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EFFECTS OF SEWAGE DISPOSAL SYSTEMS ON THE ENVIRONMENT IN PUBLIC HOUSING ESTATES IN ENUGU METRPOLIS

Boniface S. Okoye [1]; Chukwunonso O. Umeora [2]; Oluchi C. Ifebi [3]; Chijioke C. Onwuzuligbo [4]
[1-4]*Department of Architecture, Chukwuemeka Odumegwu Ojukwu University, Uli campus*

Abstract

This study examines the effects of sewage disposal systems on the environment in Riverside Housing Estate, Abakpa in Enugu metropolis. The research method adopted for this study was survey method; questionnaire was developed, which consisted of 5-point Likert rating scale ranging from 1-5 in which respondents indicated the extent of their perception of listed variables. The results showed the sewage disposal systems common in the estates are On-site system and Centralized system. The onsite system is gaining more importance in the estates as different from the centralized system which was initially planned in the estate. However, the systems are not without challenges resulting from choice of inept skill, improper siting, non- adherence to proper design concepts and lack of proper maintenance. These bring about negative environmental impacts ranging from ground water contamination, pollution of surface water bodies to contribution to global warming through the emission of green house gases. From the survey, it was observed that the only problem with on-site system is the contamination of water gotten from hand dug wells in the estates owing to its proximity to onsite sanitary facilities and it is easier to maintain the on-site system than the centralized system. In the centralized system when there is blockage of the sewerage, the sewage flows out into people's compounds and environment thereby polluting the water source (underground wells, which is common in the study area) and environment. The paper recommends that On-site system/septic tank should be encouraged with the design and construction supervised by an architect as well as located away from water source.
Keywords: *Centralized system, Environment, Housing Estates, Sewage Disposal Systems*

INTRODUCTION

Sufficient attention has not been given to sewage disposal especially its effects on the environment and quality of life of residents in an estate. Sewage disposal is the process in which waste water that is disposed from homes and shops, which is normally transported in form of small liquid with suspension of small solid in large pipes called sewers to produce environmentally safe waste (Ask, 2014). The waste water are either directed to a designated place where it could be recycled or disposed of far away from the city as it can lead to spread of diseases. Disposal of sewage waste protects public health and prevents disease, as well as water pollution from sewage contaminants. Most cities of the developed countries have functional sewage disposal systems, coupled with technological advancement. There have been innovations which have allowed for more environmentally friendly and healthy solutions to disposing and

treating sewage. Sewage systems are part of modern infrastructure and urban utilities, which also include gas, electric, and water supply (Ladan, 2014).

The United Nations Educational, Scientific and Cultural Organization (UNESCO) (2012), noted that the global waste water generation is on the increase at a high rate, which is caused by rapid population growth and urbanization. According to Zandaryaa (2011), a large amount of untreated waste water is dumped directly into water resources, which threatens human health, ecosystems, biodiversity, food security and the environmental sustainability. In Nigeria, different cities make use of different sewage disposal methods, such as organized functional sewage system, disorganized and decentralized methods (septic tanks) of waste water disposal. Some cities with organized functional sewage system are; Abuja, Port Harcourt, Kaduna, Calabar and Lagos. Studies on sewage disposal identified some problems and amongst them are: study by Ayotamuno (1993) on Port Harcourt which revealed that some open drains and septic tanks expose people to the risk of direct contact with parasitic organisms and some discharge of waste water into the open drains threaten water resources. Ladan (2014) assessed different sewage disposal methods in Katsina, Nigeria and recommended that more efforts should be put to ensure proper sewage disposal in the metropolis and thereby reducing the negative environmental health impacts that were created by the majority of the methods used for sewage disposal.

In Enugu, households in public housing estates generate volumes of sewage (faeces and urine) that Enugu State Housing Development Corporation (ESHDC) authorities appear to be incapable of handling. ESHDC has established forty housing estates over the years and has not employed proportionate number of maintenance officers to cope with the challenges involved in maintaining the sewage disposal systems (ESHDC, 2015). It appears that the ESHDC does not have control on the residents using the central sewerage system as designed and built in only three of the estates namely: Riverside Housing Estate, Abakpa, Trans Ekulu Housing estates and Phase VI Housing estate. The residents introduce the on-site septic system, where the central sewerage system had been built, on their volition without clearance from the authorities of ESHDC. Part of the problem is the rapid rate of generation, which the corporation may not be capable of coping with and the failure of the central systems, which may not have been addressed adequately, due to financial, organizational and management challenges. Riverside Housing Estate was been selected for this study, this selection is informed by the fact the estate is served by both central sewage system and the traditional onsite septic sewage systems.

