TORORET AND OSINONI WASH PROJECTS

TOPOGRAPHICAL SURVEY DRAFT REPORT

Submitted to:

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1. INTRODUCTION

1.1 Background

The maps available for the Study Area from Survey of Kenya are in 1:50,000 scale that were prepared in the 1970s. Although the some of the maps have been updated, the changes are limited and not appropriate for pipeline route design work especially for a gravity flow pipeline system.

The sub-consultant will be responsible for conducting a detailed topographical survey capable of design and setting out of a pipeline route for the water supply for Tororet and Osinoni villages.

The product of the survey exercise will be a topographical map and pipeline route survey data which will be useful to the water engineers for the design of the water pipeline route. A pipeline route survey is carried out to collect data and information of the features and elevations along the main and minor pipeline routes. The data collected will be primary used for the design of the pipeline routes, pipe sizes, pipe types, fittings, gravity flows, air valve and gate valve points.

1.2 Main objectives

The main objectives of the study include;

- To carry out topographical survey to identify highest point within the area
- To plot the surveyed data and produce topographical maps that include the main profile.
- To identify the best route for location of the pipelines and water towers for water to flow via gravity

1.3 Study phases

In order to successfully meet the objectives, the survey was divided into the following phases;

- Reconnaissance -Phase 1
- Survey Control establishment- Phase 2
- Topographical survey and Data collection- Phase 3
- Data processing, Plotting and Reporting-Phase 4

2. EQUIPMENT AND SOFTWARE

2.1 Equipment

The following equipment was used during the topographical survey

- Stonex S3II GNSS Receivers RTK equipment
- Garmin Handheld GPS
- 50m Tape Measure
- Metallic tripod and Assorted staff

2.2 Software

The following software was used during the topographical survey and data processing

- Field Genius software
- MapSource
- Microsoft Excel
- AutoCAD Civil 3D
- Global Mapper

3. SCOPE OF WORK

The survey has been conducted by local consultants with proficiency in water surveys. The scope of work specified in the Technical Specification part include;

1. Reconnaissance
2. Topographical survey of additional pipeline route for the 2 sites; Tororet and Osinoni villages
3. Survey report to include survey control points, levels, profile and layouts

4. GROUND CONTROL SURVEY

4.1 Datum

The following datum was used for the survey

The datum parameters are;

Grid: UTM Zone 36 M (South)
Projection: Transverse Mercator
Ellipsoid: WGS84
Unit of Measurement: Meter
Central Meridian: 33 Degrees East of Greenwich
Latitude of Origin: Equator 0.0000
Scale Factor at origin: 0.9996
False Coordinate of Origin:
False Easting = 500,000 m
False Northing= 10,000,000 m
Datum: WGS84

4.2 Establishment of Survey Control Points

The established control points were used for extension of pipeline routes. The point had been successfully selected and installed on the ground away from canopy, electric lines, structures or obstacles. This is necessary to ensure the GPS satellites signals are not obstructed during the survey. The points are established and concreted using a metallic rod and mixed concrete. The point name is inscribed on the face of the benchmark.

4.3 Survey Control Points/Benchmarks

Site Benchmarks are as shown in the Table below. Benchmarks are given in UTM coordinates with a WGS84 datum Zone 36M.

Table 1: Site Benchmark Information

Benchmarks	Northing	Easting	Elevation	Description	Remarks
1	9888286.930	721308.319	1723.128	BMT1	Tororet Primary School - benchmark at the borehole site
2	9887115.155	700940.549	1763.708	BMN1	Osinoni Primary School – benchmark at the school compound

5. GPS DATA COLLECTION

The data was collected using GNSS Equipment that utilizes satellites for navigation. During the survey Stonex S3 II RTK equipment was used with a horizontal accuracy of 0.015 m and vertical accuracy of 0.030m. The equipment utilizes a 2Watt UHF radio that has a range of 10km for a clear site.

