OFFICE OF THE COURSERA GEOSPATIAL-INTELLIGENCE AGENCY (CGIA)

COURSERA GEOINT CAPSTONE & FINAL ASSIGNMENT PROJECT REPORT FEBUARY 2015

TABLE OF CONTENTS

PROJECT INFORMATION

Peer Assessment	**Lesson 05: Assignment & Discussion**
Code Name:	Operation Healing Hope
Objective:	Locating an Ebola Treatment Center based on GEOINT principles.
Description:	Select a location for a notional Ebola treatment unit in Monrovia, Liberia. The exercise uses data and a capability similar to the NGA Ebola map site designed to assist Ebola relief in West Africa. Similarly, our parallel site is supported with ESRI's ArcGIS online, DigitalGlobe's human geography data, and hosted on Amazon Web Services.
Release:	February 9th 2015 (0001 ZULU)
Coursera Name:	Geospatial Intelligence & the Geospatial Revolution
Coursera Code:	Geoint-001
Course Director-in-Charge:	Dr. Todd S. Bacastow
Analysis Timeline:	Feb 12th 2015 to Feb 13th 2015
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Coursera Peer Review of Project Report	https://class.coursera.org/geoint-001/forum/thread?thread_id=1606
Coursera ACH Discussion of Project	https://class.coursera.org/geoint-001/forum/thread?thread_id=1609
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Classification:	Unclassified w/ redactions

INTRODUCTION

Objective:

Site location recommendation based on Geospatial-Intelligence (GEOINT) tradecraft & Analysis of Competing Hypotheses (ACH) methodology.

Background:

NGOWorldWide (NGOWW), a leading charity & non-governmental organization (NGO) has plans to set up a new Ebola Treatment Unit (ETU) in Monrovia, Liberia.

The Coursera Geospatial-Intelligence Agency (CGIA) has been asked to provide support in the form of recommendations for an ideal site location based on the requirements & conditions of NGOWW.

An analyst from the West Africa GEOINT Directorate (WAGD) has been assigned to the task.

Initial Assessment:

The Ebola Virus Disease (EVD) crisis in Africa has generated worldwide attention. The rapid spread of EVD has led a lot of countries, international aid/relief agencies & non-governmental organizations to participate in trying to stop the spread of EVD. The USNGA has also opened up its unclassified geographical information for federal agencies & its partners to help in this effort.

This global effort has led to the generation of a huge amount of data.

1) Geographical Type: Maps, geolocation data of the EVD spread, incidents, clinics, ETU, population infected. Proximity of various geographical entities such as roads, airports, settlements, etc…
2) Statistical Type: Various statistics from the number of people infected, treated, quarantined. Number of medical personnel in a particular location. These statistics assist in stopping the spread of new cases as well as efficiently allocating resources to where it is needed the most.
3) Crowdsourced Geospatial Data (CGD): Various volunteer groups around the world are involved in studying & refining the raw data put out by the official agencies. These include setting up specialized geospatial maps with layers added to assist governmental agencies, medical personnel, NGOs & local volunteers.

Keeping all these diverse efforts & factors in mind, this report will focus solely on the primary tasks.

1) Site selection limited only to the three sites proposed by the NGO.
2) Use only selective & suitable data sources & tools to get the task completed. This helps to avoid Information Overload Syndrome.
3) Use GEOINT tradecraft & ACH methodology to establish suitability of each of the three sites.
4) Create a brief report will summarize all the analyses & findings.

SOURCES AND CRITERIA FOR GEOSPATIAL TOOLS AND DATA:

Selection Criteria:

1) Data & geospatial maps/imagery must be from reliable & accurate sources.
2) Tools must be able to integrate data & imagery together with ease.
3) Tools should be user-friendly so that the main focus is on analyzing & gaining insight rather than figuring out how to use the software.

Geospatial Tools:

1) Monrovia WebMap for Ebola Activity for Penn State GEOINT MOOC Main Page:

http://education.maps.arcgis.com/home/item.html?id=684d5dab42824b3582cf224a6d5ba3c0

2) Direct link to Monrovia Web Map:

http://education.maps.arcgis.com/home/webmap/viewer.html?webmap=684d5dab42824b3582cf224a6d5ba3c0

3) Ebola Outbreaks 1976-2015 Story Maps by BFlanagan_TS ESRI UK:

http://techsupportuk.maps.arcgis.com/apps/MapJournal/?appid=deb9d5151d954de5b3933294c911b67f

4) USNGA Ebola Open Data Download Main Portal:

http://ebolaopendata.nga.opendata.arcgis.com/

5) Map Journal Ebola Support Map Products includes data & PDFs from:
   - United States National Geospatial-Intelligence Agency (USNGA)
   - United Kingdom's Defence Geographic Centre (DGC)
   - United Nations Mission in Liberia Engineering/GIS Unit (UNMIL)
   - Germany's Bundeswehr Geoinformation Center (BGIC)

https://nga.maps.arcgis.com/apps/MapJournal/index.html?appid=1158dcee8b4f4fdeab478cf1030b70f5&webmap=2f5300bbe3a5454eb30fc3f0a2c9c193

6) CGIA Analyst created ArcGIS Public Account Web Map:

http://www.arcgis.com/home/webmap/viewer.html?webmap=3406be0be1b643808ae67fbe68af908b

Data Sources:

1) DigitalGlobe Landscape + Human datasets: WWHG map layers for ArcGIS.

https://www.digitalglobe.com/products/human-landscape

http://wwhgd.org/sites/default/files/OnePager.docx

2) OpenStreetMap for ArcGIS Web Online:

http://www.arcgis.com/home/item.html?id=b834a68d7a484c5fb473d4ba90d35e71

3) OSM Layers for ArcGIS Direct Link:

http://www.arcgis.com/home/item.html?id=b834a68d7a484c5fb473d4ba90d35e71

4) UN Mission for Ebola Emergency Response: UNMEER Layers for ArcGIS

https://ebolaresponse.un.org/un-mission-ebola-emergency-response-unmeer

5) NGA Ebola Open Data Download: NGA_PUBLIC Layers for ArcGIS

http://ebolaopendata.nga.opendata.arcgis.com/datasets?q=monrovia&sort_by=relevance

Summary:

ArcGIS platform was selected as it integrates various sources of data from military, intelligence, government & NGO as map layers easily.

The data sources were selected for reliability & also for easy integration into ArcGIS Web Online.

Note:

1) The Monrovia Web Map cannot be edited. For specialized analysis, create a free ArcGIS Public Account & load the same layers.
2) ArcGIS Public Online Account is different from ArcGIS Education Account.

Software & report creation tools:

- Windows XP
- Microsoft Office
- Firefox Web Browser
- IrfanView

THREE PROPOSED SITES FOR NEW EBOLA TREATMENT UNIT (ETU)

	GPS Co-ordinates for ArcGIS	Nickname
Site 1	-10.789111, 6.302805	IslandSite1
Site 2	-10.701749, 6.258846	StadiumSite2
Site 3	-10.732666, 6.333250	RefinerySite3