This study is aimed at assessing the effects of sewage disposal system on the environment with a view to identify the system that best suits for environmental sustainability. The objectives are: to identify the sewage disposal methods in the study area; to examine their effects on the environment.

Study Area

This research is focused on Enugu city/metropolis which is the capital of Enugu State of southeastern part of Nigeria with area coverage of 113km2 and population density of about 427.6 persons per square kilometer. It is geographically located at latitude 6^{o} 25”N and 7 ^{o} 03”N of the equator and 7 ^{o} 25”E and 8 ^{o} 19”E of the Greenwich Meridian. Figure 1.0 shows the location of Enugu metropolis and is bounded in the east by Nkanu East Local Government Area, in the west

by Udi Local Government Area, in the north by Igbo-Etiti and Isiuzo Local Government Areas and in the south by Nkanu West Local Government Area. Hills in Enugu at the extreme may reach an elevation of 1,000 metres (3,300 ft). The Highlands surrounding Enugu for the most part are underlain by sandstone, while lowlands are underlain by shale (Chukwu, 2015).

According to the 2006 Nigerian census, the Enugu metropolitan area had a population of 764,590 and nearly two million according to 2015 estimates (National Population Commission 2006). The city of Enugu falls under hot – humid climatic zone, humidity is at its highest between March and November. The annual mean temperature ranges between 22^0C and 30^0C whereas the relative humidity fluctuates between 40% and 80%. The prevailing winds are of two types, namely the North-east trade wind and South-west trade wind. The North-east trade wind blows from across the Sahara over the area thereby leading to the dusty harmattan weather or dry season. The dry season usually lasts from November to around March. The South-west trade wind blows as water saturates wind from across the Atlantic and brings about the rainy season. The rainy season usually lasts from April to October with a short break in August. The average annual rainfall in Enugu is around 2,000 millimetres (79 in), which arrives intermittently and becomes very heavy during the rainy season. Residential land use accounts for the highest land- use area and it comprises about 54.3% of total urban area in Enugu (Nwankwo, Diogu & Nwankwo, 2014).`

Figure: 1.0 Map of Enugu State showing Enugu Metropolis.
Source: (Chukwu, 2015)

Figure 2.0 displays the map of Nigeria showing Enugu state with the other 35 states and the Federal Capital Territory. The state shares boundaries with Anambra State on the West, Abia State on the South, Kogi State on the North while Benue and Ebonyi States are on the East. The soil in Enugu is made up of soils whose morphology is influenced by underlying impervious shale.