The Tororet site has a borehole already drilled and a solar structure. The borehole is on a site that is far from the school such that distribution lines are needed to supply water to the school. Other routes that were surveyed include the route to proposed water kiosk 1, the route to Mopel Primary School and the route to the proposed water kiosk 3.

The Osinoni site has an existing spring eye that requires rehabilitation works. The spring eye has sufficient flow for water to flow to Osinoni primary school. Additionally, a distribution line to the populated osinoni centre where proposed water kiosk 1 is located was surveyed.

The survey of the pipeline routes was done on 11th to 16th November 2024.

5.1 Tororet Pipeline Route

Tororet primary school is located on geographic coordinate 1° 00' 24.41"S 34° 59' 50.44"E. The school has insufficient water sources heavily relying on rain water and gutters to feed water to the existing tanks. The school is located at an elevation of 1744 m ASL which is approx. 20 metre above the elevation at the borehole.

5.1.1 Borehole to proposed water kiosk 1

Tororet primary school borehole is located on geographic coordinates 1° 00' 36.51"S 34° 59' 19.08"E. The horizontal distance between the borehole and water kiosk 1 is approx. 1232 metres. The proposed route for the pipeline traverses along the road next to the fence.

The elevation at the borehole is approx. 1723.5 mASL while that of the proposed water kiosk 1 is 1743 mASL. The elevation difference between the borehole and the water kiosk is approx. 20 metres rise. The difference is very high which means the water from the borehole would have to be pumped to the water kiosk. However, another site whose elevation is higher than that of water kiosk 1 would be proposed as water tank tower site. The water would then flow via gravity from the proposed water tank tower site to water kiosk 1.

The line can also be plotted as a graph as shown in the figure.

