REPORT ON THE FIELD WORK BY UWI STUDENTS IN THE MILE GULLY WARWICK CASTLE AREA
SUMMER 2008
Prepared by Students

INTRODUCTION

The area under study in this report is the Mile Gully/ Warwick Castle area. However, the report focuses along the route that the proposed pipeline is to follow shown in the map provided by the Water Resources Authority of Jamaica.

From previous research, this area along the Rio Sambre River from Mile Gully to George Town area is underlain by the Montpelier Formation and Gibraltar/ Bonny Gate Formation (both part of the White Limestone Group which is Lower Miocene to Mid-Eocene in age) and the Pembroke Hall Formation (part of the Wagwater Group and Lower Eocene to Paleocene in age).

The purpose of this field work is to study the water resources and physical environment the area which is entwined with social issues as well as related to the geology of the area and the proposed water supply system that is to be put in place to alleviate problems.

The main aims and objectives are:

(1) geological and structural mapping at 12.5K scale

(2) hydrological assessment

(3) geotechnical characters of geological materials

(4) assessment of natural hazard processes including flooding, landslides, earthquakes

(5) demographic analysis using pre-existing surveys

In this three day period of summer field work, as much of the aims listed above were

achieved, however, as time progresses furthur fieldwork will be done and in depth analysis and any change in data will be duly noted before final report is made.

METHODOLOGY

On Monday 12th May, 2008, the three students participating met with Mr. Rafi Ahmad to begin research and do an overview as to the type of research methods that are to be employed as well as the gathering of background information on the area. On Tuesday there was a meeting at the Water Resources Authority (WRA) in Kingston where the group including Mr. Ahmad met with Mr. Herbert Thomas and Mr. Andreas Haiduck to discuss the field Mapping Project. On Wednesday students again met with Mr. Ahmad at the Department of Geology and Geography and on the Thursday following had a reconnaissance field trip to the Mile Gully area to be introduces to the area in which work was o be carried out. There we met with Mr. Lyndon Gordon and two other officials from the WRA who carried us on a tour of the area. On Friday 16th May, 2008 field work commenced whereby the group stayed in Gayle (3 miles from the area of study) until the morning of Monday 19th, May, 2008.

Everyday for the full 3 days of stay and fieldwork, the group was accompanied by Mr. Lyndon Gordon who helped us become familiar with the area. At first mapping was carried out along the main road from Merlie to George Town. This was the first day of field mapping. The second day, mapping was carried out along the river and paths that we came across as we mapped along the river on both sides. The first half of the river was mapped on day 2 the second half was mapped on day 3. During mapping Global Positioning Systems (GPS) were used to pinpoint the location of springs and landslides.

The strike and dip of beds were noted as well. Water samples from the major springs were taken (Chapel and Silver Spring) to be analyzed and well as rock samples from major outcrops.

PRESENTATION AND ANALYSIS OF DATA

A geological map of the area was prepared. Most of the area is under limestone of the White Limestone Formation with limited outcrops of the Yellow Limestone Formation. This is an area of karst topography. The major outcrops were mapped along the river course. Conglomerates and mudrocks were also mapped. These two lithologies appear to have faulted contacts with limestone. In one area slickenside striations were noted in the rocks in faulted zone.

The white limestone seen was basically hard in most areas except where weathered. In most cases the limestone was bedded or jointed with huge blocks falling into the river due to wedge failure. This is shown in picture 1 below.

PICTURE 1 SHOWING BLOCKS OF WHITE LIMESTONE

GEOLOGICAL AND STRUCTURAL MAPPING

The geology of the area is basically that of limestone. The limestone is mainly of two types that of Yellow Limestone and White Limestone with the second being in most abundance. This is followed by conglomerates and the boundary between the limestone and conglomerates along the river is inferred as a faulted boundary adding to the occurrence of springs along the length of the river. There are also major areas of mudstone found along the river; however the contact boundary for the mudstone was not clearly seen. Youngest unit is alluvium mapped in the river bed. Soils are fine grained to decipher their composition.

Most of the bedding seen dips to the south west with some beds dipping northeast. This is inferred to be overturned beds or an exposed angular unconformity with sandstone beds deposited on top of limestone beds.

Geomorphologically area comprises limestone hills. Valleys are steep sided with landslides especially along roads cuts. Alluvial sediments along the river are rounded and higher up the river clasts are huge boulders and cobbles measuring up to 5m in diameter which are quite angular. However, as we progressed down the river, clasts become much smaller, harder and rounded leading to mostly pebbles and sand lower in the river's course.

Thin sections are to be made which would help in identifying possible microfossils and therefore age correspondents of various rock types.

The stratigraphy of the area is interpreted from the geological cross and stratigraphic column prepared.

HYDROLOGICAL ASSESSMENT

Although the Rio Sambre and its tributaries are the main water sources in the area; the source of water for these rivers is that of underground water provided by springs. Springs are the result of the resurfacing of groundwater and the cause of the springs found at the Mile Gully to George Town and surroundings were found to be faulted contacts. It is inferred from observation that the main impermeable rock in the area is that of the conglomerate which is quite hard with little porosity. Therefore it stops the flow of groundwater furthur down into greater depths. The pore spaces of the conglomerates are also too small to hold water. On top of the conglomerate are limestone rocks which erode easily by water running underground. This also accounts for the block fall which occurs as mentioned before. As a result, limestone is porous and permeable to some extent with pore spaces in some cases being visible to the naked eye. As a result

water is able to flow through and where the impermeable rock meets the surface, the groundwater reemerges as a spring. Limestone and mudstone are therefore the aquifers and the conglomerate the aquiclude.

