Investigation of Drainage Inverts levels for optimal Functionality in a Section of Onne Multipurpose Terminal: Rivers State, Nigeria

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Abstract- The section of Onne Multipurpose Terminal under study is usually flooded especially when it rains heavily. The inability of existing drainage system to discharging rain water to the river through the existing carnal has also resulted to the occurance of stagnant water in the drainage under study. The study is therefore aimed to investigate the status of the drainage invert levels with the objective of determining the change in invert level at chainage of Five meter 5m interval, determine the tidal levels at the existing canal and proposed a water discharge point. The study methodology was based on the classical (conventional) surveying techniques which involves the determination of the distances, directions and elevation between series of points. The Lieca flexline TS06plus Total Station Instrument with 3mm accuracy and Kolida K9TX (DGPS) GNSS Reciever with 2mm accuracy and were deployed to acquire spatial data of the drainage system under study, this data includes drainage position, elevation and invert levels. The results revealed a highest and lowest invert levels of 2.713m and 2.125 respectively with a change in invert level of between 0.002m to 0.593m. this findings indicates an inconsistence differences in invert level at chainage of 5m along the drainage profile, this means that the drainage gradient has been heavely impacted resulting to its inability to discharge water to the to the river through the existing canal. Redesigning and reconstruction of the drainage using acquired spatial data from this study is neccesary to prevent total collapse of the drain and continous flash flood and stagnant water in the environment.

Indexed Terms- Drainage, Inverts Level, Chainage, Tidal, Spatial

I. INTRODUCTION

Drainage facility is very sueful in the removal of excess rain water from the earth surface and cotrolling of water log in the bulit environment. This excess water may be as a result of runoff from rainfall or irrigated water. Drainage network can either be natural or artificial, however; natural drainage may often be inadequate to dischrge water from unwanted areas to the discharge points, hence the nned for artifical drainage system (Qianqian, 2014). The importance of a drainage system is such that it ensures the tranportation of waste water and sewage materials to disposal points thereby keeping the environment free from stagnant water and liquid waste products among others. Drainage system exist as a major infrastructure to dispose storm water and wastewaters and reduce the impact of flash fllod in the environment (Musa et al, 2019).

Offiong et al (2008), noted some health effect and implications of stagnant water in the drain and bulit enviroment. This includes gsatro-instestinal diseases such as stomoch disorders, constpation, water borne related diseases and contamination of drinking water as a result of infilteration and percolation of polluted water. The study also noted that proper and regular cleaning of drainage channels is neccesary to prevent curb likely enviromental hazardsand to eradicate the habitation of pathogens responsible for noted diseases. Several research schorlars have also noted some contributive factors of drainage blockage and non functionality. Eze, Kaboufou and Ruth, (2023) opinned that indiscriminate dumping of solid waste results to blockage of drainage infrastructure as these waste materials are transported into the drainage espectially during rainy seasons in port harcourt, Nigeria and proffered solutions for suitable solid waste disposal points in Port Harcourt. Parkinson, Tayler and

Mark (2017), also noted that poor maintainance and encroachments on drainage facilities contributes to drainage blockage, citing erection of buliding on drainge right of ways as a key issue of serous concern. However, non of these schorlars have considered the inconsistent gradient of drainage surface due to distorsions in the inver levels, hence the quest for the present study which is aimed to investigate the drainage inverts levels for flood control at Onne Multipurpose Terminal, Onne Town, Rivers State of Nigeria.

The drainage system under study is in a very bad state and has been unable to transport or discharge water to the river through the existing canal. Efforts has been made to consistently clean the surface to enable efficient discharge of rain and waste water but all to know avail. The need to adopt scientific investigation of the status of the drainage invert levels became imparative. The significance of this study is such that it will provide fundamental spatial data that will assist the management in the award for possible planning, redesigning, reconstruction and management of the drainage system to forestall total collapse of the drainage infrastructure.

