Phase II Environmental Site Assessment

The Halmos College of Natural Sciences and Oceanography
I.e. Oceanographic Campus
8000 N Ocean Dr.
Dania Beach, FL 33004

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Project Report I
ENVS 3000

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8000 North Ocean Drive, Dania Beach, Florida

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Executive Summary

The completion of a Phase I Environmental Site Assessment was requested for the property located at 8000 N Ocean Drive in Dania Beach, FL. The total area of the subject property sits on 10 acres of land and currently has approximately 6 acres of commercial building situated on it. Information from historical land records, historic air photos, analysis of neighboring properties, and hydrogeological conditions were complemented with groundwater analysis, surface water analysis and reviews of regulatory agency records.

<u>On-site:</u>

1. Florida consists primarily of limestone that rests upon a much older basement of igneous, metamorphic, and some sedimentary rock like sandstone and shale. This porous material will continue to create issues like saltwater pushing through into the drinking water supply as well as the flooding of rivers and canals from heavy rains.
2. The site consists of one parcel of land resting on approximately 10 acres in size. The main structures of the facility include the Center of Excellence for Coral Reef Ecosystem Research and the Coral Reef Tank Research Area. The remaining area of the facility includes faculty offices, classrooms, and research laboratories.
3. According to the USGS topographic map, the site perimeter remains at a minimum of 0.61 meters below sea level and a maximum of 5 meters above sea level. The topography appears to be sloping from the southeast, which would demonstrate the direction of drainage creating runoff issues within the structure.
4. The subject site is located above the Biscayne aquifer, which is at risk of saltwater intrusion according to recent developments. Potential sources of contaminants that are currently present include arsenic, manganese, radon, and uranium.

Off-site:

1. Maps provided by the U.S. Fish and Wildlife Service, as well as visual inspection, determined that the site includes wetland category Estuarine and Marine Deepwater. Based on Figure 4, marine wetlands are within proximity to assist with water purification and locations for nurseries. This is determined by the distinct coloration assigned to the nurseries on the map.
2. Twenty RCRA facilities were found within a two km radius of the Oceanographic Campus according to Figure 1. These facilities are managed to protect and properly dispose of hazardous.
3. According to 'EnviroMapper' created by the EPA, there are three Solid Waste Landfill Facilities within 8047m to the west of the property.

1: INTRODUCTION

1.1 Summary of the Scenario

The purpose of the *environmental site assessment* was to:

- evaluate the impact to the surface water, groundwater, and/or soils within the property boundaries as well as the local vicinity
- evaluate historical land usage to identify previous conditions that could impact the environmental condition of the site as well as in the future
- evaluate the potential on-site and off-site contamination; and,
- provide a professional opinion regarding the potential environmental impact at the site and list the recognized environmental impacts or conditions

Under the rules of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), Property owners are responsible for remediating contaminated property, whether or not they caused the problem. The reason for conducting this ESA is to conduct all inquiries based on the uses and prior ownerships of the site due to pending real estate agreement.

1.2 Regional Physiography

South Florida's coastal waters lie between the Charlotte Harbor on the Gulf of Mexico and the St. Lucie River on the Atlantic Ocean. The ecosystems within this vicinity include coastal waters like estuaries, lagoons, bays, and coral reefs. The highest altitude in this region is on Lake Wales Ridge where the sand hills are from 21 to 91 meters above sea level. The Atlantic Coastal Ridge lies on the eastern coast and is a low ridge of sand over limestone that has an altitude from 7 to 15 meters above sea level (Kambly, Moreland, 2009).

In addition to climate change in general, Florida has also shown evidence of temperatures rising in response to change of global gas concentrations, ultraviolet rays increasingly penetrating the atmosphere, water pollution, increased invasive species, and less biodiversity (Whitney, Means, Rudloe, 2014).

Lastly, Florida represents a peninsula bordering the Gulf of Mexico to the west, the Atlantic Ocean to the East and the Caribbean Sea to the south and southwest. Therefore, there are many different variables to consider when investigating the impacts of surface water, groundwater, as well as land formation, geology and other features.

1.3 Regional Geology

Florida rests on top of the Florida Platform,a plateau that lies underwater beneath the present-day surface. The Florida Platform has a topographic relief of about 3,048 meters due to the sea level fluctuations that produce emergence and submergence of the land. The changing of land shape is evident in the change of rock and soil distribution shown in Figure 8 and Figure 9. Approximately 200 million years ago, Florida's igneous basement was flooded which then began the formation of carbonates. In present day, Florida consists primarily of limestone that rests upon a much older basement of igneous, metamorphic, and some sedimentary rock like sandstone and shale (Hine, 2013). It would be likely to encounter Miami Limestone and Key Largo limestone throughout South Florida at or near the surface. This is evident in Figure 9 illustrating the surrounding limestone among the area at hand.

2: SITE DESCRIPTION

2.1 Current Site Operations

The assessed area referred to as the "site" is located at 8000 N Ocean Drive, Dania Beach FL 33004. The site consists of one parcel of land approximately 10 acres in size. The southwestern portion is developed with the main structure, the Center of Excellence for Coral Reef Ecosystem Research, as well as the Coral Reef Tank Research Area. These two structures take up approximately 6 acres as shown in Figure 2. This portion of the land was completed in 2012. The remaining area includes faculty offices, classrooms, and research laboratories. All of which were completed prior to 2000. Associated parking lots and landscaped areas are located throughout the subject property.