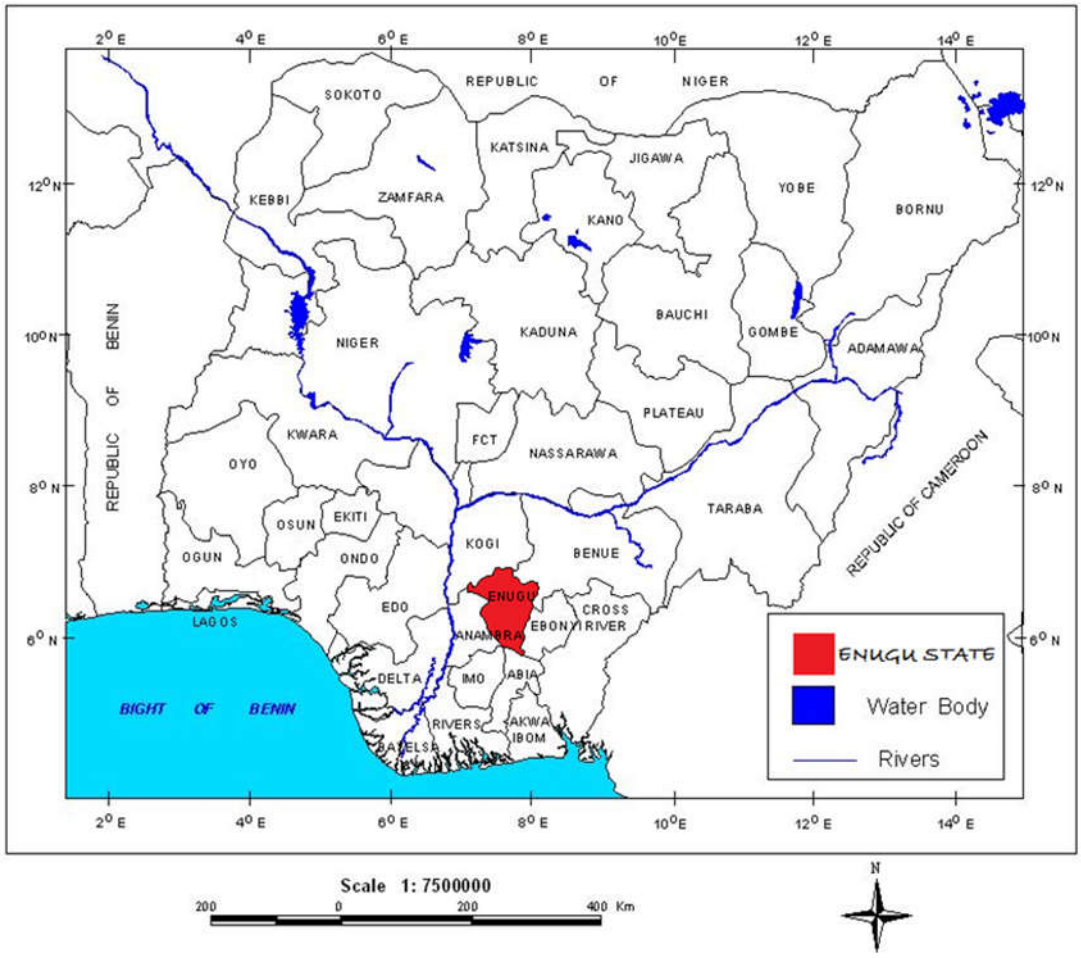

Figure 2.0: Map of Nigeria showing the 36 States and the Federal Capital Territory
Source: (Nationsonline, 2016)

LITERATURE REVIEW

Conceptual Framework

Social perception concept is adopted for this work. Here, perception deals with people's abilities to derive information from the environment, interpret that information and act upon it. The

perception serves as the mediating link between individual's sensory clues and the environment (Steggell, Binder, Davidson, Vega, Hutton & Rodecap, 2003). Social perception concept suggests that these clues are interpreted through a set of generalizations gained through the culture in which people are immersed and are processed through individuals' own feelings about the environment. This concept is applied to this study to ascertain how residents perceive their environment given the existing sewage disposal system in the compound.

Empirical studies

Sewage was described by Odetola and Awoniyi (2007) as a complex mixture containing nutrients, suspended solids, pathogens, oxygen's dissolving substances, other contaminants and each has its own different environmental impact. Sewage is a water-carried waste, in solution or suspension that is intended to be removed from a community. Also known as domestic or municipal wastewater, it is more than 99% water and is characterized by volume or rate of flow, physical condition, chemical and toxic constituents, and its bacteriologic status (which organisms it contains and in what quantities). It consists mostly of grey water (from sinks, tubs, showers, dishwashers, and clothes washers), black water (the water used to flush toilets, combined with the human waste that it flushes away); soaps and detergents; and toilet paper (less so in regions where bidets are widely used instead of paper). Whether it also contains surface runoff depends on the design of sewer system. (Metcalf, 2003). Ideally the runoffs should not be directed to the sewerage.

Sewerage refers to the infrastructure that conveys sewage. It encompasses components such as receiving drains, manholes, pumping stations, storm overflows, and screening chambers of the combined sewer or sanitary sewer. Sewerage ends at the entry to a sewage treatment plant or at the point of discharge into the environment. Also, sewerage refers to the system of pipes, chambers and manholes that conveys the sewage (Abubakar, 2014). A sewerage system receives domestic, commercial and industrial wastewater to protect public health and the environment and treats and disposes of the effluent at a location distant from an individual property, enabling higher density development, with savings in other services such as water supply, energy and transport. It enables large-scale treatment installations to be built and operated, resulting in considerable cost savings and results in point source rather than diffuse source discharges, which are easier to manage, monitor and modify. Thus, the concept of sewerage may be seen to improve the housing condition of the neighbourhoods (Ibeaka, 2014).