- Study Area Description

The study area is a section of Onne Multipurpose Terminal, in Onne Town of Eleme Local Government Area of Rivers State of Nigeria. It is spatially located within projected coordinates of 516144.96m.E, 294565.47m.N, the drainage facility under study covers a distance of 1.35km

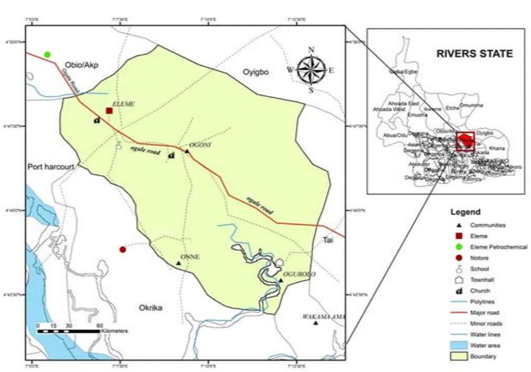

Figure 1.1: Study Area Map and section of drainage facility under study

II. MATERIALS AND METHODS

The following equipment and instruments were utilized during the project.

Hardware and Software Selection

Surveying Insrument Used:

i. Kolida K9TX (DGPS) GNSS Reciever with 2mm accuracy and accessories.
ii. The Lieca flexline TS06plus Total Station Instrument with 3mm accuracy
iii. Leica (NA520) Automatic Level with 5mm accuracy
iv. 100m measuring wheel, 100m steel tape, Tripods and leveling staff.
v. HP Elite Pro-book H1072 laptop installed with Intel CORE i5, 16gig, 64-bits with windows 11 operating system.
vi. Printer and Field books

Software Requirement

i. Q-GIS 10.1 vector based software
ii. Integrated Land and Water Information System(ILWIS)
iii. AutoCAD (computer aided design). 2007 version
iv. Ms excel 2013 version
v. Sulfur TES ML (SWR-23-02) Graphic Software

Scope of Study: Traversing, Levelling and Tidal Observation

Projection: Universal Tranverse Mercator (UTM) Zone 32N, WGS-84 Datum)

Research Methods
The methodology adopted for this study was based on the quantitative paradigm of field data collections. The spatial positions, elevations and directions of drainage facility under study were determined with the use of Total station instrument and DGPS by ground observation using traversing and levelling techniques of surveying field data acquisition.

The following research methods were useful during field data collection:

Reconnaissance Survey
First-hand information about the area were obtained during reconnaissance survey. A general view of the state and extent of the drainage carried out. Ground controls within the study site in form of monument were identified, also noted were stations for instrument setups, number of turning points and order of survey. The first-hand information of the study area obtained during reconnaissance survey assisted greatly during pre-analysis which consists of choice of instrument, number of survey crew, and duration of study; others were accuracy of data and study deliverables.

Secondary Data Search
Secondary data such as projected coordinates in Northing (m) and Easting (m) of identified ground controls were obtained from the EN Engineering Limited, a consulting Engineering firm in Onne Multipurpose Terminal shown in table 2.1. In-situ check was also carried out to ascertain the reliability of the controls to both linear and angular observations. The controls were free from vertical and horizontal displacement and was used as a reference point for traversing and leveling operations.

Table 2.1: Coordinates of Controls Points Identified in the Study Area

Station	Easting (m)	Northing (m)	Origin
KR06	294580.351	516141.63	UTM Zone 32N
KR05	294584.641	516139.74	UTM Zone 32N
KR04	294590.178	516138.27	UTM Zone 32N

Primary Data Acquisition: Three dimensional observations (Northing, Easthing and Elevation) were carried along the center of the existing drain at five (5m) chainage with the use of Kolida K9TX (DGPS) GNSS reciever, the positions and elevations of proposed discharge points were also observed and referenced to benchmark (KR6). Leica (NA5220) Authomatic Level was used for hight transfer from arbitrary benchmark value (3.960m) to station ONNE TD1 and station ONNE TD2 with Benchmark values of (4.860m) and (4.180m) respectively. Tidal readings were obtained in one hour (1hr) interval for fourtheeen (24) hours between morning, afternoon, evening and night

The leveling was carried out at interval of 5 meters chainage to ensure that critical points on the drainage floor are properly captured and not omitted.