The two major springs in the area supplying water to the residents are Chapel Spring and Silver Spring. (Shown in the pictures following)

PICTURE 2 AND 3 SHOWING CHAPEL SPRING AND SILVER SPRING RESPECTIVELY.

These springs maintain an almost constant flow all the year round and never go dry according to residents, which allowed us to infer that the size of the underground aquifer and the surrounding watershed is quite large and groundwater may be flowing from far distances to this area. It should be noted that furthur up the course of the river much of it is dry as this is the dry season and there are much more larger limestone outcrops seen which are harder, therefore more compacted and more resistant to erosion. However, at about 1.5km down the river, 2-3 springs emerge and the flow of the river is started by these springs. Therefore, it has been these springs that have been keeping the river flowing all through the year and not primarily that of precipitation.

One feature of the area that is quite prominent due to the flow of water over the limestone is that of gullies that are clearly seen on aerial photographs and looking at the

contours on the map. In the field these gullies were clearly seen and used as paths for water flow into the river and sinks into groundwater which eventually makes its way into the river.

The discharge of the river and springs was not measured; however this is essential as the rate of discharge mainly of the springs over time will be able to help decipher the vastness of the aquifer underground. It must be noted that topography is the key to gravity flow of water into the river whether over the surface or underground.

Water quality, however, is to be found from the samples taken from the main springs and analyzed in lab. But, judging from the use of the water by the surrounding village people, the water is quite safe for a number of uses including that of drinking, cooking and bathing. However, it is used for washing clothes, the detergents of which are found all along the river.

GEOTECHNICAL CHARACTERS OF GEOLOGICAL MATERIALS

LIMESTONE: Two types mapped (1) extensive White Lst. Fm outcrop and (2) limited Yellow Lst. Fm. Most of the limestones are fine grained and weathered and formed much of the soils found in the Merlie to Mile Gully. In moving higher up the river, the limestone becomes much more massive than tabular and blocky and much more compacted or concreted with larger chert fragments. The grains where they were large enough to be seen with the handlens were equigranular. Where the limestone has dissolved away, the springs have formed. The springs arise as joints along the limestone beds. Jointing is another feature prominent amongst the limestone beds.

PICTURE 4 SHOWING BEDDING OF LIMESTONE.

CONGLOMERATE: purplish brown, massive, average sized 0.5 m in diameter. Rock clasts have a porphyritic texture with quartz, calcite veins and K-feldspar. Just as the limestone outcrop, lower down the river and closer to river bank it is much more weathered than further up where it is so hard that it cannot be broken with the geological hammer. Dark coloured rock fragments are mafic igneous rock fragments and some metamorphic fragments and granite are evident.

PICTURE 5 SHOWING CONGLOMERATE.

NATURAL HAZARD PROCESSES

Landslides

PICTURE 6 SHOWING LOOSE BLOCKS OF LIMESTONE ALONG THE JOINTS.

This is an example of one type of landslip seen on the field along the river bank known as block fall. The blocks of limestone fall off along joints into the river along the river and along road cuts. Blocks that fall into the river add to the sediments load carried along the river course. Along the roads, these blocks fall off blocking roadway and preventing transportation to and from the area.

PICTURE 7 SHOWING SLUMPING

The picture above shows slumping of the land. The lack of vegetation in the slumping area results in excessive erosion when rain falls. Debris and water makes its way into the river. The limestone allows for the water to make its way through the weathered soil.

PICTURE 8 SHOWING MAJOR LANDSLIDE ALONG THE RIVER BANK

The landslip seen is mainly due to heavy precipitation and undercutting of the river bank by the moving water when river is in flood. It is also due to the movement of water through the pore spaces of the already loose soil. This results in the soil and rock becoming fluid and under gravity makes its way down slope.

Flooding

As far as residents have reported, there have not been major floods in the area. However, in the gullies water seems to settle creating problems fro road networks. This is because most of the underlying material for the roads is again limestone and therefore, the continuous flow of water across the roads dissolves the limestone creating huge 'potholes' which are a problem for vehicles to pass in some cases rendering the road impassable.

CONCLUSION & RECOMMENDATIONS

1) The area under study is basically that of limestone which host springs.

2) The springs are also associated with faults.

3) The various rock types found are major aquifers and aquicludes with limestone being the major aquifer and conglomerate aquicludes.

4) The discharge of the river and continual discharge throughout the year is mainly sourced from underground water.

5) The area is also prone to Landslides and flooding which are directly related to the limestone makeup of the bedrock

However, there were many limitations to the 3 day study carried out which meant a limited information can be collected over that specific period of time.

It is proposed that the fieldwork should last more then just 3 days as this is a very short time period to cover the area. As well, the area is quite hazardous, especially the rocks along the river. One member of the group lost her camera in water as she fell down due to slippery rocks. Also, in drinking the spring water, one group member got sick which resulted in the stay being curtailed. River flow also changes with the season and therefore, another visit will have to be made to look at the changes in discharge in wet season as opposed to dry season.

However, as much information that can possibly be collected was collected. More information is certainly needed on the area before final conclusions can be made. From this report we have note the areas that are next to be assessed; our ‘gaps’ in information which will be filled on our next visit which will take place in the next 3 months.