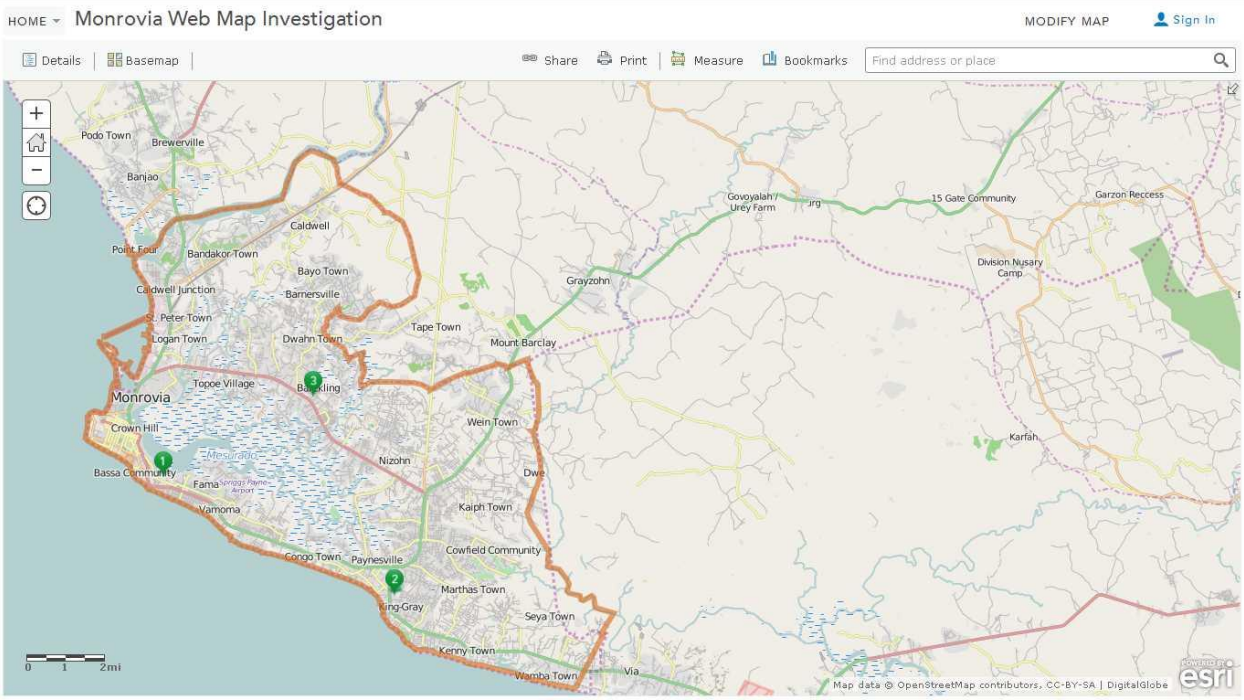

Figure 1: Three proposed ETU sites in Monrovia

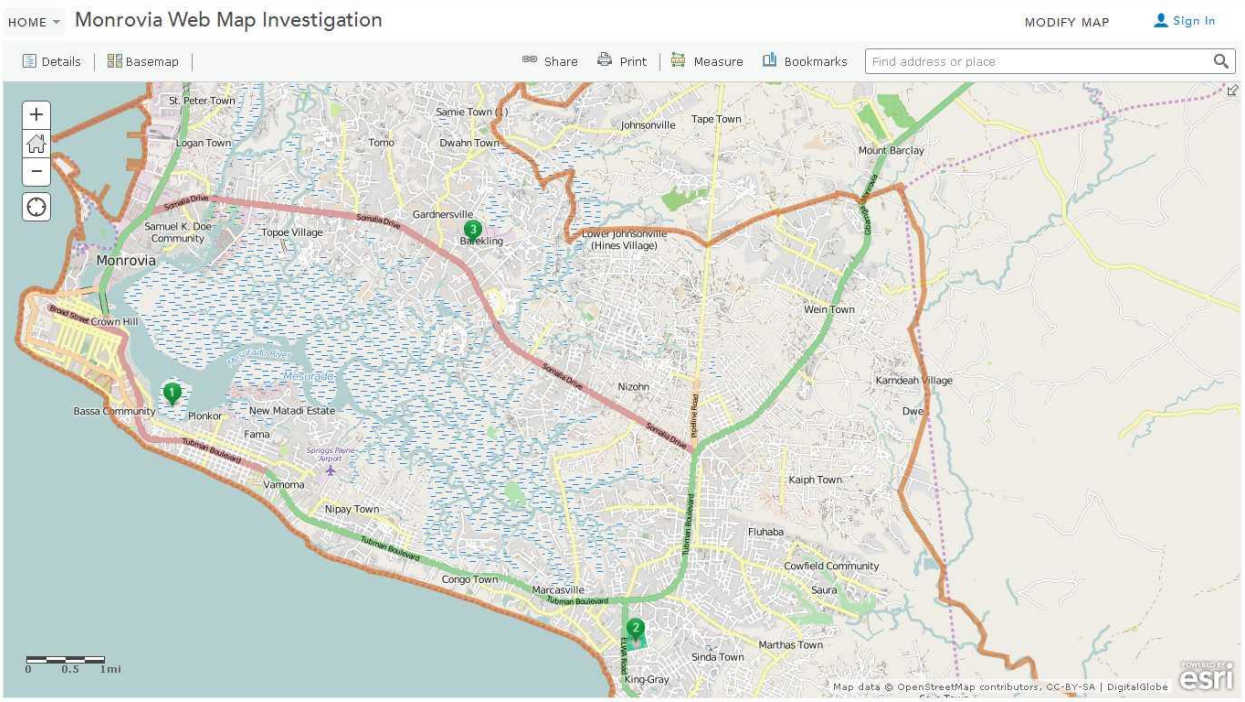

Figure 2: Three proposed ETU sites zoomed in

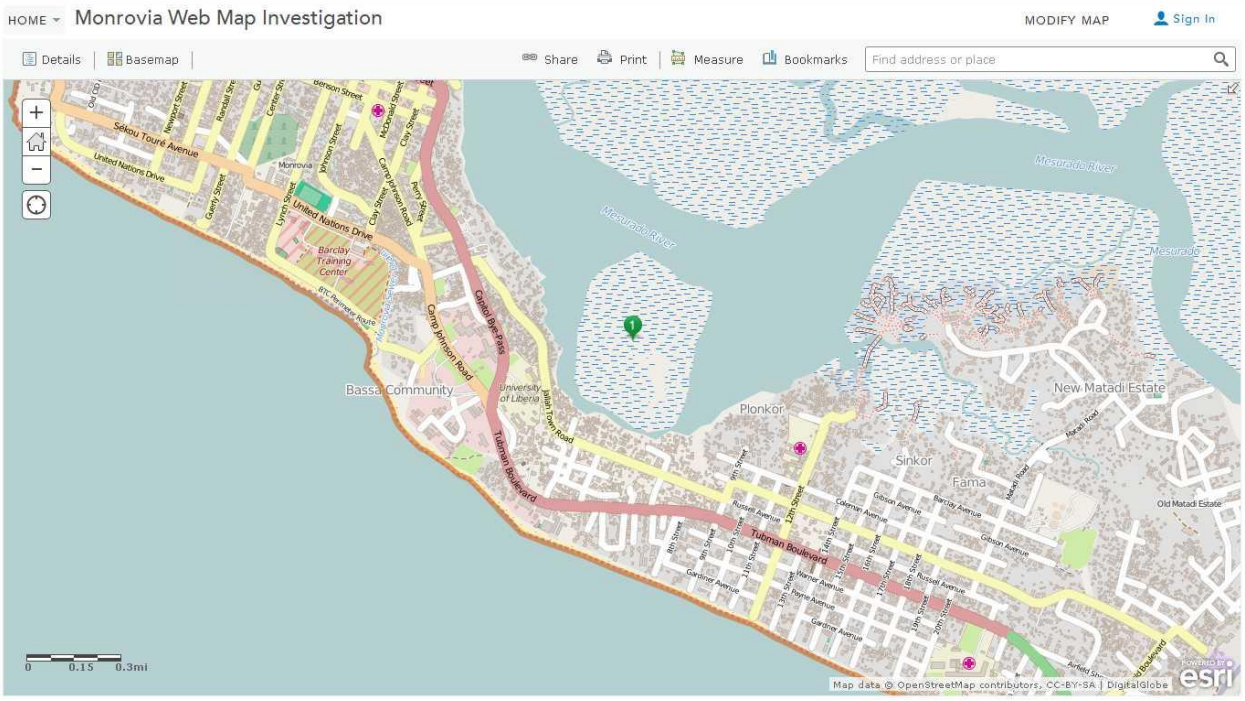

Figure 3: IslandSite1 zoomed. Well Connected. But being on island could pose problems such as flooding & water-borne illnesses.

