Coastal Water Quality Improvement Project

USAID Contract No. 532-C-00-98-00777-00

SEWAGE INFLUENT QUALITY GUIDELINES AND ITS RELATIONSHIP TO SEWAGE TREATMENT

July 15, 2001
Revised October 2001

Prepared for the:

Government of Jamaica's
National Environment and Planning Agency

And the

United States Agency for International Development

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PREFACE

The Coastal Water Quality Improvement Project (CWIP) is a five-year bilateral initiative between the Government of Jamaica's National Environment and Planning Agency (NEPA) and the United States Government, through the Agency for International Development (USAID). Five distinct, but interrelated, activities associated with coastal water quality improvement are being carried out to form a synergy of interventions contributing to the achievement of the USAID Strategic Objective 2 (SO2) – Improved quality of key natural resources in selected areas that are both environmentally and economically significant. CWIP is being implemented by Associates in Rural Development, Inc. (ARD) with assistance from Camp, Dresser & McKee, Inc. (CDM) and the Construction Resource and Development Centre (CRDC).

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INTRODUCTION

Under the auspices of the Coastal Water Quality Project, sponsored by the United States Agency for International Development (USAID), this manual has been developed to assist in disseminating information, considered to be critically important for the satisfactory long term service of NWC's public sewage systems, to existing and potential sewage customers of the National Water Commission in Jamaica.

It is NOT a textbook, it is NOT intended to be a comprehensive engineering guide for either central sewage system design (or operation or maintenance) or property connection design – although it does contain a substantial amount of technical information – presented, hopefully, in an easily readable and understandable format.

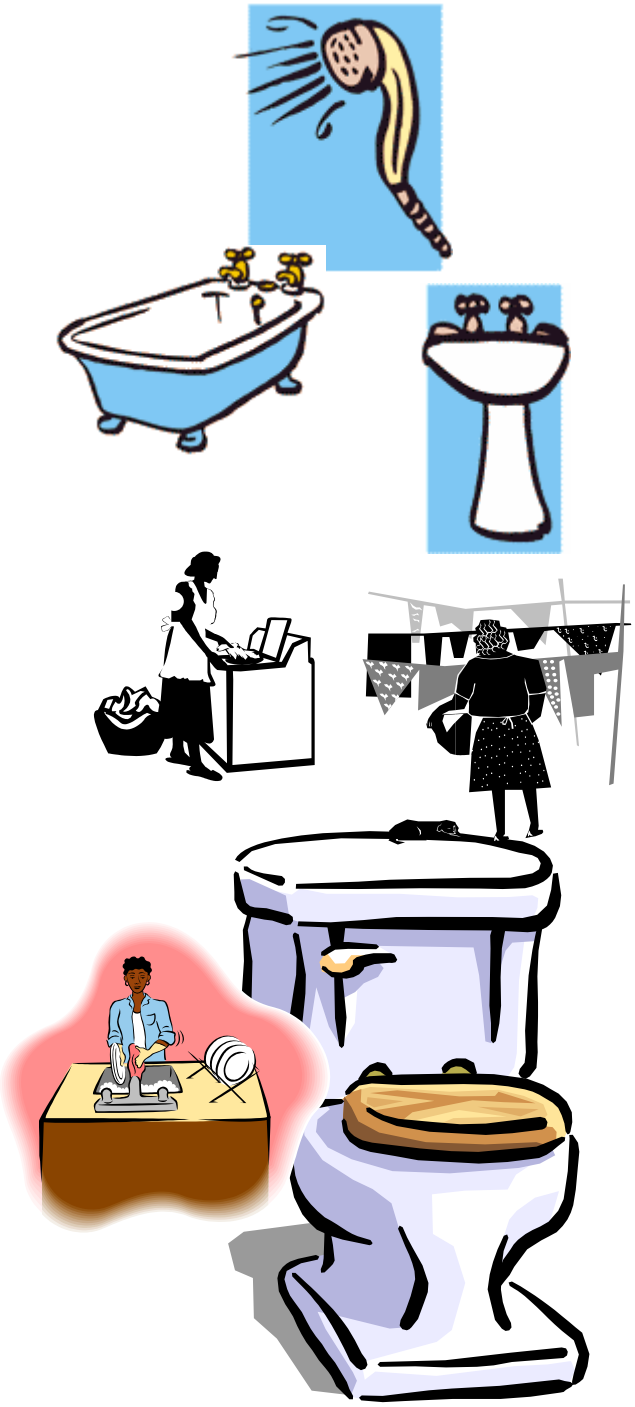
It has been prepared as a series of individual sections (each separately identified and paged) and is presented in a loose leaf folder format – so that any combination of individual sections may be combined into a purpose specific manual to serve particular customer needs as they may arise.

The sections seek to answer simple questions and to address specific issues as follows:

What is "sewage" or "wastewater"?
Why do we need to collect and treat sewage?
Who does what in Jamaica?
How do we characterize sewage and industrial wastewater?
Why do we need to limit the things put into our sewers?
Fats, Oils and Greases (FOG) - in discharges
Sand - in discharges
Other Oils and Greases Etc., **-** in discharges
A short history of sewage collection and treatment
How we collect sewage
Microorganisms and sewage treatment
How can we, and how do we, treat sewage in Jamaica & how do we dispose of the treatment products
Waste Stabilization Ponds – as now provided for Negril and Montego Bay
The Oxidation Ditch Sewage Treatment Works – as now provided in Ocho Rios
How to have a property (properly) connected to an NWC sewer
The NWC's "Consent to Discharge"

The purpose of this manual is to explain how the NWC can assist new customers to connect properly and to explain the reasons behind the NWC's rules and regulations for connections – to promote the maximum levels of connections to the new sewage systems in Negril and Ocho Rios and the extension of the Montego Bay system (with new treatment facilities), to promote "best practices" in Customers use of their sewage disposal facilities with particular emphasis on sewage influent quality guidelines and how influent quality impact sewage treatment.

WHAT IS "SEWAGE" AND "WASTEWATER"?



"Sewage" is defined as used household or "domestic" water - and water-carried solids - that is the dirty water that we put down our kitchen sinks, our dirty laundry or face-basin water, our bath or shower water and, of course, the water and waste that we flush down our toilets.

Sewage is primarily organic waste ♠ (provided that we only we flush down our toilets what we are supposed to flush down them and pour down our drains what should be poured down them!).

However it also contains soap and detergent that we use in our bathing and laundry activities and, in the case of kitchen sink water, may contain waste food particles and cooking oils and grease washed from dirty dishes or cooking pots and pans.

Sewage can conveniently be separated into **body wastes** (feces and urine) and **gray water**, which is all the other liquid wastes of the household, including both laundry and kitchen waste water.

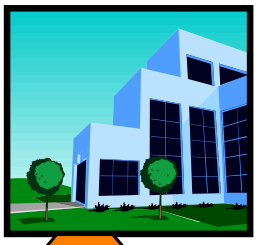
Body wastes (or "**black water**") are the most hazardous - due to the possibility of contact with intestinal disease organisms.

Gray water ordinarily has few disease organisms unless the laundry has contained garments soiled by body wastes.

♠ **Organic** waste is waste material that comes mainly from animal and plant sources. It can generally be consumed by small living organisms. Inorganic wastes are chemical substances of mineral origin. Inorganic wastes, such as sand and salt, for example, are generally either not affected or are only slightly affected by the actions of these same small living organisms.

Organism means a form of plant or animal life. Bacteria and algae are microscopic organisms. Certain bacteria play important roles in virtually all wastewater treatment processes while some algae are important in others.

Because the activities normally associated with **offices, shops, hotels and restaurants** are similar to those that we practice in our individual homes - laundry, washing of cooking pots and utensils, bathing (of workers) and using the toilet – these commercial establishments **generate** water borne wastes very similar in character to (domestic or household) **sewage.**



However the used water from **hotels** and **restaurants** often has much greater quantities of gray water - because of the large scale of food preparation and cooking activities associated with such properties and because many hotels operate their own laundries.

(*As commercial operations, hotel and restaurant wastes may also contain larger quantities of "industrial" cleaners.*)

As a result of cooking activities, a particular problem often experienced with sewage (particularly from restaurants and hotels) **is the presence of excessive quantities of fats, oil & grease (FOG).** FOG results in major operational problems both in the collecting sewers and at treatment facilities. FOG solidifies on the inside of sewers restricting the flow of sewage, similar to the way that cholesterol restricts the flow of blood through arteries and veins. At treatment plants a high level of fats, oils and grease in the sewage inhibits the biological treatment processes used.

"Wastewater" is the used water and water-carried solids originating from <u>all the variety of sources within a community</u> - not only water-borne household or domestic waste (sewage) but also used and contaminated water from industrial facilities and the like – and the definition also includes rain or storm water drainage.

Industrial wastewater may contain concentrated levels of organic waste and/or other types of water-borne waste products - depending on the particular industrial processes involved – and therefore **may have a composition very different from normal sewage**. Some industrial wastewaters can be extremely difficult (and expensive) to treat but some can be satisfactorily "pre-treated" to a similar composition to sewage.

In <u>Jamaica</u>, **the National Water Commission (NWC) operates <u>sewage</u> collection and treatment systems –** to serve individual homes (domestic or residential customers) and commercial/ institutional properties that generate used water of a similar character to that produced by "residential"

customers. *The responsibility for treating industrial wastewater rests primarily with the particular industrial organization concerned – but properly and reliably pre-treated industrial wastewater may, at the discretion of and with the approval of the NWC, be discharged into NWC sewers.*

WHY DO WE NEED TO COLLECT AND PROPERLY TREAT SEWAGE?

The improper disposal of <u>any</u> waste makes our communal lives very unpleasant (even our garbage can smell terribly when it is not collected and disposed off promptly) and **can pollute our environment**.

However, as sewage contains urine and feces and urine and feces can contain germs**, the improper disposal of <u>sewage</u> can result in** not only pollution but also **the spread of disease**.

As we have already said, sewage is primarily of "organic" origin i.e. waste that be decomposed by microorganisms (tiny living animals or plants that are so small that they can only be seen under a microscope).

When a **moderate** amount of organic waste is disposed of on or in the soil or in a watercourse or the sea, nature provides a natural purification process.

When moderate amounts of sewage are disposed of on or in the ground, the sewage decays and the soil absorbs the by-products of decomposition - human and animal wastes contain nitrogen which can be broken down by microorganisms in the soil such that the decomposed materials can be used by plants for their growth - in much the same way as plants use the fertilizer that we spread on our fields and crops.

Nature also helps to return our water into a natural state of purity through the actions of other microorganisms that live in our streams, rivers and the sea - provided the quantity of organic waste is reasonably small.

However, if too much waste is disposed of in a single location, we can overload "nature" and problems can arise.

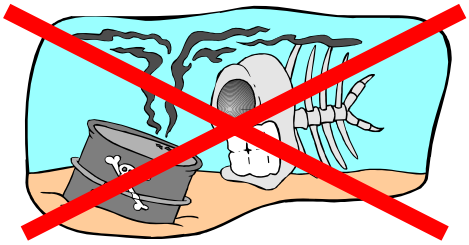
If too much sewage enters the soil, the groundwater that we often use as our drinking water can become polluted.

If too much sewage is discharged into a river or stream the water becomes unsightly in colour, foul smelling and uninhabitable for fish and other aquatic life.

The same degradation can affect our seas, killing the fish and corals and creating major problems for our fishermen and for our tourism industry.

In addition, our commercial and industrial activities can produce large volumes of contaminated wastewater. As this wastewater may contain excessively high amounts of organic material and/or man-made or inorganic pollutants (e.g. heavy metals, complex hydrocarbons and the like - depending on the particular "industrial" processes involved), the improper disposal of this waste can also result in serious damage to our environment (or, at times, even be dangerous to our health).

So, when we live in close proximity to each other in towns and cities, and the volumes of wastewater produced become large, it is vitally important that we collect, treat and dispose of our wastes in a proper and "environmentally friendly" way - otherwise our health can suffer and our local water supplies and our local rivers, streams and the sea can become seriously polluted - a situation that none of us wants!



A SHORT HISTORY OF SEWAGE COLLECTION AND TREATMENT SYSTEMS

Even primitive man urinated, defecated and to some degree washed himself and his garments. However in primitive times the volumes of this waste were limited and, with a small and sparse population spread out across the land, the disposal of these wastes was not a major issue.

However **as people congregated in settlements and towns in close proximity to one another**, the disposal of human body wastes had to be handled somewhat differently. Even in ancient times the importance of properly dealing with human wastes was understood and the Old Testament of the Bible contains clear instructions on this subject.

In early civilizations, use was often made of drainage systems (built to channel storm rainfall away) to carry away human wastes from the immediate vicinity of a community - the first uses of waterborne (using water to "carry" or transport other materials) waste disposal. However, over time, many of these early drainage systems fell into disrepair.

Attempts at organized waste removal restarted in the early Middle Ages. In towns and cities, privies (outhouse latrines) were built to serve several families and were periodically cleaned. Wealthy families preferred to live adjacent to, or over, a watercourse with the "privy" so constructed that it was hanging out over the water. However for those who could not afford such "luxury", it was common practice to use a chamber pot or similar container for body waste - **but to dispose of the contents by throwing it through a window into an open drain in the street** - *pity the person walking in the street at the wrong moment!* When it rained the waste would either be flushed away to either soak into the ground at a remote location or to be eventually discharged to a river or the sea. - *think of the smell in the street - if it did not rain for some time!*

As the populations of towns and cities grew and piped water supplies became more common, disastrous outbreaks of epidemics of cholera and typhoid fever broke out as a result of the contamination of drinking water by sewage.

Eventually, the connection between improper disposal of sewage and the contamination of drinking water - leading to the spread of disease - was recognized.

(Although the scientific reason for the connection was only fully appreciated much later).

Soon came the use of collective "cess pools" or septic ponds away from the sources of water - where human wastes would start the process of natural decomposition and ultimately drain into the ground.

Elsewhere the use of storm water drainage systems to carry sewage away began to be practiced again - the forerunners of our modern sewage collection systems - but the sheer volume of sewage discharged into some rivers turned them black and foul smelling - the first clear evidence of major man-made environmental pollution!

Hence pressure mounted for the treatment of the sewage that was collected through the drainage systems or sewers.

Early treatment systems simulated the natural processes observed in nature.

Because of the absorptive capacity of the soil and the value of organic material as a fertilizer, an early attempt at disposal was that of sewage "**farming**".

On the sewage farm the waste was simply spread over the ground, left to decompose and then, after a suitable period of time, the resulting sludge was harvested for use as a fertilizer.

However sewage “farms” were notorious for their smell and, again observing nature, workers sought to improve the “treatment” process by increasing the exposure of the sewage flow to oxygen by various means – initially by allowing it to trickle slowly over large stones placed in tanks so that as the sewage drained slowly downwards it came into intimate contact with the air **- the trickling filter**.

Later experiments were undertaken using other means to introduce oxygen into the sewage more effectively.

Such experiments included bubbling compressed air through the sewage - after it had first been settled to remove solids. This remains a form of sewage treatment still in use in many places today - whereby settled sewage undergoes "**extended aeration**".

However engineers also observed that such "treatment" was enhanced by re-circulating some of the sludge produced back into the "aeration" tank - i.e. by combining the organisms carried by the sludge, oxygen supplied by the incoming air and new food supplied by the settled waste water entering the tanks, higher levels of treatment could be achieved. Because the sludge was teeming with bacterial and other associated biological life, the sludge was called "activated" and the process called the "**activated sludge process**".

Ultimately, with a greater understanding of the **natural processes** involved in purifying waste and the roles played by various microorganisms, the waste stabilization pond was conceived - which makes full use of natural processes, adapted by man, to treat sewage in a simple and cost effective manner.

The waste stabilization pond approach is often the preferred means of sewage treatment for many communities worldwide. Waste stabilization ponds however need large land areas.

When land is not readily available or its cost is prohibitively high, modern day versions of the activated sludge process are still very appropriate.

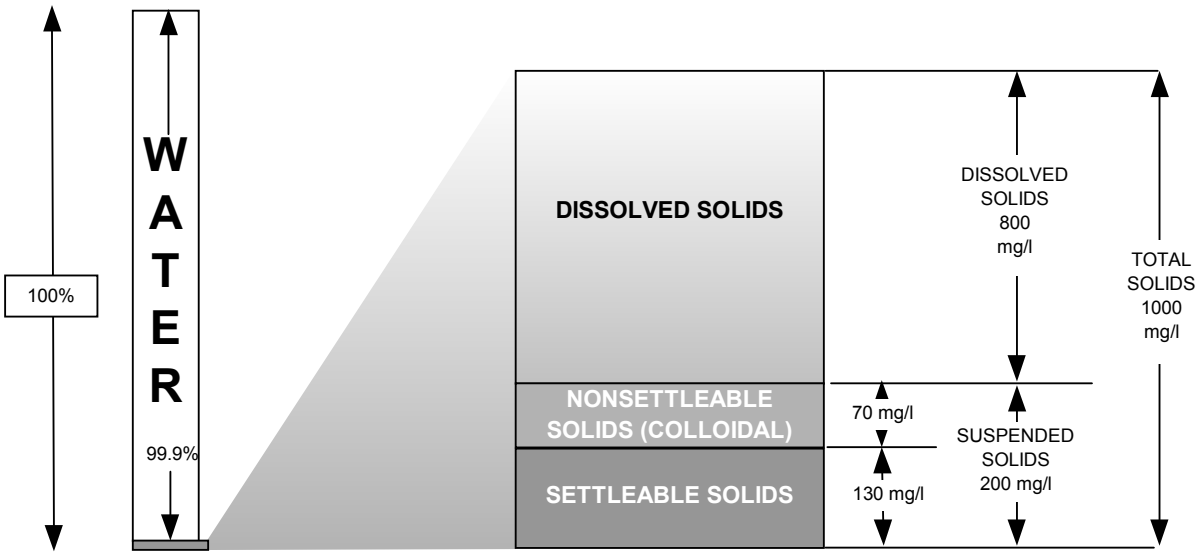
Because of the high costs of building central sewage collection and treatment systems and because, compared to the sewage generated within any particular community, the volumes of rainwater drainage are usually massive and the level of pollution is relatively low, it is increasingly rare for both sewage and storm water drainage to be collected in the same piping system - the modern sewerage system (the system of pipes and pumping stations that collect sewage and transport it to the treatment plant is collectively called “**sewerage**”) is designed specifically to collect sewage and properly pre-treated industrial wastewater only.

Note: *where the density of development remains low, “on-site” systems of domestic sewage remain acceptable.*

Therefore for scattered individual properties (particularly where groundwater pollution is not a major concern) the use of a septic tank (where naturally occurring bacteria breakdown the sewage wastes) coupled with a properly built soakaway or tile field is an acceptable means of small-scale sewage treatment and disposal.

HOW DO WE CHARACTERIZE SEWAGE & WASTEWATER?

Sewage (domestic or residential wastewater) consists mainly of feces, urine and "dirty" washing (bathing or laundry) water and is approximately 99.9% water and 0.1% solids - with the amount of total solids being approximately 1000 milligrams per litre (mg/l) - as shown in the diagram below.



Of the "**solids**", most (approximately 80% or 800 mg/l) are dissolved while the remaining 200 mg/l is suspended within the wastewater.

These solids in sewage are about 70% **organic** (mainly proteins, carbohydrates and fats) and about 30% **inorganic** (mainly grit, salts and metals).

The large number of chemical compounds present in sewage makes it impossible to list them all but **we can characterize sewage, and its potential effect on our environment, using certain specific (standard) parameters. The most important are:**

BOD & COD	• Biological and Chemical Oxygen Demand
SS	• Suspended Solids
N	• Nitrogen, as **Ammonia**, NH_3 , or **Nitrate**, NO_3)
P	• Phosphorous as **Phosphate,** $P0_4$
FC	• Fecal Coliform

*Of course, "**Toxic " Pollutants** are always important as they can be hazardous to the environment (particularly aquatic life) and, indeed, to human life. However, provided that we put down our drains and toilets only those things that should be put down them, **sewage** does not contain significant quantities of toxic pollutants.*

The **organic strength of sewage** is normally expressed in terms of the **oxygen demand** exerted by the waste matter during oxidation. **The most commonly used parameters are Biochemical Oxygen Demand** (BOD, where the wastes are biologically oxidized through degradation by bacteria) and **Chemical Oxygen Demand** (COD, where wastes are oxidized chemically). Simply stated BOD is the amount of oxygen used by microorganisms as they biologically decompose organic matter in wastewater. The larger the amount of organics, the greater the amount of oxygen that will be needed by these microorganisms. A BOD load can pose a threat to the aquatic environment by depressing the levels of oxygen dissolved in the water such that fish and other life can be affected. *BOD is usually reported as the amount of oxygen consumed over a specified time period at a specified incubation temperature. A 5-day time period at 20° C is frequently used and is reported as BOD_5. Waters with a BOD_5 level of less than 4 mg/l are considered reasonably clean.*

Chemical Oxygen Demand COD is the amount of oxygen required to oxidize the organic matter in water through chemical reactions. A high COD level can affect aquatic life in a similar manner to BOD.

