

# Mapping in Ghana

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## **Introduction**

At the beginning of the semester our group set out to complete a project that was much different in scope than our final product. Originally our project involved the team mapping the roads in the study area. Upon review of what currently existed in the studios database we determined that it lacked a sufficient and accurate depiction of the roads. Brandon had started the process of drawing the roads in the North Offinso District (OND) using an OND shapefile and a world base-map from Esri-Online with roads on it. The second item the group was going to focus on was to assist other groups in mapping out their study locations. This would have been useful if an alternate route had to be taken to get to a study site due to a washed out road or if there were poor road conditions. If groups knew the conditions of the roads they were to travel on beforehand they could more accurately predict how much travel time to the site would take away from actual working time. It was determined that none of the groups needed this assistance because none of them would be going too far from the main roads. About a week or two before the group left for Ghana we decided we wanted to work on an address system for the areas we were going to work in. This idea was eventually rejected when it was realized that a solid map would be necessary to introduce an address system. It was unlikely that a detailed enough map existed as it was not included in the database. The plan upon arriving in Ghana was to use handheld GPS devices to map a section of a town and then apply an address system with the approval of the local government. Figure 1 shows the work area.

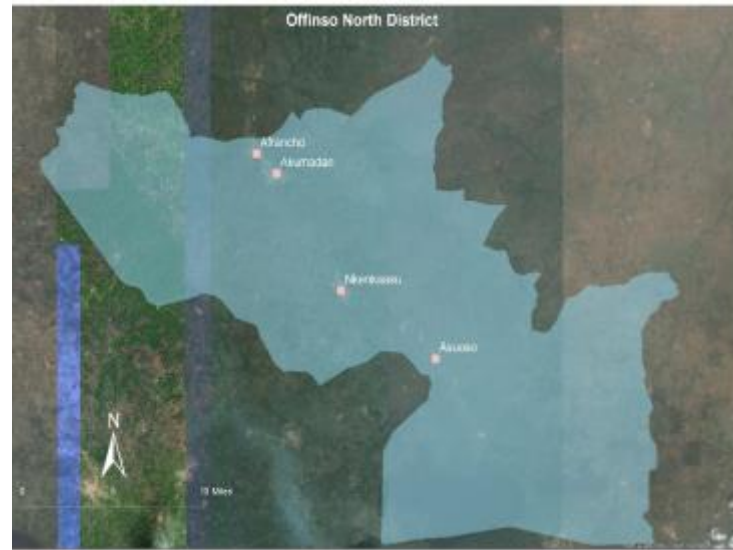


Figure 1 Study Location

### **In Country Work**

Upon reaching ONDA it was discovered through a series of meetings that implementing an address system is not a short-term goal of the planning

department. Mapping the existing structures is a short term-goal. Because of a language barrier it was unclear exactly what the planning department, represented by Kwasi Oppong, desired. It was made clear that the goal was to map crucial structures, defined as hospitals, schools, religious institutions, markets, and government buildings, to update the maps for Nkenkaasu and Afrancho, to create a map for Asuoso, and finally to update the site plan for Nkenkaasu.

The in country work process can be broken down into two steps: mapping with the GPS devices and studying the existing planning process in ONDA. Step one is a simple process. The GPS devices collect a waypoint at the location the user is standing. The user can input data into

the device (example: Nkenkaasu – School – Private). The team, with some assistance from Dr. Kareem Usher, gathered multiple points for each structure. If the structure was a rectangle only two points were collected at opposite corners. If the structure was not a square then the team needed to gather waypoints for all of the vertices of the structure. These waypoints would later be used to draw polygon representations of the structures. This process will be further described in the next section.

The second step is perhaps more crucial. Kwabena Agyekum, a fellow student, assisted the team in gathering existing digital copies of plans for several towns in the district. He also acquired copies of the print version of the site plan for Nkenkaasu and the map of Afrancho. Mr. Oppong explained the problems with the existing maps and plans, and some were identified by the team. First, they are outdated by 40 years. Second, the plan for Nkenkaasu does not have plot lines that take existing structures into considerations. Third, paper copies of permits have no connection to the construction project they are permitting outside of arbitrary permit code. The planning department bases this on memory and the permit holder is instructed to keep his or her copy as evidence (see Figure 2, left). Notice that the plot number section is left blank, but the permit number is filled out. Figure 2, right is a photo of a stop work order taken on the 2016 Ghana Sustainable Change trip. The construction that was halted is for a church. Notice how advanced the construction process is, which indicates that ONDA did not become aware of the non-permitted construction early in the process. Moreover, notice the stop work date of 2015. Fourth, there is no existing map of Asuoso. Finally, permits, taxation, and addresses are not uniform, although they are assigned.