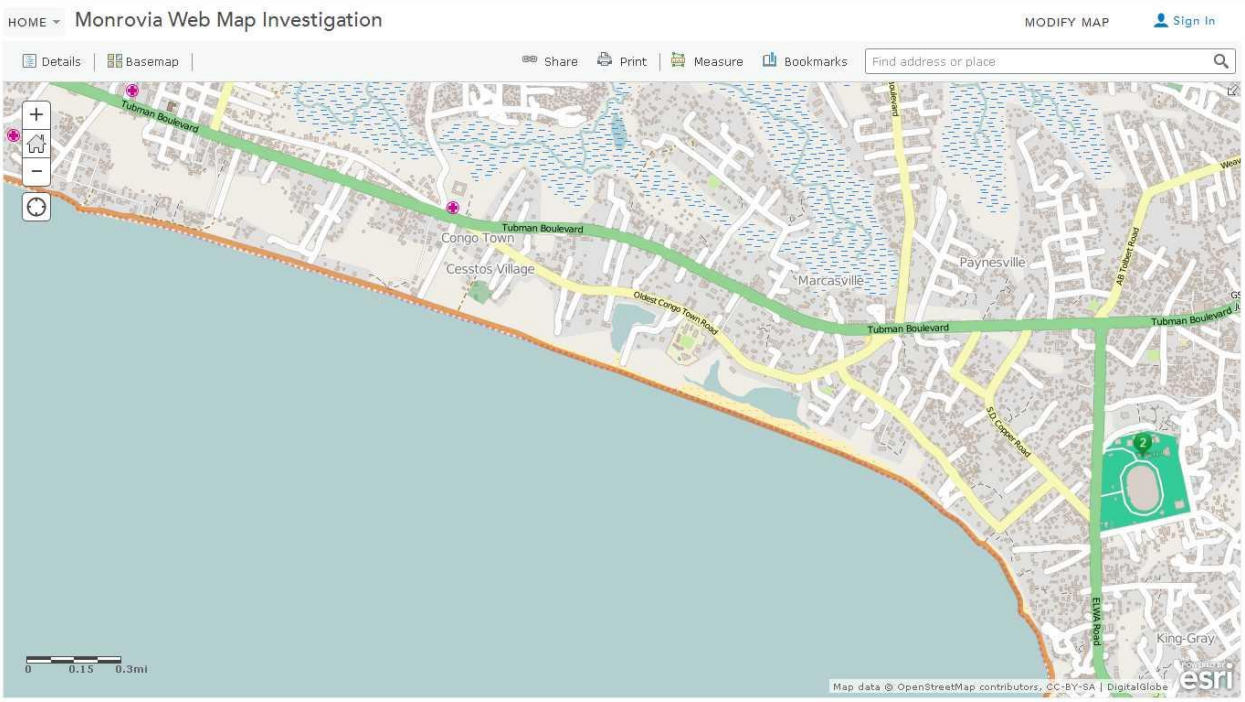

Figure 4: StadiumSite2 NW view zoomed. Well connected. Being in a stadium, ETU can be kept protected.

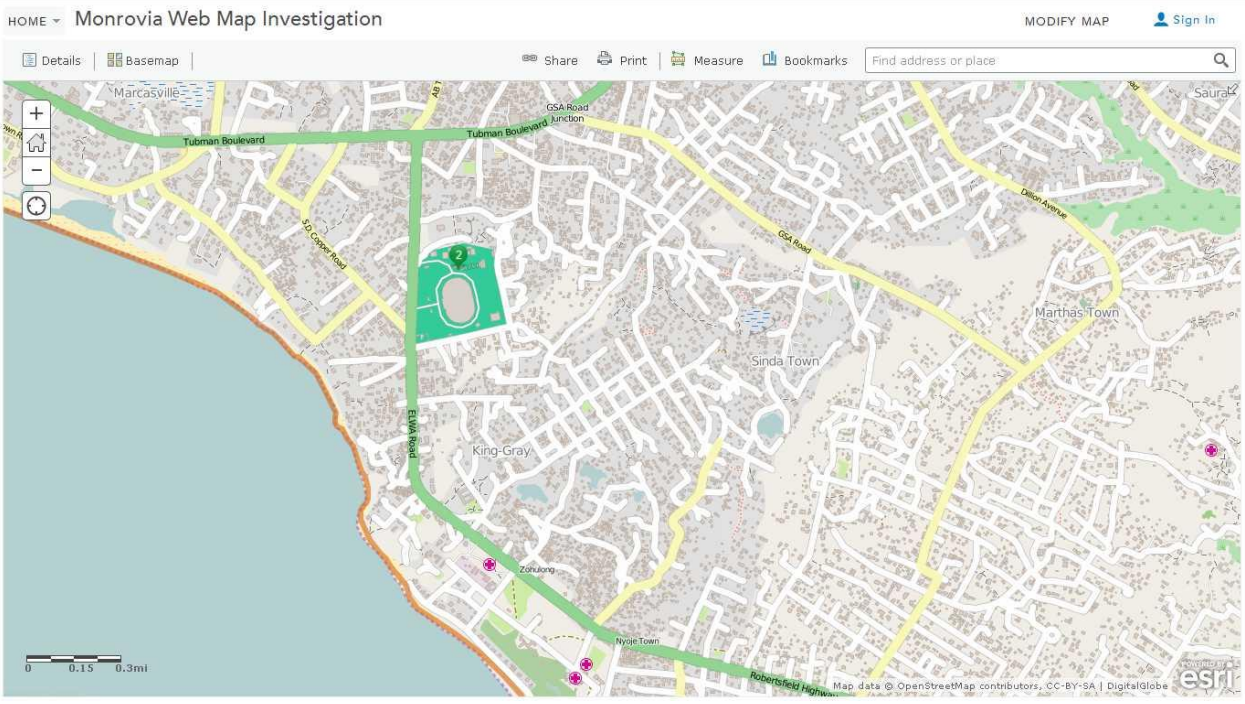

Figure 5: StadiumSite2 SE view zoomed. Three medical facilities in the South of StadiumSite2.