The drainage invert level were determine using the height of collimation method of level reduction, this method relies on the theory the when a level instrument is set up, centered and levelled, the reduce level of the line of collimation is the height of instrument.

Mathematically; Instrument Height (H.I) = BS+RL of BM (1)
Reduce Level of a point (RL) = H.I – IS or FS (2)

Where; BS = Back Sight Reading, IS = Fore Sight Reading, IS = Intermediate Sight Reading and BM = Benchmark.

Data Processing: Drainage position and elevation data were carefully downloaded, ploted and edited. Tidal readings were also referenced to benchmark ONNE TDI and ONNE TD1 respectively. Linear and level misclosure of 0.002m and 0.006m and 0.005 were obtained for DGPS, Total Station and Level instruments used. The downloaded field data were carefully edited to ensure that the data is a true reflection of ground observations. AutoCAD 2007 vector based graphic software was used inplotting the acquired field data and produce rhe plan and longitudinal profile of the drainage infractructure under study on a scale of 1:2000. Ms Excel 2013 Software was used to produce the tidal chart overflow ton the canal, whereas Sulfur TES ML (SWR-23-02) graphic software was utilized to produce the 3D Wire Frame and the 3D Invert level as shown in figures 3.3 and 3.4

III. RESULTS AND DISCUSSIONS

Table 1: Three Dimensional Data of a section of the Drainage Facility Under Study

Point ID	Chainage (m)	Eastings (m)	Northings (m)	Invert Levels (m)	Difference	Remark
Onne 1	0	294565.47	516144.96	3.690	0.959	BM (KR6)
Onne 2	5	294570.791	516143.82	2.731	-0.089	
Onne 3	10	294575.266	516141.92	2.820	0.158	
Onne 4	15	294580.351	516141.63	2.662	-0.017	
Onne 5	20	294584.641	516139.74	2.679	-0.006	
Onne 6	25	294590.178	516138.27	2.685	0.039	
Onne 7	30	294594.997	516137.09	2.646	-0.058	
Onne 8	35	294599.546	516135.84	2.704	0.127	
Onne 9	40	294604.162	516134.69	2.577	-0.038	
Onne 10	45	294609.007	516134.43	2.615	0.006	
Onne 11	50	294613.779	516133.16	2.609	0.064	
Onne 12	55	294619.046	516131.51	2.545	0.022	
Onne 13	60	294624.26	516130.57	2.523	0.089	
Onne 14	65	294628.75	516129.42	2.434	-0.057	
Onne 15	70	294634.935	516127.92	2.491	0.09	
Onne 16	75	294638.874	516126.45	2.401	-0.158	
Onne 17	80	294643.75	516124.71	2.459	0.058	
Onne 18	85	294648.52	516123.58	2.401	0.026	
Onne 19	90	294653.226	516122.83	2.375	0.141	
Onne 20	95	294657.884	516121.17	2.234	-0.149	