Suspended solids **are the discrete particles present in suspension in water.** The presence of suspended material, such as clay, silt, finely divided organic matter, plankton and other (inorganic) material in water is known as **turbidity**. Turbidities in excess of 5 units can be visually detected in a glass of water and are usually objectionable for aesthetic reasons. High levels of suspended solids can prevent the successful development of fish eggs and larvae and reduce fish growth rates and their resistance to disease.

Nitrates and Phosphates Nitrates (the principal form of combined nitrogen found in natural waters) and Phosphates (a compound of the non-metallic element phosphorous - primarily in the ortho-phosphate form - derived primarily from certain detergents, industrial wastes and fertilizers) are **nutrients supportive of growth in plants and certain other organisms. High levels of nitrates and phosphates in water bodies promote the growth of certain algae**, **which**, **if allowed to grow excessively, can deplete the levels of oxygen in water such that fish and other aquatic life** (which also depend on the oxygen in the water to live) **may die.** Also, because **one major source of nitrates is human and animal wastes**, nitrate is a reliable indicator of pollution. Other reasons for high nitrate and phosphate levels in bodies of water can be drainage from agricultural land where fertilizers are applied (as fertilizers are designed to provide nitrogen and phosphorous for plant growth).

Fecal coliform organisms **are bacteria exclusively found in feces** (both human feces as well as in the feces of other animals such as cattle, birds etc). *A high level of fecal coliforms is interpreted to mean that there is a possibility of the presence of organisms capable of producing disease (pathogens[α])*. The most common fecal coliform is Escherichia coli and this group of bacteria is used as an indicator for pathogenic bacteria since their die-off rates are generally similar.

[α] Bacteria, viruses or cysts which can cause disease (for example, typhoid, cholera, dysentery) in a host (such as a person) are termed "pathogenic"

There are usually between 500 million and 5,000 million fecal coliform per gallon of raw domestic sewage - *the number of coliforms is estimated by special techniques in the laboratory and the results are normally expressed as the "Most Probable Number" or MPN per 100 ml.*

The table following shows, for a typical North American family, the **other main characteristics of the various components of sewage** (domestic or residential wastewater**) – i.e. those of particular concern for pollution of our environment by sewage**:

Source	Approximate flow per person in gallons per day	Milligrams per liter – mg/l			
		Biological Oxygen demand	**Chemical Oxygen Demand**	(Ammonia) **Nitrogen**	Ortho- **Phosphate**
Kitchen sink	3	675	1380	5.4	12.7
Bathtub	7	190	280	1.3	1
Face basin	2	235	380	1.2	48.8
Washing Machine	6	280	725	11.3	171
Toilet	17	315	900	37.1	77

As you can see the toilet, kitchen sink and washing machine in the average North American home contribute the largest oxygen demands, the toilet the most nitrogen (because of the feces and urine) and the washing machine the greatest amount of phosphate (because of the detergent used) – although the face basin also contributes a significant phosphate load, once again because of the soap and toothpaste used and the effects of washing off make-up! The oxygen demand generated by the waste from the kitchen sink is primarily attributable to oil, fat grease and food scraps from dirty plates and cooking pots and pans.

In Jamaica, the numbers will be somewhat different because of our differing life style but the foregoing remains a useful illustration of the relative contributions of our various household plumbing fixtures to the average residential sewage discharge.

However, in particular, in Jamaica **there is often excessive quantities of fats, oil & grease (FOG) in sewage discharges from hotels, restaurants and, indeed, from many individual homes .** FOG results in major operational problems both in the collecting sewers and at treatment facilities. FOG solidifies on the inside of sewers restricting the flow of sewage, similar to the way that cholesterol restricts the flow of blood through arteries and veins. At treatment plants a high level of fats, oils and grease in the sewage inhibits the biological treatment processes used by the NWC to treat collected sewage. In addition, where an NWC system serves major beachfront hotels, such as Negril, **excessive volumes of sand discharged into NWC sewers creates major problems for the operation and maintenance of sewage pumping plant**. ***These issues, FOG and sand, are of such significance that a separate section of this manual is dedicated to the problem and how NWC customers can help!.***

Wastewater, however, may have a significantly different character depending on the nature of its various sources and **industrial wastewater** will contain at least as many different chemical compounds as (domestic) sewage and very often more.

Industrial wastewater will generally differ from domestic sewage in the proportion of organic materials and inorganic salts present. Industrial wastewater often has either a very high organic content or a high proportion of salts.

The high organic content may be easily biodegradable* (such as slaughterhouse or milk processing waste) or not readily biodegradable (such as textile industry waste).

Some industrial wastewater may arise from activities that may be appear apparently simple - like the cleaning by garage operators or mechanics of motor vehicle engines (or component parts) of oily coatings or, say, dry-cleaning of clothes and fabrics. While such processes may appear simple, the resulting wastewater can be extremely complex and difficult to treat by simple cost efficient means. The oil and grease washed off an engine are complex chemicals and as anyone who has tried to clean up the oil and grease stains on a driveway or carport knows, they do not readily decay and disappear. Some industrial cleaners used in certain dry cleaning processes can pollute groundwater such that it can no longer be readily used as drinking water.

To illustrate the differences between sewage and industrial wastewater we should note the difference in discharge standards that the National Resource Conservation Authority applies to **sewage** effluent as opposed to "**trade**" effluent discharges ("trade" effluents being defined by NRCA as all wastewater produced in the course of any trade or industrial process other than domestic or residential sewage).

To meet NRCA standards the **treated sewage effluent** discharged from **existing** sewage treatment works (approved before 1st January 1997 ⊗) must be of a quality equal to or better than the following:

Parameter	Maximum Level
Biological Oxygen Demand, BOD_5	20 mg/l
Chemical Oxygen Demand, COD	100 mg/l
Total suspended Solids, TSS	30 mg/l
Nitrates (measured as Nitrogen)	30 mg/l
Phosphates	10 mg/l
Fecal Coliform	1000 MPN per 100 ml

In addition, **treated sewage effluent must also have a pH within the range of 6.5 to 8.5 -** *the degree of acidity of water is measured in terms of pH. A pH of 7 represents neutral water, neither acidic nor alkaline; pH's either above or below 7 represent a potentially corrosive water with above being " caustic" and below 7*

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* Material that can be broken down by naturally occurring bacteria to more stable chemical forms that will not create a nuisance or give off foul odours is considered "biodegradable".

⊗ The NRCA has established further, more stringent, standards for proposed sewage schemes, which provide for a reduced Total Suspended Solids limit at 20 mg/l, a Total Nitrogen (as opposed to Nitrate) limit of 10 mg/l and a phosphate limit of 4 mg/l. Where the effluent is to be discharged to a body of fresh water (as opposed to the sea) the allowable fecal coliform count is also reduced to 200 MPN per 100 ml and the effluent shall exhibit a disinfecting dose of chlorine with a free residual of chlorine of some 1.5 mg/l.

being "acidic". pH is an important factor in chemical and biological systems and effluent discharges should have a pH close to neutral.

Further, **as temperature affects the natural self-purification process in water bodies** (as higher temperatures accelerate the biodegradation of organic material in the water and the solubility of oxygen in water declines as temperature rises, the combination of high water temperatures and organic load can result in total oxygen depletion and obnoxious septic[+] conditions), **the effect of any sewage effluent discharge on the water body into which it is discharged should not result in a change of ambient (normal) water temperature of more than 2° C**.

Hence the range of parameters for normal sewage are relatively few – because **it is known that normal sewage does not contain high concentrations of other specific metals, salts and other chemicals that are potentially harmful to our environment.**

Let us, in comparison review regulated parameters set by the NRCA for "trade" or industrial effluent discharges.

Trade Effluent discharges must **not** only comply with the above standards for sewage effluent but must also **not** contain more than the following levels of other contaminants listed below:

Parameter	Standard Limit
Ammonia/Ammonium	1 mg/l
Barium	5 mg/l
Boron	0.5 mg/l
Calcium	5 mg/l
Colour	100 TCU
Detergent	15 mg/l or less than 0.015 kg / 1000kg of product
Fluoride	3 mg/l
Iron	3 mg/l
Manganese	1 mg/l
Oil & Grease	10 mg/l or less than 0.01 kg / 1000kg of product
Phenols	0.1 mg/l
Phosphate	5 mg/l
Sodium	100 mg/l
Sulphate	250 mg/l
Sulphide	0.2 mg/l
Total Dissolved Solids	1000 mg/l

Parameter	Standard Limit
Total Organic Carbon	100 mg/l
Total Suspended Solids	At ALL times < 150 NTU Monthly average < 50 NTU
Heavy Metals	
Arsenic	0.5 mg/l
Cadmium	0.1 mg/l
Chromium	1 mg/l
Copper	0.1 mg/l
Cyanide (free HCN)	0.1 mg/l
Total Cyanide	0.2 mg/l
Lead	0.1 mg/l
Mercury	0.02 mg/l
Nickel	1 mg/l
Selenium	0.5 mg/l
Silver	0.1 mg/l

[+] Organic waste, such as the materials that makes up the major portion of sewage, can be readily decomposed by various naturally occurring bacteria. Some bacteria can only live when oxygen is not present while others need oxygen to live. The first type of bacteria decompose waste in a process that creates gases that have obnoxious smells but when the second type of bacteria is present they further decompose these gases such that there is no smell. Where, in normal sewage oxygen is absent, decomposition occurs only by first set of bacteria and obnoxious smells result – a condition know as septicity.

While we may not be familiar with all of the above chemical names, that is not necessary for us to recognize that, compared to sewage, the list of regulated contaminants for **industrial wastewater effluent** discharge is much wider in its range – as an excessive amount of any of the listed contaminants can be harmful to our environment and may be present in wastewater generated by various industrial processes. These same contaminants are **not** present in normal sewage – once again, provided that we do not put down our toilets or drains any things that should not be disposed off in that way - and hence need not be regulated for normal treated sewage effluent discharges!

MICROORGANISMS AND SEWAGE TREATMENT

Modern sewage treatment processes make beneficial use of naturally occurring microorganisms - forms of animal or plant life that are so small that they can only be seen under the microscope.

Bacteria are of particular importance for modern sewage treatment processes.

Bacteria are microorganisms with only one cell and are probably the most common form of life on earth.

When we talk about bacteria, most people think of germs that are harmful and cause disease.

However there are over two thousand different kinds of bacteria and most of them are either harmless or helpful to other forms of life - including man.

Some bacteria play an important part in the digestive process of man (and other animals).

There are a great number of bacteria in the human intestine working for our direct benefit. As these bacteria feed, they break down the foods that we have eaten into substances that our bodies can readily use and waste matter - which our bodies dispose of by defecation and urination.

Other bacteria cause the decay of dead plants and animals both on land and in water and help to breakdown all manner of waste products from all forms of life.

Without such bacteria the earth would be filled with dead matter and our wastes.

The bacteria that do this "work" of decomposing dead material and waste, use the organic material available as a source of food and, while feeding, the bacteria break down complicated substances into simpler ones.

The simpler substances are then restored to the soil, water and air in forms that can be used by living plants and animals.

Bacteria are therefore a vital link in the food chain that supports life.

While there are some other (chemical) means available, most modern wastewater treatment processes use bacteria to decompose or digest the organic material within the wastewater.

There are three types of bacteria that can live in wastewater that, depending on the particular treatment process, may play important roles in its treatment.

They are aerobic, anaerobic and facultative bacteria.

> **Aerobic** bacteria need oxygen dissolved in the water to live and grow (oxygen is the life giving part of the air that <u>we</u> breathe).
>
> **Anaerobic** bacteria can live and grow only when there is no dissolved oxygen present.
>
> **Facultative** bacteria can adapt to either condition and thus can live and grow with or without dissolved oxygen.

Some sewage treatment processes also make good use of certain types of **algae**.

Algae are microscopic plants that live either floating or suspended in water. Like all plants, they produce oxygen during the day (through the process known as photosynthesis, whereby they use chlorophyll - which is responsible for the green colour of most plants - and Carbon Dioxide - which humans breathe out - and sunlight to convert nutrients in the water into new cells for growth).

HOW CAN WE, AND HOW DO WE, TREAT SEWAGE IN JAMAICA AND HOW DO WE DISPOSE OF THE PRODUCTS OF TREATMENT?

All sewage treatment includes at least one or more of the following processes, although not necessarily in the same order or accomplished in the same manner – some processes may be combined into one single stage of treatment:

- **Screening**
- **Sedimentation or settling**
- **Oxidation or stabilization of the wastes**

Plants that only include screening and, sometimes, an initial settling/sludge "digestion" process before the waste is discharged to, usually, the sea, are termed "primary" treatment facilities – as the treatment given to the sewage is only very basic. The largest sewage treatment plant in Jamaica, at Greenwich, in Kingston, is a primary plant and discharges directly into the Kingston Harbour. Unless the effluent from such plants is discharged (via a long "sea outfall") into deeper parts of the sea, far from the coast, in areas of appropriate offshore currents such treatment is no longer considered acceptable to satisfactorily protect our environment and public health. *As such, the NWC is actively seeking financial assistance to be able to provide an alternative for the existing Greenwich Treatment Works so that it can play its part in returning the Kingston Harbour to its original clean and healthy state*.

"Secondary" treatment plants provide addition treatment stages to oxidize or stabilize the sewage. Compared to primary treatment, this improves the quality of the effluent discharged substantially and with appropriate final discharge arrangements they can be acceptable as being adequately environmentally friendly.

However most secondary sewage treatment plants cannot normally remove sufficient numbers of fecal coliform to satisfy the standards established in Jamaica for treated sewage effluent discharges. Their effluent still needs to be either discharged sufficiently far offshore (where the ocean currents move in an appropriate direction) to achieve adequate **dilution** of the effluent or, where the final discharge is to an inland body of freshwater such as a river or lake, must be properly disinfected before discharge. Where disinfection is done by adding chlorine to the final waste stream the dose of chlorine has to be carefully controlled so as to be enough to do the disinfection job properly but not so much as to seriously affect or kill the other "good" and essential organisms (including fish and lower forms of aquatic life) living naturally in the freshwater body to which the treated waste is discharged.

The addition of a disinfecting agent to the final waste stream before discharge into the environment is one form of "**tertiary**" (or "third" stage) **treatment**. Others include the use of "maturation" or "polishing" ponds, as explained elsewhere, to achieve the necessary reductions in the numbers of coliforms present in final treated sewage effluents.

Further, greater emphasis is being placed today on reducing the levels of "nutrients" in final treated sewage effluent discharged into the natural environment. Discharges with excessive levels of nutrients, such as nitrates and phosphates, in them can result in excessive growth of certain organisms in the waters that receive them – such as algae in freshwater and

seaweed in the sea – and this can create major problems for fish and other beneficial aquatic life.

Even when operated at optimal (best) levels treating simple “domestic” sewage, most secondary treatment plants cannot reduce the levels of nutrients in their final effluent to the levels now being considered in Jamaica as acceptable for discharges - other than via long and deep sea outfalls. **Therefore** for yet another reason **a third or tertiary stage of sewage treatment will become increasingly necessary in Jamaica**.

The process options currently available to remove nutrients down to the levels now promoted in Jamaica are limited. While some secondary treatment processes might be re-configured or modified so as to improve their nitrate removal efficiencies, tertiary treatment will most likely be necessary specifically for nitrate removal. While chemical treatment incorporating settlement is available for the removal of phosphates it can prove expensive and the most cost effective way to achieve tertiary level removal of both nitrate and phosphate nutrients through the use of nature in the form of overground flow through natural wetlands (such as a mangrove swamp), artificially constructed wetlands or through specially built “reed beds”. In all of these options the plant life will “take-up” the nutrients and use them for their growth.

Let us now examine in more detail:

PRIMARY & SECONDARY TREATMENT PROCESSES THAT HAVE BEEN, OR ARE BEING, USED IN JAMAICA TO TREAT SEWAGE.

Screening is used before other processes to remove from the flow of waste into a treatment facility larger material that is not conducive to simple treatment - plastic bags, condoms, sticks, lumber scraps and the like.

"Screenings" are usually collected and disposed of as
solid waste (garbage) or may sometimes be incinerated (burnt). Bar screens, both mechanical and hand cleaned are used to remove the large objects and serve to protect downstream mechanical equipment.

Sedimentation or settling is accomplished by slowing the flow of wastewater to the point at which silt, grit, metal and other inorganic particles and sewage sludge, which are all heavier than water, fall to the bottom of a channel or tank so that they may be collected and disposed of separately. In Jamaica, such facilities are normally open to the atmosphere at the top – in cold climates where there is a possibility of freezing temperatures they are usually enclosed.

Where (*although it should not*) sewage entering a treatment works includes large quantities of grit (inorganic, fine solids such as sand) this is removed by controlled settling before other treatment processes. Removing grit helps to protect downstream pumps and mechanical equipment from abrasion and prevents grit from settling in other treatment units. A simple grit removal facility at the inlet of a sewage treatment works consists of a channel through which wastewater flows at a constant slow velocity - independent of the volumes of the sewage flows. At this low velocity the grit settles to the bottom of the channel and is periodically removed and disposed of to a solid waste landfill.

Settling tanks, which are rectangular or circular in shape, are designed to remove sewage sludge and are sized according to the velocity of the flow through the tank. Solids settle out and fall to the bottom of the tank and a subsurface scraping

mechanism directs the settled solids or sludge to a pump well for discharge to a sludge treatment or drying facility. Overflow from the tank exits over an outlet weir for further treatment or discharge. A surface skimmer is often employed to remove floating solids and scum from settling tanks.

Flow equalization facilities are tanks that serve to regulate and dampen the variable peaks of flow that occur over a normal day's time or as a result of severe inflow caused by rain.

Most modern sewage treatment works use biological systems to "oxidize" or "stabilize" sewage in the first part of a secondary treatment stage.

One is the **activated sludge process –** a process used at the new **Ocho Rios Sewage Treatment Works.** This process involves mechanically adding air to the wastewater to promote the growth of specific "aerobic" microorganisms – *small organisms that need air to live* – which feed on and digest the organic material.

With some two to six hours necessary to "stabilize" the sewage in the activated sludge process, the process requires tanks capable of holding a volume equivalent to two to six hours of the average daily sewage flow entering the works.

Air is introduced into the sewage in these tanks, by either blowing air in or, in the now more often used case of the **oxidation ditch**, by the use of a "brush rotor" (*more details of the oxidation ditch process are given elsewhere*). Large amounts of power are required to mix and aerate the tanks when air blowers are used but the oxidation ditch plant, while still using considerable electrical power, are more energy efficient for larger installations.

While in some activated sludge plants primary settling tanks are used before the tanks in which air is added, **settling tanks** (or clarifiers) **always follow the activated sludge system, with the final treated effluent overflowing from these tanks finally discharged**, *sometimes following* ***disinfection*****, to an appropriate body of water**.

In the "activated" sludge process, some of the sludge from the settling tanks, containing a high concentration of microorganisms, is returned to the aeration tanks to further enhance the growth of the beneficial microorganisms.

The operation of activated sludge plants requires highly skilled personnel and such plants use a lot of electrical power (to drive the mechanical equipment that introduces the air into the sewage). Therefore they are expensive to operate. However, they are relatively compact in size and hence, where land space is limited or expensive to purchase, the activated sludge process, and particularly the oxidation ditch, is often the preferred form of sewage treatment today.

Two other types of treatment systems, which have been used in Jamaica in older treatment plants and which make beneficial use of "aerobic" microorganisms, are the trickling filter and extended aeration processes.

The "old" Montego Bay Sewage Plant was an example of a treatment plant using trickling filters. *However, trickling filter plants require larger areas of land than those necessary for the activated sludge process. Also, because some of the settled sewage sludge from such a plant must undergo further treatment before it can be disposed of safely, the trickling filter plant will be more complex than an activated sludge plant. Therefore, the trickling filter process does not usually represent best value for money for the construction of complete new sewage treatment facilities today.*

In **trickling filter treatment plants**, incoming sewage flows first to large primary (or "first") open settling tanks. The overflow from these settling tanks is then distributed at a uniform, but very slow, rate over the surface of the "filtering media" made up of large rock pieces or specially shaped plastic, packed in a large circular open tank very loosely so as create large voids between the media. The trickling filature does **NOT** actually "filter" the sewage but rather forms a suitable environment in which a biological treatment process can take place. As the sewage flows slowly down to the bottom of the tank through the gaps in the media it is naturally exposed to air and is attacked and decomposed by specific beneficial "**aerobic**" microorganisms that attach themselves to the filter media in a dense biological slime. These organisms use the organic material in the sewage to grow thus reducing it in strength. When the thickness of the slime increases with the growth of the constituent microorganisms sufficiently then some will drop off and be carried away with the downward flow. However in addition, as the total population of such microorganisms in the filter tank increases, a point is reached at which there is insufficient food for all – so that some will die off and these dead organisms will either be consumed by those remaining or will also be washed out in the downward flow. Ultimately the size of the microorganism population will reach a stable balance - with just enough of them living to consume no more or no less than the food available in the sewage flows.