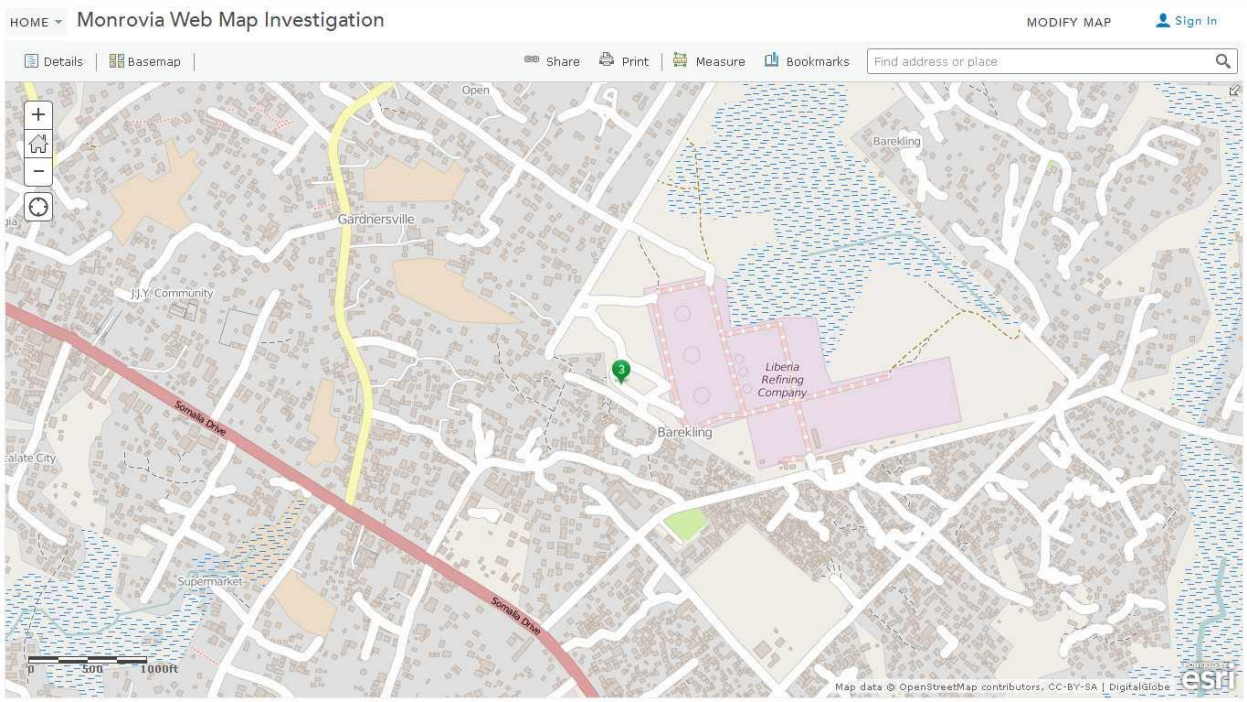

Figure 6: RefinerySite3 zoomed. Not well connected but could serve as ETU in that location for people in and around the facility. Being close to the refinery could be a problem such as noise or chemical pollution.

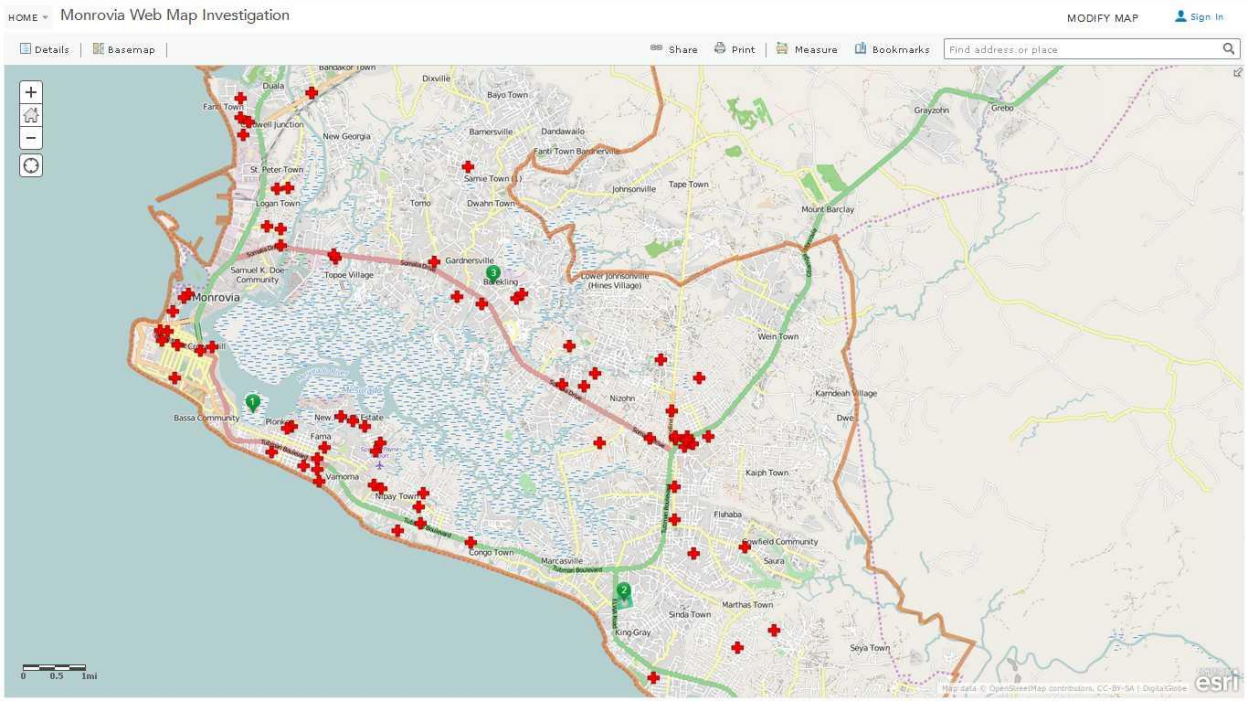

Figure 7: Monrovia Web Map layer shows health facilities distribution around each site.

CRITERIA FOR THE PROPOSED CLINIC LOCATION.

Criteria that the proposed clinic location:

1) is in an area known to have the Ebola disease present.
2) is in an area not served by an existing Ebola facility.
3) is in the proximity to existing medical facilities.
4) serves a significant population.
5) has access to transportation.
6) is in favorable physical environment.
7) is in a location safe for the patients and staff.

CONDITION 1: IS IN AN AREA KNOWN TO HAVE THE EBOLA DISEASE PRESENT.

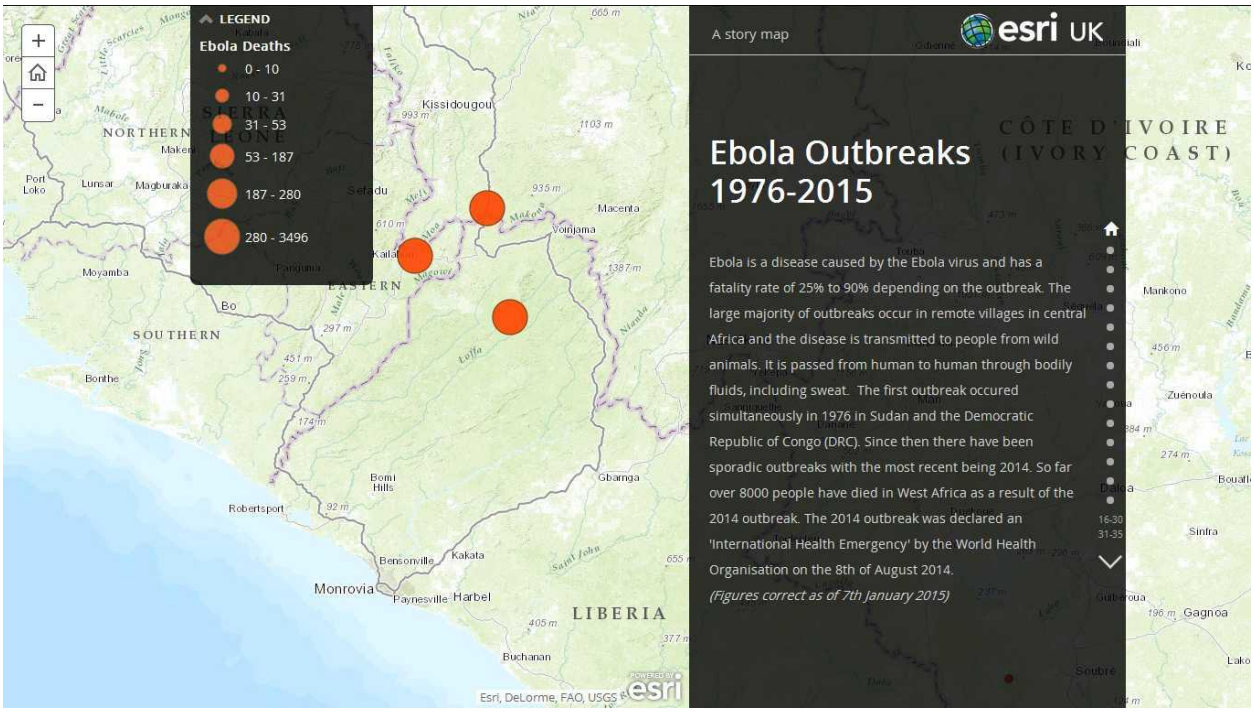

Figure 8: Ebola Outbreaks in Liberia based on ESRI UK Story Map using ArcGIS

Figure 9: Statistics for Ebola Outbreaks in Liberia based on ESRI UK Story Map using ArcGIS