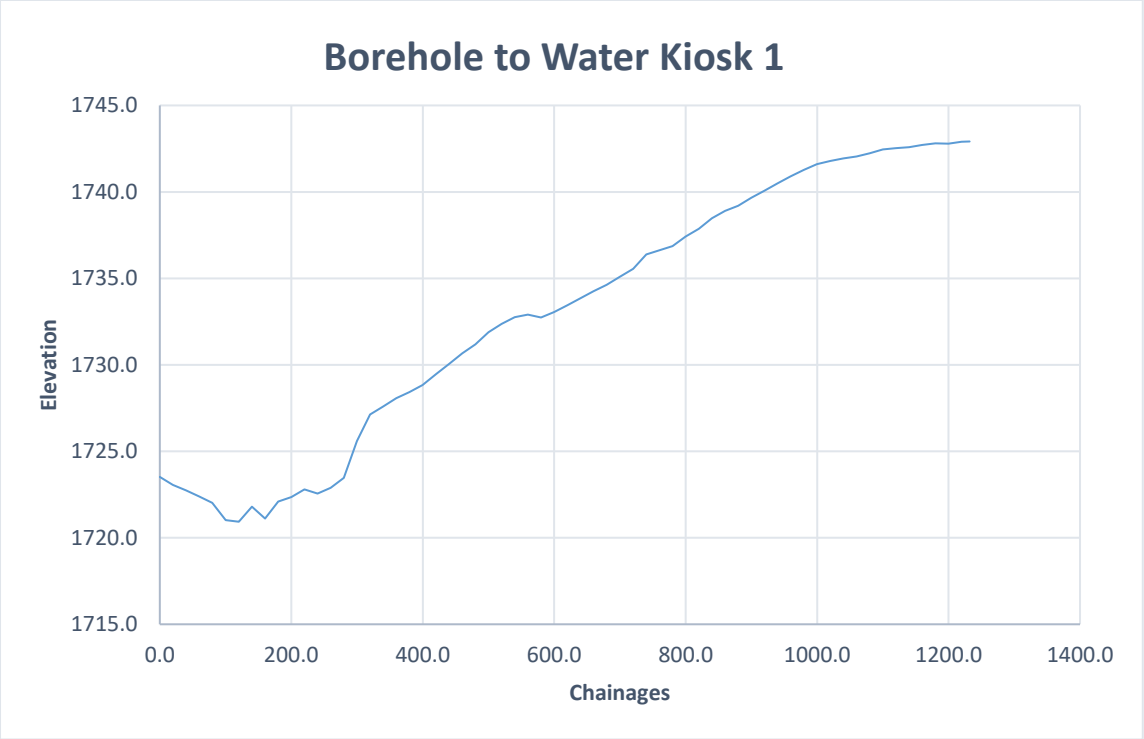

Figure 1: Borehole to Water Kiosk 1

5.1.2 Water Kiosk 1 to Water Point

The pipeline route from the proposed water kiosk 1 to the proposed water point within the school compound is 500 metres in length. The elevation at the proposed water point is 1744 mASL. The pipeline route branches off to feed in VIP girls at KM0+040, VIP boys' toilets at KM0+220 and VIP teachers at KM0+420. The proposed water point is at geographic coordinates 1° 18' 56.96"S 35° 08' 29.34"E.

The elevation at VIP girls is 1743.5 mASL while its approx. 14 metres the pipeline route. The elevation at the junction where VIP boys toilets/T-junction is 1743.3 mASL. The elevation at VIP teachers is 1744.3 mASL. The 1 m rise from water kiosk 1 to the proposed water point in addition to the elevation at the borehole means the water cannot flow via gravity.

The graphical representation of the line is as below

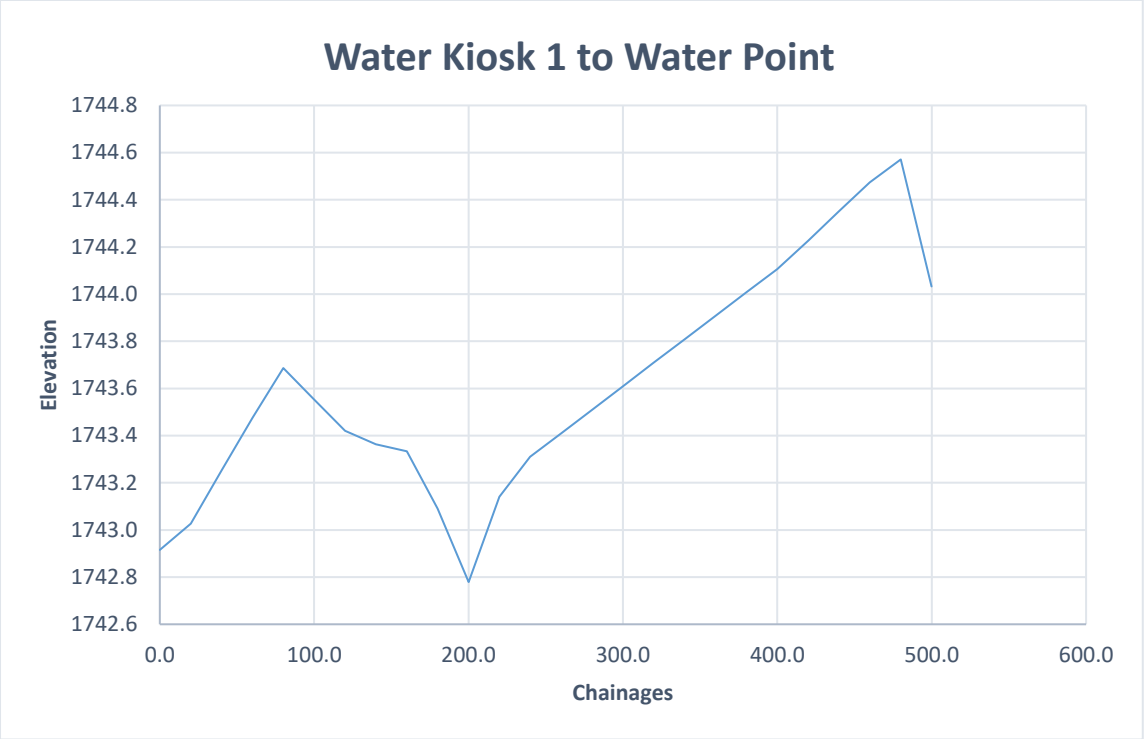

Figure 2: Water Kiosk 1 to Water point

5.1.3 T-junction to Water Kiosk 2

The T-junction is located on KM0+220 of the line between water kiosk 1 and the water point, where the VIP boys' toilets are. The geographic coordinates of water kiosk 2 is 1° 00' 02.24"S 35° 00' 28.58"E, this is the entrance of Mopel Primary School. The horizontal distance between T-junction and proposed water kiosk 2 is 1495.1 metres.