The outflow from the bottom of the trickling filter is then sent to secondary settling tanks where the dead organisms and other solids are removed. As in activated sludge plants, the final overflow from these tanks is discharged to an appropriate body of water (sometimes with chlorination as a tertiary treatment stage).

Sometimes part of the effluent from the trickling filter is also recycled to enhance the growth of the beneficial microorganism in the filter. This allows the filters to be operated at higher flow rates and hence to be smaller in diameter.

Because the sewage flowing through the primary settling tanks has not been completely "stabilized" by exposure to air and the actions of beneficial microorganisms, the sludge from these tanks must receive further treatment before it can be properly disposed of – *this is not the case for sludge from the secondary setting tanks, as they are downstream of the trickling filters, and that sludge is already "stabilized".*

"**Anaerobic**" microorganisms (which live only when oxygen is absent) are commonly used to "digest" this sludge.

Primary sludge digesters are "sealed" tanks of 6 to 7 metres (20 feet) or more in depth. Without the presence of large quantities of air, the anaerobic microorganisms inside these tanks further decompose or stabilize the sludge. Anaerobic digesters, if well insulated or operated in warm climates, need little or no input of energy to function. They usually decompose wastes at temperatures of 35 to 40 [degrees] C. Gas produced from the decomposition can be captured and is sometimes used to provide fuel to operate natural gas engines to drive process pumps. Digester performance is a function of sludge feed rate, moisture content, the amount of volatile contents of the sludge, and the amount of toxic materials present. Large quantities of moisture and toxics will retard sludge digestion and minimize methane gas production.

Although not as complex as the activated sludge process, the trickling filter process is a delicate treatment method that also requires a high level of operator skill.

In the **extended aeration** process incoming sewage is first screened and then enters the aeration tank. This tank is larger than those used in the activated sludge process as the sewage must be retained for treatment for a longer period of time.

Here large volumes of air are blown into the sewage and over an extended period, created by the larger retention volumes of these "extended aeration" tanks, both the ongoing wastewater stream and the sewage sludge are stabilized ready for further treatment by simple settling.

The energy requirements necessary to provide the volumes of air needed to accomplish the waste stabilization and to keep the sludge particles in suspension are however very large and as a consequence this particular type of sewage treatment plant is seldom built today.

In many other countries around the world there are many other types of processes using various arrangements of tanks in which both naturally occurring aerobic and anaerobic microorganisms are used to effect treatment of sewage. Some are used in Jamaica – such as the rotating biological contactor (RBC) which is an adaptation of the trickling filter style of treatment, but here they are normally only employed in private developments where the volume of sewage generated is small.

Today, in tropical or temperate climates, where adequate land space is available, waste stabilization ponds are usually the preferred form of sewage treatment. In such treatment works the beneficial action of both types of microorganisms (aerobic and anaerobic) may be used - either in different ponds or in combined treatment ponds (where, in addition, some organisms that can adapt to variable conditions where oxygen is sometimes present and sometimes not also play an important role in the treatment process). Where organic loads in the sewage are very high, deep ponds in which anaerobic organisms do most of the work may be used as the first stage of treatment following screening. However, particular gases are produced as a result of the anerobic process, and these can often cause anaerobic ponds to smell. Thus anaerobic ponds are seldom employed for treatment works near to human habitation.

Where used, anaerobic ponds are followed by shallower "aerobic" ponds in which the presence of certain algae (small plant matter that floats or is suspended in water) helps to provide adequate levels of oxygen in the top layers of the pond for the aerobic microorganisms to do their work of waste oxidation or stabilization. Algae do this by the same process by which all "plants" grow – photosynthesis. *Photosynthesis uses sunlight energy, with the assistance of chlorophyll (which gives plants their green colour) to convert carbon dioxide (the gas that human beings and other animals breathe out) into carbon – which is used by the plant as food to grow new cells - and oxygen*.

Most often waste stabilization pond treatment works are designed using an alternative "facultative" pond approach – where in a pond of intermediate depth (relative to the deep anaerobic and shallow aerobic ponds) in which not only aerobic and anaerobic processes are employed but where facultative microorganisms (which can adapt conditions of either no oxygen or some oxygen is present in the water) assist in the treatment process.

To remove many of the coliform bacteria that are present in great numbers throughout all waste stabilization ponds, they are usually followed by "maturation" or "polishing" ponds. Here in shallow

ponds the action of sunlight and the natural process of

coliform die-off over time in the absence of adequate supplies of food both serve to reduce coliform levels dramatically.

Sewage treatment for Negril and now for Montego Bay is based on facultative waste stabilization pond technology.

From the foregoing it will be clear that waste stabilization ponds and the oxidation ditch form of the activated sludge process are the most important types of sewage treatment processes used by the NWC in Jamaica.

WASTE STABILIZATION PONDS

Domestic sewage and <u>some</u> industrial wastewater may be treated (stabilized) in specially designed shallow ponds open to the sun and the air. These ponds are called waste stabilization ponds, sewage lagoons or, simply, sewage ponds.

Sewage ponds use naturally occurring bacteria in combination with sunlight, wind and air to treat the incoming sewage.

Ponds are classified according to the type of bacteria working in them and the types of ponds used in **Negril** and **Montego Bay** are **Facultative Ponds**. **In a facultative pond, aerobic, anaerobic and facultative bacteria <u>all</u> work to treat the wastewater.**

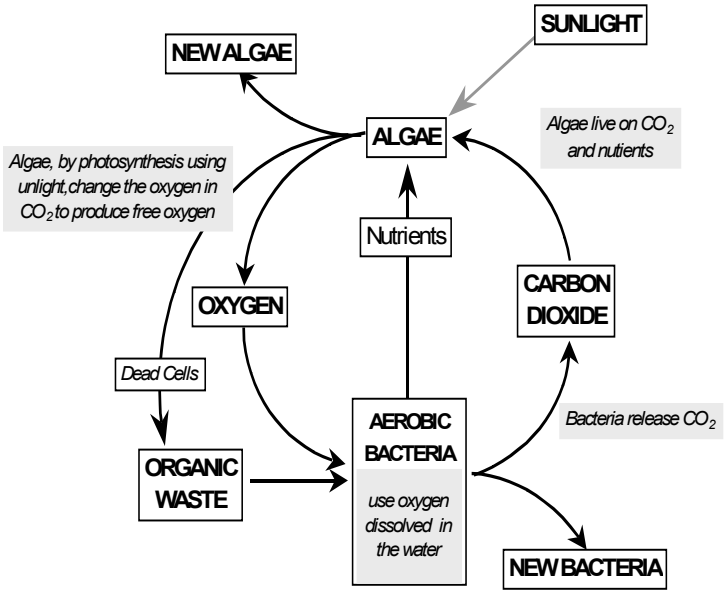
For **aerobic** bacteria to live and grow in any pond, oxygen must be provided for them. In sewage ponds, nature helps in two ways - through **photosynthesis** (*the use of the energy in sunlight by green plants to convert carbon dioxide gas - the same gas that we exhale when we breath - water and minerals into organic compounds to build new cells and in the process the plants produce gaseous oxygen*) by specific types of algae (small green plants that float on the water surface or are suspended in the water) and, in part, by wind and wave driven surface aeration.

In both aerobic and facultative sewage ponds, the algae provide most of the oxygen needed by the aerobic bacteria. As the algae produce new cells they release oxygen as a by-product. This oxygen dissolves in the water and is used by the aerobic bacteria.

Thus the algae and bacteria work together as shown in the following diagram.

As aerobic decomposition of the waste takes place carbon dioxide and new bacteria are produced. If there is sunlight present, algae use the carbon dioxide to live and reproduce and at the same time produce oxygen that can be used by the bacteria.

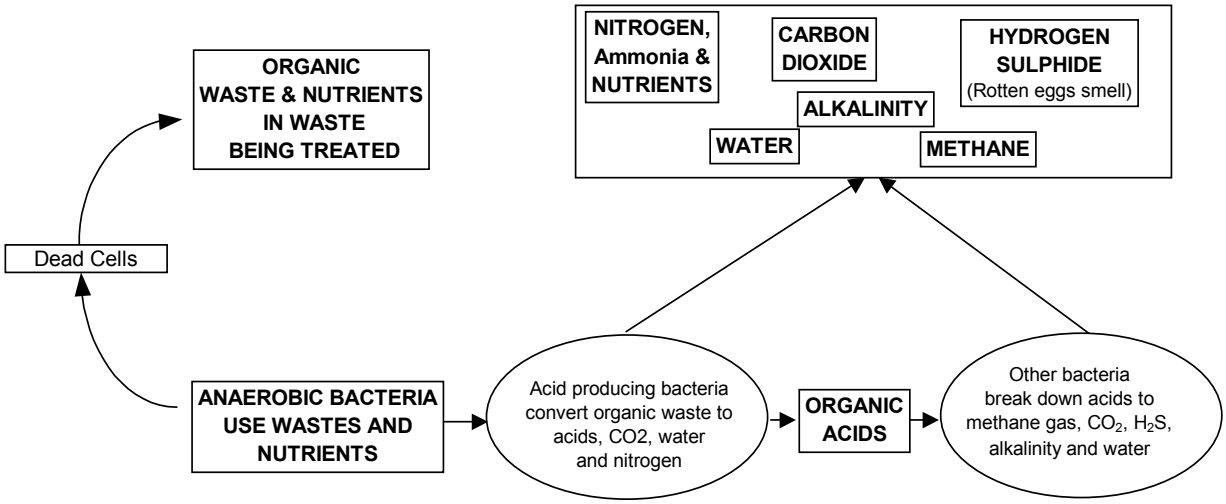
Algae will however thrive only when sunlight is present. They cannot grow at night or during extended periods of cloudy weather.



However, the work of the algae is helped by the action of the waves and turbulence caused by the wind. The turbulence exposes the wastewater to the oxygen in the air and some of this oxygen dissolves in the water. The amount of oxygen added by **surface aeration** depends on the strength of the wind, the size of waves

and the temperature of the wastewater (oxygen dissolves more quickly in cold water than it does in warmer water).

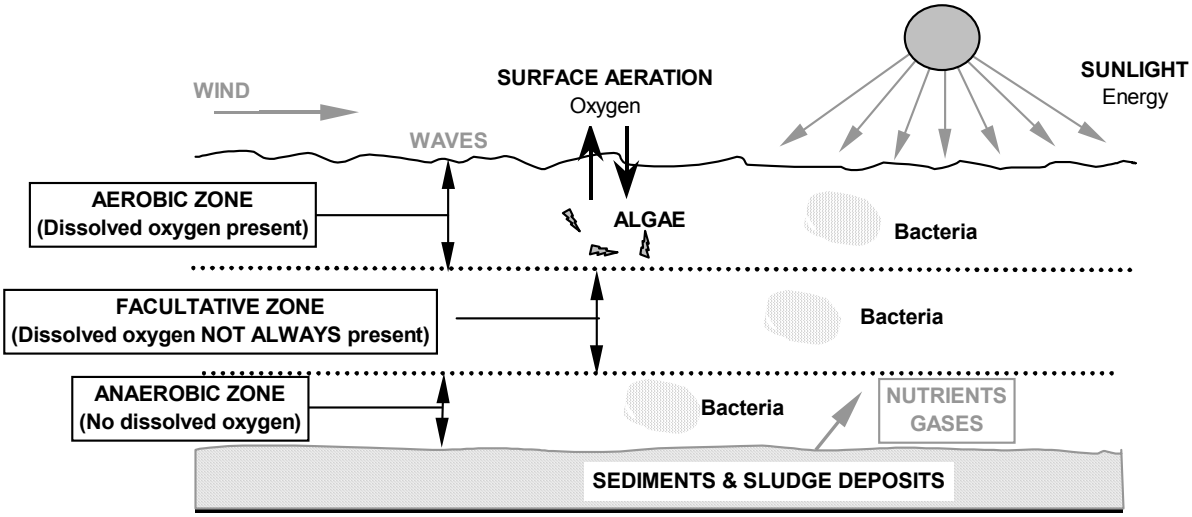
Anaerobic bacteria in waste stabilization ponds work in a different manner - as shown in the diagram below.



First, certain anaerobic bacteria (acid producing bacteria) break down the waste into acids, water, nitrogen and carbon dioxide. Then other anaerobic bacteria (methane fermenting bacteria) break down those acids into water, alkalinity (the opposite of acids), carbon dioxide gas, methane gas and hydrogen sulphide gas (the last one having a "rotten egg" smell).

THE FACULTATIVE POND

Because there are three types of bacteria active in the **facultative sewage pond,** we can distinguish three different layers:



The amount of oxygen produced by algae depends directly on the amount of sunlight available to the algae (because algae can grow and produce only when sunlight is present). Because of algae and other waste

material in the top layer of the pond, sunlight cannot pass completely though the wastewater to the bottom. Thus, only the top layer has a high level of dissolved oxygen.

The **upper layer** into which the sunlight penetrates is called the **aerobic zone**. In this zone the production of oxygen by algae is most effective.

In the middle layer not only is the amount of oxygen produced smaller but also the oxygen production rate will vary. For this reason, bacteria living in the middle layer must be able to adjust to changing oxygen concentrations and only facultative bacteria can live there. Therefore **the middle layer** is called the **facultative zone**.

As wastewater enters the facultative sewage pond, some solids, bacteria and algae settle to the bottom and form a layer of sludge. At the bottom of the pond there is no sunlight, therefore no algae can live there and so no oxygen is produced. Surface induced oxygenation (by waves etc.) will not penetrate to the bottom of the pond and so, at the bottom of the pond oxygen is NOT present. Only bacteria that can live without oxygen can work here and hence the **bottom layer** is called the **anaerobic zone**. In this zone anaerobic digestion of the waste occurs with anaerobic (and some facultative) bacteria converting organic waste first into carbon dioxide, nitrogen and acids (by the “acid producers”) and then into methane gas, alkalinity and hydrogen sulphide.

As the gases and certain other wastes produced in the anaerobic layer rise upwards, they either react with other compounds present or are used as sources of food by the facultative and aerobic bacteria in the higher pond layers – and so, under optimal facultative pond operating conditions, no obnoxious (smelly) gases are released from the pond surface.

In a well operated pond all conditions are in balance and the pond adequately stabilizes the waste. If however one link in the chain is upset then the whole pond will be upset. Operators can tell a lot about the condition of their facultative pond by simply observing its color.

FACULTATIVE POND COLOURS

A dark sparkling green is good - it means that the appropriate algae are flourishing and there is a high level of dissolved oxygen in the water (for use by aerobic bacteria to decompose the organic waste present and to reproduce more bacteria).

A dull green to yellow colour means that blue-green algae (an inappropriate type of algae) are becoming established **and dissolved oxygen levels are low**.

A gray to black colour means that conditions are very bad - virtually no "good" algae are growing, there is very little dissolved oxygen and hence very few aerobic bacteria. Only anaerobic bacteria are flourishing and they are unable alone to satisfactorily treat the wastes. Inevitably the pond will start to smell very badly.

A tan to brown colour may be caused by a particular type of algae - this may be acceptable - depending on the type of algae.

A red or pink colour indicates the presence of sulphur bacteria (anaerobic conditions) or red algae (aerobic conditions)

FACULTATIVE POND PROBLEMS - OVERLOADING

Facultative ponds can be overloaded either hydraulically or organically.

Hydraulic overloading can occur when greater flows of wastewater than allowed for in the original design are discharged into the sewer system.

Such extra flows often come from:

- Infiltration into the sewerage system because of poorly laid sewer pipes (or badly built manholes) allowing surface or groundwater water drainage to enter the system, or
- From the connection of rainwater drains (e.g. from roofs and yards) to the sewage system.

When extra wastewater flows into the sewage pond for the above reasons, the time that the sewage remains in the facultative pond is greatly reduced. As a result the bacteria and algae do not have enough time to properly complete their job. Thus poorly treated sewage is discharged from the facultative pond (and any downstream maturation ponds, in turn, suffer from inadequately treated inflows and cannot perform their particular functions properly either).

Organic overloading occurs when the amount of organic waste entering the facultative pond is greater than the capacity of the bacteria/algae population to satisfactorily handle and, in similar manner, the balance of the facultative pond and of any maturation ponds will be upset.

High concentrations of phenol based hydrocarbons in the incoming sewage flows are particularly to be avoided as these chemicals will inhibit algal photosynthesis. Further, wastewater with a nutrient balance differing widely from that of domestic sewage can cause reduced treatment efficiency or algal inhibition and hence increased risk of anaerobic conditions in facultative ponds – therefore any trade or industrial wastes that have a very high organic content will undoubtedly require pre-treatment before their acceptance into the sewage collection system.

A NOTE ON SAFETY AND SECURITY

Sewage ponds, like other sewage facilities, must be treated with caution and respect by all.

As **there is always a possibility of infection from pathogenic organisms when one comes into contact with sewage**, all sewage facilities will normally be securely fenced. However sewage pond installations are large and, because of the high cost, it is not always possible to provide full height chain-link security fencing around such facilities. Instead many sewage ponds will be fenced with stranded barbed wire.

Ponds are often a source of attraction for children. While every effort is made to keep security fences intact, breaks can occur and the curious uninformed child will often find a way through any fencing. Please remember that in addition to the risk of infection, **drowning deaths can occur**!

PLEASE TELL YOUR CHILDREN NOT TO PLAY CLOSE TO SEWAGE PONDS!

TELL THEM THAT THEY MUST NOT ENTER ANY SEWAGE POND COMPOUND!

MATURATION PONDS

Fecal coliforms die off in the sewage pond at a certain rate affected primarily by sunlight. The greater the sunlight penetration the faster the coliform die.

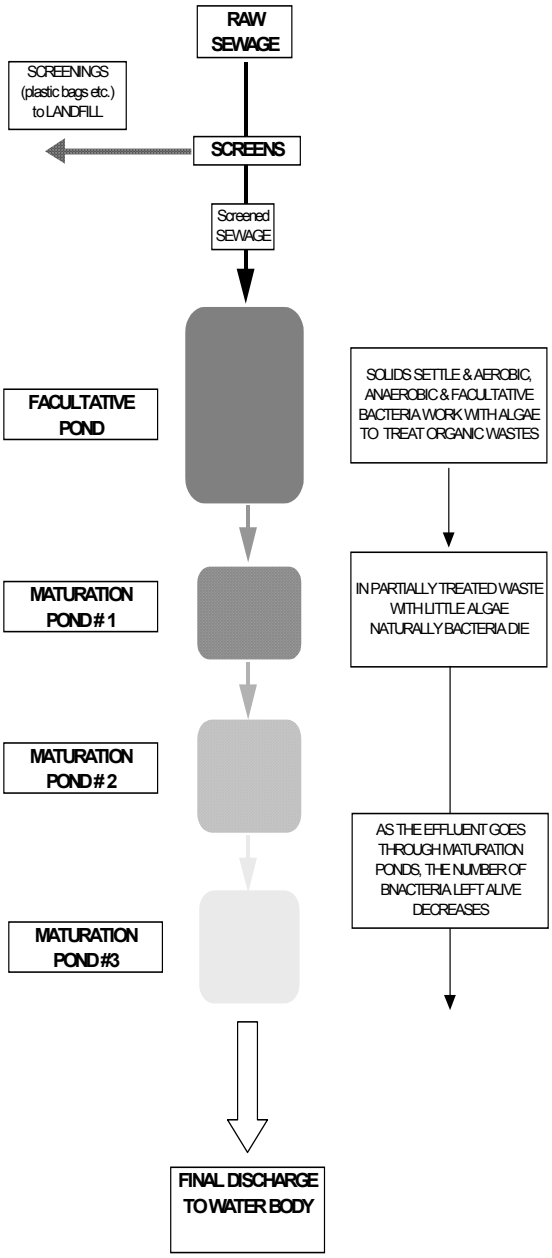
For this reason it is common for water from a facultative treatment pond to be taken **into a series of further shallower ponds called maturation ponds**.

The wastewater in the facultative pond has already received considerable biological treatment and the effluent from that pond carried into the first maturation pond is a lot clearer than the original sewage and has a much smaller organic content.

Therefore in the first maturation pond there is less waste material available as food for the bacteria and they will start to die off. Declining numbers of bacteria mean decreasing amounts of carbon dioxide available for algae and they in turn will be reduced in numbers. Thus the water will be clearer. With the clearer water the sunlight can penetrate to a much greater depth than in the facultative pond - once again allowing nature to kill off bacteria.

When we now take the effluent from the first maturation pond and transfer it into a second similar pond it is even cleaner and more bacteria and other microorganisms die.

To achieve a high quality effluent containing few fecal bacteria, it is quite common for three maturation ponds to be used – as shown in the overall layout opposite.