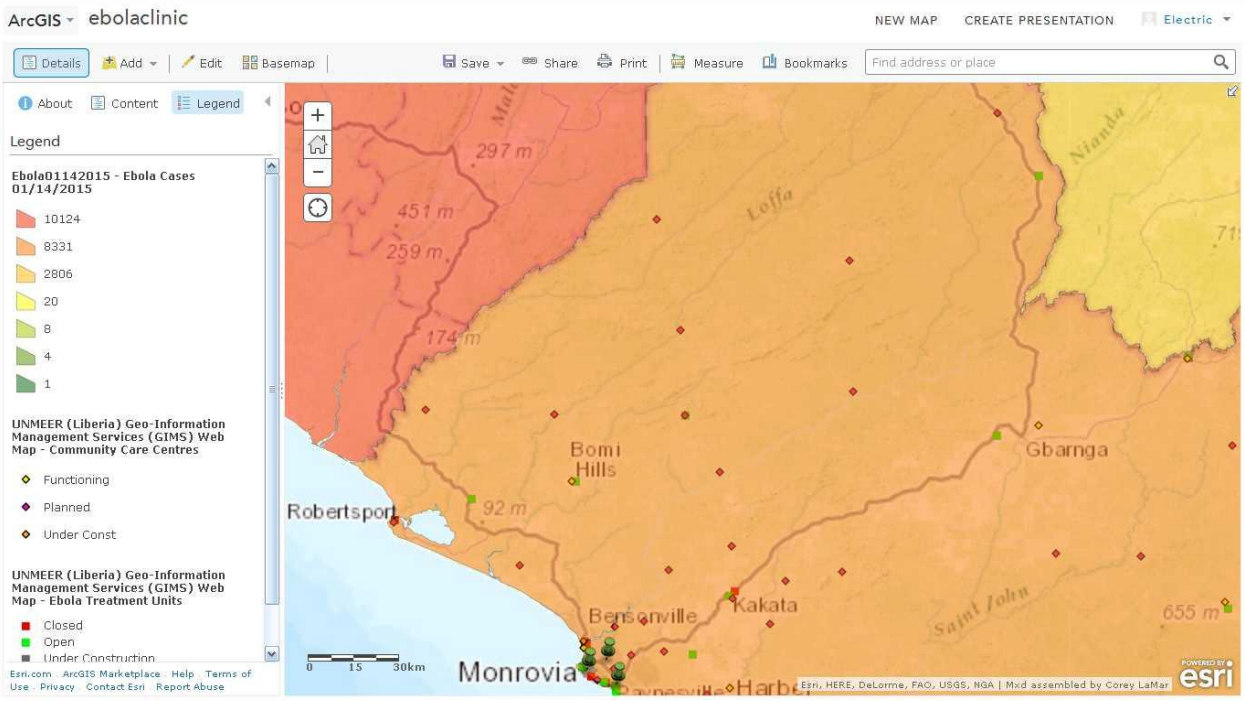

Figure 10: Ebola Cases 2015. As seen most cases are in the North of the country.

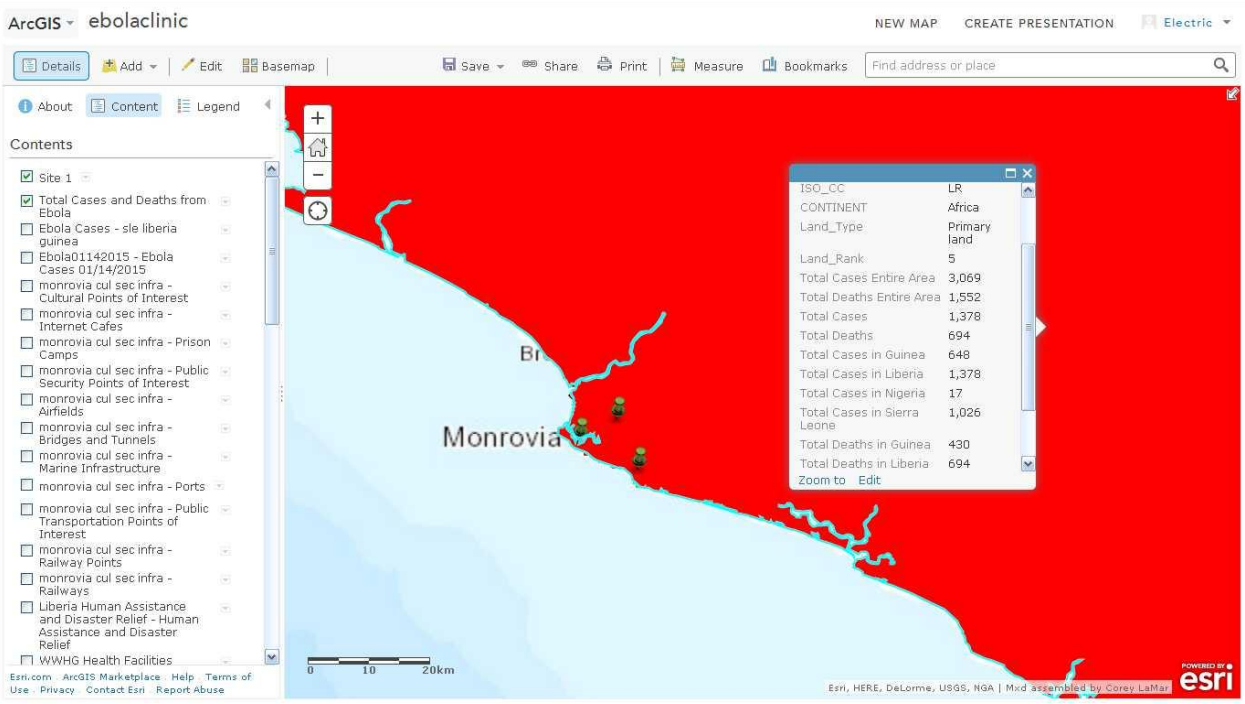

Figure 11: Ebola total cases. Among its neighbors, Liberia is the worst affected.

As seen in the ArcGIS maps & its various layers, all three locations are in the vicinity of EVD.