Sewage need to be disposed off as it is unwanted water from homes and shops. Sewage disposal is therefore the return of used water to the environment. Disposal points distribute the used water either to aquatic water bodies such as oceans, rivers, lakes, stream, ponds or lagoons or to land by absorption systems, ground water recharge and irrigation (Farlex, 2014). Sewage disposal methods are the ways that are available to home and shop owners for the release of waste water into the environment. The wastewater from residences and institutions, carrying body wastes (primarily faeces and urine), washing water, food preparation wastes, laundry wastes, and other waste products of normal living, are classed as domestic or sanitary sewage. Human faeces together with human urine are collectively referred to as human waste or human excreta. Containing human faeces, and preventing spreading of pathogens from human faeces via the faecal, are the main goals of sanitation. Liquid-carried wastes from stores and service establishments serving the immediate community, termed commercial wastes, are included in the

sanitary or domestic sewage category if their characteristics are similar to household flows. Wastes that result from an industrial process such as the production or manufacture of goods are classed as industrial wastewater, not as sewage.

A system of sewer pipes (sewers) collects sewage and takes it for treatment or disposal. The system of sewers is called sewerage or sewerage system. Where a main sewerage system has not been provided, sewage may be collected from homes by pipes into septic tanks or cesspits, where it may be treated or collected in vehicles and taken for treatment or disposal. Properly functioning septic tanks require emptying every 2–5 years depending on the load of the system.

A septic tank (On-site system) is a key component of the septic system, a small-scale sewage treatment system common in areas that lack connection to main sewage pipes provided by local governments or private corporations, (Tilley, Ulrich, Reymond & Zurburgg 2012). A septic tank consists of one or more concrete or plastic tanks of between 4000 and 7500 liters (1,000 and 2,000 gallons); one end is connected to an inlet wastewater pipe and the other to a septic drain field. Generally these pipe connections are made with a T pipe, allowing liquid to enter and exit without disturbing any crust on the surface.

In the Riverside Housing Estate, as is the case with most cities in Nigeria, though, the central system still exists, but the common method is the decentralized system where every resident constructs outlets at ground level to discharge waste water.

Central sewage system
This is the method by which sewage is directed to flow into the water pond found in the estate. Houses within the estate are simply directed to central sewage pipes and empties into the pond. The sewage sometimes flows into the open ground when there is blockage which ends up forming puddles. The system is difficult to manage as it sometimes require large sum of money to trace blockages and repair the channel. The ESHDC pay little or no attention in the maintenance of the central sewage system, leaving it in the hands of the residents.

On-site/Septic Tank
In this method, a large hole is dug underground lined with sandcrete blocks with an inlet pipe for sewage and outlet. The tank normally has a man hole with removable concrete cover with air vents for gases to escape. This method is more hygienic as the sewage does not come out to the ground surface and do not occupy floor area on the roadsides or impair the beauty of the surroundings (Garg, 2004). This system is cheaper to maintain and manage since each compound has its own septic tank which may take up to 5years to get filled up, before talking about evacuation.

All sewage ends up back in the environment (from which its constituents came), by any of several routes. A basic distinction in its route is whether it undergoes sewage treatment to mitigate its effect on the environment before arriving there. Sewage usually travels from a building's plumbing either into a sewer, which will carry it elsewhere, or into an onsite sewage facility (of which there are many kinds). Sewage and wastewater is also disposed of into rivers, streams, and the sea in many parts of the world. Doing so can lead to serious pollution of the receiving water. This is common in developing countries and may still occur in some developed countries, where septic tank systems are too expensive.

Before the 20th century, sewers usually discharged into a body of water such as a stream, river, lake, bay, or ocean. There was no treatment plant, so the breakdown of the human waste was left

to the ecosystem. Today, the goal is that sewers route their contents to a wastewater treatment plant rather than directly to a body of water.