2.2 Land Value

According to the Broward County Property Appraiser, the subject of land at 8000 N Ocean Drive, Dania Beach FL 33004 remains currently under the owner Nova Southeastern University Inc. Facilities Management. This 10-acre parcel of real estate has a land value of $27,930,530, a building value of $15,029,640, and a total value of $42,960,170 (BCPA Web Map, 2015).

2.3 Surface Waters and Wetlands

The site resides between the intracoastal, once referred to as Lake Mabel to the west, as well as the ocean to the east. As determined by the USGS topographic map, the site perimeter remains at a minimum of -0.6 meters below sea level and a maximum of 5 meters above sea level (USGS Topographic Map, 2018). The topography appears to be sloping from the southeast, which would demonstrate the direction of drainage creating runoff issues within the structure. The elevation profile for the site can be viewed from Figure 3.

Wetlands are extremely important for the purification of the surrounding waters. Wetland plants for example, extract pollutant materials from water and deposit them into their own tissues (Whitney, 2014). The parcel of real estate has also been assessed for the presence of wetlands within the 2 km buffer surrounding the site. This is shown in Figure 4 located in the appendix. Wetlands were found adjacent to the property except where the property boundary includes the submerged area of Lake Mabel to the southwest.

2.4 Soils

The soil in the Broward County consists of level, poorly drained soils that are covered by water most of the year. The upper level of the soil is black or dark reddish sapric material or muck. Below the muck, there is brown fine sand and light gray sandy marl that consists of 50%

limestone fragments. Limestone is found at the deepest depth of 0.45 meters. The organic material is twice as thick as the mineral material and is slightly acidic (Pendleton, 1970). The present-day soil distribution can be visually identified throughout Figure 9 located in the appendix below. According to SoilWeb, 85% of the parcel of land is urban land classified as marine terraces flatwoods, 3% consists Matlacha and 3% St. Augustine. Matlacha consists of 0-35 inches of gravelly very fine sand with shell and limestone fragments less than 3 inches. While St. Augustine sediment consists of 0-4 inches of fine sand, weak medium granular structure and 3 cm diameter fragments of shells (“SoilWeb, 2019”).

2.5 Geology

The 1970s marked the beginning of the major housing development throughout Florida. This widespread development also increased the numbers of landfill quarries and canal digs directly affecting the surrounding geology and soil distribution at the surface and below (Petuch, 2017). However, this excavation helped geologic researches understand the composition below the surface. It was found that there was a high endemic fossil mollusks in multiple areas of excavation from the Army Corp of Engineers (Petuch, 2017).

Alternatively, the sediment currently is made up of Holocene sediments near the coastline. This sediment consists of quartz, carbonate sands and muds, and organics. While most of Florida’s coastline is dominated by quartz-rich sand due to the massive deposition of siliciclastic sediment like quartz sand and phosphate which occurred about 20 million years ago (Hine, 2013).

According to Figure 10, the ground below the surface consists of Miami Limestone below a thin layer of sand sediment. This was determined through the analysis of soil sediment samples taken from the parcel of land.

2.6 Groundwater

In most aquifers, there are geologic and manmade sources of contaminants present like arsenic, manganese, radon, and uranium. Groundwater then moves through the aquifer while the geochemical conditions within aquifers affect concentrations of contaminants. The water sources affected directly include surrounding groundwater, surface water, and the saturation of soil (DeSimone, McMahon, & Rosen, 2015). Agriculture increases the occurrence of nitrate to concentrations greater than the background concentration indicated that the Floridan aquifer (Berndt, 2014). This allows other surrounding aquifers to become vulnerable to contamination due to human activity at the land surface.

The Biscayne Aquifer underlying Miami-Dade county and southern Broward County is the principle source of drinking water. The Biscayne Aquifer is prone to saltwater intrusion due to its low land-surface altitude and a low topographic gradient since it borders various sources of saltwater. This saltwater intrusion began when the Everglades were drained to provide dry land for urban development and agriculture (Lodge, 2010). The reduction in water levels from this drainage combined with droughts allowed the saltwater to flow inland seeping directly into the aquifer from canals (Prinos, 2014). Additionally, the Floridan Aquifer is approximately 305 m below the surface. The Floridan Aquifer is one of the highest producing aquifers in the world and is comprised of limestone and dolomite. This is the source of a vast majority of the public water systems in Florida after the treatment of the water (FL DEP, 2012).

3: REVIEW OF REGULATORY AGENCIES RECORDS AND DOCUMENTS

3.1 Superfund: NPL and CERCLA Sites

Chemform, INC. Pompano Beach, FL

The EPA, the Florida Department of Environmental Protection (FDEP), and other parties are currently working together to investigate the source of remaining groundwater contamination. The site contamination does not currently threaten people living and working at or near the site. This site is 14.5 km northwest of the ocean campus.

Flash Cleaners. Pompano Beach, FL

EPA placed this former dry cleaning facility on the NPL in 2008 because of contaminated soil and groundwater resulting from dry cleaning activities. The EPA and FDEP have investigated site conditions and taken steps to clean up the site in order to protect people and the environment from contamination. Site contamination does not threaten people living and working near the site. This site is 21.2 km north of the ocean campus.