SEWAGE POND MAINTENANCE

To properly maintain a sewage pond the following four inter-related factors are important: -

1. Odour control
2. Weed control in the pond
3. Weed and vegetation control on the berms
4. Insect control

ODOUR CONTROL

The prolonged release of odours from a facultative pond is indicative of organic overloading i.e. the amount of organic material received exceeds that for which the pond was designed. There is no easy solution to this situation (unless caused by the illegal discharge of untreated or poorly pre-treated waste from a particular industrial customer) other than the construction of additional treatment plant capacity.

However, ponds may **occasionally** give off odours, no matter how well operated and maintained. Odours are an indication that something is out of balance.

Odours are often common in the early morning when the dissolved oxygen levels may be low because, as already noted, the algae has no sunlight during the night hours and cannot therefore generate oxygen for the aerobic bacteria working in the top layer of the pond (indeed during the night algae actually use oxygen themselves).In addition the variation in temperature between night and day can also result in some pond "turnover" whereby some of the anaerobic bottom layer is carried to the top and gases such as hydrogen sulphide and methane can be released.

Usually, occasional odours are caused by: -

- Anaerobic conditions in the pond, and
- By the **excessive** growth of **blue-green algae** - in an algal "bloom" (*see below*)

Algal bloom is a sudden and extreme algal growth. It consists mainly of blue-green algae, which may be caused by pond overloading, lack of sunlight, pond turnover or other reasons. The blue-green algae give off a characteristic odour - although most algae odours are caused by the just as sudden die-off of the bloom. The large amount of dead algae creates a very high biological oxygen demand (BOD) condition in the pond, the dissolved oxygen is used up and the pond turns anaerobic creating odour problems. Spraying with water can often sink algal blooms but chemical treatment methods are available if necessary.

Either of the foregoing conditions can be caused by: -

- Extensive cloud cover reducing the amount of sunlight and hence the amount of dissolved oxygen in the pond
- The presence of toxic waste in the inflow that has killed a portion or all of the bacteria

- A sudden inflow of high strength organic waste
- Floating sludge mats

The answer to occasional odour problems due to the first three causes is to find a way to increase the levels of dissolved oxygen in the pond.

This can first be attempted by trying to increase contact of the wastewater with air by: -

- Using portable pumps (like fire pumps) to spray the pond contents into the air back over the pond;
- Installing portable aeration equipment into the pond; or
- Re-circulating secondary effluent - *(if it has a dissolved oxygen content higher than the contents of the facultative pond)*

However care must be exercised with any of these methods, and particularly with the first and last, as you might end up with further odour problems resulting from the re-suspension (stirring up) of sludge from the bottom of the pond.

In extreme circumstances the addition of certain chemicals (sodium nitrate or hydrogen peroxide) can be added as a source of (chemical) oxygen.

Sometimes just shutting off the inflow to a particular pond (provided of course there is more than one facultative pond in parallel) will allow time for the problem to correct itself.

If the problem is as a result of floating debris, such as mats of scum, septic sludge or blue green algae, these should be repeatedly broken up (as they tend to reform) – spraying with water can usually do this unless the scum has been left too long and has become dry on the top and crusted. As a last result, crusted scum should be skimmed from the pond surface and buried (to avoid smells).

WEED CONTROL - IN THE POND

Weeds in sewage ponds can cause problems and thus their control is one of the main tasks in sewage pond maintenance.

Some weeds have large roots that can puncture the pond seal and cause leakage problems. Weeds that grow to the surface promote concentration of scum and sludge mats and therefore encourage insect breeding. If weeds are dense in a sewage pond then the sunlight cannot penetrate very far into the wastewater and the dissolved oxygen in the top layer will not be mixed and distributed by wind/wave action - resulting in a low Dissolved Oxygen (DO) level.

Surface weeds such as Duckweed can cause problems. Although very often confused with algae, duckweed is actually a small three leafed plant that looks like cloverleaf. Duckweed floats on the wastewater surface and has long hair-like roots hanging down into the water. It is green during its normal growth periods but turns brownish yellow as it dies. Duckweed grows rapidly and can completely cover a pond if not controlled. This reduces the amount of sunlight received by the wastewater in the pond, reducing algae growth and hence the production of oxygen needed by the aerobic bacteria. Under such conditions the pond can turn

anaerobic and start to smell. Besides causing problems with sunlight penetration, duckweed creates a very high oxygen demand by itself when it dies thus depleting the available oxygen for the aerobic bacteria.

There are a number of ways available to control surface weeds but the simplest (but most time consuming) is to regularly skim the pond surface and then bury the weeds - to avoid other odour problems.

Submerged or bottom growing weeds can also cause problems but provided the water depth in a facultative pond remains greater than 2 feet or so the degree of penetration of sunlight to the bottom is rarely sufficient to allow vegetation growth. However, in maturation ponds, where the water is much clearer, there will likely be more weed growth. The best approach to dealing with bottom weed growth is by first cutting them and then drowning the remaining weed growth by rapidly raising the water level so that it covers the weeds for a reasonably protracted period. Drowning by itself may be sufficient to discourage continued growth without having to cut the weeds.

Of course all weed growth can be controlled by the use of herbicides but this solution is a last resort and care must be taken to follow the manufacturer's instructions in their use (otherwise other pollution problems could arise).

WEED AND VEGETATION CONTROL AROUND THE PONDS

Weeds and other vegetation around the edge of the water surface are most objectionable as they provide a sheltered area for mosquito breeding.

The berms that form most sewage ponds will normally be covered by a fast growing, spreading, shallow but dense grass. It must be cut regularly (below the water line) and the cuttings collected and disposed of – so that they do not collect in the water. Weeds on the berms can be removed by hand or using chemicals. Hand weeding is time consuming but is preferable to the use of herbicides. It is much better to pull young weeds out (including the roots) and dispose of them elsewhere.

INSECT CONTROL

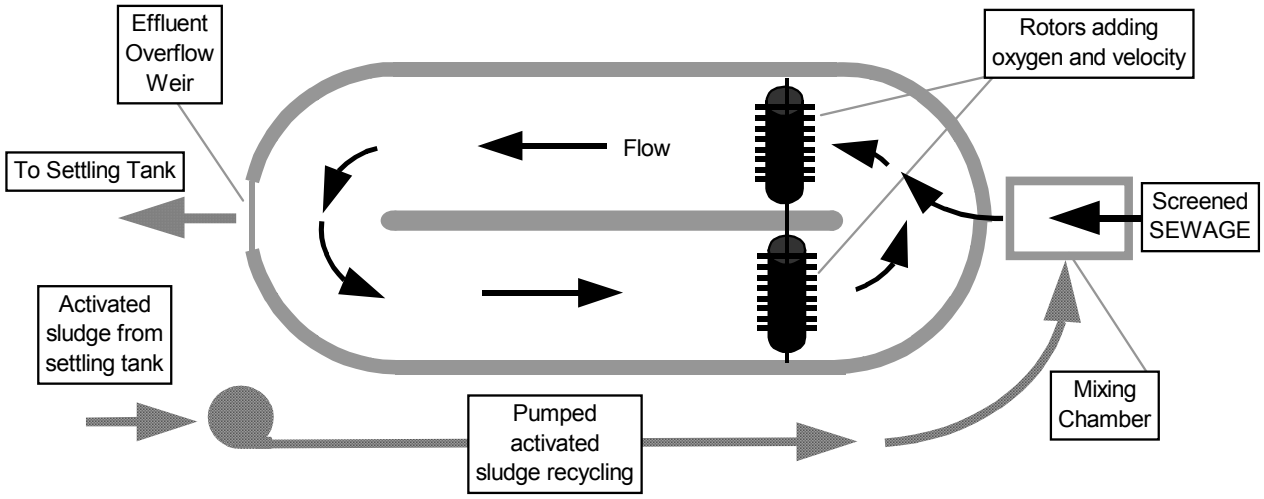
Mosquitoes will breed where there is vegetation or scum to which the egg rafts of the female mosquito can become attached. These egg rafts are fragile and will not withstand the action of water disturbed by wind action. Therefore keeping the water edge clear of vegetation and keeping any scum that forms broken up is critical to avoid mosquito infestations.

THE OCHO RIOS TREATMENT PLANT - THE OXIDATION DITCH

The Ocho Rios Wastewater Treatment Plant incorporates screens, two **oxidation ditches** and two clarifiers (settling tanks) to treat the incoming sewage and drying beds to air dry the sludge produced during the process. Treated effluent is discharged to an outfall into the Caribbean Sea (into deeper water past the offshore coral reef).

In this type of plant, **the main treatment process occurs in the oxidation ditch** - with each ditch normally equipped with two "brush rotors".

A plan of an oxidation ditch is shown below.



Driven by the "rotors" (as explained below), the screened wastewater travels around and around the oxidation ditch for sufficient time for natural (primarily aerobic) bacteria to treat the organic waste in an activated sludge process - i.e. some of the "activated" sludge (sludge teeming with beneficial bacteria and microorganisms) that settles out in the downstream clarifiers is pumped back into the oxidation ditches to enhance the treatment process.

The rotors of an oxidation ditch serve two purposes.

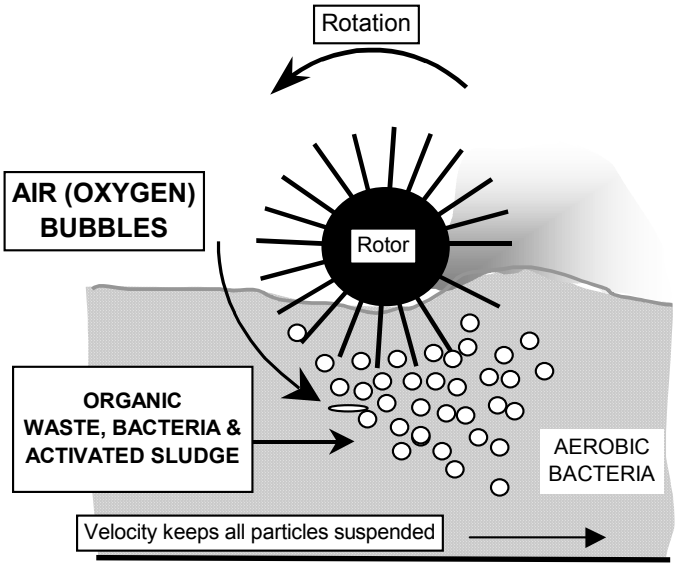
Firstly, they transfer into the wastewater the oxygen needed for the beneficial aerobic bacteria to live and work treating waste in the ditch.

In waste stabilization ponds the oxygen needed for aerobic bacteria to thrive is provided by the natural action of algae - and because of this, the ponds need to be very large. - a problem where suitable land for sewage ponds is scarce or would be expensive. Under such circumstances, oxidation ditches are often the preferred form of treatment specifically because they require much smaller land areas to treat a given volume of wastewater than ponds. However, in the case of the

oxidation ditch, the exposed water surface area is relatively, very small and therefore cannot support enough algal activity through photosynthesis alone to provide proper treatment. Hence the oxygen must be introduced into an oxidation ditch mechanically.

Secondly, the rotors drive the flow around and around the ditch itself - keeping "suspended" solids is suspension.

A "brush" rotor is, just like many hairbrushes, a long cylinder fitted with many "bristles" – in this case metal ones. The rotor is set up horizontally and turned by an electric motor. As the rotor turns, partially immersed in the wastewater, it draws air down into the wastewater and imparts a forward velocity to it, as shown in the diagram below.



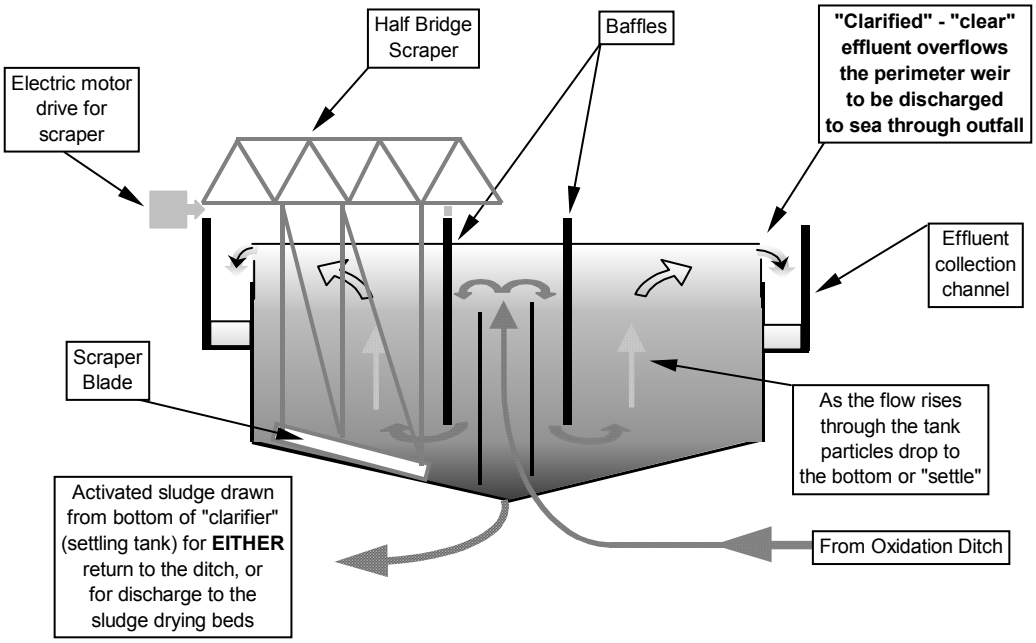
The amount of oxygen that is transferred to the sewage in any ditch can be varied by running either both rotors or only one rotor - and by varying the depth of immersion of the rotor(s) in the wastewater - the depth of immersion of the rotors being controlled by the elevation of an adjustable outlet overflow weir. *(Note that the speed of rotation could also be varied - but this facility is not provided at the Ocho Rios Plant.)*

When flows are low and the oxygen demand is small, only a single rotor may be run with just the tips of the "brushes" submerged.

When however the wastewater inflows are high or the concentration of organic waste in the flow is high - and hence the oxygen demand of the wastewater is high - both rotors will be run with the "bristles" of each brush rotor submerged much deeper into the flow.

The second stage of the treatment process is to remove the particulate matter and the flow over the outlet weir of the oxidation ditch is carried into **upflow clarifiers** or settling tanks - where particles settle out.

A cross section through a typical upflow clarifier is presented at the top of the next page.



In such clarifiers, the incoming flows from the oxidation ditches are directed by concentric central bafflers towards the centre of the sloping bottom of the tank. The flow is dispersed through out the tanks area and **slowly** rises towards the surface. Heavier particles of solids begin to drop downwards and as smaller particles come into contact with each other they tend to accumulate together into larger and denser particles – thus aiding the settling process. By the time the flow reaches the surface virtually all particles have been dropped out and the flow is clear (or “clarified). The "clarified" water flows over a weir around the outside of the tank and is then discharged through the sea outfall.

The sludge that settles to the bottom of the clarifier is teeming with biological life – it is “activated”. A rotating scraper arm, suspended from the overhead travelling “half-bridge”, sweeps the settled sludge towards a central sludge drain where it is continuously drawn off – usually to be returned to the inlet of the oxidation ditches (mixed with incoming screened raw sewage to provide the “Mixed Liquor” in the oxidation ditch) by the sludge return pumps. However when the volume of sludge grows too large, excess sludge is pumped out to the sludge drying beds. Once dry, the sludge makes an excellent soil conditioner for agricultural use.

Thus, once again, the wastewater has undergone screening, oxidation of the organic waste and settlement.

The layout of the overall Ocho Rios Sewage treatment Works is illustrated on the following page.

Operational Control

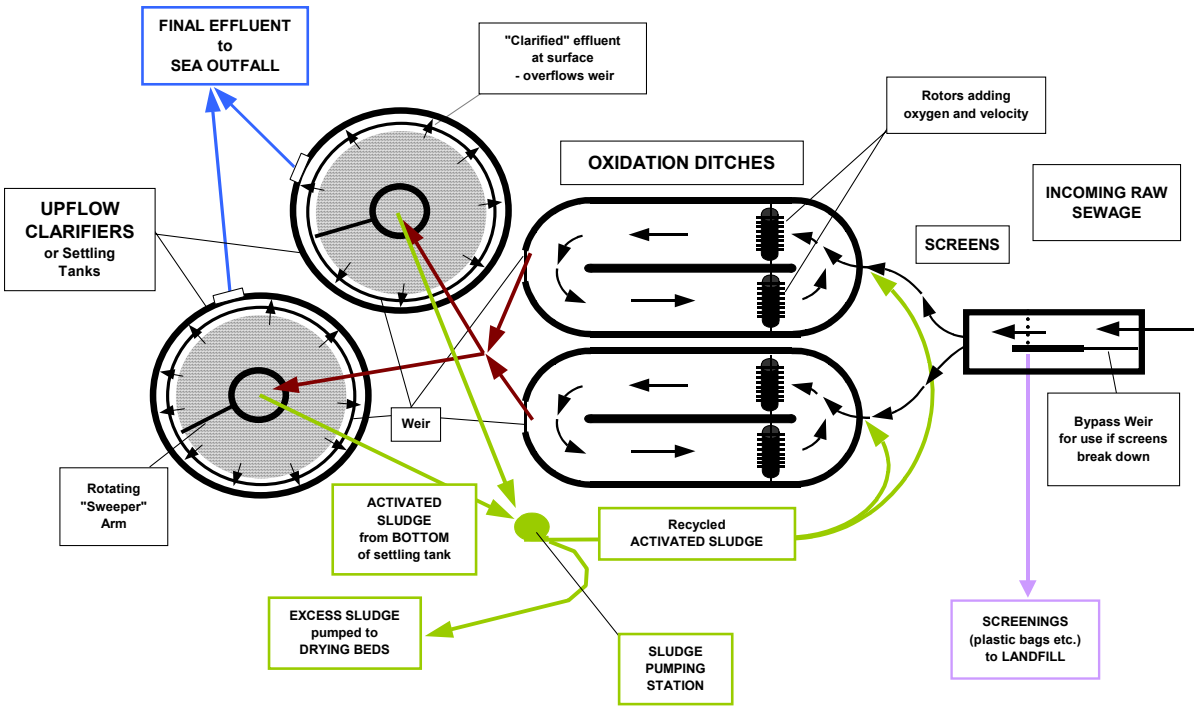
The oxidation ditch is an activated sludge process operating in an extended aeration mode and the operation is primarily dependent on managing two parameters correctly – namely the dissolved oxygen level in the ditch itself and the correct concentrations of sludge in the ditch and the clarifier.

Too little oxygen addition in the ditch will allow anaerobic bacteria to establish themselves and ultimately "take over" the process if no action is taken. As anaerobic conditions worsen, the mixed liquor will turn darker and darker as septic conditions spread. Too much oxygen addition is wasteful of electrical power and excessive dissolved oxygen levels can cause a "pin-point" floc (small aggregated particles) to form - this will not settle out properly in the clarifier but be carried over the outlet weir in the final discharge stream. To maintain the dissolved oxygen (DO) content of the sewage in the ditch at the correct level, the operator will use a "DO Meter" to periodically check on the parameter and then, as necessary adjust the numbers of rotors operating and/or the submergence of them (by raising or lowering the adjustable outlet weir.

To maintain the correct balance in sludge volumes, the operator will run laboratory tests to determine the "Mixed Liquor Suspended Solids" (MLSS) concentration in the oxidation ditch and, based on the results, will adjust the activated sludge return and waste rates appropriately.

The skilled operator will also have a good feel for the condition of his process by simple observation. The colour of the mixed liquor in the ditch will tell him a lot about whether the solid level is correct or whether he needs to adjust the sludge return/waste rates. In a properly operating ditch a layer of "clear" water is usually visible a few feet upstream of the rotor. Foam on the surface of the ditch, dependent on its colour and characteristics can also alert the operator to changed conditions – whether because of some unusual inflow or another operational problem. Observation of the clarity of the final effluent and of the depth to which one can see down into the water in the clarifier will also help the experienced operator to judge the efficiency of his treatment process.

Successful operation of the overall Ocho Rios Sewage works therefore requires trained and skilled personnel with a "feel" for the "art" of sewage treatment – the layout of the overall plant is shown below.



LIQUID INDUSTRIAL WASTES and NWC SEWAGE SYSTEMS

Any business place where liquid industrial wastes are produced is considered to be a generator of "trade" effluent. As such the responsibility for the proper treatment and discharge of treated effluent to the environment rests with the particular business, in accordance with the laws, rules and regulations of the National Resources Conservation Agency, NRCA, (now a division of the National Environment & Planning Agency, NEPA).

However, **recognizing that many such businesses will also have "ordinary" domestic sewage that they may be required to discharge into an NWC sewer and therefore the particular property must be connected to the public sewage system**, under certain circumstances the NWC will permit "trade" wastes to be discharged to an NWC sewer – PROVIDED IT IS PROPERLY AND RELIABLY PRE-TREATED (to meet NWC Sewage Influent Standards) and prior NWC permission is properly sought and obtained.