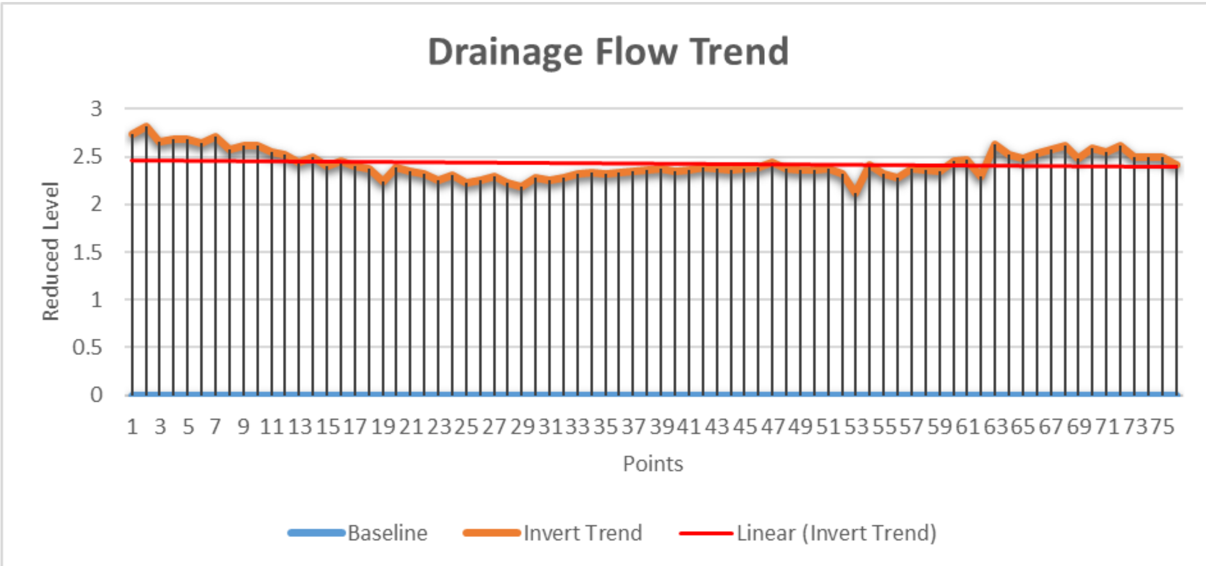

Figure 3.1 Longitudinal Profile of Drainage under study

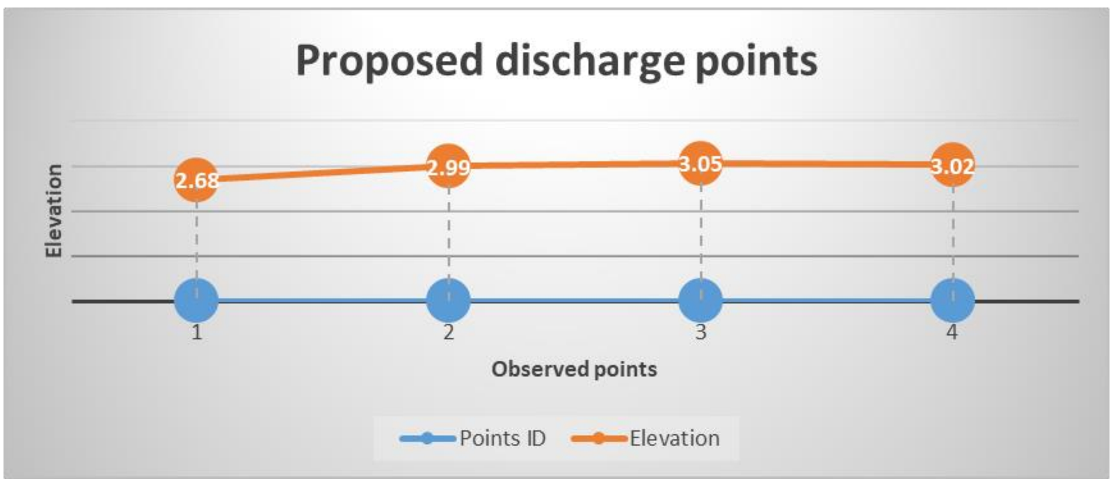

Figure 3.2: Elevation and Flow Trend of Proposed Discharge Points

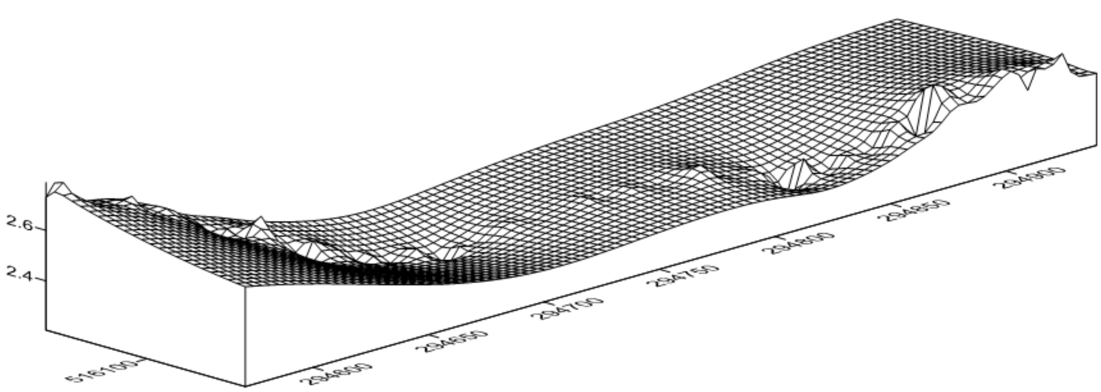

Figure 3.3: 3D Wireframe or Drainage infrastructure under study

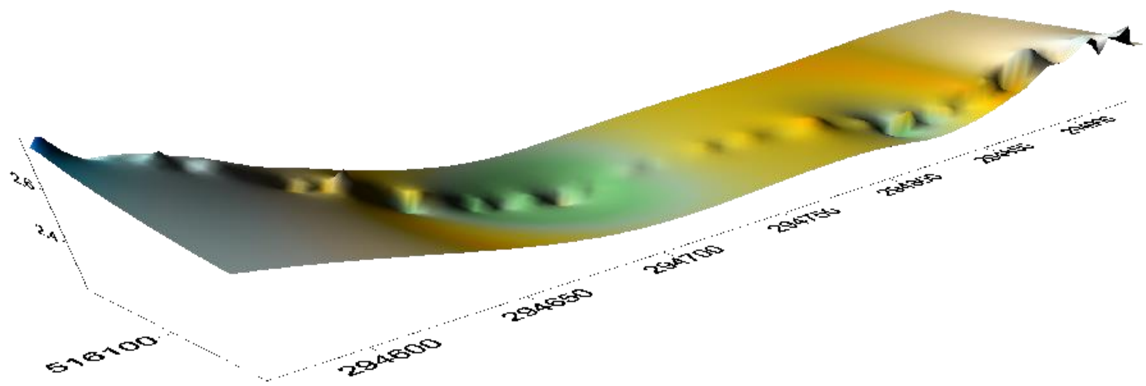

Figure 3.4: 3D Surface of Existing Drain

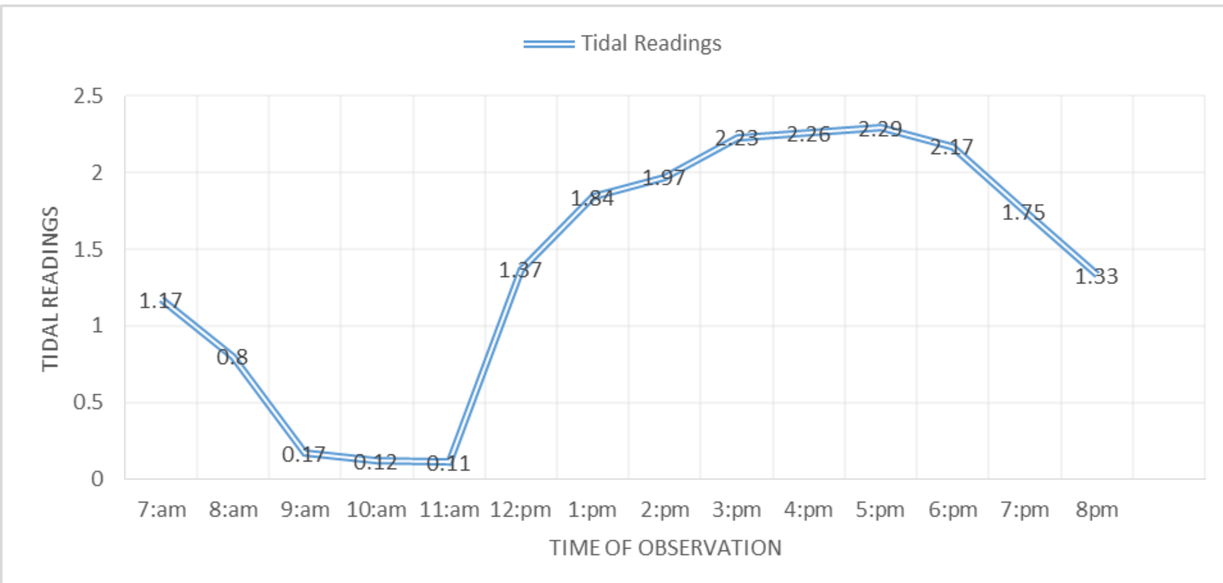

Figure 3.5: Tidal Flow Observations to Existing Canal

Table 3.2: Major Research Findings

Highest Drainage Elevation	2.713m
Lowest Drainage Invert Elevation	2.125m
Highest Tidal Reading (Deep Sea)	3.21m
Lowest Tidal Reading (Deep Sea)	1.47m
Mean Tidal Reading (Deep Sea)	2.34m
Highest Tidal Reading (Carnal)	2.29m
Lowest Tidal Reading (Carnal)	0.11m
Mean Tidal Reading (Carnal)	1.20m
Discharge (1) Elevation	2.680m
Discharge (2) Elevation	2.989m
Discharge (3) Elevation	3.054m
Discharge (4) Elevation	3.016m
Difference Between Highest Discharge Elevation and Highest Drainage Elevation	0.34m
Linear and Level misclosure	0.002m and 0.006m