Wingate Road Municipal Incinerator Dump. Fort Lauderdale, FL

EPA placed this former waste incineration facility on the NPL in 1989 due to contaminated oil, sediment and surface water resulting from waste disposal practices. The EPA, FEDP, the City of Fort Lauderdale, and other parties have investigated site conditions and taken steps to clean up

the site in order to protect people and the environment from contamination. This is the closest site in proximity to the parcel of land, located approximately 9.48 km northwest of the site.

3.2 RCRA Generators

Additionally, the US EPA Resource Conservation and Recovery Act facilities were mapped through ArcGIS online to demonstrate vicinity of these facilities to the parcel of land being sold. A 2-km buffer was set around the segment of land to show the number of Hazardous Waste Facilities within a 2 km radius. This is shown in Figure 1 below in the appendix. It was determined that twenty RCRA facilities are found within a 2 km radius of the Oceanographic Center. Although, these facilities are developed to protect and properly dispose of solid and hazardous waste. There are studies that show there is still potential for exposure to the surrounding environment. For example, air quality assessments can be performed to account for each toxic contaminant (Shen, 2003).

Two large quantity generator facilities have been identified among others within the 2 km radius of the site for sale. The RCRA generator with the closest vicinity to the site was determined to be MS Legend IMO #9224726 i.e. Carnival Legends located approximately 280 meters southwest of the campus based on Figure 1. The most recent Biennial Report indicates that the facility generates and ships 4 tons of waste a year. The types of waste processed and shipped include ignitable waste, mercury, silver, and nonhalogenated solvents including xylene, acetone, ethyl, acetate, methanol, among others (“EPA: RCRA Info”, 2017).

Approximately 1279 meters from the southwest corner of the property lies the Costa Magical IMO #9239795 RCRA facility. This facility, according to the Biennial Report, generates and ships

6.6 tons from the most recent update in 2007. The type of waste disposed of includes ignitable waste, silver, tetrachloroethylene along with other nonhalogenated solvents (“EPA: RCRA Info”, 2017).

Lastly, a conditionally exempt small quantity generator facility was determined 1385 meters to the southwest of the site under the name FPL - Port Everglades Plant. The most recent Biennial Report states that 4.6 tons are generated and shipped every year (“EPA: RCRA Info”, 2017). This plant in particular has a smaller range of waste being collected, merely ignitable waste and reactive waste, compared to larger facilities.

3.3 State Landfills and Solid Waste Facilities

Along with the assistance of the ‘EnviroMapper’ created by the Environmental Protection Agency, it was determined that there are three solid waste landfills within a 8,047 m radius of the subject property at hand. These landfills are all located to the west of the site and are identified as Snyder Park Transfer Station, WM Recycling Sun 3, and Envirocycle Inc (‘EPA - EnviroMapper”, n.d). The three locations within a 8,047 m proximity of the subject land can be viewed from Figure 5. The two facilities, WM RECYCLING SUN 3 and ENVIROCYCLE INC, are classified as Material Recovery Facilities (C & D). While the third facility, SNYDER PARK TRANSFER STATION, is classified as a transfer station focused on the disposal of household, construction and demolition waste.

4: SITE HISTORY

An ArcGIS map layer created by the Everglades Project of the Soil Conservation Service was investigated to determine the change in soil composition from 1948 until present day based on

Figure 6 and Figure 7. The layer was created by digitizing 1948 soil maps to understand water control for agricultural land. This can be used to understand the change in soil within the last 71 years. According the 1948 soil maps, the OC Campus site was classified as wet Rockland shown throughout Figure 8. A Rockland hammock is classified as a rich hardwood forest where limestone is very near the surface while oftentimes exposed (Snyder, 1990). Additionally, Rockland hammock communities often have well drained organic soil covering the underlying limestone. The map also shows the wet marl and calcareous soils to the east, south and southwest of the site. Figure 7 demonstrates the presence of more trees and vegetation in 1955 than in present day. While Figure 6 shows the minimal construction that took place prior to prior to 1955.

Closer to present day an additional map was analyzed through ArcGIS showing the Rock and Sediment Distribution as of 2018. The subject land falls within the region of medium fine sand and silt compared to the surrounding area that was determined to be shell beds to the south and limestone to the southwest. This determination can be viewed using Figure 9.

5. Phase II Activities

Two samples of soil were collected for analysis as a precaution on the OC campus. A sampling plan was created for the soil analysis, followed by analysis of the results which then allowed for the compilation of new recommendations. The determination will require remediation strategies to assist with this environmental contamination. After the substance was determined to be present within the soil, the chemical characteristics were investigated.

There are multiple treatments of adamantium in contaminated soils however the most logical for this particular situation involves the removal of contaminated soils and replacement with uncontaminated soils. However, this process will only be beneficial if the entire property is determined to remain at safe levels of adamantium or else the entire property will need to be decontaminated and re-soiled. Using the data table from the Soil Map survey found on ArcGIS, a table was created with each soil sample with their concentrations and elevations. The average concentration and standard deviation of the samples was then determined. Using this table, a line graph was created to show the trend of concentration with elevation. Using the information in Table 1 in addition to the EPA's data information, a bar graph was created to compare the concentration of adamantium in the soil and the natural levels of lead in soil.