Such Commercial customers should note that where the NWC grants permission for pre-treated industrial waste to be discharged into NWC sewers, THE NWC WILL ESTABLISH AN ONGOING PROGRAMME OF COMPREHENSIVE INFLUENT QUALITY MONITORING (to check and verify that the NWC's Influent Standards are reliably and consistently met) TO BE PAID FOR BY THE CUSTOMER, and, dependent on the quantities of wastewater being discharged, may require that the Customer provide, and maintain in proper working order at all times, a CONTINUOUS TOTAL DISCHARGE FLOW RECORDING FACILITY (regularly certified as to measurement accuracy).

The specification of the pre-treatment processes necessary for any particular liquid "trade" waste and their design is a job for an appropriately qualified professional engineer BUT if, as a business owner, you have any questions regarding this issue, please contact the NWC and one of our engineers will be pleased to discuss the matter with you at your convenience!

DO NOT DISCHARGE ANY TRADE WASTES TO NWC SEWERS – whether pre-treated or not – AT ANY TIME WITHOUT NWC PERMISSION!

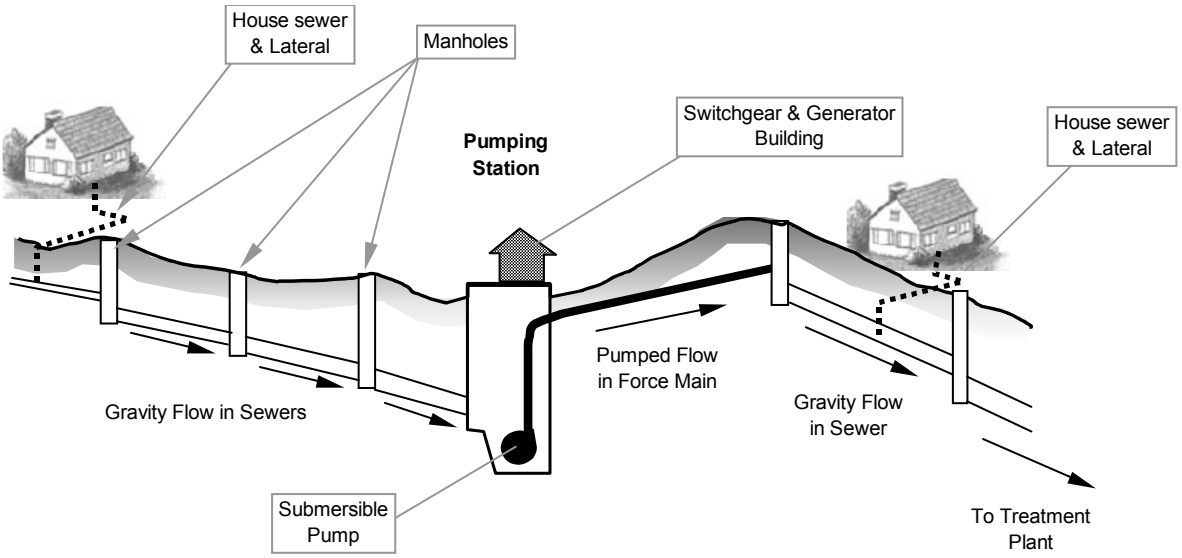
HOW DO WE COLLECT SEWAGE?

Sewage is collected by the NWC using a central sewerage system - a system of pipes laid under our roads and streets connected to each individual property by a "house sewer" or "lateral".

The diagram below shows the outline of a simple NWC "sewerage" system.

The house at the left-hand side of the diagram is connected to an NWC street sewer via a house sewer and lateral. Sewage flows from the various waste pipes from the house into the NWC street sewer by gravity and then flows, also by gravity, through more (and increasingly larger) sewers downhill until it arrives at an NWC sewage pumping station located at a low point on the system.

At the pumping station, the arriving sewage is pumped through a rising main to the highest manhole on the next section of gravity sewers leading towards the NWC Treatment Plant. Note the second house is also connected to the downstream sewer by gravity.



Note that **there are no house connections on the pumping main** - as the sewage in this main is under pressure.

In one single overall sewerage system there may be many pumping stations to move the sewage from the extremes of the system through to the Treatment Plant and, indeed, where an individual property is below the street sewer, the individual property must have its own small sewage pumping station to lift the sewage draining from the building(s) into the street sewer.

As the capital costs associated with the construction of gravity sewers, usually at considerable depth below ground, are high and future modifications to accommodate increases in actual flow cannot be made without incurring similarly high capital costs, **sewage collection systems are designed for the total projected long-term needs within the specific service area.**

To estimate the total flows to be ultimately serviced, the likely use of all developable land is considered (using available long term planning concepts) and the ultimate total population, other institutional (schools, hospitals and public buildings) needs are assessed using appropriate development densities and proven sewage flow parameters.

Designs use a basic sewage flow per person for residential areas, while specific allowances are made for possible needs arising from commercial and light industrial development. To these base sewage flows are added allowances for ground and surface water infiltration (through sewer joints and manhole covers) based on past experience of systems with similar characteristics – a similar water table level, similar soil types etc.

Design figures for domestic or residential sewage discharges range from 40 to 50 gallons per person per day in homes having flush toilets, sinks, showers, and laundry facilities. Allowing for infiltration, total per person flow from residential properties can be expected to range from 70 to 100 gallons per day.

Of course, this flow is not distributed evenly over each 24-hour period. Sewage flows vary just as the demand for potable water varies during the day. Water demands peak for 2 to 4 hours each morning, as people arise from sleep and bathe, and again in the evening as they repeat this when they return to their homes after work or school or as the children prepare for bed and adults prepare for the rest of the evening. During the remaining daytime hours water demand is close to the average (when household laundry and house-keeping chores are most usually done) while in the middle of the night water demand is minimal (as most people are fast asleep!). Basic sewage flows follow this same pattern – for the obvious reason that sewage is “used” potable water!

Sewerage systems are, by definition, gravity flow systems. *(Unlike water distribution systems which operate under pressure, in sewers there is no force available to drive the flow thorough the pipes other than simple gravity – remember that the pressure from your water tap is lost immediately it is opened and there is nothing forcing the water down your toilet and other drains - other than gravity*).

Therefore the sewers must large enough to satisfactorily carry the peak, or maximum, flow that will occur - otherwise the sewers will back-up and the manhole will overflow allowing raw sewage to flow on the surfaces of our streets.

Peak sewage flow rates from an individual property can be very large – just how long does it for the 5 gallons or so of water usually used to flush a toilet to disappear? Fifteen seconds? If so, then the instantaneous flow-rate of one toilet flush is equivalent to that of some 20 gallons in one minute or 1200 gallons in one hour or 28,800 gallons per day – this peak flow from one plumbing fixture that actually uses perhaps a total of 50 to 75 gallons for an average family in one whole day! *However, at the flow velocities found in sewers, the sewage from your single toilet flush could take more than 30 minutes to travel one kilometer (or over 58 minutes to travel one mile), without allowing for any time that it may spend in pumping station sumps! Given that for most sewerage systems the overall travel distance from the far ends of the system to the final point of treatment can be many kilometers the sewage will take considerable time to reach the treatment plant*.

However, as everyone will neither flush their toilets nor bathe nor do the laundry at the same time, for design purposes, engineers use proven formula to estimate the peak flow levels that will be experienced at the various points within a sewerage system and size the sewers (and pumps for any necessary pumping stations) accordingly.

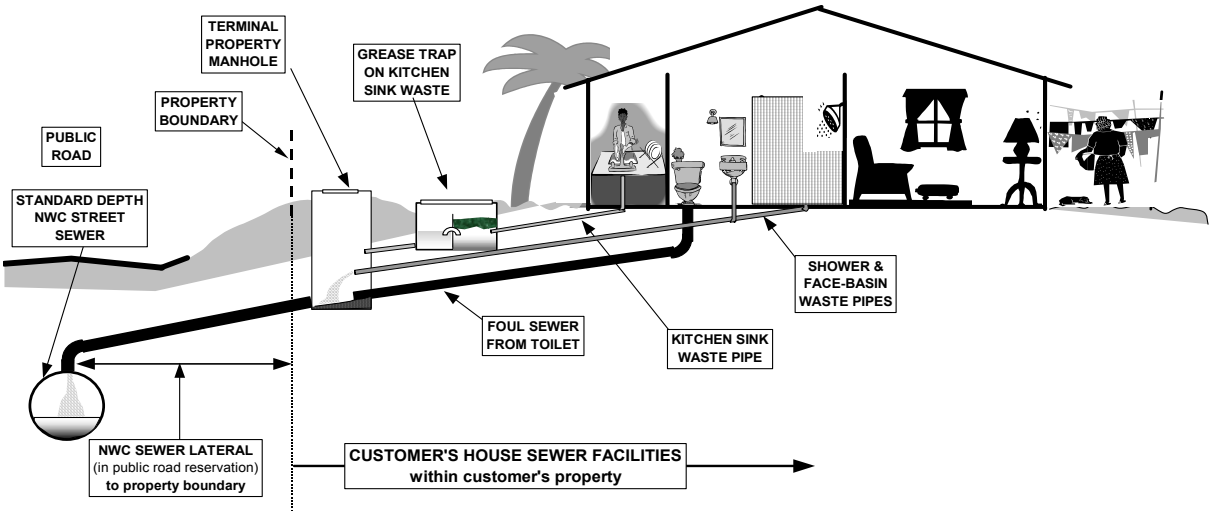
Sewer sizes vary according to the flow being conveyed and are a function of slope, velocity, and internal roughness of the pipes used.

All sewers are designed so that, even at minimum flow rates, the solids present in "normal" sewage will not be deposited in the bottom of the sewer but that the sewers will be "self-cleansing. (*The introduction of other solids, not normally present in ordinary sewage, such as sand and grit will inevitably cause problems of deposition in sewers and will mean that, at intervals, the sewers will have to be flushed or cleaned, using high power "jetters" – with the result that sewer maintenance costs become much higher than they ought to be.*).

Within wholly residential areas, the minimum sewer size is generally eight inches in diameter

Manholes are built to gain access to the sewers from ground level for cleaning and inspection. The manholes are generally placed at approximately 90 metre (300-foot) intervals and at those points where changes in direction, slope and sewer diameter occur.

Let us now examine how the waste pipes in a house or building are actually connected to the NWC's street sewer. The following diagram shows, where there is an existing sewerage system, how a newly constructed house is connected to the street sewer.



The important things to note about the diagram are:

1. **The wastewater from the kitchen sink, the shower and face basin in the bathroom and the toilet all have separate pipes coming out of the building**. This is because each type of wastewater is

different – the toilet waste is "black water" containing body wastes while the other wastes are "gray water". However **the waste from the kitchen sink will often contain fats, oils or grease from washing up plates and cooking pots and pans** and, as we shall see later, it is important that we minimize the amount of such fats, oils and greases that enter the sewerage system – **so the kitchen waste goes through a "grease trap" before joining the other waste flows** in a downstream manhole (a manhole is necessary wherever a drain changes horizontal direction);

2. **There is a "terminal property manhole" just inside the property boundary** – between the "house sewers" and the NWC's lateral. *Depending on the layout of a house, there may be numbers of manholes that waste pipes go through before reaching the "terminal manhole"*,

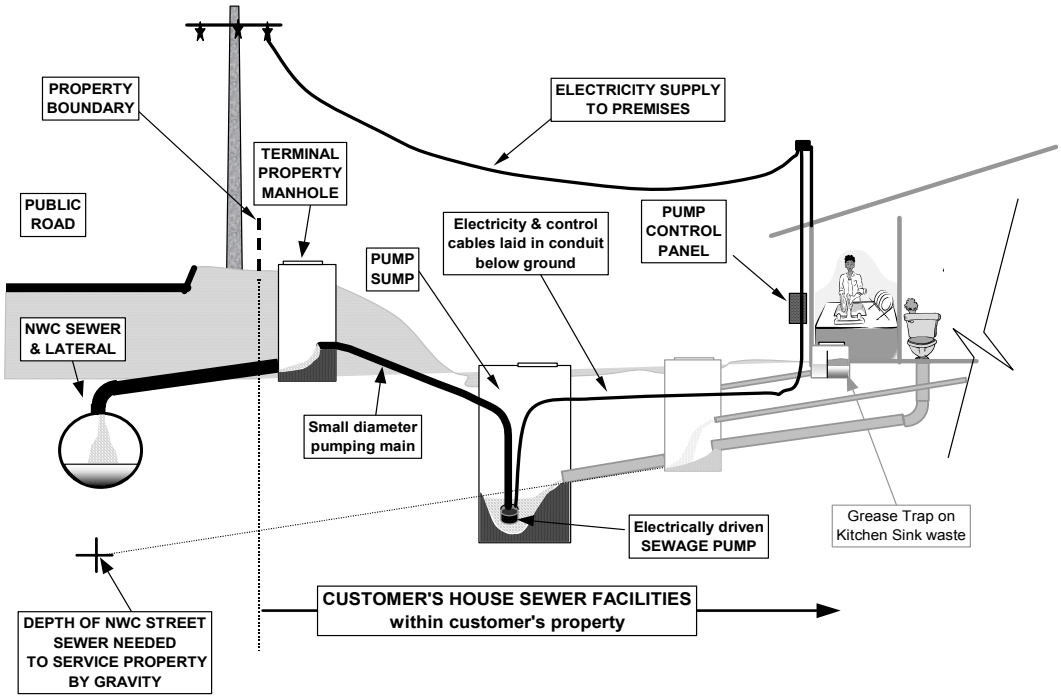
3. **All the pipes fall towards the street sewer** – so all the waste water drains into the street sewer by gravity,

4. **All facilities within the property are referred to as the "Customer's House Sewer Facilities" and the Customer is responsible for maintaining these facilities in good and serviceable condition – AT HIS/HER OWN COST**,

5. **The NWC provides, within the reservation of the public road, the street sewer and the connecting pipe (lateral) from the NWC sewer to the edge of the customer's property**. Provided the Customer abides by the NWC's rules and regulations as to what may be put into an NWC sewer, the NWC will maintain the street sewer and the "lateral" without extra charge to the Customer BUT if problems arise in either the street sewer or the lateral because of inappropriate discharges from a particular property the offending individual property owner (or occupier) could be held responsible for the costs of rectifying such problems.

6. While every attempt will be made by the NWC at the design stage of a central sewerage system to provide street sewers at depths such that most properties can drain to the sewer by gravity, the costs of constructing deep sewers can be prohibitive and **consequently some individual properties may NOT be able to drain sewage flows to the NWC's sewer by gravity**.

The next diagram shows a typical situation where an individual house has its own small sewage pumping station.



Once again the general arrangement is the same up to the individual manhole where all wastes from the various drains in the house come together.

Then, because the continuing downhill grade needed for gravity flow past this manhole would result in a lateral below the level of the street sewer (as shown by the sloping dotted line), **the sewage is taken into a pump sump**.

A small electrically driven sewage pump installed in this sump then lifts the sewage up to the terminal manhole (just inside the property boundary**) and from that terminal manhole the sewage then flows by gravity into the street sewer via a standard lateral**.

The operation of the pump is controlled so that when the depth of sewage in the pump sump reaches a particular level a level switch will start the pump and it will pump sewage out of the sump until the level falls such that another level switch will turn the pump off. Then over time more sewage will flow into the sump until eventually the pump will “trip in” again and the whole cycle will be repeated.

The most important thing to note about this particular diagram is **that all the facilities within the property are still referred to as the “Customer’s**”. Hence, as before, the Customer is responsible for their operation and maintenance BUT in this case **the Customer’s responsibilities include responsibility for the**

electricity costs of running the pump (note that the electricity supply for the pump is taken from the electricity supply into the house) **and for maintaining/repairing the pump itself**.

Clearly it is most important that the customer abides by the recommendations of the pump supplier as to the size of the pump sump and as to routine maintenance of his pump and abides by the NWC's recommendations as to what is put down the house drains – as any extended breakdown of the pump (or prolonged electricity outages) will mean that the customer will have to employ the services of a septic tanker (or cess pool emptier) to empty his sump or sewage will eventually result in sewage backing up in the Customer's house sewers!

To minimize the risk of pump problems, the **three most important things for owners/occupiers** of individual properties serviced by their own individual sewage pumping station are:

1. **Insist that nobody disposes of anything that could cause damage to the pump or to block it down any drain or any toilet**. So no rags, garbage, tampons, sanitary towels, condoms etc., down the toilet and the absolute minimum of food scraps cooking fats, oils and grease down the kitchen sink (which must drain through a regularly cleaned and properly designed grease trap);
2. In accordance with the advice of the professional engineer who will have designed your house sewer facilities**, have the pump and motor set supplied and installed by an experienced and competent company** - one that undertakes to keep spare parts for the pump and electrical motor in stock for many years in the future, will provide regular routine maintenance after sales services and*, provided you undertake to adhere to the advice at item 1*, will provide a guarantee of satisfactory service over a "reasonable" period (say

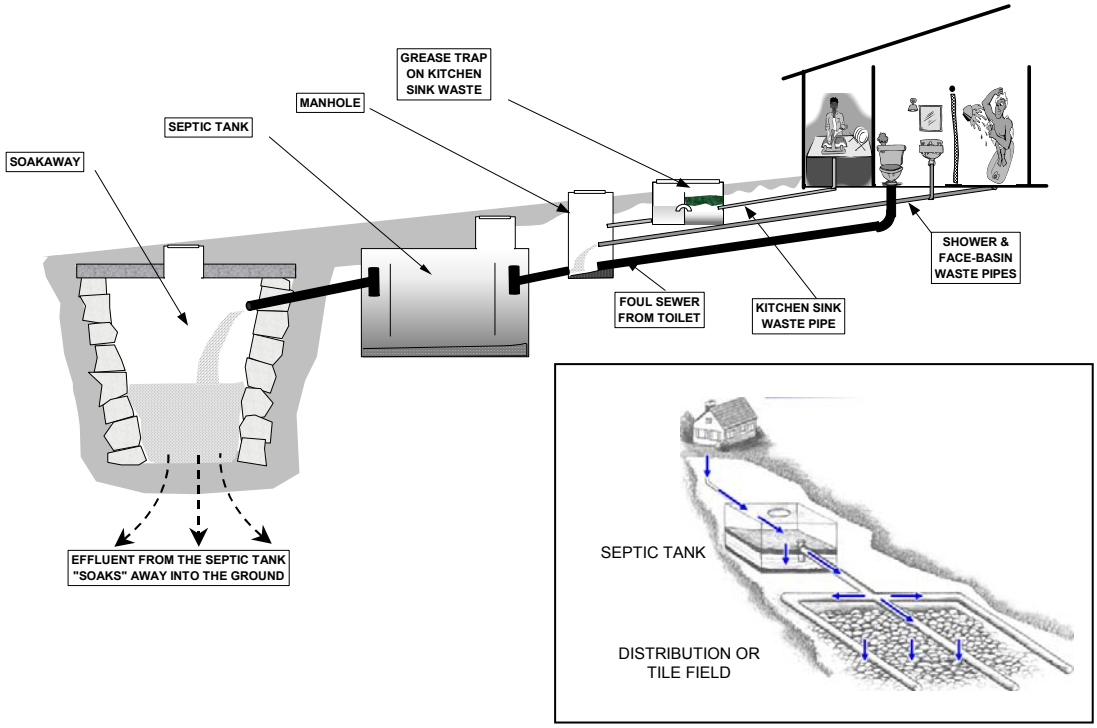
   6 to 12 months) after installation - and **have the necessary electrical works done by a certified electrician** (whether a member of the pump supplier's staff or a sub-contractor; and
3. **Have your sewage pumping installation regularly serviced (preventive maintenance) by your pump and motor supplier**

The foregoing diagrams illustrated the position when a new house is constructed in an area already served by a central NWC sewerage system but **what is the position for an existing house in an already built-up area when the NWC constructs a new sewerage system there?**

Existing properties not served by a central sewerage system will undoubtedly already have a sewage disposal system within their property – an "on-site" sewage system.

Such systems will usually include a septic tank and either a soakaway or tile field to dispose of the effluent from the septic tank (some older properties may only have a soakaway). A typical septic tank/soakaway system is shown in the next diagram – with the smaller insert showing a typical septic tank/tile field

alternative[⊕].



To connect such properties, the combined existing flows of sewage are intercepted at the manhole immediately before (upstream) of the septic tank and are directed to a new "terminal" manhole just inside the property boundary, adjacent to the NWC's lateral – either by gravity (if there is sufficient "fall" available) or through a small pumping station (if the relative elevations do not allow gravity flow)**.**

However **additionally**, as they will be abandoned and never used again, **the previously used septic tank and soakaway/tile field must be drained of sewage and filled in** – it is very dangerous to leave such facilities with sewage in them as inflammable gas (methane) can accumulate in disused septic tanks and soakaways and dangerously explosive situations can occur.