Initially from the T-junction the elevation declines to KM0+540 whose elevation is 10m below that at the T-junction. The elevation at water kiosk 2 is 1750.7 mASL, this is 7.5m higher than the elevation at the T-junction and approx. 27 metres higher than the elevation at the borehole. Water cannot flow via gravity to Mopel Primary School. Additional measures such as an alternative route, alternative location of raised water tank or use of pump system would assist.

The line can be represented as

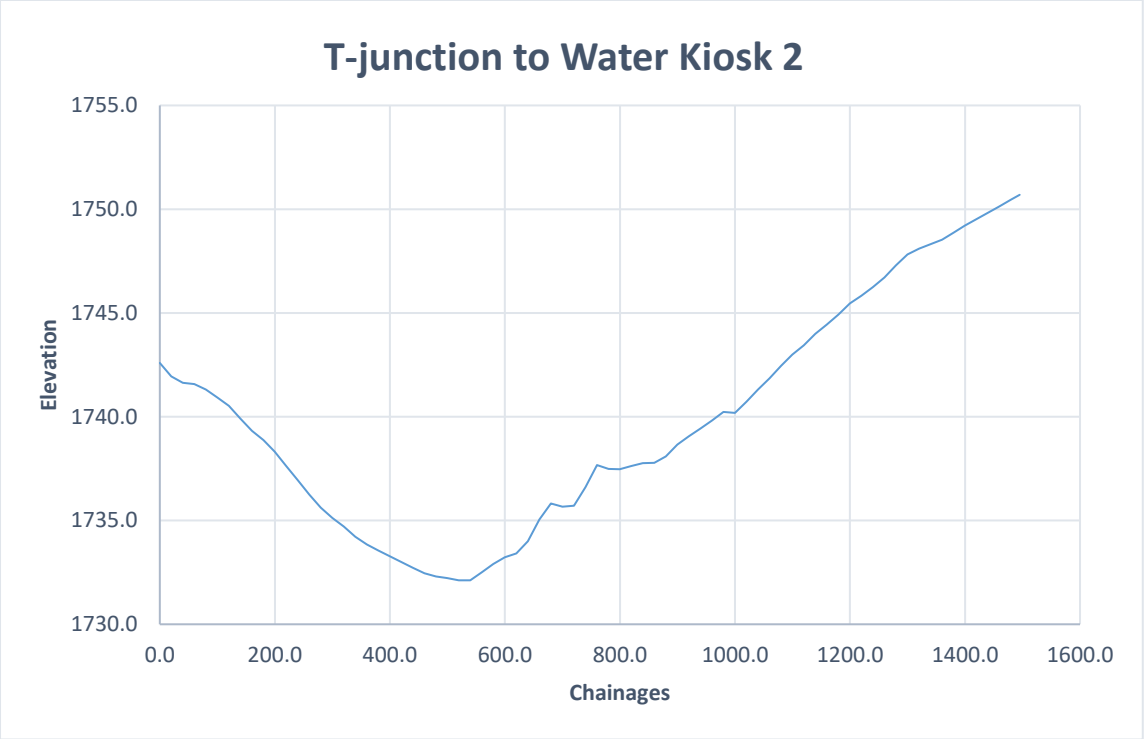

Figure 3: T-junction to water kiosk 2

5.1.4 Water Point to Water Kiosk 3

The geographic coordinates of water kiosk 3 is 0° 59' 19.17"S 34° 59' 32.55"E. The horizontal distance between the proposed water point and proposed water kiosk 3 is approx. 1927 metres.