6. Result of Analyses

Following the analysis of the two soil samples, it was determined that the soil was contaminated with adamantium. Given these results, it was determined that the OC soil is contaminated in at least two different locations. Natural levels of adamantium in the soil range between 50 to 400 ppm, however concentrations above this are most commonly from human activities including the use of fossil fuels ("EPA", 2018). There are many health effects of exposure to this substance to both humans and wildlife, therefore extreme caution should be take to prevent exposure all together.

Based on Figure 11, the risk of the environmental contaminant is relatively high along the eastern line of sampling. This was determined through the use of ArcGIS online heatmap tool. Five soil samples had unnatural concentration levels of adamantium which ranged from 800 ppm-1,000 ppm. The highest concentration among the sampling points was 1,200 ppm adamantium. This sample was found near the benches by the OC roundabout. The sample with the concentration of 1,000 ppm was on the hill by the solar panels. Thus, the location of the soil

sample does not affect concentration of adamantium. Figure 13 emphasizes the high contamination concentrations of adamantium compared to natural levels of lead in soil.

7. Discussion of Findings

According to the Environmental Protection Agency, adamantium is considered a hazard when equal to or exceeding 1200 ppm average for bare soil in a given vicinity. Therefore, the concentration of adamantium equals the maximum concentration to be considered a hazard. The soil sample that was by the roundabout at the OC had an elevation of 1.14 feet and the highest concentration of adamantium with 1,200 ppm. The soil sample on the hill by the solar panels had an elevation of 6.50 feet and a concentration of adamantium of 1,000 ppm. Figure 12 further emphasizes the lack correlation between the concentration of adamantium and elevation. Figure 13 visually demonstrates how the concentration of adamantium is double the naturally occuring adamantium value. To remediate the soil at the OC, the contaminated soils will have to be replaced by uncontaminated soils however the entire property is suggested to be re-soiled to prevent future unknown contamination from arising. These processes must be performed in order for the OC campus to contain safe concentration levels of adamantium.

8. SUMMARY OF RECOMMENDATIONS

Based on the information provided as part of this *environmental site assessment,* the following conclusions and recommendations of the surrounding site have been made:

1. Remediation of grounds to rid the facility of the environmental contaminant Adamantium.

2. Perform additional soil analysis of the surrounding vicinity local to the ocean, the intercoastal waterway and various other locations to determine the quality of the soil throughout the entire property.
3. Collect groundwater samples as well as around the vicinity where the Adamantium was found. A water quality analysis will be beneficial in determining whether the environmental contaminant is present in the water supply underground.

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10. APPENDIX

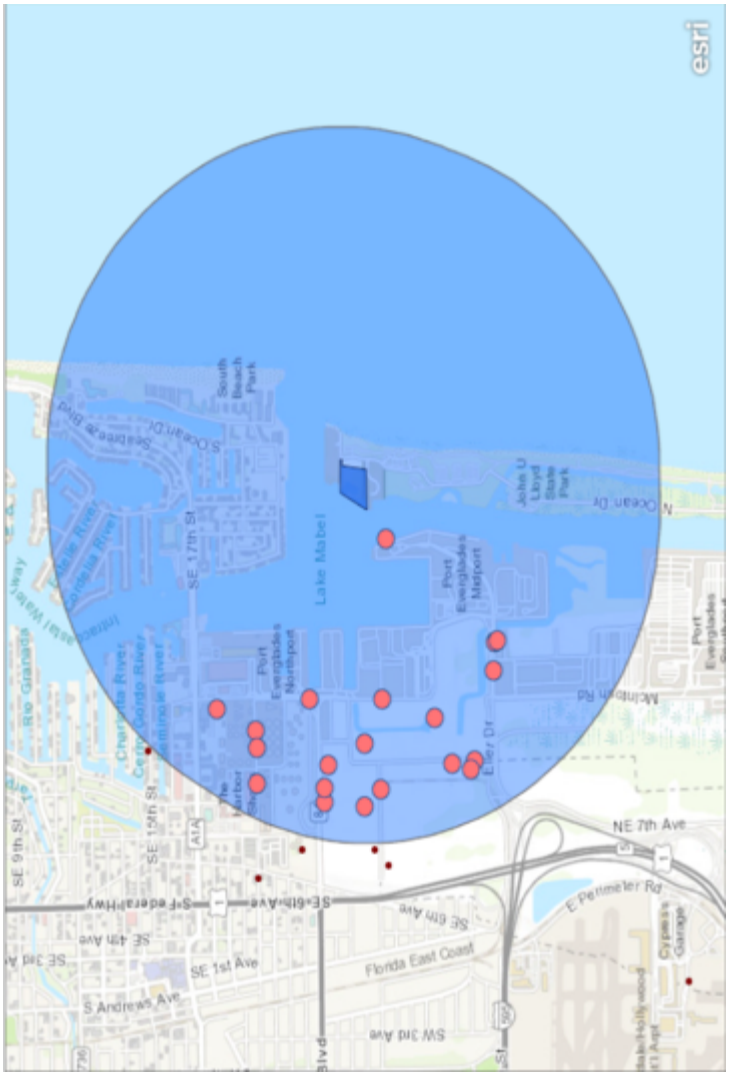

Figure 1. US EPA Resource Conservation and Recovery Act (RCRA) facilities within 2 km of the project area, i.e. Hazardous Waste Sites. Red Circular dot illustrates a 2km buffer around each RCRA site.