Of course the foregoing assumes that the remainder of the existing drains on the property (originally leading to the septic tank) have been properly constructed. If this is not the case, then suitable modifications must be made during the construction of the new sewage connection to ensure that the completed house sewer

[⊕] Wastewater from the home flows into the septic tank where solids separate from the wastewater. The heavier solids, called sludge, collect on the bottom of the tank. The lighter solids, like hair and grease, float to the top and form a scum layer on the water. Both the top and bottom layers of solids are trapped in the tank and need to be pumped out periodically. In the meantime, the microorganisms in the tank begin breaking down many of these solid waste materials. The clarified wastewater, or effluent, is transported to a drain field by a pipeline. The drain field (sometimes called a tile field or leach field) consists of a series of distribution pipes set in trenches filled with gravel. These distribution pipes have holes so that the wastewater from the septic tank flows out into the gravel trenches, then trickles through the gravel and into the soil under the drain field. Soil acts as a natural filter to filter out many of the bacteria that can cause diseases. Soil can also retain certain nutrients, such as phosphate and some forms of nitrogen. The microorganisms in the soil break down many of the remaining impurities. Finally, the filtered water flows into the groundwater.

facilities comply with NWC regulations and good/sound practice.

Whether a new house is under construction or an existing house is to be connected to a new NWC central sewage system, an application must be submitted to the NWC before any construction work is started and the design and execution of the work necessary must be done in a proper engineering manner – it is usually arranged by the customer working with a registered professional engineer and a contractor (both being of his/her own choice) but **the design / specifications must be approved by the NWC before construction commences and the workmanship of actual construction must be inspected and tested by the NWC before the final connection to the NWC's lateral is made**. However, the NWC can, in certain circumstances, provide direct assistance to potential customers with both design and construction of house sewer facilities – ask at your local NWC office whether such assistance is available!

In any event the NWC will be happy to provide guidance to its prospective customers and indeed provides, with every Application Form for connection to an NWC sewer, guidelines as to proper design and construction requirements.

The foregoing has considered only the position for single family residential homes.

The situation is however similar for **offices and ordinary commercial shops** and the same principles apply – although the actual arrangements of drains may be different.

The same principles also apply to **restaurants and hotels BUT**, for these customers, **particular attention must be paid to the proper and reliable interception of fats, oils or grease (FOG)** and **for hotels on the beach any issues of excessive sand in the sewage discharges must be addressed**.

For all other potential customers – those who potentially will be discharging some form of "trade" or "industrial wastewater (which includes garages and service stations) - **special consideration must be given as to the nature of the waste generated on the property and hence to the extent of pre-treatment necessary before the waste flows can be discharged into the NWC sewer**.

WHY DO WE NEED TO LIMIT THE THINGS WE PUT INTO NWC SEWERS?

Over the years, engineers and scientists have developed sound methods for the collection and treatment of **wastewater** so as to protect public health and the environment around us.

In the case of normal **sewage**, these methods are simple, safe and efficient. Most methods use naturally occurring biological processes.

By contrast with domestic sewage, the treatment of **industrial wastewater** can be difficult and expensive and, indeed, much individual industrial wastewater may need forms of treatment much more complicated than those required for normal sewage* - including chemical treatment in addition to the use of natural biological processes. In addition, the discharge of raw industrial wastewater directly into NWC systems can create special problems in sewers and pumping stations – and can be a major health hazard for NWC employees (and, indeed, the wider community).

Therefore, as **the NWC's wastewater collection and treatment systems are designed ONLY for "normal" SEWAGE** (*and not for industrial or trade wastes*):

- If we put down our sinks and basins or flush down our toilets, things such that the sewage contains certain materials or chemicals that it normally would not

  or

- If any industrial wastewater is directly discharged into NWC sewers then major problems can arise in NWC collection systems and at NWC treatment facilities.

Further, because NWC treatment systems are NOT designed to treat industrial wastewater, many of the contaminants, found in significant quantities only in such wastes, will not be removed in NWC sewage treatment plants and hence will simply pass through into the environment - where they will create the same pollution as if they had been discharged directly to the environment in the first place – a situation that none of us, as concerned citizens of Jamaica, will want!

So:

- **The NWC needs all its sewage customers to be careful and conscious of what goes down their drains**, and
- **The NWC cannot allow any wastewater other than domestic sewage to be discharged into NWC sewers unless it has been properly and reliably pre-treated to the standards set by the NWC and the discharge is made with the prior approval of the NWC,**

The NWC has developed a set of regulations regarding these issues. These are incorporated in the "**Consent to Discharge**" – a document issued to each customer when a property is connected to an NWC sewer. The Consent to Discharge is the basis of the **contract** between the customer and the NWC for sewage service.

We will now examine in more detail what these regulations are, the reasons for them and what they mean for both present and potential NWC customers.

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* **NWC sewage systems are provided to serve the "public" good and not the particular needs of any private commercial or industrial concern.** Thus, it is only fair that the particular organization, person or company producing **industrial** wastewater should be responsible for individually treating and disposing of that wastewater in a proper manner and should directly bear the costs associated with doing so – the general public should not be expected to bear such costs.

First we will review the position for NWC's "domestic" or "residential" sewage customers.

*Note: The conditions placed on domestic or residential customers also apply to **all** NWC sewage customers. However additional regulations apply to non-residential customers*

The **first** condition of the Consent to Discharge regarding the nature of **all** discharges to NWC sewers, at paragraph 8 of the Consent to Discharge, is that:

"(a) There shall be eliminated from the discharge from the said premises into the Commission's connecting sewer any matter which, either alone or in combination with any other matter with which it is likely to come into contact in the Commission's public sewage system to which it is connected, would cause damage or obstruct the said public sewage system or cause injury to the health of any person lawfully present in any sewer or appurtenances of the said public sewage system, or in or at any sewage pumping station or sewage treatment works connected thereto or therewith through which such discharge passes or would make difficult or expensive its treatment or disposal."

These are **general principles** in order to protect:

- The NWC's sewers and other sewerage facilities - as some discharges can attack these structures or cause serious corrosion of mechanical plant, e.g. strong acids or caustic solutions can seriously attack concrete structures (and mechanical equipment) and, eventually, literally destroy them
- NWC employees from being exposed to additional health risks
- The environment – because NWC treatment plants are specifically designed to treat "normal" sewage and many contaminants in industrial or trade wastes will pass directly through such treatment processes unchanged and cause serious environmental pollution when ultimately discharged (unless extra money is spent on additional, more complex, treatment facilities)

As with most of these NWC conditions, **the average residential or domestic customer receiving NWC sewage services need not be overly concerned at the apparent complexity of this or any of the other regulations** – because if such customers simply make sure that they follow good sense and only dispose of things that <u>should</u> go down their drains and toilets (and that they maintain their kitchen sink grease trap properly – see later) they will never be in breach of this or any other NWC discharge regulation.

While this first condition is quite general, other conditions set out in the Consent to Discharge give more guidance to NWC customers as to specifics.

Paragraph 8 (c) of the Consent to Discharge states that:

"….. *as a general principle, at no time shall the following be permitted to enter any public sewer …..*"

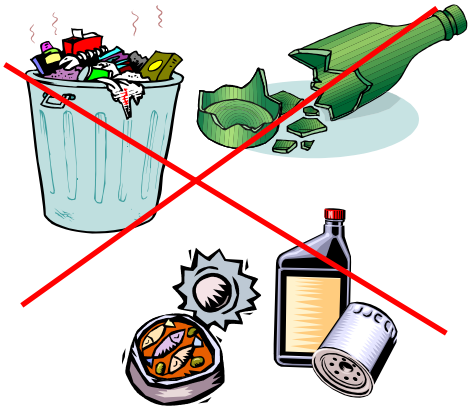
and then continues to list 9 specific categories of prohibited discharges - as follows:

(i) Garbage, rags, bottles, tins and other general refuse

Although most of us would not think of putting "garbage" down our drains or toilet, an amazing

amount of garbage and general refuse does find its way into NWC sewers. Such material usually causes blockages in the sewers but may also cause major damage to pumping plant and mechanical equipment.

So..… **NO**….. **GARBAGE**…..



…… down NWC sewers …. PLEASE!

(ii) Rain, storm and surface water drainage

(iii) Cooling water, water from swimming pools and the like

In even the best of designed and constructed sewerage system, the flows will inevitably include some small quantities of storm water – rainfall drainage infiltrating through manhole covers - and some groundwater - infiltrating through the joints of the sewer pipes and through the concrete of manholes.

Sewage collection systems are designed for a basic per person flow plus an allowance for such "normal" infiltration – with actual sewage discharges for domestic or residential customers ranging from 40 to 80 gallons per person per day (in homes having flush toilets, sinks, showers, and laundry facilities) designs usually include for additional flows for "normal" infiltration such that the total per person design flow from residential properties ranges from 70 to 110 gallons per day. These figures are more than adequate for sewerage systems in Jamaica - provided that extra quantities of simple drainage water (not contaminated by human wastes and therefore not needing the treatment that we must give sewage) do not enter the system. To provide for larger flows would be significantly more expensive – in terms of both initial construction and ongoing maintenance – and this makes no economic sense. ♦

The NWC must therefore limit the quantities of simple drainage water entering their systems.

So . NO **rainwater, A/C or swimming pool drainage**

…water down NWC sewers……**PLEASE !**

(iv) Waste from food grinders

Fats oils and grease (FOG) **are a major problem in NWC sewage systems**. Vegetable and meat scraps, salad dressing, rice, butter, cooking oils, and many other common culinary delights that are disposed off down the kitchen drain quickly turn to grease and will eventually

♦ While historically both sewage and storm water drainage were often collected in the same system, because of the high costs of central wastewater collection and treatment systems, and because, compared to the sewage generated within any particular community, the volumes of rainwater drainage are usually massive and the level of pollution is relatively low, it is increasingly rare for both sewage and storm water drainage to be collected in the same piping system

block either your sewer or the NWC's public sewer. In-sink waste disposal units or grinders exacerbate this problem as they encourage the disposal "down the drain" of larger pieces of food waste.

For this reason, the NWC's rule is

"**no waste from food grinders into public sewers**"

Note that the specific problems of FOG and solutions for dealing with FOG are addressed in detail in a separate section of this manual.

(v) Excessively hot liquids (specifically wastes with a temperature in excess of 45° C);

Temperature affects the natural self-purification process in water (higher temperatures accelerate the biodegradation of organic material in water and the solubility of oxygen in water declines as temperature rises). If excessively hot wastes are discharged into NWC sewers total oxygen depletion can quickly occur and the resulting septic conditions will create odour problems.

So … **NOTHING EXCESSIVELY HOT** ….

……down NWC sewers……**PLEASE!**

(vi) Seawater (whether or not contaminated with sewage);

Seawater contains approximately 35,000 mg/l of common salt, Sodium Chloride.

The contamination of sewage by seawater can affect the NWC in two ways.

Firstly chloride solutions will aggressively attack concrete and secondly chloride affects the balance of bacteria naturally occurring in sewage such that septic and odorous conditions can result.

So ……. NO……

…**SEAWATER** in NWC sewers …..**PLEASE !**

(vii) Inflammable wastes (including petroleum spirit, oils and volatile solvents);

Inflammable wastes must be excluded from public sewers for two reasons. Firstly, for obvious reasons, they create a potential fire and explosion hazard – a danger to both NWC employees and to the public at large. Secondly inflammable wastes are usually complex chemicals that, although eventually biodegradable in nature, require long periods of special bacterial decomposition. Normal sewage treatment plants are not able to handle these clearly industrial wastes efficiently.

So ……. **nothing that will go "BANG"**……

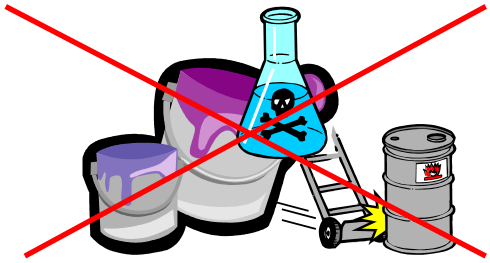
……in NWC sewers …..**PLEASE!**

(viii) wastes containing strong acids or harmful chemicals, highly coloured matters and those creating excessively offensive odours (specifically including wastes with a pH below 6 or above 11);

pH is an important factor in chemical and biological systems and treated sewage effluent discharges should have a pH close to 7, the neutral value♦. Ordinary sewage does not contain materials having the characteristic stated and therefore standard sewage treatment processes can readily achieve the required effluent discharge standards. The presence of any of the materials listed under regulation *(viii)* clearly indicates that materials other than normal sewage have been discharged into the public sewer and, as with other listed contaminants, their presence can cause septicity in NWC sewers - resulting in obnoxious smells - and can disrupt treatment (which use natural biological processes), causing major problems for the NWC, the public and the environment.

♦ The degree of acidity of water is measured in terms of pH. A pH of 7 represents a neutral water, neither acidic nor alkaline; pH's either above or below 7 represent a potentially corrosive water with above being " caustic" and below 7 being "acidic".

So…… **NO ACIDS or STRONG CHEMICALS..**



……in NWC sewers …..**PLEASE!**

(ix) All wastes of whatever kind which cannot be satisfactorily purified by the normal processes of sewage treatment (which shall specifically include non-biodegradable detergents or organics generally, pesticides and herbicides).

The first part of this paragraph re-emphasizes that **NO materials are to enter public sewers if they cannot be treated by the usual processes of treatment employed for normal domestic or residential sewage**.

It further identifies **non-biodegradable materials** (i.e. materials that cannot be decomposed by natural biological processes) **as a general prohibited category but specifically prohibits the discharge of non-biodegradable detergents, pesticides and herbicides**.

Detergents use various complex chemicals that help to reduce water hardness, provide alkalinity (which helps cleaning), help to keep dirt from redepositing on surfaces and to help whiten, brighten and remove stains. Fabric softening agents are used to impart softness and control static electricity in fabrics. Fluorescent whitening agents attach to fabrics to create whitening or brightening effects.

The major components in detergents are usually **surfactants** - these enable the cleaner to wet a

surface more quickly so dirt can be easily loosened and removed. Surfactants break up oily dirt and keeps it suspended in the wash water so it doesn't settle back on the surface being cleaned.

Other major ingredients are **builders**. The most commonly used builders are inorganic compounds, including carbonate and phosphate compounds. The chemicals used in some detergents readily break down into more simple compounds readily found in nature (that is they biodegrade) while those in other detergents do not. The chemicals in these later detergents therefore enter the environment directly and contribute to pollution.

So please check the labels on the soaps, detergents and other cleaning products and use only those ones that clearly say "**BIODEGRADABLE**".

Many detergents also contain **Phosphate** (a compound of the non-metallic element phosphorous). Phosphate is a **nutrient supportive of growth in plants and certain other organisms. High levels of phosphates in water bodies promote the growth of certain algae**, **which**, **if allowed to grow excessively, can deplete the levels of oxygen in water to the point that fish and other aquatic life** (which also depend on the oxygen in the water to live) **may die.** Further excessive levels of nutrient in the sea (derived from raw or improperly treated sewage) will promote excessive seaweed growth – spoiling our bathing beaches and threatening our tourism industry.

So please check the labels on the soaps, detergents and other cleaning products and use only those ones that clearly say "NO PHOSPHATES" or **"LOW PHOSPHATE".**

Naturally, as pesticides and herbicides are intended to kill living materials (pests and weeds) they can seriously affect the natural biological processes most commonly used today by the NWC to efficiently and cost effectively treat sewage.

Further **many of the pesticides and herbicides used today in commercial farming activities in Jamaica can end up in our groundwater** if considerable care is not taken in their proper use (and in the disposal of their containers and residues) **and some are carcinogenic (i.e. potentially causing cancer in humans). D**rinking water standards require that the quantities in drinking water are extremely small and while drinking water can be treated for such materials, it is at a substantial price. If our groundwater becomes seriously polluted with man-made pesticides and herbicides then we shall all start to pay the price!

So…..**PLEASE**……. BE KIND TO THE ENVIRONMENT **and DO NOT PUT PESTICDIES WEEDKILLERS or AGRICULTURAL CHEMICALS drown the drain**!

and PLEASE use BIO-DEGRADABLE DETERGENTS …..CHECK THE LABEL and use those that do not contain "phosphates" or use those labeled as "low phosphate".

After the foregoing, the NWC's Consent to Discharge continues with:

"Discharges into any NWC public sewer shall not contain any of the substances listed below at concentrations, expressed in milligrams per litre, greater than those stated:

(i)	*Settleable Solids*	*250*
(ii)	*Oil, Grease or Fat*	*15*
(iii)	*BOD_5*	*215*
(iv)	*Sulphide*	*0.25*
(v)	*Cyanide*	*0.9*
(vi)	*Ammoniac Nitrogen (as N)*	*9*
(vii)	*Sulphate (as SO_4)*	*250*
(viii)	*Available Chlorine (as Cl)*	*4*
(ix)	*Sulphur Dioxide (as SO_2)*	*0.8*
(x)	*Phenolics*	*1*
(xi)	*Phosphate (as P)*	*6*
(xii)	*Heavy Metals - Total*	*2.5*
	Max. any individual HM	*0.5*
(xiii)	*COD*	*350*

While this may appear to be a formidable list, the average domestic or residential NWC sewage customer need not be overly concerned - for the reason indicated on the note that appears alongside the list on the Consent to Discharge,

The provisions of this Section will not normally impact the discharge of domestic sewage

i.e. **normal residential sewage discharges will not breach these contaminant levels** – of course, provided, once again that we do not put down our toilets or drains any things that should not be disposed off in that way and we maintain our kitchen sink grease trap properly !

This particular NWC standard represents the maximum levels of certain potential constituents derived from wastewater OTHER THAN NORMAL SEWAGE i.e. these levels of constituents will arise only from trade or industrial wastewater discharges OR BECAUSE SOMETHING, THAT SHOULD NOT HAVE BEEN PUT DOWN THE DRAIN, WAS!

It is clear that ALL activities **other** than the "domestic" activities that we practice in our homes must be considered as generating industrial wastewater. Therefore the responsibility for its proper treatment and the proper disposal of the treated effluent rests with the generator of this waste.

In conjunction with the Environmental Health Unit of the Ministry of Health, the National Environment & Planning Agency (NEPA) has developed standards for the quality of "trade" or industrial wastewater effluent that can be legally discharged into the environment in Jamaica and <u>it is the legal responsibility of the "trade" waste generator to comply with NEPA regulations in this matter</u>

However, some industrial wastewater can be satisfactorily "pre-treated" on an individual basis so as to be of very similar composition to normal sewage.

Therefore, provided that the NWC's system is able to accept the effluent volumes and the NWC gives its prior approval, **the NWC <u>may</u> allow industrial wastewater properly pre-treated to NWC Influent Standards** (described above) **to be discharged into the public sewage system** - <u>provided it is satisfied that proper operation of the pre-treatment facilities is assured at all times</u> through:

- Proper and appropriate design of the pre-treatment facilities
- Proper operation of the pre-treatment facilities by competent personnel
- Proper maintenance of the pre-treatment facilities.

To ensure that the NWC can properly further treat any wastewater derived from trade or industrial processes, (i.e. to ensure that harmful contaminants present in industrial wastes, but not sewage, do not enter the environment by simply "passing through" NWC sewage plants unchanged), **all discharges to NWC sewers must meet the foregoing NWC Influent Standards** – including that same list of chemicals (noted as not relevant to residential sewage customers) referred to above i.e.

(i)	*Settleable Solids*	*250*
(ii)	*Oil, Grease or Fat*	*15*
(iii)	*BOD_5*	*215*
(iv)	*Sulphide*	*0.25*
(v)	*Cyanide*	*0.9*
(vi)	*Ammoniac Nitrogen (as N)*	*9*
(vii)	*Sulphate (as SO_4)*	*250*
(viii)	*Available Chlorine (as Cl)*	*4*
(ix)	*Sulphur Dioxide (as SO_2)*	*0.8*
(x)	*Phenolics*	*1*
(xi)	*Phosphate (as P)*	*6*
(xii)	*Heavy Metals - Total* *Max. any individual HM*	*2.5* *0.5*
(xiii)	COD	*350*

This list may be compared with the NRCA Standards for Trade Effluent as shown below.

The NRCA "Trade" effluent standards are:

Parameter	NRCA Limit
Ammonia/Ammonium	1 mg/l
Barium	5 mg/l
Boron	0.5 mg/l
Calcium	5 mg/l
Colour	100 TCU
Detergent	15 mg/l or less than 0.015 kg / 1000kg of product
Fluoride	3 mg/l
Iron	3 mg/l
Manganese	1 mg/l
Oil & Grease	10 mg/l or less than 0.01 kg / 1000kg of product
Phenols	0.1 mg/l
Phosphate	5 mg/l
Sodium	100 mg/l
Sulphate	250 mg/l
Sulphide	0.2 mg/l
Total Dissolved Solids	1000 mg/l
Total Organic Carbon	100 mg/l
Total Suspended Solids	At ALL times < 150 NTU Monthly average < 50 NTU
Heavy Metals	
Arsenic	0.5 mg/l
Cadmium	0.1 mg/l
Chromium	1 mg/l
Copper	0.1 mg/l
Cyanide (free HCN)	0.1 mg/l
Total Cyanide	0.2 mg/l
Lead	0.1 mg/l
Mercury	0.02 mg/l
Nickel	1 mg/l
Selenium	0.5 mg/l
Silver	0.1 mg/l

As can be seen by comparing the two standards, the NWC is prepared to accept certain industrial or trade wastes into NWC sewers **BUT ONLY IF**

IT HAS BEEN ADEQUATELY PRE-TREATED -

by the organization responsible for it.