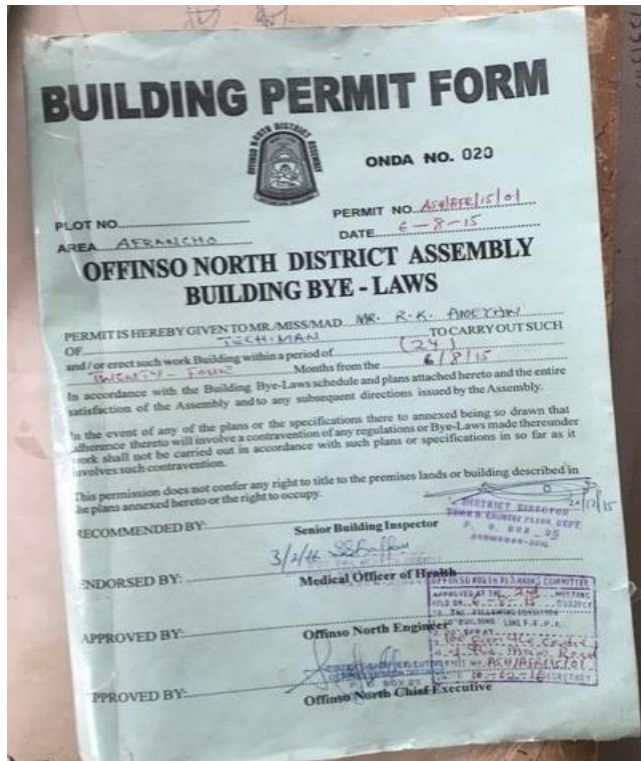


Figure 2 Permits and Stop Work Orders

The land ownership and address

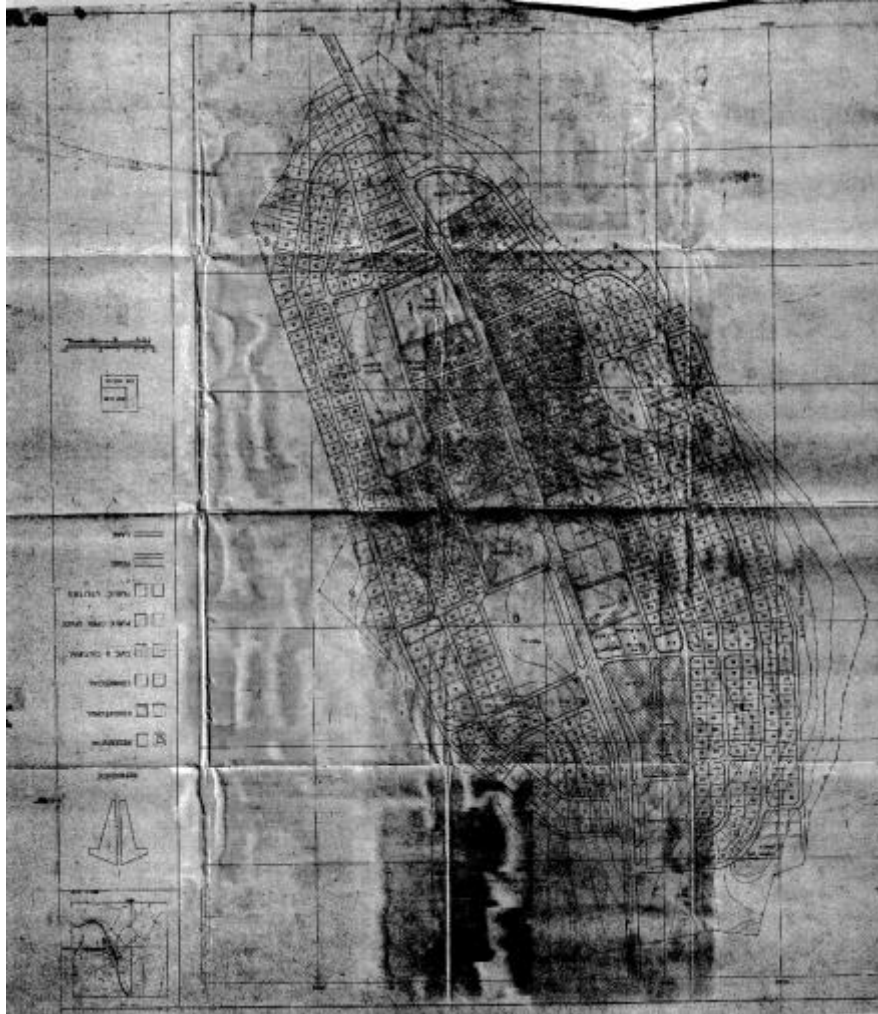
problem can be explained through an encounter the team had at a hospital in Afrancho. The doctor in charge of the hospital informed the team of a nearby farmer who has begun to plant on hospital land. He asked how the government will help him clearly mark the boundaries of his land. Mr. Oppong explained that a man in a nearby town knew where land boundaries began and ended. When asked who would know this information when the man passed, Mr. Oppong answered, "I will go write it down," because the information had not been recorded.