Figure 2. Phase I landscape elements at NSU Oceanographic Center. Each aspect of the facility is labeled on the map.

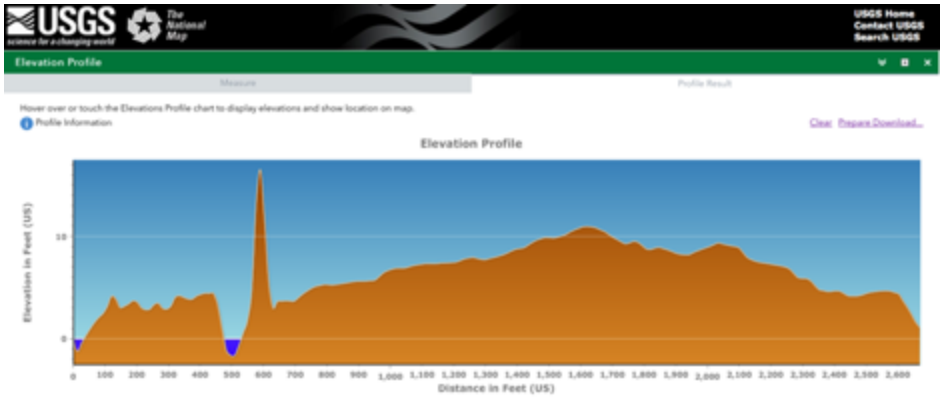

Figure 3. USGS Topographic Map of Elevation Profile of 8000 N Ocean Drive Hollywood, FL 33304.

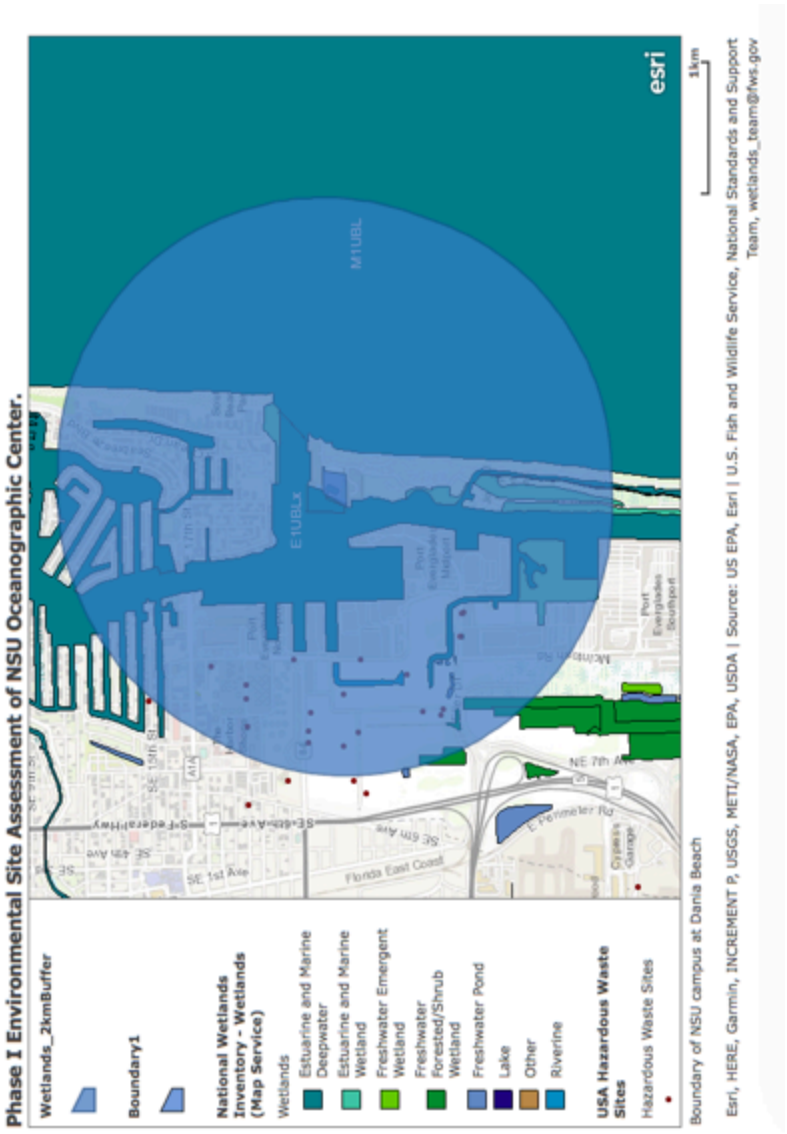

Figure 4. National Wetlands Inventory of the land surrounding the parcel of land at hand. Wetland categorization illustrated in the legend.