Seems complicated?

If you have any **QUESTIONS**

PLEASE

CALL US!

List appropriate local NWC contact telephone numbers

THE CONSENT TO DISCHARGE

The Consent to Discharge, illustrated alongside, is a 3-page document that forms a contract between a property owner and the NWC for the provision of sewage services to the property by the NWC.

As a contract, it is to be signed by authorized representatives of the property owner and the NWC (the two parties to the contract) in the presence of a witness (who will also sign the document as having witnessed the two parties so sign).

Two copies of the formal document, with the necessary particulars of the connection in question already completed by the NWC and ready for both parties to sign, are to be signed immediately before the NWC permits the final connection of any house sewer facilities to be connected to an NWC sewer - so that the final connection can be made (*a connection made without the prior signature of the Consent is illegal*).

A copy of this document will have been provided by the NWC with each application form and prospective NWC sewage customers should read have already read it carefully by that time … but if there are any questions about the document please ask - long before it is time to sign. An NWC representative will be happy to explain anything that is not understood - at any time.

The Consent starts out by recording that: -

- The Owner or **authorized** Occupier confirms that the house sewer facilities (everything on the private property needed to collect and convey sewage from the property to the NWC's sewer) have been constructed in accordance with the plan approved by the NWC (inclusive of any "pre-treatment facilities – such as grease tarps, oil or sand interceptors etc.), and
- The Owner or **authorized** Occupier "**AGREES AT ALL TIMES TO FAITHFULLY COMPLY WITH THE CONDITIONS SET OUT BELOW**" ,

and continues to set out some 11 conditions (*which will be explained below*) and ends, on page 3, with appropriate spaces for the signature of the document by the Owner (or his/her authorized representative), an authorized NWC representative and by a witness. In addition, both parties are to initial the first two pages of the document and the specific list of pre-treatment facilities provided (if any).

The Conditions are mostly simple and straightforward as follows: -

Condition 1 requires that the Consent to Discharge is to be kept at the property and must be available for inspection by an NWC representative at all times – *this is to facilitate the NWC in case of any emergency and during any routine inspection that the NWC may make*.

Condition 2 **requires that the Owner/Occupier maintains the house sewer facilities** (including any pre-treatment facilities) **in good condition at all times <u>at his/her own cost</u>** – *the facilities on the property belong to the owner of the property and their maintenance is NOT the NWC's responsibility. Poorly maintained facilities on any private property can result in serious problems on the main sewage system.*

Condition 3 further emphasizes that **the owner/occupier of the premises must clean out any grease, oil or sand traps on the property regularly and dispose of the material removed from such traps properly** – either in the garbage or to a proper waste disposal site. ***Traps that are not cleaned out regularly can become a health hazard for those people living on the property and for their neighbours.*** *Flushing material accumulated in any trap out into the outlet drain or dumping any material removed from any trap into a downstream manhole is simply defeating the purpose of the trap and will result in blockages in NWC sewers or problems at NWC pumping stations or treatment works.*

Condition 4 **requires that no modification be made to the house sewer facilities without the prior approval of the NWC** – *as the facilities will have been specifically designed to properly serve the needs of the property as it exists at the time of connection, an inappropriate subsequent modification may render the existing system inappropriate and result in improper discharges to the NWC sewer. Therefore, any modification must be made under the same conditions as the original work i.e. with proper, professional designs and the resulting construction work vetted, approved and tested by the NWC.*

Condition 5 **ensures that authorized NWC representatives may inspect the house sewer facilities <u>at any reasonable time</u>** – to ensure that everything is as approved and in good working condition – *that is, to enable the NWC to check, as may be reasonable necessary, that the property owner/occupier is living up to his end of the contract! Sometimes problems experienced on NWC sewers point to problems within a particular property and the NWC must have reasonable access to that property to check for defects so that, in the common interest of all members of the community affected by the problem, they can determine its real cause and have it fixed.*

Condition 6 follows on from Condition 5 in that, **if**, based on an inspection carried out by the NWC under Condition 5, **any of the facilities on a private property require repair or modification** *(because of some changes improperly made to the original installation or for any other reason)* **the Owner/Occupier is required to have any necessary work carried out, at his/her own cost, within 30 days** of receipt of a Notice from the NWC.

The clause continues to point out that **if such work is not carried out in a timely manner the penalties prescribed by law may be invoked against the Owner/Occupier.** Further, in the event that as a consequence of the failure to undertake the necessary work of repair or modification, improper discharges are made into an NWC

sewer, then the penalties that may be invoked include for the NWC to recover any costs that they may incur in dealing with the improper discharges.

Very serious problems can be experienced on NWC's systems as a result of improper discharges with costs potentially running into many thousands of dollars. The discharge of prohibited chemicals can create major treatment problems requiring expensive remedies (and potential lawsuits if the chemicals are hazardous to human life and personal injuries result) while the excessive discharge of fats, oils and greases, garbage and other materials can result in blockages on NWC sewers or breakdown of pumping equipment. The costs which can be incurred for hiring mobile power generators and temporary pumping equipment to transfer sewage through over ground hoses from a manhole upstream of a blockage to one below it are very substantial!

For this reason the NWC must take every necessary step to ensure that each NWC sewage customer does his/her part – properly and promptly – for the good of all!

Condition 7 **permits the NWC to sample the sewage flow coming from any property – before it joins other flows in the NWC sewer**. This will enable the NWC to clearly document any illegal or improper discharges of major significance and **identify the offender.**

Condition 8 **identifies**, in sections (a) to (c), **materials, chemicals and the like which must <u>NOT</u> be discharged into NWC sewers.** The collective Condition 8 represents the **NWC's "Influent Standards"**

The specific prohibitions set out in the three paragraphs of Condition 8 and the reasons for them can be briefly summarized as follows: -

Paragraph 8 (a) sets out **general prohibitions** in order to protect

- The NWC's sewers and other sewerage facilities - as some discharges can attack these structures or cause serious corrosion of mechanical plant, e.g. strong acids or caustic solutions can seriously attack concrete structures (and mechanical equipment) and, eventually, literally destroy them
- NWC employees from being exposed to additional health risks, and
- The environment – because NWC treatment plants are specifically designed to treat domestic sewage and many contaminants in industrial or trade wastes will pass directly through such treatment processes unchanged potentially causing serious environmental pollution when ultimately discharged (unless extra money is spent on additional more complex treatment facilities)

by stating that no matter which "*either alone or in combination with any other matter with which it is likely to come into contact in the Commission's public sewage system to which it is connected, would cause damage or obstruct the said public sewage system or cause injury to the health of any person lawfully present in any sewer or appurtenances of the said public sewage system, or in or at any sewage pumping station or sewage treatment works connected thereto or therewith through which such discharge passes or would make difficult or expensive its treatment or disposal*" shall be discharged into an NWC sewer.

Paragraph 8 (b) states, in rather precise chemical language, the maximum levels of certain specific potential contaminants. However **this paragraph need not concern the average careful and conscientious sewage customer** as most of the referenced contaminants are NOT present in problematic concentrations in ordinary domestic sewage – **provided, of course, that we do not throw into our household sinks, showers/baths or toilets things that should NOT be disposed off that way!**

Many of the contaminants listed at Paragraph 8 (b) may however be present in high concentrations in trade or industrial wastewater discharges and that is why the condition is included on the Consent to Discharge – to protect the environment from industrial waste pollution.

Paragraph 8 (c) complements the general principles established at paragraph (a) **and lists 9 specific things that must NOT be discharged to an NWC sewer**. These are: -

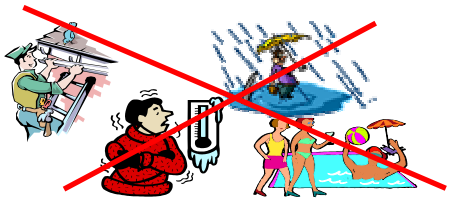
(i) GARBAGE, RAGS, BOTTLES, TINS and OTHER GENERAL REFUSE

Amazingly people do throw these things in their drains, toilets and manholes. Inevitably this results in blockages – often in NWC sewers.

So ……. please, ……**NO GARBAGE** down your drains!

(ii) RAIN STORM AND SURFACE WATER DRAINAGE, and

(iii) COOLING WATER, WATER FROM SWIMMING POOLS and the like



The NWC must limit the quantities of simple drainage water (which does not need the level of treatment given, at considerable cost, to sewage) entering their systems - otherwise massive extra costs would have to incurred in building even bigger collection and treatment facilities – and that would be a waste of all our money.

So **NO RAINWATER, A/C OR SWIMMING POOL DRAINAGE WATER** down NWC sewers……PLEASE !

(iv) WASTE from FOOD GRINDERS

Fats oils and grease (FOG) **are a major problem in NWC sewage systems**. Vegetable and meat scraps, salad dressing, rice, butter, cooking oils, and many other common culinary delights that are disposed off down the kitchen drain quickly turn to grease and will eventually block either your sewer or the NWC's public sewer. In-sink waste disposal units or grinders exacerbate this problem as they

encourage the disposal "down the drain" of larger pieces of food waste.

So the NWC's rule is "**NO WASTE FROM FOOD GRINDERS**" into public sewers

(v) EXCESSIVELY HOT LIQUIDS (specifically wastes with a temperature in excess of 45° C);

Temperature affects the natural self-purification process in water. If excessively hot wastes are discharged into NWC sewers total oxygen depletion can quickly occur and the resulting septic conditions will create odour problems.

So **NOTHING EXCESSIVELY HOT** down the drain!

(vi) SEAWATER (whether or not contaminated with sewage);

Seawater contains approximately 35,000 mg/l of common salt, Sodium Chloride. Chloride will aggressively attack concrete and affect the balance of bacteria naturally occurring in sewage such that septic and odorous conditions can result.

So **NO SEAWATER** in NWC sewers .....**PLEASE !**

(vii) INFLAMMABLE WASTES (including petroleum spirit, oils and volatile solvents);

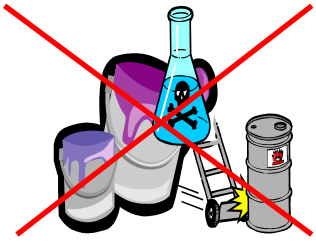
Inflammable wastes must be excluded from public sewers for two reasons. Firstly, for obvious reasons, they create a potential fire and explosion hazard – a danger to both NWC employees and to the public at large. Secondly inflammable wastes are usually complex chemicals that, although eventually biodegradable in nature, require long periods of special bacterial decomposition. Normal sewage treatment plants are not able to handle these obvious industrial wastes efficiently.

So **NOTHING THAT WILL GO "BANG"** in NWC sewers

PLEASE!

(viii) Wastes containing STRONG ACIDS OR HARMFUL CHEMICALS, HIGHLY COLOURED MATTERS and THOSE CREATING EXCESSIVELY OFFENSIVE ODOURS (specifically including wastes with a pH below 6 or above 11);

Strong acids or caustic chemicals affect the biological processes used by the NWC to treat sewage. The presence of any of the materials listed under regulation *(viii)* clearly indicates that materials other than normal sewage have been discharged into the public sewer and their presence can cause septicity in NWC sewers - resulting in obnoxious smells - and can disrupt treatment.



So **NO ACIDS or STRONG CHEMICALS** in NWC sewers **PLEASE!**

(ix) ALL WASTES of whatever kind WHICH CANNOT BE SATISFACTORILY PURIFIED BY THE <u>NORMAL</u> PROCESSES OF <u>SEWAGE</u> TREATMENT (which shall specifically INCLUDE NON-BIODEGRADABLE DETERGENTS OR ORGANICS GENERALLY, PESTICIDES AND HERBICIDES).

The first part of this paragraph re-emphasizes that **NO materials are to enter public sewers if they cannot be treated by the usual processes of treatment employed for normal domestic or residential sewage**.

It further identifies **non-biodegradable materials** (i.e. materials that cannot be decomposed by natural biological processes) **as a general prohibited category but specifically prohibits the discharge of non-biodegradable detergents, pesticides and herbicides**.

Detergents use various complex chemicals that help to reduce water hardness, provide alkalinity (which helps cleaning), help to keep dirt from redepositing on surfaces and to help whiten, brighten and remove stains. Fabric softening agents are used to impart softness and control static electricity in fabrics. Fluorescent whitening agents attach to fabrics to create whitening or brightening effects. The major components are usually **surfactants** - these enable the cleaner to wet a surface more quickly so dirt can be easily loosened and removed. Surfactants break up oily dirt and keeps it suspended in the wash water so it doesn't settle back on the surface being cleaned. Other major ingredients are **builders**. The most commonly used builders are inorganic compounds, including carbonate and phosphate compounds.

The chemicals used in some detergents readily break down into more simple compounds readily found in nature (that is they biodegrade) while those in other detergents do not. The chemicals in these later detergents therefore enter the environment directly and contribute to pollution. So please check the labels on the soaps, detergents and other cleaning products and use only those ones that clearly say "**BIODEGRADABLE**".

Many detergents also contain **Phosphate** (a compound of the non-metallic element phosphorous). Phosphate is a **nutrient supportive of growth in plants and certain other organisms. High levels of phosphates in water bodies promote the growth of certain algae**, **which**, **if allowed to grow excessively, can deplete the levels of oxygen in water to the point that fish and other aquatic life** (which also depend on the oxygen in the water to live) **may die.** Further excessive levels of nutrient in the sea (derived from raw or improperly treated sewage) will promote excessive seaweed growth – spoiling our bathing beaches and threatening our tourism industry. **So please check the labels on the soaps, detergents and other cleaning products and use only those ones that clearly say** "**NO PHOSPHATES"** or **"LOW PHOSPHATE".**

Naturally, as pesticides and herbicides are intended to kill living materials (pests and weeds) they can seriously affect the natural biological processes most commonly used today by the NWC to efficiently and cost effectively treat sewage. Further **many of the pesticides and herbicides used today in commercial farming activities in Jamaica can end up in our groundwater** if considerable care is not taken in their proper use (and in the disposal of their containers and residues) **and some are carcinogenic (i.e. potentially causing cancer in humans).**

Nitrate is another "nutrient" like phosphate and both of these are major components in most fertilizers - to provide nitrogen and phosphorous for plant growth. So do not dispose of any waste fertilizer down your sewers.

So…..**PLEASE**……. **BE KIND TO THE ENVIRONMENT**

DO NOT PUT

PESTICDIES,

WEEDKILLERS

or AGRICULTURAL CHEMICALS

drown the drain!

and … …… PLEASE ….. CHECK THE LABELS ON THE SOAPS, DETERGENTS AND OTHER CLEANING PRODUCTS THAT YOU BUY and **USE** those that are **BIODEGRADABLE** and have **NO PHOSPHATE** or are **LOW PHOSPHATE** **!!!!!!!!**

At paragraph 8 (d) the Consent to Discharge reminds the Owner/Occupier of the connected premises that **the discharge of any of the prohibited wastes will make him/her liable for legal penalties for each and every day that such discharges occur** – so please take the conditions under paragraphs 8 (a), (b) and (c) seriously as improper discharges could be costly!

Condition 10 **requires the Owner/Occupier** of any premises connected to an NWC **sewer to <u>promptly</u> advise the NWC**, in writing, **of any change in ownership or occupancy of the property or of any change in use or any change of the circumstances of the property that could result in a change in the nature or composition of wastewater that will be discharged into the NWC's sewer**.

This is to reinforce the requirements of Condition 4 – for the same reasons noted for that condition.

Condition 10 **makes the Owner/Occupier of any premises connected to an NWC sewer responsible for paying "on demand"** (that is, promptly) **the NWC's bill for Sewage Service –** and any other charges or penalties that may be properly levied on the customer**.**

Condition 11 reminds the Owner/Occupier that **any failure to pay all proper NWC charges gives the NWC the right to discontinue BOTH sewage and WATER SERVICES to the particular property involved –** and to recover any costs that the NWC may incur in disconnecting (and re-connecting) the premises – **with a deposit** of the estimated costs for restoration of service **to be paid** to the NWC **before any service is restored.**

THAT"S IT --- ANY QUESTIONS PLEASE CALL US!

As you can see the Consent to Discharge is a very necessary agreement that clearly sets out the responsibilities of the Owner / Occupier of any property connected to an NWC sewer – so that the NWC can do its part in providing its customers and the community at large with efficient and cost-effective sewage collection, treatment and treated sewage effluent disposal in a manner such that everyone may enjoy the benefits of a clean and healthy environment.

The NWC has invested many billions of dollars in modern sewage systems around Jamaica – and will continue to expand its sewage services throughout the island in the years to come.

Remember, NWC sewage systems do not generate waste they collect, treat and dispose of it properly.

Be careful of how you dispose of your waste and assist the NWC in its efforts to preserve our beautiful natural environment!

THE NATIONAL WATER COMMISSION *Water* is life **WORKING IN EVERYONE'S INTEREST**

HOW TO HAVE YOUR PROPERTY CONNECTED TO AN NWC SEWER

The first step for anyone who wishes to have his or her premises connected to an NWC sewer **is to complete an official application form** - available from any NWC office. **It is illegal to connect to an NWC sewer without NWC approval**.

Who may apply for a sewage connection?

Because the NWC must have a contractual relationship with the owner of the property serviced, the application should preferably be made by that person. However, an agent of the owner (which may include a tenant) may, with the permission of the owner, submit an application for sewage service.

Completing the form

Alongside you will see the top section of the first page of the application form.

At **item 1**, write in the address of the premises. This should be a street address - if there is no such address then use the best description that you can to identify exactly where your premises are. (*Do **not** give a Post Office Box or the name of a Postal Agency – this does not help the NWC to identify your particular property)*

Item 2 requires the details of the actual property owner to be entered. This **must** include the full postal address (at which the NWC may contact the owner by mail) and preferably a telephone number.

The NWC will need to visit the premises to be connected and, if the property is rented out, to avoid any problems with ready access at a convenient time, then **item 3** asks for the name and contact telephone number of the tenant(s).

NATIONAL WATER COMMISSION
Water is life

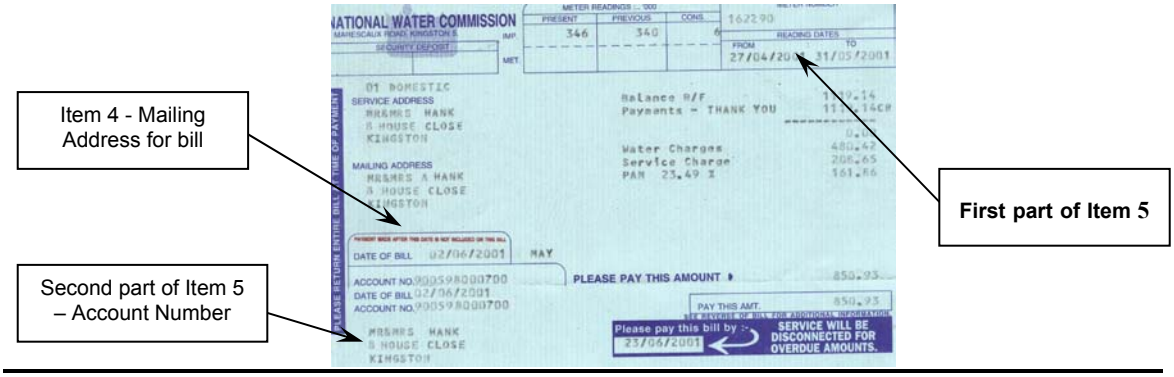
NWC Sewage Application Form **Page 1**

APPLICATION for CONNECTION to an NWC SEWER

Scheme | Application Number
NWC use only

1	Address of Premises	.....
2	Details of Owner(s) or Strata Plan Details *If multiple owners please list on additional sheet of paper and attach with staple*	Name: ..... Tel. No. ☐☐☐ ☐☐☐☐ Address: .....
3	Details of Tenant(s) *(If any – if multiple tenants please list on additional sheet of paper and attach with staple - if no tenants please indicate with "No tenants")*	Name: ..... Tel. No. ☐☐☐ ☐☐☐☐ Type of Tenancy: Weekly ☐ Monthly ☐ Yearly ☐ Date of Commencement ...../...../..... (Day Month Year) Other ☐ (Please describe) .....
4	To whom is current NWC **WATER** bill addressed? (Refer NWC Bill)	Name: ..... Address: .....
5	Details of current NWC **WATER** Account for the PREMISES TO BE CONNECTED (Refer NWC Bill)	Meter No. ☐☐☐☐☐☐☐☐☐☐☐☐ Account No. ☐☐☐☐☐☐☐☐☐☐☐☐

Items 4 and 5 ask for details of a current NWC water bill for the premises – firstly the name and address to which the bill is sent and then the actual water meter number and the account number. All of this information is readily available on the actual NWC bill - as shown below:



5	Details of current NWC **WATER** Account for the PREMISES TO BE CONNECTED (Refer NWC Bill)	Meter No. ☐☐☐☐☐☐☐☐☐☐☐☐ Account No. ☐☐☐☐☐☐☐☐☐☐☐☐
6	Are there any other NWC **WATER** Connections on premises? *(If insufficient space please list on additional sheet of paper and attach with staple)*	No ☐ Yes ☐ if "Yes" give details of other NWC Connections ... Other NWC Account No.'s ☐☐☐☐☐☐☐☐☐☐☐☐ ☐☐☐☐☐☐☐☐☐☐☐☐
7	Number of Persons normally LIVING on premises	☐☐☐
8	Description of Premises	RESIDENCE ONLY ☐ with ☐ toilets, ☐ basins, and ☐ baths/shower stalls OTHER ☐ **(If OTHER, sections 11 to 14 and section 15 must be completed)**
9	**ARE YOU APPLYING FOR NWC ASSISTANCE WITH THE CONSTRUCTION OF YOUR HOUSE SEWER FACILITIES?** (Tick appropriate box) YES ☐ NO ☐ **(If you are NOT applying for assistance, this application should be accompanied by 3 copies of an engineering plan of your proposed house sewers and connection together with full details thereof PLUS the Application Fee)**	
10	If you are NOT applying for NWC assistance, Name and Address of Contractor who will construct the house sewers	Name: ..... Tel. No. ..... Address: .....