METHODOLOGY

This paper reports a research on Riverside Housing Estate in Enugu, Nigeria. The instrument of research was a questionnaire designed to gather data from the field survey conducted to examine the disposal methods and interview conducted on the residents. The questionnaire has two sections, section A which elicited from respondents personal information on respondents' and was analysed using percentages such as gender, age, marital status, size of family, educational qualifications of respondents. Section B focused sewage disposal methods and the effects on the environment. It had multiple-choice, structured, 5-point Likert Scale questions of possible responses, from which respondents chose as appropriate. The sample size of 30% drawn from research population of 821 housing units which gave 246 housing units were randomly selected in the study area for examination. Household heads (Men or women) were used as primary respondents in each household. 246 copies of questionnaire were distributed, but 233 copies were retrieved from the respondents.

RESULTS AND DISCUSSION

In the assessment of the effects of sewage disposal system in the study area, over seventy percent (80%) of the housing units have constructed septic tanks in the compound abandoning the central sewage system originally planned for the estate. Table 1 shows the number of housing unit and the type of sewage system in their compound. Two percent (2%) housing units retained both systems, but only channeled grey water into the central sewage system and dug septic tank for sewage. While the remaining 18% still use the central system.

Table 1: Housing units and type of sewage disposal system used

Sewage Disposal System	Number of housing unit
Central sewage system	42
Septic tank	186
Both central system and septic tank	5

Source: (Fieldwork, 2018)

For household strength, the analysis of the household strength of respondents is shown the Table 2. The households of between five and seven people form about 52.31% of the total respondents, small households of between one and four people constitute 37.69%, while households of eight to 10 people constitute 10%.

Table 2: Household strength of the respondents

Household strength	No. of respondents	% of the total
1-4	88	37.69
5-7	122	52.31
8-10	23	10
	233	100

Source: (Fieldwork, 2018)

The performance perception of the sewage disposal methods in use in the Riverside Housing Estate is shown in Table 3. More of the respondents perceived the septic tank to be very good compared to the central sewage system

Table 3: Comparative performance of the sewage disposal systems

Rating	Central sewage system (No. of respondents)	Septic tank (No. of respondents)	Both methods (No. of respondents)
Very good	110	30	3
Good	45	5	1
Neutral	5	3	0
Poor	12	3	1
Very poor	4	1	0
	186	42	5

Source: (Fieldwork, 2018)

From the interview conducted with the residents, the method they thought had very little negative impact on the environment is the septic tank system. The several negative environmental impacts on the environment of the central sewage system are as follows:

Stagnant water - is created in the ponds and puddles, which serve as breeding ground for mosquitoes and other disease vectors. Also, pathogenic organisms that are contained in sewage are bound to cause ailments and diseases. This can also be blamed for causing diseases such as typhoid fever, malaria, diarrhea and dysentery.

Air pollution - decomposition of organic materials that are dumped in the pond generates foul odour which emanates from the pond. This foul odour pollutes the air people breathe in and can create health hazards to the residents living around the area.

Water pollution – when there is blockage on the system, sewage flows on the ground surface which pollutes underground wells in the area. The water is sometimes collected and used by the residents for various domestic purposes especially as there is shortage of portable water supply in the estate. Furthermore, where water pipes break, sewage may find its way into the water pipes causing water pollution. Water pollution can cause Diarrhea and Dysentery to the residents.

Restricted movement - Difficulty of movement due to puddles created on the ground surface as a result of broken or blocked sewage pipes. Movement of people on foot would become hard as a result of the puddles that cross the streets and walkways. There is also the risk of falling into the puddles which can get a person in direct contact with the pathogens contained in the sewage.

CONCLUSION

Going by the discussions above, it could be deduced that the central sewage disposal method in River side housing estate has negative environmental impacts which affect the residents. The State Government through the ESHDC can come in to help drain puddles to remove stagnant water from residential areas. . From the survey, it was observed that the only problem with on-site system is the contamination of water gotten from hand dug wells in the estates owing to its proximity to onsite sanitary facilities. In the centralized system when there is blockage of the sewerage, the sewage flows out into people's compound and environment thereby polluting the water source (underground wells, which is common in the study area) and environment. The paper recommends that On-site system should be encouraged and more awareness creation on it. But its design and construction ought to be supervised by an architect; and located away from water source. This was chosen from the maintenance management point of view, since it is easier to maintain the on-site system than the centralized system.