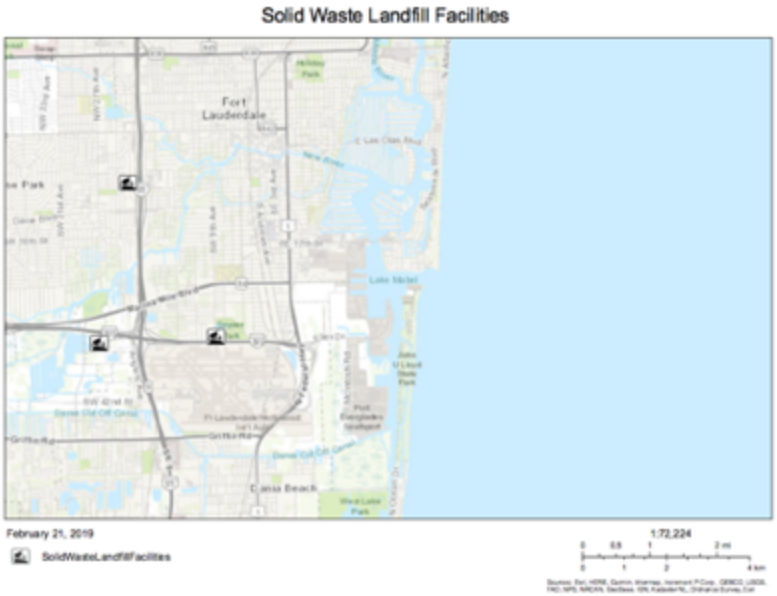

Figure 5. Solid Waste Landfill Facilities.

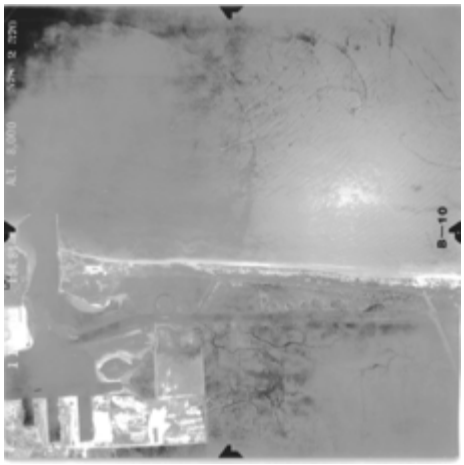

Figure 6. The Oceanographic Campus 1955.

Figure 7. The Oceanographic Campus 1995.

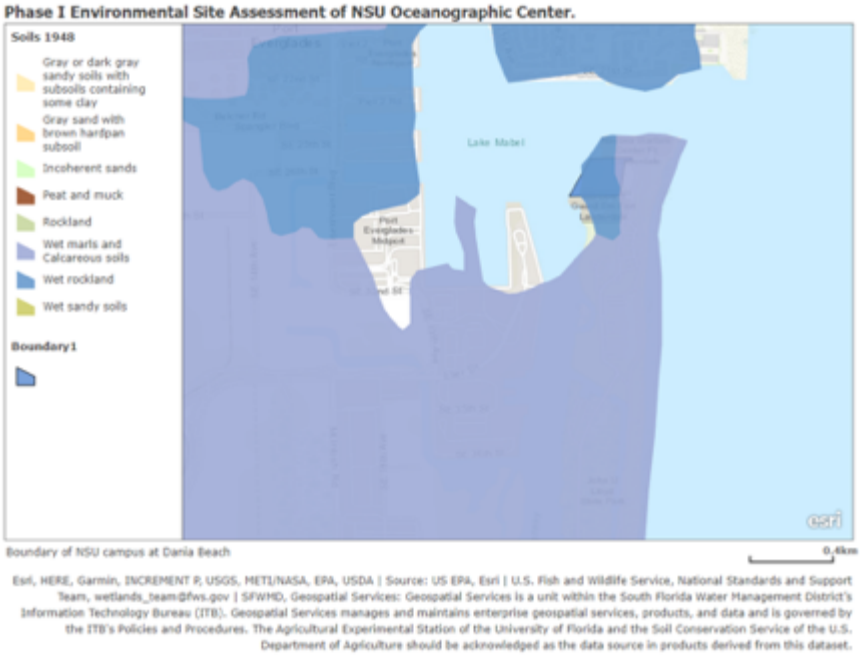

Figure 8. Soils of 1948.

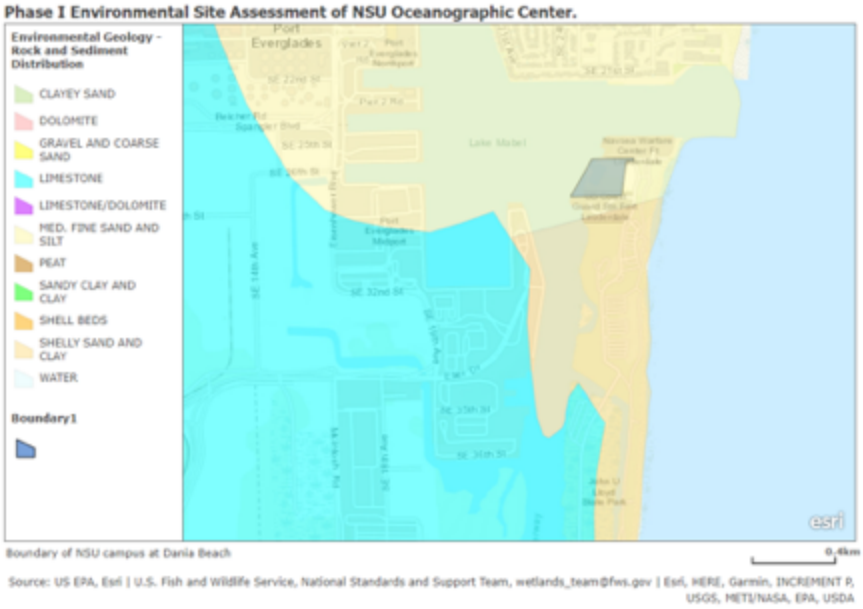

Figure 9. Rock and Sediment Distribution 2018.