CONDITION 2: IS IN AN AREA NOT SERVED BY AN EXISTING EBOLA FACILITY

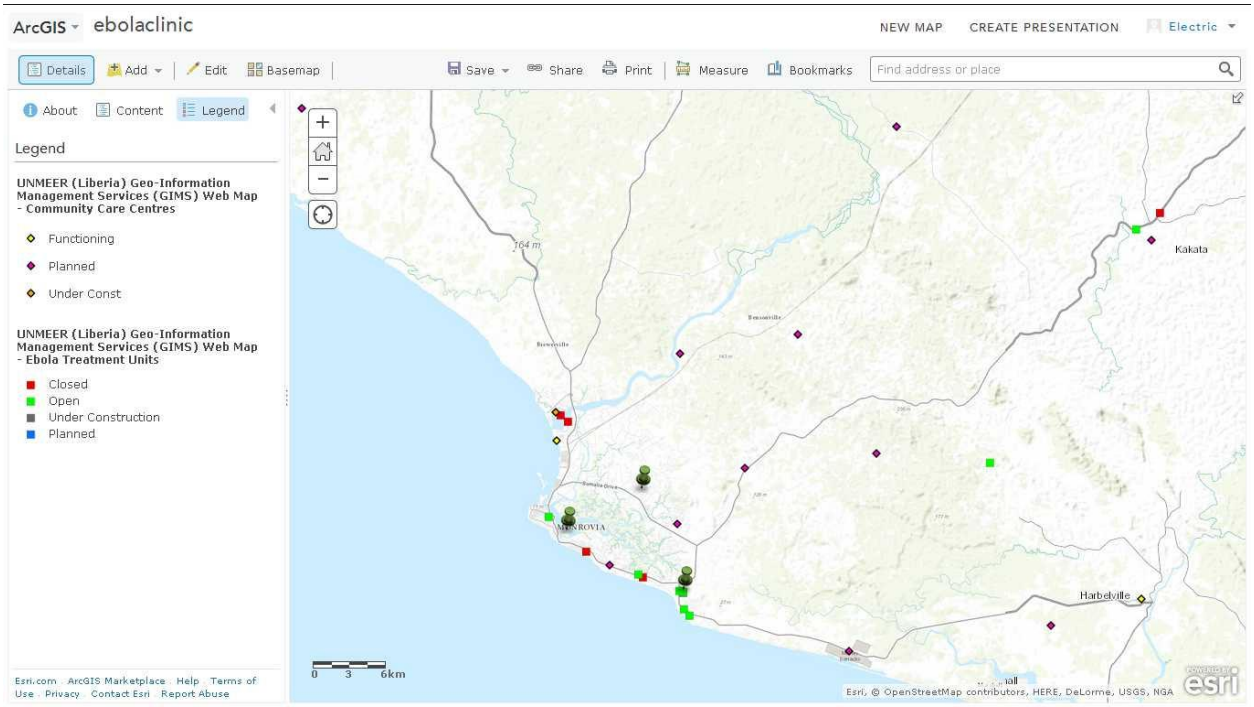

Figure 12: Overview ETU in area surrounding Monrovia Region. RefinerySite2 has no ETUs nearby.

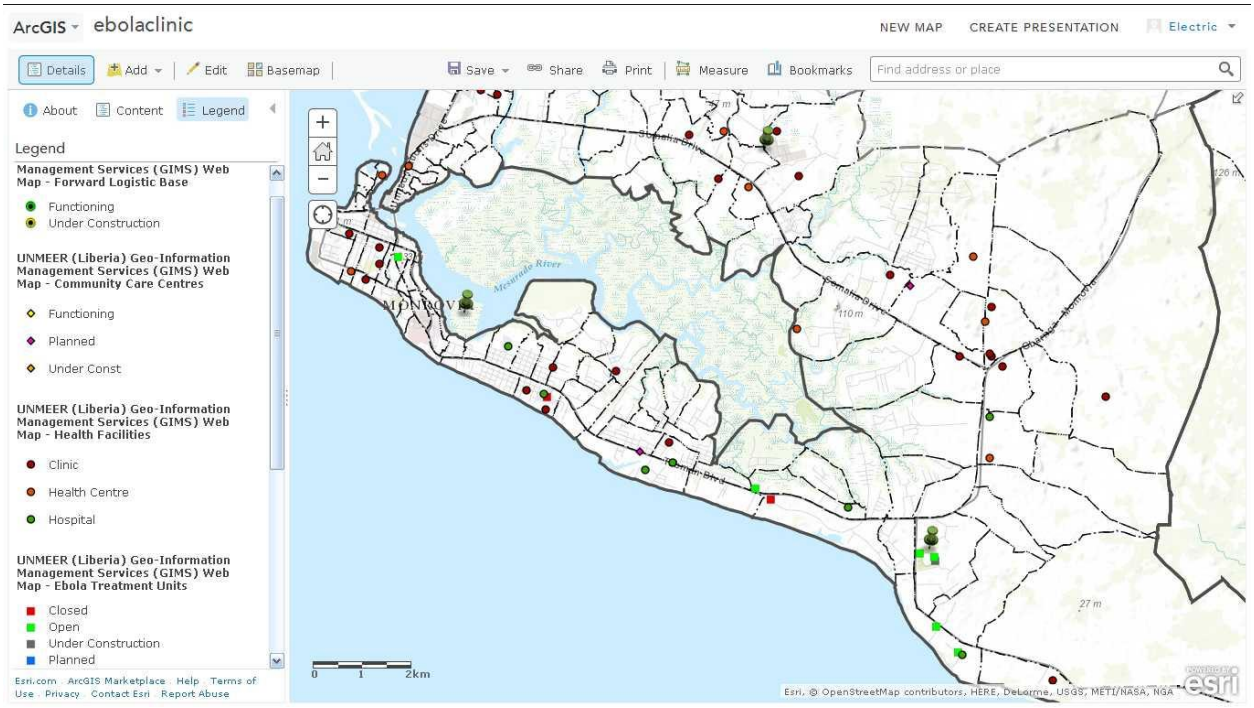

Figure 13: All square shapes represent ETUs. RefinerySite2 is in more need of an ETU than others.

CONDITION 3: IS IN THE PROXIMITY TO EXISTING MEDICAL FACILITIES

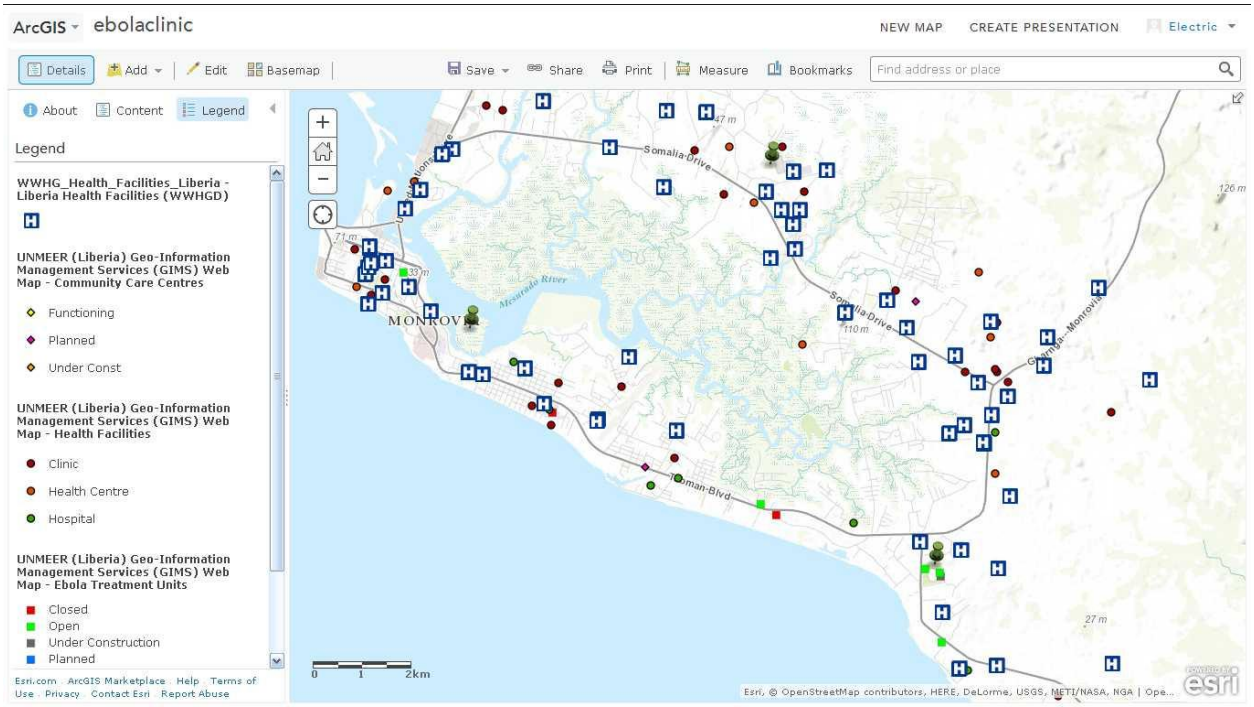

Figure 14: WWHG health facilities Liberia

As seen from the Figure 14. all three sites are in the proximity of establish medical facilities.