The elevation at water kiosk 3 is 1757.3 mASL, this is the highest elevation for all the routes surveyed within Tororet. The elevation difference between the water point and water kiosk 3 is a rise of 13.3 metres. Water cannot flow via gravity towards water kiosk 3. However, if water kiosk 3 is selected as the location of the water tank tower it would be suitable for water to flow to water kiosk 1 and 2.

The graphical representation of the line is

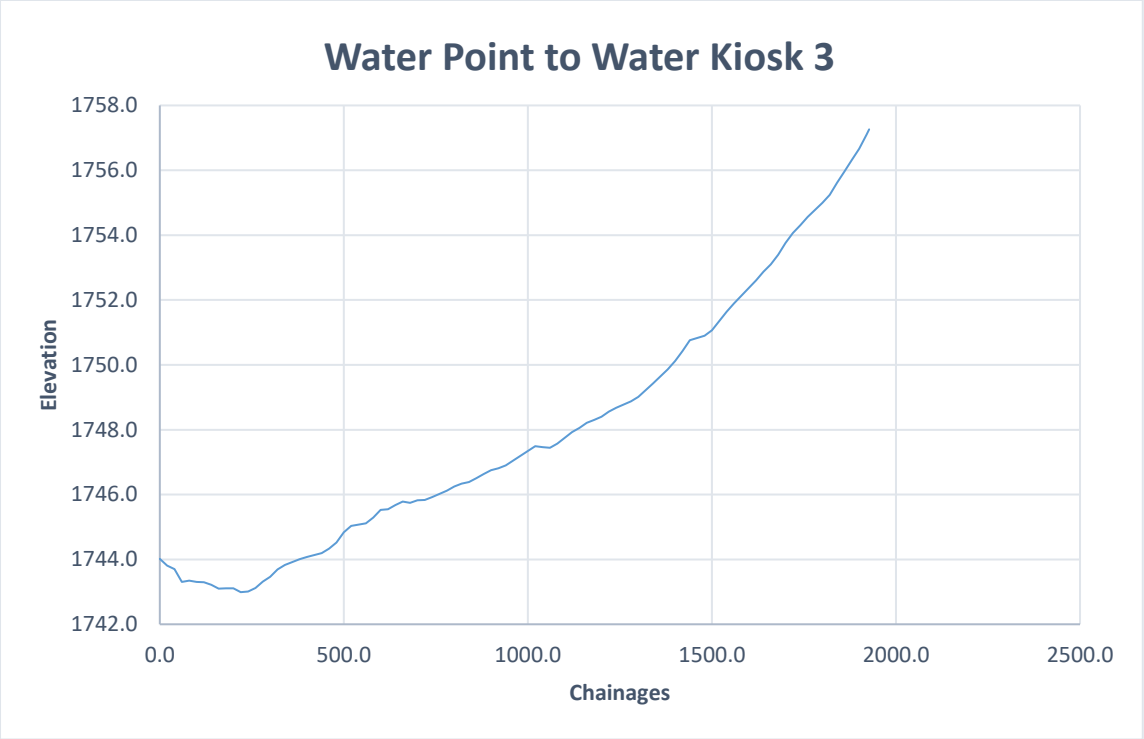

Figure 4: Water point to water kiosk 3

5.2 Osinoni Spring Protection

Osinoni water supply project is a proposed water supply system that will supply water to Osinoni primary school and a water kiosk for the community. The water supply intends to get water from a single springs eye which had been previously rehabilitated. The proposal is for the water to flow to a sump, from the sump due to the levels at the spring location the water will be pumped to elevated tanks. Once at the tanks the water will be distributed to the primary school to serve the VIP toilets and to the proposed water kiosk.

A comprehensive hydrological survey of the springs has to be undertaken to determine the yield. The spring flows will need to be measured during the dry season.

The sub-consultant was responsible for conducting a detailed topographical survey of the spring eyes. The data collected will be used for design of spring protection works and setting out of pipeline route to the school and water kiosks.