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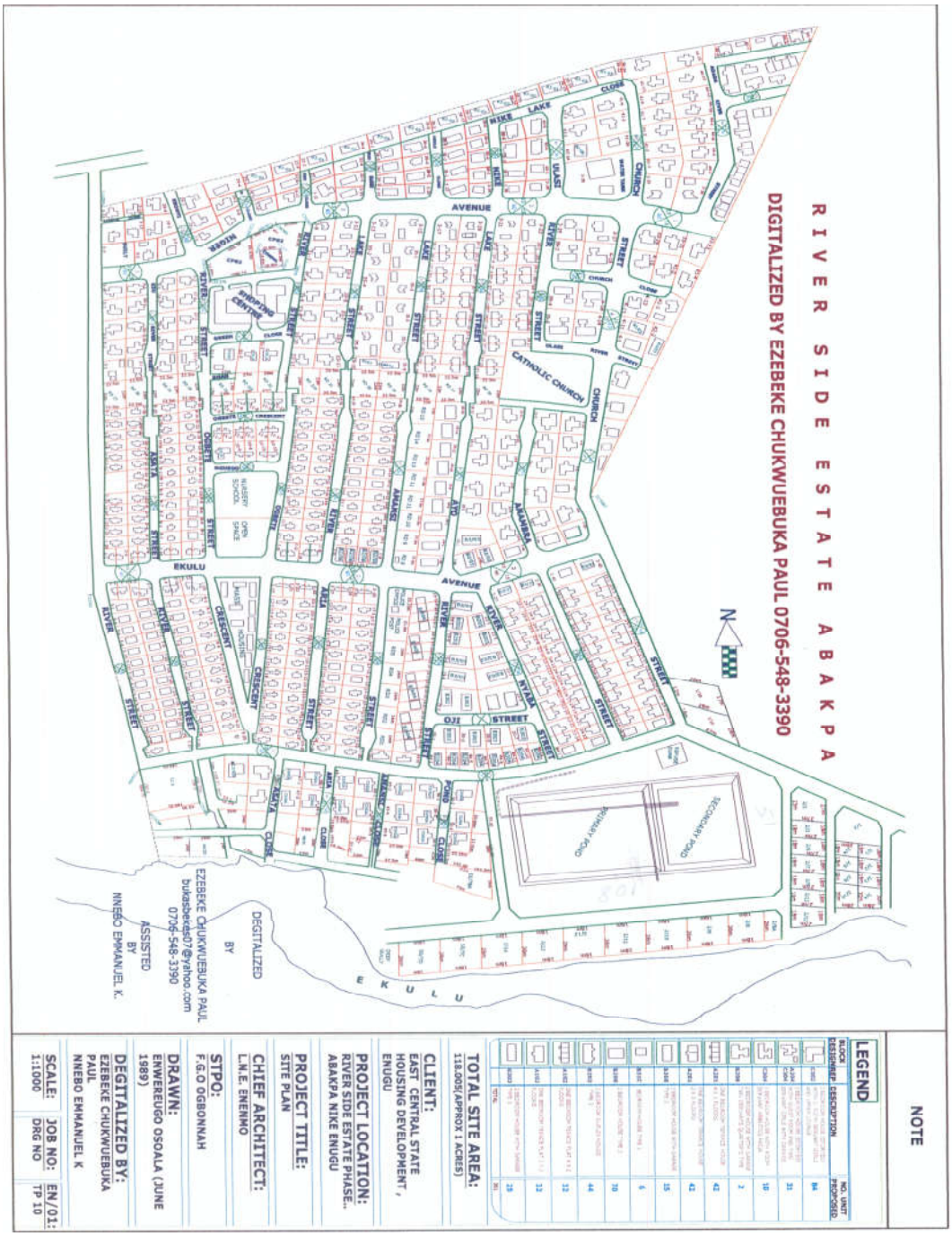
APPENDIX I: Layout of River Side Housing Estate, Abakpa, Enugu



Source: (ESHDC, 2015)