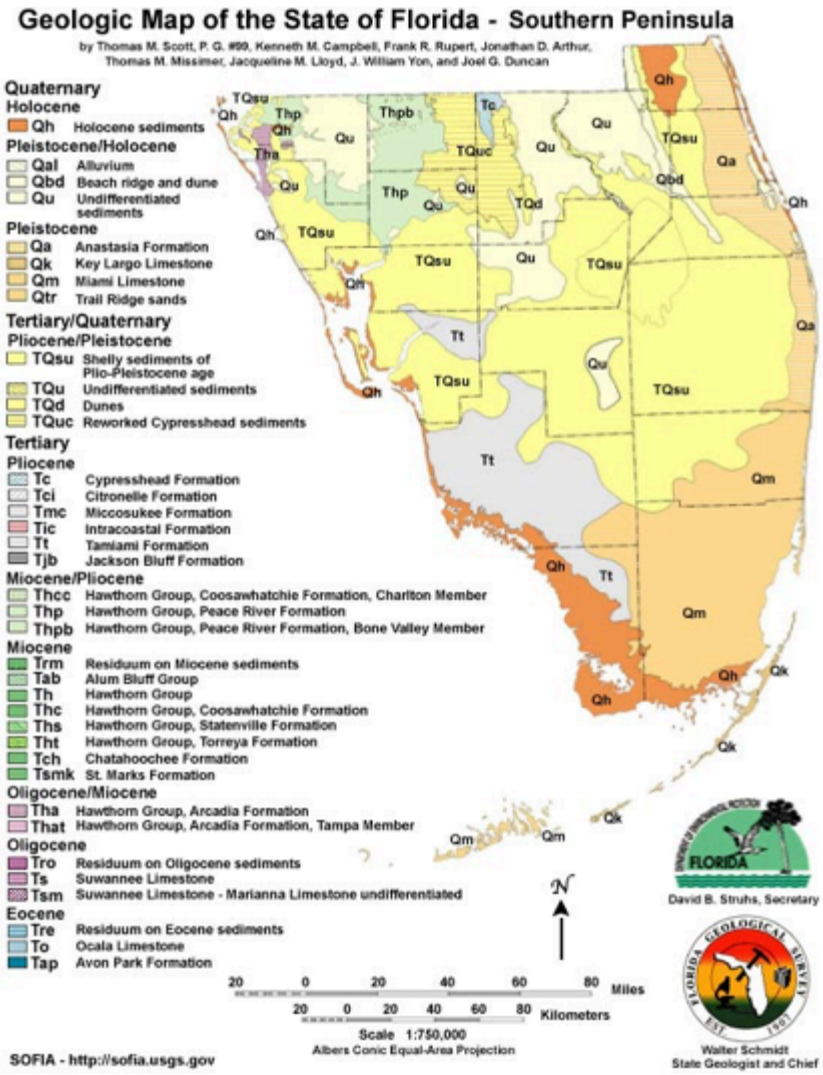

Figure 10. Geologic Map of the State of Florida - Southern Peninsula

Phase II Environmental Site Assessment of NSU Oceanographic Center.

Boundary of NSU campus at Dania Beach

10m

Source: US EPA, Esri | U.S. Fish and Wildlife Service, National Standards and Support Team, wetlands_team@fws.gov | State of Florida, State of Florida, DigitalGlobe, Microsoft

Figure 11. Soil Map Survey.

Table 1: Concentrations of Adamantium in Soils			
Name	Concentration (ppm)	Average	Standard Deviation
45	1,000.00	383.33	465.1761912
51	0		
52	0		
43	0		
44	0		
45	0		
46	800		
47	0		
29	0		
31	800		
32	1,200.00		
33	800		