5.2.1 Spring eye

The spring eye is located in geographic coordinate 1° 01' 16.83"S and 34° 48' 37.62"E. The elevation at spring 1 is 1735.0 m ASL. The spring eyes is beyond a swampy area and flows throughout the year. It has been a source of water for Osinoni during all seasons. The spring can be classified as an underground type of spring due the its natural water source. The water for the rehabilitated springs comes from underground and flows towards a constructed infiltration pond before it flows out into the connected outlet The depth at the spring eye is approx. 1m, it's a permanent spring.

Plate 1: Existing spring eye

The major design components that should be considered for the spring are

- The spring area rehabilitation of the existing weir
- Outlet through pipes to the pipeline route
- Construction of an infiltration gallery and silt trap
- Construction of a collection sump and a pump house

The spring eye requires adequate protection to prevent from human and animal pollution. Considering the nature of the spring the following design procedures are recommended;

i. Clearing the area with reeds after the spring
ii. A collection chamber made of masonry stones to be used as first collection point
iii. Training wall for the underground spring channel to avoid mixing with stream flood waters.

5.3 Osinoni Pipeline Route

Osinoni primary school is located on geographic coordinate 1° 01' 14.85"S 35° 37' 59.3"E. The school would need the spring to be rehabilitated to offer better flow and for the water to be directed to a storage tank. The school is located at an elevation of 1764.5 m ASL which is approx. 29 metres above the spring eye elevation.

5.3.1 Spring eye to school T-junction

The horizontal distance between the spring eye and the school T-junction is approx. 647 metres. The T-junction separates the waters that serve the school and the ones that go to water kiosk 1.

The elevation at the spring eye is 1735.1 mASL while that at the T-junction is 1766.1 mASL. The elevation difference is a rise of 31 metres. The waters from the spring cannot flow via gravity. Options such as solar pump will have to be considered for the waters to be pumped to the highest point.