CONDITION 4: SERVES A SIGNIFICANT POPULATION

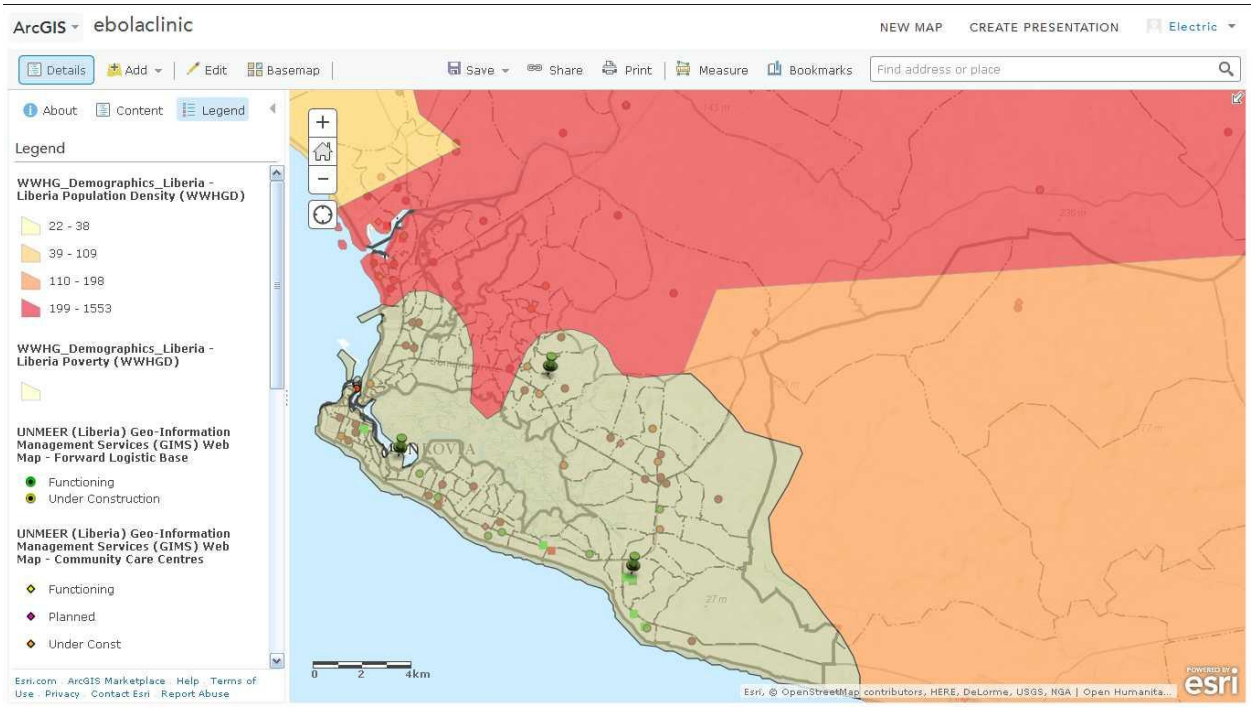

Figure 15: Liberia Demographics using WWHG Demographics Map Layer. North part of Monrovia is more heavily populated than other areas.

As seen from Figure 15, there is more population in the North of Monrovia, hence there could be more cases of EVD from the North.

Here RefinerySite2 could be used to serve that North population.

CONDITION 5: HAS ACCESS TO TRANSPORTATION

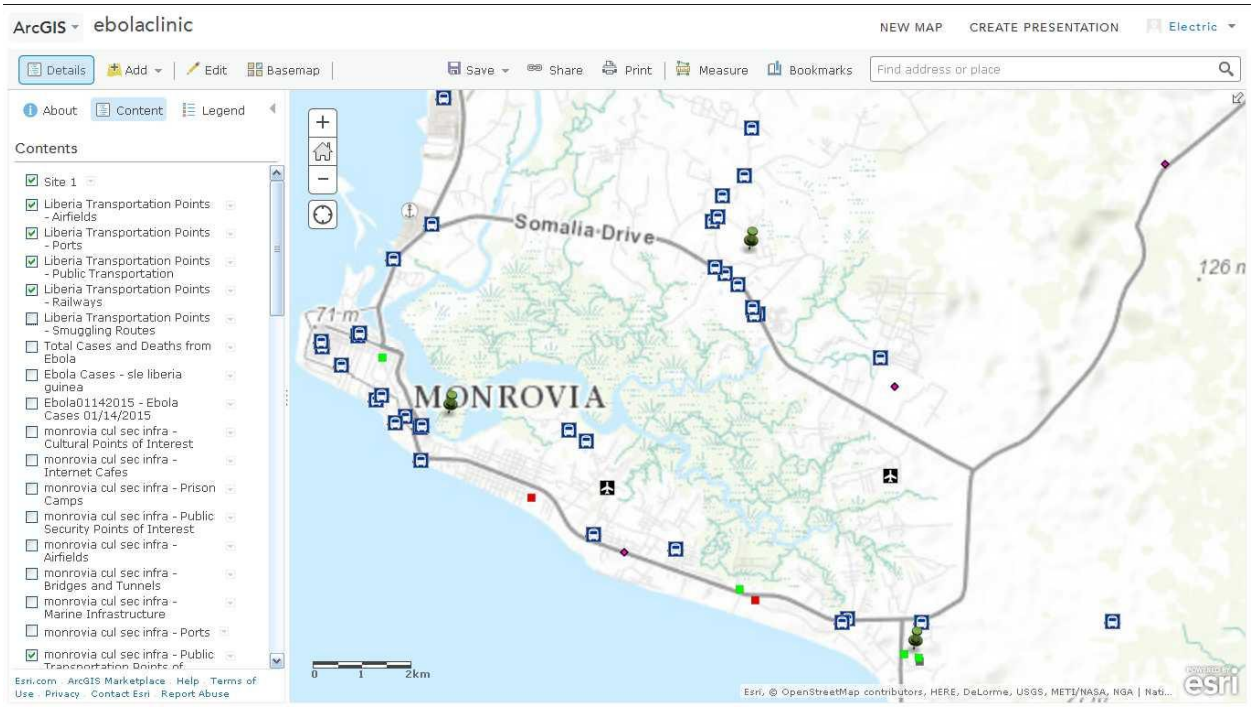

Figure 16: Monrovia Transportation

IslandSite1 is well connected by road & several transportation points.

StadiumSite2 is also well connected by road & several transportation points.

RefinerySite3 is also well connected by transportation points.

CONDITION 6: IS IN FAVORABLE PHYSICAL ENVIRONMENT

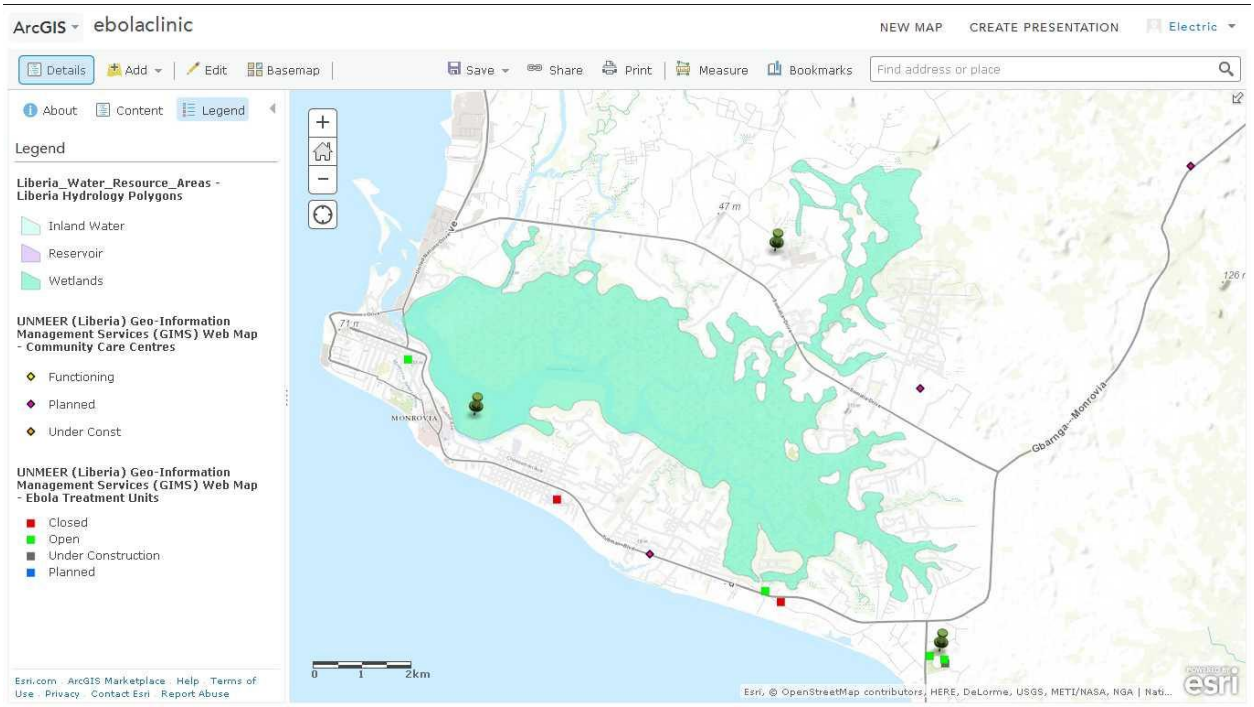

Figure 17: Water Hydrology of Monrovia. As seen IslandSite1 is prone to flooding.

