons, and other areas where munitions constituents are most likely to be found. In order to identify the highest concentrations, many samples were collected underneath or next to unexploded munitions.
- All Navy sampling followed the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund.
- All Navy sampling was performed in collaboration with the US Environmental Protection Agency, the Puerto Rico Environmental Quality Board, the Puerto Rico Department of Natural and Environmental Resources, and the US Fish and Wildlife Service.



Soil, sediment, surface water, and groundwater sample locations shown in yellow

How were munitions constituents evaluated?

- Samples of soil, sediment, groundwater, and surface water were analyzed for the following munitions constituents:
 - 19 explosive compounds, including TNT, HMX, RDX, nitroglycerin, PETN, tetryl, and perchlorate
 - 235 organic chemicals, including naphthalene, acetone, benzene, toluene, and solvents
 - 27 metals, including lead, mercury, cadmium, iron, zinc, aluminum, and copper
- Each sample was analyzed for many munitions constituents, thus producing over 25,000 sample results for explosive compounds, over 30,000 results for organic chemicals, and over 25,000 results for metals.
- All detected concentrations were compared to human health and ecological risk standards. Since metals are found everywhere in nature, the metals results were also compared to the concentrations of metals that occur naturally on Vieques. If the comparison to risk standards suggested potential risk, then a full CERCLA risk assessment was performed to determine whether or not cleanup would be needed.



What do the sample results show?

- Explosive compounds and organic chemicals were detected in approximately 2% of the sample results. Since metals are part of the natural environment, metals were detected in most of the sample results.
- CERCLA risk assessments have been performed for 9 munitions sites on land and one underwater area on the western end of Vieques.
 - At 8 land sites and the underwater area, the risk assessments have not identified any chemicals of concern, indicating cleanup will not be needed for munitions constituents at these sites.
 - At SWMU 4 on the western end of Vieques, perchlorate was identified as a chemical of concern in groundwater, so cleanup is required for perchlorate in groundwater. No chemicals of concern were identified in soil, sediment, or surface water at SWMU 4, so no cleanup of munitions constituents is needed for these media.
- Risk assessments are still in process for 9 munitions sites on land. For the underwater areas on the eastern end of Vieques, risk assessments are pending sample collection.

What happened to the munitions constituents?

- When munitions detonate, the explosive compounds are consumed, releasing non-toxic gases (nitrogen, carbon dioxide, hydrogen, and water vapor), plus small amounts of carbon monoxide, nitrogen oxides, organic chemicals, and metal compounds (EPA, 1998 and SEESAC, 2004). The extreme heat of a detonation immediately destroys many of the organic chemicals. Over time, sunlight and microbes also break down explosive compounds and organic chemicals.
- Even though thousands of munitions were fired at Vieques, the overall amount of metal from munitions is extremely small compared to the large amount of metal that exists naturally in the environment. Therefore, the munitions do not cause a significant increase in the natural concentration of metals on Vieques.

References

1. *Site Characterization for Munitions Constituents*, US Environmental Protection Agency, EPA-505-S-11-001, 2012.
2. *Emission Factors for the Disposal of Energetic Materials by Open Burning and Open Detonation (OB/OD)*, US Environmental Protection Agency, EPA/600/R-98/103, 1998.
3. *SALW Ammunition Destruction – Environmental Releases from Open Burning (OB) and Open Detonation (OD) Events*, South Eastern Europe Clearinghouse for the Control of Small Arms and Light Weapons (SEESAC), 2004.

Summary and Conclusions

- Explosive compounds and organic chemicals associated with munitions are rarely detected on Vieques, and the few detections typically occur at very low concentrations. Metals are commonly detected at naturally occurring concentrations.
- CERCLA risk assessments have been performed for approximately half of the munitions sites on Vieques. The risk assessments show that cleanup is not needed for munitions constituents in soil, sediment, or surface water. In groundwater, cleanup of perchlorate is required at one munitions site (SWMU 4 in west Vieques).
- The major concern at munitions sites on Vieques is the explosive hazard, rather than chemical risk from munitions constituents.
- The findings for munitions constituents on Vieques are similar to other military training ranges across the United States (EPA, 2012).

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