The graphical representation of the line is as below

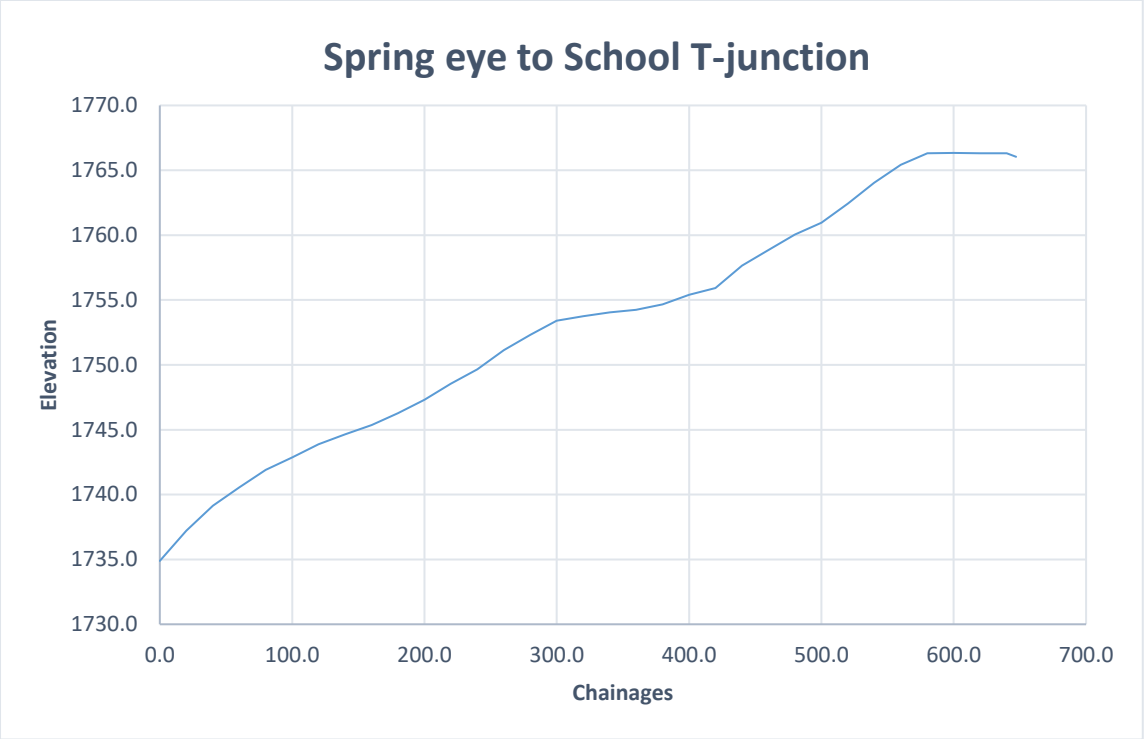

Figure 5: Spring eye to school T-junction

5.3.2 T-junction to VIP Toilets

The pipeline route from the T-junction to the last VIP toilets is 116.5 metres. The line serves the VIP Girls toilets at KM0+080 and the VIP boys at KM0+117.

The elevation difference between the T-junction and the VIP boys is a decline of 6.4 metres. With the horizontal distance water can sufficiently flow via gravity from the T-junction to VIP Boys. The elevation at VIP boys is 1759.7 mASL.

The line can be represented as

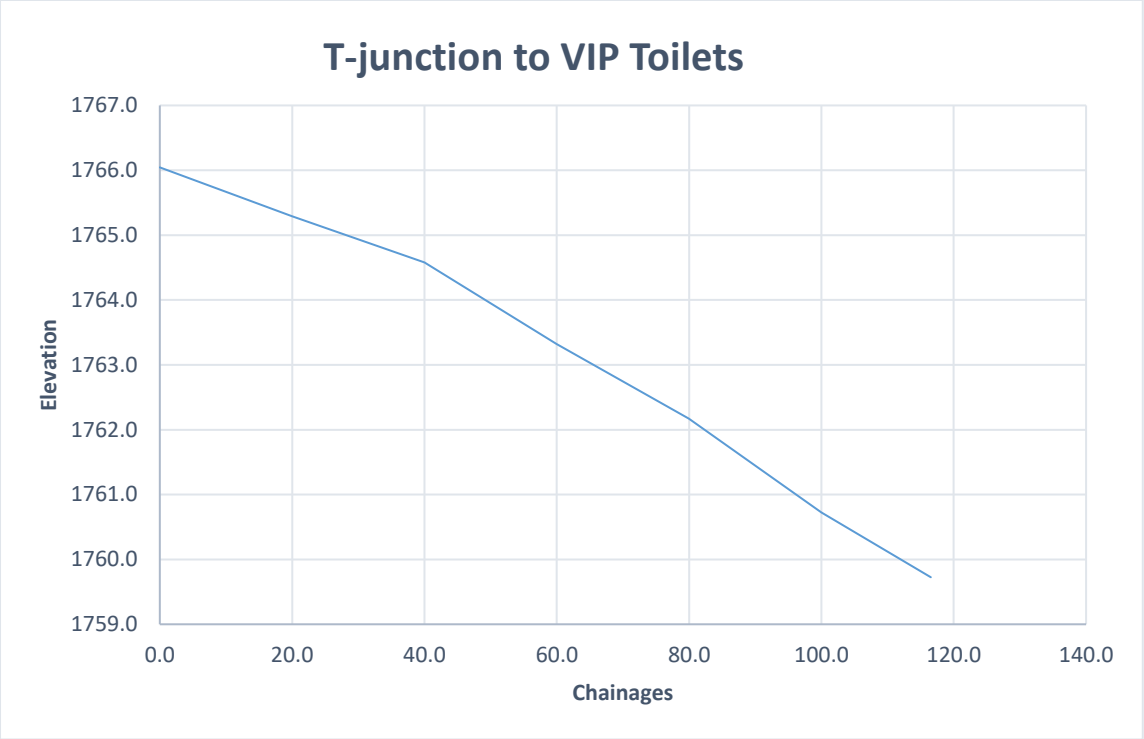

Figure 6: T-junction to VIP Toilets

5.3.3 T-junction to water kiosk 1

The geographic coordinates of water kiosk 1 is 1° 01' 07.57"S 34° 48' 19.01"E. The water kiosk 1 is located at approx. 214 metres from the T-junction.