IslandSite1 is a severe risk for flooding. It could be completely submerged in water.

StadiumSite2 is safe being assuming that the stadium was built in a physically favorable location.

RefinerySite3 is safe assuming that the refinery was built in a physically favorable location.

CONDITION 7: IS IN A LOCATION SAFE FOR THE PATIENTS AND STAFF

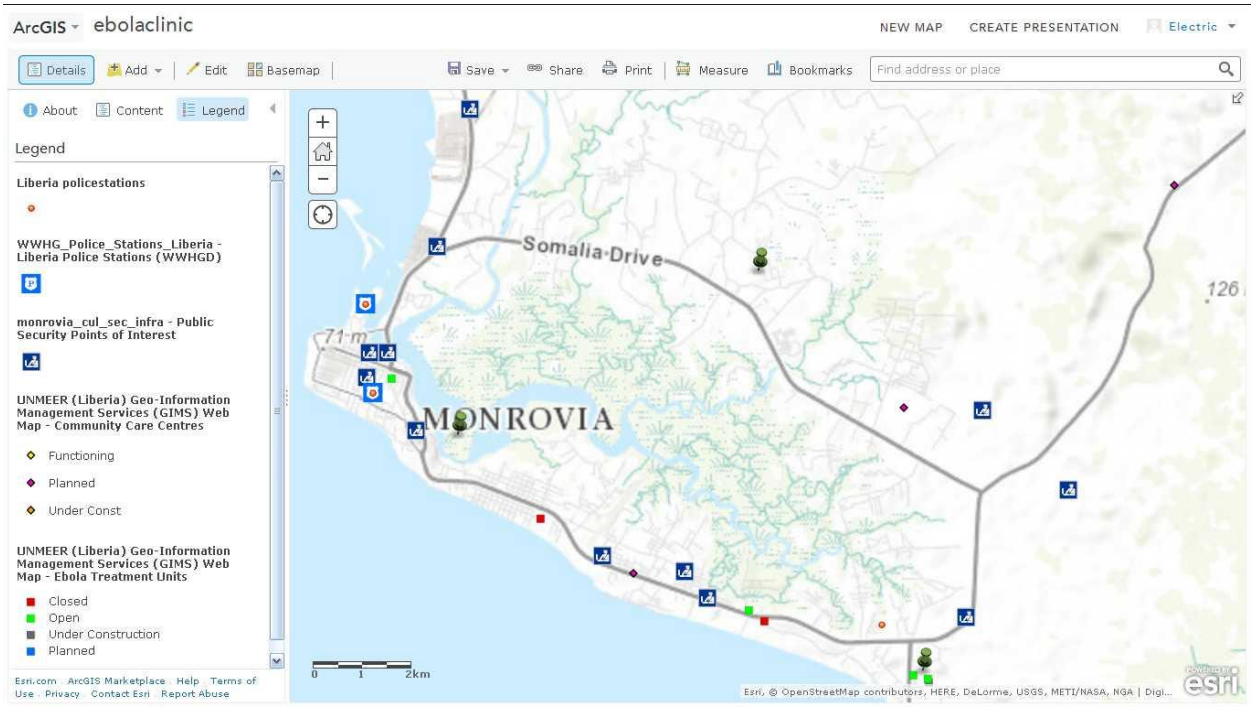

Figure 18: Monrovia police stations and security points

IslandSite1 is in vicinity of the police stations & many security check points.

StadiumSite2 is also in vicinity of security check points.

RefinerySite3 is relatively unguarded. However being a refinery, it should have enough internal security.

ACH MATRIX METHODOLOGY

This methodology was developed in conjunction with the geospatial data from the various map layers in ArcGIS.

Table 1: ACH Matrix: Evidence vs. Hypotheses

Please refer to Figures for data & explanation.	**IslandSite1 is best location.**	**StadiumSite2 is best location.**	**RefinerySite3 is best location.**	**Optional: Specify alternate Site4**
Criterion 1: FIG. 8,9,10,11 In area known to have Ebola disease present.	Almost Certainly +1	Almost Certainly +1	Almost Certainly, more cases in North of Monrovia +2	
Criterion 2: FIG. 12, 13 In area not served by an existing Ebola facility.	Certainly N/A	Certainly N/A	Almost Certainly Not +2	
Criterion 3: FIG. 7,14 In proximity to existing medical facilities.	Certainly +2	Certainly +2	Certainly +1	
Criterion 4: FIG. 15 Is located to serve a significant population.	Likely +1	Likely +1	Most Likely +2	
Criterion 5: FIG. 16 Has access to transportation.	Most Certainly +2	Most Certainly +2	Certainly +1	
Criterion 6: FIG. 17 In a favorable physical environment at the location.	Highly Unlikely. Severe Flooding -2	Appears Likely. Favorable +2	Appears Likely. Risk of Refinery Fire /Accident -1	
Criterion 7: FIG. 18 In a location safe for the patients and staff.	Certainly. Police, Security +2	Appears Likely. Security +1	Can anticipate safety. Refinery security. Not enough -1	
Overall Assessment.	As seen from **FIG 17.** IslandSite1 is prone to flooding & submersion in water. This rules it out for ETU	As seen from **FIG. 12, 13** StadiumSite2 already has many functioning ETUs. This rules it out for new ETUs.	As seen from **FIG. 6,7,12,13** RefinerySite3 is in more isolated region but there are no existing ETUs there.	

SUMMARY & CONCLUSION

IslandSite1:

Reasons to accept:

- Well connected by transportation & roads.
- Well protected by police & security
- Several existing clinics & health facilities to act as a support network.
- Island could act as an isolating element to stop the spread from existing patients.

Reasons to reject:

- Area prone to severe flooding. Submersion of ETU is a possibility.
- There are existing ETUs in the neighborhood.
- Risk of infection from water-borne diseases.

StadiumSite2

Reasons to accept:

- Well connected by transportation & roads.
- Well protected by police & security
- Several existing clinics & health facilities to act as a support network.
- Stadium could act as an isolating element to stop the spread from existing patients.

Reasons to reject:

- There are many existing ETUs setup in the neighborhood.
- Most of the new infections are coming from the North.

RefinerySite3:

Reasons to accept:

- There are no existing ETUs in the neighborhood.
- Existing clinics & health facilities to act as a support network.
- Well connected by transportation & roads.
- Could serve as ETU for the North of Monrovia as most new infections are in the North.

Reasons to reject:

- Area prone to noise & chemical pollution.
- Fewer existing clinics & health facilities to act as a support network.
- Risk of Refinery Fire or accident.

- Not protected well by police & security but refinery internal security exists.

Conclusion:

For new ETUs **RefinerySite3** (-10.732666, 6.333250) seems to be the ideal location for the NGO. With additional security arrangements and coordination with refinery management, the site can be made secure & operational quickly.