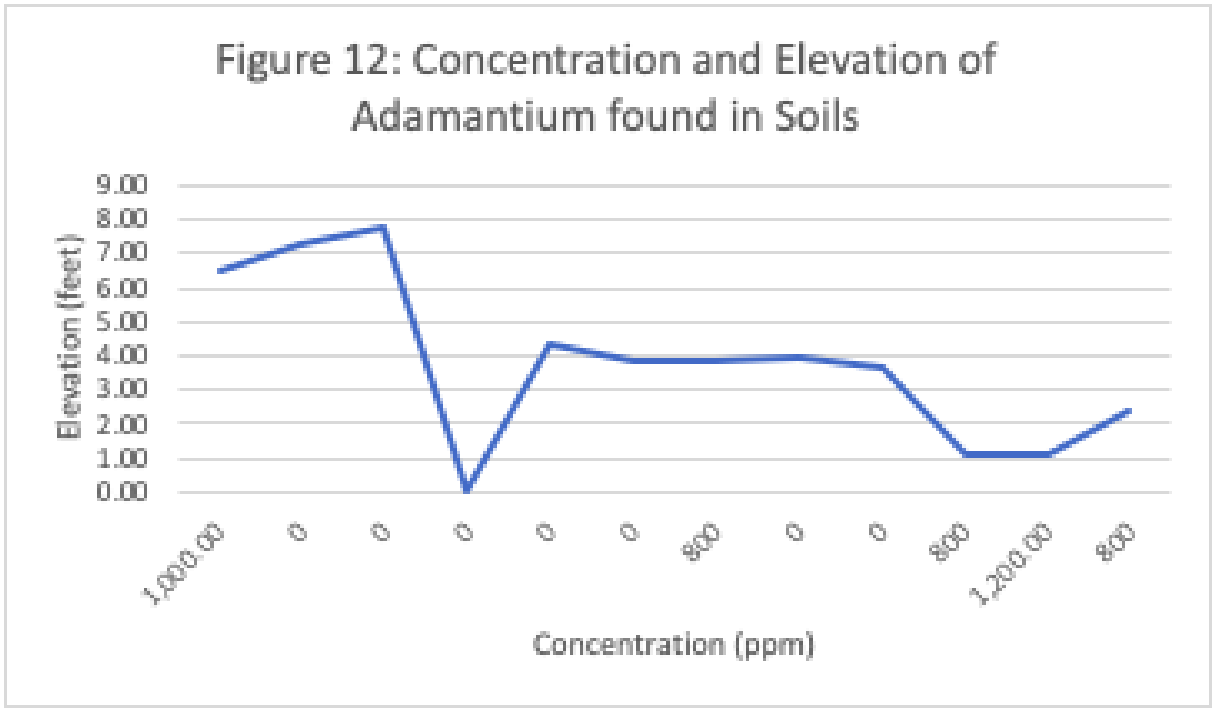

Figure 12. Concentration and Elevation of Adamantium in Soil Samples

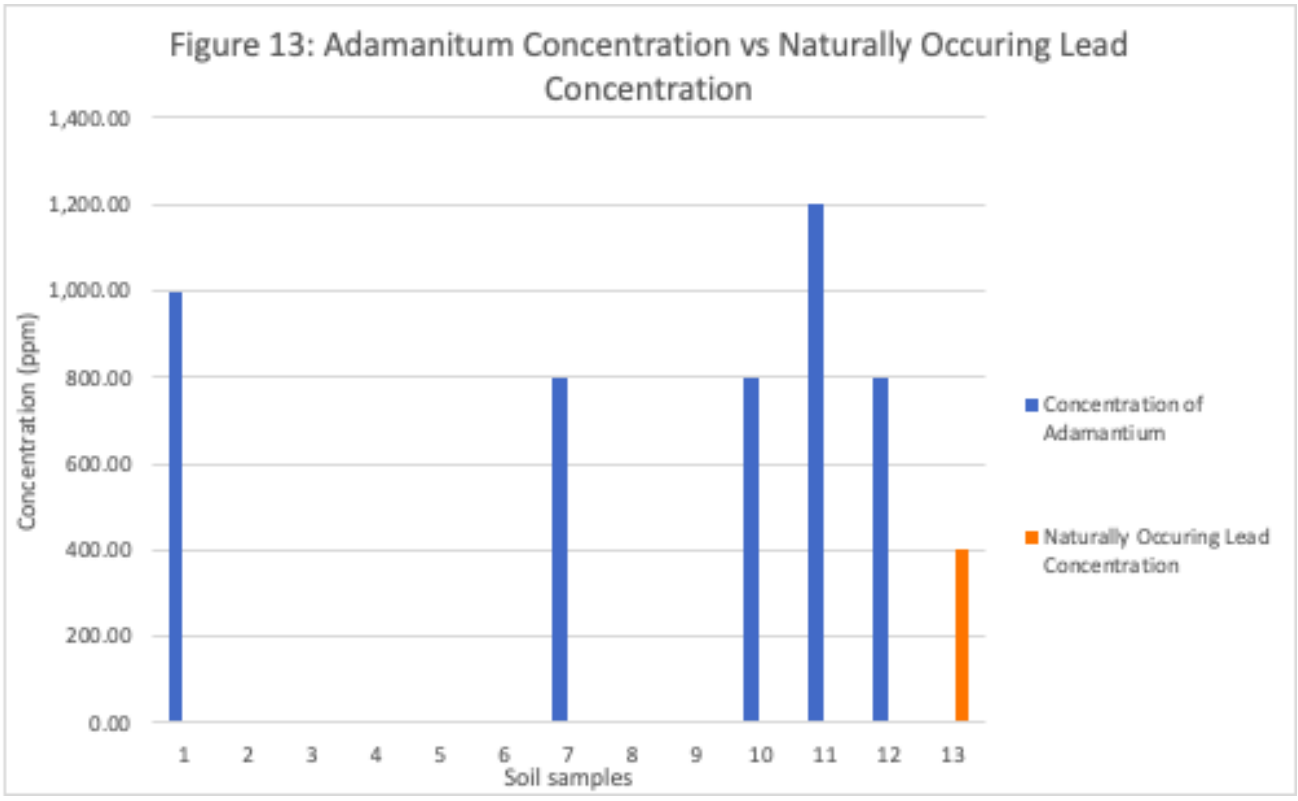

Figure 13. Comparison between Adamantium Concentration in Soil and Naturally Occuring Lead Concentration