The elevation at water kiosk 1 is 1779.2 mASL. This is the highest elevation in the areas surveyed. With the elevation being 44 metres above that of the spring eye, this is the most suitable place for location of an elevated water tank. The elevation difference between the T-junction and water kiosk 1 is 13 metres rise. Design calculation that consider frictional loss should be done to determine the height of the proposed elevated tank or pump specifications.

The graphical representation of the line is

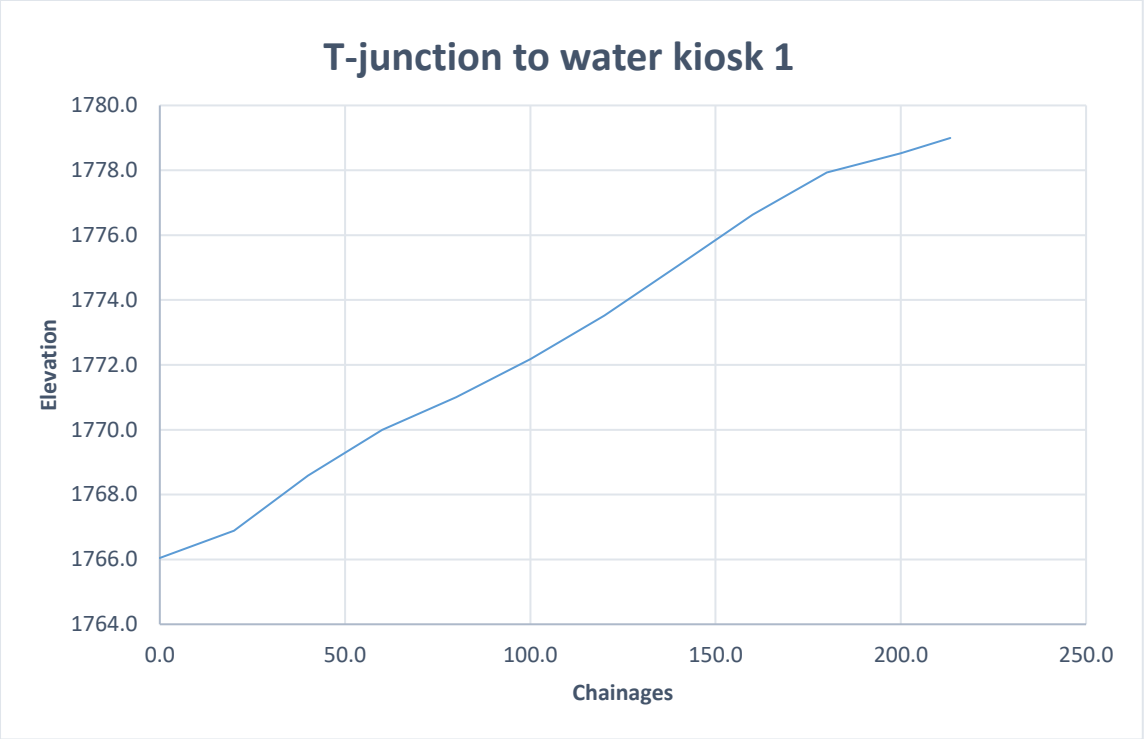

Figure 7: T-junction to water kiosk 1

6. AUTOCAD SITE LAYOUT

From source to site on Google Earth View

Figure 8 : AutoCAD maps

7. DIGITAL ATTACHMENTS

The following files are available with regards to this report

- Tororet and Osinoni Survey Report.docx — This report;
- Tororet and Osinoni Survey Report.pdf — This report;
- Tororet Layout — AutoCAD dwg
- Osinoni Layout — AutoCAD dwg
- Tororet Survey data + Graphs — Excel
- Osinoni Survey data + Graphs — Excel