Discussion of Findings: The project findings as shown in figure (3.1) revealed that the existing drainage under investigation is not fully functional as a result of sediments on the several points on the drainage and inappropriate gradient or slope, hence; a new invert level is needed to recast the drainage floor to enable complete discharge of water to available discharge points. It was also revealed that proposed discharge points (2), (3) and (4) cannot be used because its elevations are higher than all points in the existing drainage, whereas discharge (1) elevation is not also suitable with a difference in elevation of 3mm lower than the highest elevation in the drainage under investigation. There was almost completely discharge of water to the deep sea between hours of (9am – 11am), this indicates that the canal tide level will not be a threat if water is channel to the canal since the highest tide reading is (o.45m) difference from the highest elevation of existing drainage. The research findings also revealed that the drainage invert levels are totally deformed with inconsistence slope factor along the chainage.

CONCLUSION

The survey was carried out in accordance to client's specifications and Surveyors Council of Nigeria (SURCON) specification for survey of third order accuracy. The project aim was achieved with the use of selected surveying instruments used and methods adopted. The field data were carefully acquired and processed and all necessary checks were carried out to ensure that result obtained were within allowable accuracy. The research findings clearly justified the need for the study, the classical surveying (Geomatics) technique adopted prove to be the best method for scientific investigation involving non-functionality of drainage systems.

RECCOMENDATION

i. The acquired field data should be used to planned, redesigned and reconstruct the drainage for optimum use and funtionality.
ii. Regular cleaning of the drainage is neccesary to check for eventual obstruction of water transportation to discharge or disposal points.
iii. Drainage water should be channeled to the existing storm water canal to enable effective transportation of rain water and othe liquid waste to the deep sea disposal points.

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