The issues named above are too numerous to be addressed here. Instead, the maps will be updated and displayed below, with a before and after comparison. A map for Asuoso is also included below.

## **Post Trip Work**

Upon returning, the team decided that completing the maps for Afrancho, Nkenkaasu, and Asuoso, and updating the site plan for Nkenkaasu was well within the scope of this project. A few concerns arose. Mr. Oppong has not provided feedback on the type of plan he desires for Nkenkaasu, beyond using 80m by 80m plots instead of 100m x 100m plots. The team decided that creating a site plan that may not be used would be a waste of time. Another issue was the size of the towns and the amount of work that would go into mapping all three. The team instead shifted their focus to completely mapping Afrancho and Asuoso.

The first step for completing the maps was to acquire high-resolution satellite imagery. This was completed by acquiring a free license to Bing map services. Bing has high-resolution base maps that can be accessed within ArcGIS. The team added GPS waypoints over the base map. This is done using a simple conversion tool within ArcGIS called 'GPX to Shapefile'. The data were merged and the points displayed on the overlay. We then drew the polygons of the buildings that were mapped on top of the base map. There are two primary reasons for using GPS waypoints instead of the aerial imagery to trace buildings. The base map is from 2010, and therefore will not show recent construction of any important structures. Also, the satellite imagery has an offset, and difference in polygons and the base map can illustrate how large the offset is. For buildings that were not captured using the GPS devices, the team did rely on the satellite imagery. The buildings were traced and assigned an estimated use (residential, vendor, unknown, and under construction were the most frequent).



*Figure 3 Nkenkaasu Site Plan*

## **Nkenkaasu**

The site plan of Nkenkaasu is pictured left in figure 3. Originally, the plan upon returning was to complete a land use plan for Nkenkaasu, however several issues arose that made this difficult. The most primary issue is that Mr. Opong has not sent standards or goals for the site plan yet, and the team

did not want to create a site plan that would not be useful for ONDA. Second, as illustrated above, the digitization of the map is low quality. The existing parcel lines are difficult to make out. The team's accomplishments in Nkenkaasu include digitizing the site plan below and mapping important structures that may not appear in satellite imagery.



## Afrancho



*Figure 4 Maps of Afrancho*

The maps above in figure 4 show a section of Afrancho that the team mapped. The image on the left is a comparison of the previous map held by ONDA to the new map created by the team. The existing map is represented by dark gray polygons, while the new map is represented in light blue. The image on the right shows the satellite imagery and the polygons representing building foot prints drawn on top in light blue.

The offset seen in the comparison map has a few causes. One, the original map may not be completely accurate, and the georeference process in GIS will leave small offsets. These two issues combined mean that the new map and the old map will not line up perfectly. Keeping this

in mind, the old map in this section is surprisingly accurate, but new structures can be seen, and old structures are shown to have been demolished. Even minor issues such as the ones represented here can cause problems when a site plan is created, particularly with land ownership issues and any guidelines for setbacks. Road construction could also be planned, only for the site planner to discover that the road cuts through a home. A new team can use this updated map to work with the city planning department to create an accurate site plan for Afrancho.



Figure 5 Asuoso

### Asuoso

Asuoso is a small town about 45 minutes south of Akumadan, the capital of the Offinso North District. The town has a few filling stations, a small shopping area, and a school. This is the smallest town the team worked in. As mentioned previously the planning department did not have a map for Asuoso. Figure 5 shows the map constructed by the team. The base layer is the Bing base map described before. This was used to draw non-GPS located buildings, represented by the tan polygons. This map will be sent



to ONDA as JPEG and as an ArcGIS map document that uses an early version of GIS accessible to ONDA. The planner can continue work on the map, such as accurately coding land use, owner names, addresses, permits, etc.

### **Moving Forward**

This year, the mapping team did not complete all the goals they set out to accomplish, primarily because of the timeline. Future mapping teams, with access to this data, can code the structures accurately and perform spatial analyses. They can map other towns using the same method used here. Finally, any planning student can improve these basic maps and utilize them in a land use plan.

Several big goals in relation to mapping can be completed in future studios. Teams can begin digitizing existing maps and plans in high resolution. If they maps are lost now certain areas may have to start over. Updating the accuracy of ONDA's AutoCAD and ArcGIS documents will also improve the planning efforts of ONDA. Lastly, assisting the planning department in creating an appropriate plan for the unplanned areas within the district is an important task, particularly because this is emphasized as the primary issue for the planning department.