Here now is the bottom part of Page 1 of the application form – we have already dealt with item 5 – where a water meter and the associated account number information was entered.

It is however not unusual for there to be more than one water connection on a single property and for more than one NWC bill to be applicable. **Item 6** therefore asks for information about any, and all, other water connections to the property to be provided. (*During the processing of the application the NWC will check its comprehensive Customer Accounting System (CAS) records for multiple connections in any event, but the direct provision of accurate data on the application form will speed up processing*).

Item 7 simply asks for the number of persons "normally", i.e. usually, living at the premises, while **Item 8** requires information as to whether the property is used ONLY as a residence or has another use.

In the case where the premises are only used for residential purposes the number of sanitary fixtures of each type listed are to be provided – this being used to calculate the "application fee" normally payable – which is based on a standard schedule as shown at the appendix to this section.

NOTE: If you tick the "Other" box at **Item 8** then*, irrespective of what you enter in items 9 and 10***,** you must complete **Items 11, 12, 13 and 14** as well as **Item 15** (*Item 15 must be completed by ALL applicants*).

In certain specific areas at certain times, the NWC may be able to offer its potential sewage customers substantial assistance with their connections. This assistance may not always be available in all areas at all times and, if available to you, may range in extent. Such NWC assistance **might include** some of the following: -

- A reduction or waiver of application fees
- Technical assistance for the design of your house sewer facilities at a subsidized price
- Assistance with the selection and supervision of a competent contractor for the actual construction work
- The provision of pipes and fittings for the facilities at subsidized prices, and
- Financing of the costs of house sewer facility construction at subsidized interest rates

Item 9 therefore allows prospective customers to request any NWC assistance that may be available. Checking the "YES" box will mean that an NWC Customer Service Representative will carefully investigate any assistance that may be available and, if it is, will check preliminarily on your eligibility for such assistance. An NWC's representative will subsequently get in touch with you to explain what assistance, if any, is available, your options and the next steps necessary.

Item 15 Declaration and Signature

15 I / WE HEREBY APPLY FOR PERMISSION TO CONNECT THE FOREMENTIONED PREMISES TO AN NWC SEWER AND TO DISCHARGE SEWAGE THERETO IN ACCORDANCE WITH THE REGULATIONS OF THE NWC. I / WE DECLARE THAT THE INFORMATION PRESENTED ON THIS APPLICATION IS TO THE BEST OF MY / OUR KNOWLEDGE TRUE AND COMPLETE

as ..... for and on behalf of ..... as
(Position) (Name of Owner/Occupier)

OWNER ☐ TENANT ☐ OTHER ☐ (Please describe) .....

Date: ..... Tel No. .....

Name: ..... Signature : .....
(Block Capitals)

Address (Block Capitals): .....

.....

Residential Connection with NWC assistance

If your application is for a property that is ONLY used for residential purposes AND you have ticked the "Yes" box indicating your wish for NWC assistance, then you should simply skip to Item 15, (located on the second page of the application form) **and complete that item.** Then, **recognizing what you are about to sign as per the "Note" following**, sign the form and send it or deliver it to your nearest NWC office.

NOTE: In signing the application you have applied "TO DISCHARGE SEWAGE ….. IN ACCORDANCE WITH THE REGULATIONS OF THE NWC".

This means that you will comply with the NWC regulations regarding construction of your house sewers including for the NWC to inspect and test the same before you are connected and, once your premises are connected to the NWC's sewer, you will abide by the conditions set out in the "Consent to Discharge", a document that you will be required to sign immediately before the final connection of your house sewers to the NWC sewer. This document, a copy of which will be given to you at the time of your signature immediately before the final connection is made to the NWC sewer, is effectively a contract between you and the NWC regarding the provision of sewage service to you by the NWC – and it includes very specific conditions! *So before you sign and send in your application you should carefully read the "Consent to Discharge" (a copy of which accompanies the application form) and fully understand what your responsibilities are once your premises are connected.*

Residential Connection without NWC assistance

If on the other hand the application is for a solely residential property **BUT** you are **not** requesting any NWC assistance, then **Items 10 and 15** must be completed and, as per the note at Item 10, **your application should be submitted with:**

(1) **The appropriate application fee,** (please put up the receipt carefully!) and

(2) **Three copies of a plan for your proposed facilities as prepared (and signed) by a professional engineer properly registered to practice as such in Jamaica.**

Note: The design and specification of house sewers to give reliable and proper performance over the long–term for the most cost-effective initial price can be a complex engineering task and no potential customer should risk the likely significant investment in such facilities by poor designs or specification.

It is critical for both the NWC and the wider community in which you live that the design and the quality of the construction work comply with NWC standards so that inappropriate connections are not made to NWC sewers – as this can create problems both in NWC sewers and at NWC's sewage treatment works. The NWC carefully vets each and every design and specification submitted by a property owner – and will turn down any inappropriate submissions – and for the above reasons, the NWC requires that the designs of all house sewers and connections be prepared by professional engineers under their personal signature.

Non-Residential (Commercial) Connections

If your application is for a property that is used for other than simple residential purposes - e.g. it is used as a shop (even when the premises are used as both a shop and residence), a hotel, a restaurant or it is used for any other type of commercial enterprise **- then you would have ticked the "OTHER" box at Item 9.**

In this case, Items 11, 12, 13, 14 and 15 must be completed (irrespective of what you enter at Items 9 and 10).

Items 11 to 15 are located on the second page of the application form as shown opposite.

Item 11 asks for brief details of the type of use for the premises in question.

Item 12 requests details of two contact persons (who may be the same person) – the first, someone with whom the NWC may arrange for the necessary visits to site, and the second, the person

11	Description of Premises	
	LS	☐ COMBINED RESIDENCE and RETAIL SHOP with ☐ toilets, ☐ wash basins and ☐ bath/shower stalls
	GH	☐ GUEST HOUSE with ☐ guest rooms
	H	☐ HOTEL with ☐ guest rooms
	R	☐ RESTAURANT with seating for ☐ persons, and with ☐ toilets and ☐ urinals
	C	☐ OTHER COMMERCIAL (Please describe) .....
12	Responsible Person to Contact in connection with:	SITE OPERATIONS: Name: ..... Position: ..... Tel No: .....
		PAYMENTS: Name: ..... Position: ..... Tel No: .....
13	Sewage Connections Existing	Number: ☐ Size: ☐ inches / mm
14	Sewage Connections Required	Number: ☐ Size: ☐ mm and ☐ mm

responsible for dealing with financial matters.

Item 13 asks for details of any existing connections to an NWC sewer (if any) – as the application may relate to the provision of an additional sewer connection for the property – while **Item 14** identifies the size of the connection requested. If the designs have already been prepared and they are attached, this will be shown on them. If you are asking for NWC assistance with the connection, then you may not know this information and a simple "Not known" answer will suffice.

Once Items 11 to 14 have been completed, the declaration and application at **Item 15** must be completed**…. BUT PLEASE NOTE …. in signing the application you have applied "TO DISCHARGE SEWAGE ….. IN ACCORDANCE WITH THE REGULATIONS OF THE NWC" so you will comply with the NWC regulations regarding construction of your house and, once your premises are connected to the NWC's sewer, you will abide by the conditions set out in the "Consent to Discharge".** So ….. before you sign and send in your application you

should carefully read the "Consent to Discharge" (a copy of which accompanies the application form) and fully understand what your responsibilities are once your premises are connected**.**

Further **your particular attention is drawn to the note specifically for applications for "Non-Residential Connections"** at the top of page 2**:**

Additional information to be provided by all applicants OTHER THAN FOR SOLELY RESIDENTIAL PREMISES
Note: Pre-treatment facilities may be required to be provided and maintained by you to comply with NWC discharge standards - refer to Paragraph 6 of the NWC's "Guidelines for the Design of House Sewer Facilities".
If you have NOT requested NWC assistance at Item 9 on Page 1, this application must be accompanied by 3 copies of an engineering plan of your proposed house sewers and connection together with full details of any proposed pre-treatment facilities PLUS the Application Fee.

Important points are: -

1. As your premises are used for some kind of COMMERCIAL operation, your sewer facilities may need to include some pre-treatment facilities of some kind. This may be simply a larger grease trap than that normally used for single family residential properties or you may need particular drainage arrangements incorporating oil or sand interceptors or, if an industrial process is in operation at the premises, more comprehensive pre-treatment facilities may be needed in order for your ultimate discharge into the NWC sewer complies with NWC Influent Standards. To assist you to understand your particular position you may refer to the referenced "Guidelines for the Design of House Sewer Facilities" – a copy of which is also provided with the application form.

2. If you <u>have</u> request NWC's assistance with your connection, then following completion of Item 15 you should simply submit the form to the NWC's office nearest to you. A NWC Customer Service Representative will then get in touch with the named contact person (Item 12) to review your application further.

3. If you have <u>NOT</u> requested NWC's assistance, then the completed application form - with Item 10 completed - must be submitted with 3 copies of the plans and specification for your proposed facilities

(remember this must be prepared, and signed, by a Registered Professional Engineer) PLUS the relevant application fee (refer to the Appendix at the end of this section for details) - remember to put up the receipt carefully!

SO NOW YOUR APPLICATION IS WITH THE NWC - WHAT WILL FOLLOW?

When your application is delivered to the NWC it will first be carefully reviewed to make sure the application has been properly completed – if you submit the application in person the NWC's Customer Service Representative will routinely check this before accepting the application or any accompanying fee, otherwise, if there is any problem, then you will be notified as soon as possible by mail, telephone or by a visit from an NWC representative, whichever is most appropriate.

Once your application is accepted, **if you have requested NWC's assistance and assistance is available for you**, you will be so advised and, as appropriate, a Customer Service Representative will arrange to meet with you and to fully explain both the nature of the assistance and the responsibilities that you will have in the further processes necessary to actually connect your property properly. Similarly, if, for whatever reason, the NWC is unable to offer you any specific assistance with your connection you will be similarly advised and informed of the next steps that you should take yourself.

If you have not requested NWC's assistance with your connection, then:

1. Your application will be processed by checking on the NWC Water Account information that you have provided and NWC engineer's will carefully review the designs and specifications submitted by you for compliance with NWC regulations and sound engineering practice. As a part of this later process, a Technical Representative from the NWC's Sewage Department will visit the property in question – after having made appropriate contact to agree a date and time for the visit that is convenient for you;

2. Following the NWC's design/specification review and visit to site, you will be advised as to the NWC's approval or rejection of the design and/or specification of your proposed facilities:-

   If your submission is NOT approved, the reasons for this will be communicated to you and you will be invited to modify/correct the plans or specification and resubmit them. *When the necessary corrections have been made and the plans specifications resubmitted you may anticipate that they will then be approved and the following will apply*

if your submission is approved then you may proceed to construction BUT you should note that **the NWC must**: **be invited to inspect the work** before any pipes are covered up **and to witness final pressure testing of the sewers**, and **the Consent to Discharge must be signed** (by the property owner or someone duly authorized to sign on his/her behalf) in the presence of a authorized NWC **representative BEFORE the final connection to the NWC's lateral is actually made**.

THE NWC's "GUIDELINES FOR THE DESIGN OF HOUSE SEWER FACILITIES"

To assist the designers of your house sewer facilities and for the information of its prospective sewage customers, the NWC provides, with every application form, its guidelines for design. These guidelines are particularly directed to the professional engineers who design house sewer facilities but they are reproduced here for informed customer reference – with information considered to be of particular interest or concern to NWC customers high-lighted in bold print.

1. ***All house sewers shall be constructed strictly in accordance with plans and specifications stamped as "Approved" by the NWC.***

2. *House sewers shall be designed against a proper and appropriate assessment of peak sewage flows (using the Fixture Unit Value approach or an approved equivalent system) with self-cleansing velocities and in accordance with the following provisions.*

3. ***House sewers shall be designed to connect with the connecting sewer or lateral provided by the NWC at the property boundary via a terminal (inspection) manhole, constructed at the cost of the property owner, at the property boundary****. (This terminal manhole shall be designed to facilitate the ready collection of samples of the sewage discharging from the particular premises and the measurement/monitoring of flow rates over an extended period and where the NWC so requires a device for either instantaneous flow measurement or continuous measuring and recording as specified by the NWC shall be provided as part of the house sewer facilities)*

   No alteration shall be made to the NWC's connecting sewer without the express permission of the NWC, given in writing. Where such connecting sewer has already been provided by the NWC, the approximate level and position of the said connecting sewer may be obtained from the NWC but the exact level and location shall be determined by the owner of any property for the purposes of the design of his house sewers by carefully opening the ground and exposing the end of the connecting sewer. (Any damage to the NWC's connecting sewer occasioned by such investigations shall be made good to the satisfaction of the NWC at the cost of the property owner.)

   Where such connecting sewer remains to be provided by the NWC, the NWC will furnish within a reasonable time the exact location and level of the connecting sewer that it will provide.

4. ***All house sewers shall be completely water and airtight and shall be tested for these qualities by hydraulic pressure or otherwise as the NWC may direct****.*

5. ***All pipes, fittings and other appurtenances of house sewers shall be of a type, style, material and quality as the NWC may approve from time to time and all sewers shall be of a minimum nominal diameter of 100mm****.*

6. *(a) There shall be eliminated from the discharge from the said premises into the Commission's connecting sewer any matter which, either alone or in combination with any other matter with which it is likely to come into contact with in the Commission's public sewage system to which it is connected, would cause damage or obstruct the said public sewage system or cause injury to the health of any person lawfully present in any sewer or its appurtenances of the said public sewage system, or in or at any sewage pumping station or sewage treatment works connected thereto or therewith through which such discharge passes or would make difficult or expensive its treatment or disposal.*

(b) Discharges from the said premises into any Commission's public sewer shall not contain any of the substances listed below at concentrations, expressed in milligrams per litre, greater than those stated: -

(i)	Settleable Solids		1000
(ii)	Oil, Grease or Fat		400
(iii)	Biological Oxygen Demand (BOD_5)		1000
(iv)	Sulphide		1
(v)	Cyanide		5
(vi)	Ammoniacal Nitrogen (as N)		40
(vii)	Sulphate (as SO_4)		1800
(viii)	Available Chlorine (as Cl)		50
(ix)	Sulphur Dioxide (as SO_2)		5
(x)	Phenolics		10
(xi)	Phosphate (as P)		15
(xii)	Heavy Metals	Total	25
		Individual Maximum	5

(c) Notwithstanding the specific provisions of the foregoing, generally, at no time shall the following be permitted to enter any public sewer: -

(x) garbage, rags, bottles, tins and other general refuse

(xi) rain storm and surface water drainage

(xii) cooling water, water from swimming pools and the like (except with the special permission of, and under such conditions as may be prescribed by, the NWC)

(xiii) waste from food grinders (except with the special permission of, and under such conditions as may be prescribed by, the NWC)

(xiv) excessively hot liquids (specifically wastes with a temperature in excess of 45° C);

(xv) seawater (whether or not contaminated with sewage);

(xvi) inflammable wastes (including petroleum spirit, oils and volatile solvents);

(xvii) grease and fats

(xviii) wastes containing strong acids or harmful chemicals, highly coloured matters and those creating excessively offensive odours (specifically including wastes with a pH below 6 or above 11);

(xix) all wastes of whatever kind which cannot be satisfactorily purified by the normal processes of sewage treatment (which shall specifically include non-biodegradable detergents or organics generally, pesticides and herbicides).

7. ***For the purposes of complying with the discharge standards set out in paragraph 6 above, suitable pre-treatment facilities shall be provided (and maintained at all times) by the Owner/Occupier at his own cost. Details of appropriate pre-treatment facilities shall accompany applications for connection to NWC sewage systems.***

<u>NOTE</u> - the discharge of any substance not permitted by any of the foregoing requirements will render the Owner/Occupier of the particular offending premises liable to the penalties prescribed from time to time under the provisions of the National Water Commission Act and

associated regulations made thereunder as may be lawfully in force from time to time. Such penalties will include the prescribed penalty for each day of a breach of these conditions and the reimbursement of all costs incurred by the Commission in dealing with the consequences of each such breach.

8. ***Notwithstanding the provisions of paragraph 7 above:-***

   (i) all sinks where grease or other unctuous substances are used and which are connected to a public sewer shall be provided with of a grease trap of approved design

   (ii) drainage from all garages, motor vehicle service stations or places where mechanical vehicles are washed shall before being discharged over a trapped gully basin first be drained through a properly constructed oil and grease separator of an approved design

   (iii) if and when specifically permitted by the NWC, condensation and/or waste cooling water from air conditioning plants shall be discharged over trapped gully basins of approved design.

9. ***House sewers shall be laid in straight lines (in both the horizontal and vertical planes) between manholes or inspection chambers and shall have gradients adequate for self-cleansing of the sewer. A sufficient number of inspection chambers, manholes and cleaning eyes shall be provided to provide at all times means for the ready removal of obstructions without breaking or dislocating the pipes.***

10. *Unless otherwise approved by the NWC* ***all underground pipes shall be placed at a depth of not less than 1 metre below any roadway and not less than one-half (0.5) metre below any other ground level.*** *If pipes are permitted to be laid at any less depth they shall be properly protected in such manner and with such materials as may be approved by the NWC.*

11. ***Inspection chambers shall be provided at:***

    - ***every point where two or more sewer lines converge***
    - ***every point in a house sewer where any angle, bend or change in direction or gradient or alteration in size occurs***
    - ***every point where there occurs a change in the material of the house sewer***
    - ***such points so that no part of the sewer line shall be more than 15 metres distant from the centreline of an inspection chamber***

12. ***Every inspection chamber or manhole shall be of such internal plan dimensions relative to depth necessary to permit proper man access and shall be fitted with an approved manhole frame and movable cover****. Suitable channels and benchings shall be formed using appropriate concrete or cement mortar in the floors of same with the surfaces rendered smooth and true to offer the least resistance to the flow of sewage.*

13. ***All manholes, traps, gullies, separators or other inlets in connection with house sewers shall be raised above the general ground level and shall be surrounded with a concrete kerb not less than 150mm high or otherwise protected against the ingress of rain or surface water***

14. ***Where the use of pumps or ejectors is necessary in installations which lie below the level of the public sewer:***

    - ***a sump, constructed of water proof concrete adequately reinforced or other approved materials, shall be provided with sufficient capacity to receive the peak sewage or waste flow for thirty minutes;***
    - ***the sump shall be provided with a gas and air tight cover securely fastened in place and shall be adequately ventilated;***

- ***discharge pipes from pumps or ejectors to public sewers shall be provided with check or non-return valves;***
- ***discharge pipes from pumps and ejectors shall discharge into a manhole from which the sewage shall flow by gravity into the public sewer;***
- ***the entire installation including ejector or pump together with the prime mover shall be installed in well ventilated and easily accessible compartments.***

15. A ventillating pipe not less than 100mm in diameter shall be erected at the upstream termination of all house sewers and shall be carried up to a height not less than one half a metre above the eaves of the highest building within a radius of 10 metres of such ventilating pipe and the exposed end of such ventilation pipe shall be suitably covered to prevent the entry of rainwater, insects and vermin.

16. All trapped pipes which are likely to be subjected to syphonage or back-pressure shall be fitted with a ventilating pipe from the crown of the trap

17. An adequate air gap shall be provided through free atmosphere between the lowest opening from any pipe or delivery cock supplying water to any tank or plumbing fixture or other device connected to a house sewer and the flood level rim or overflow of the receptacle.

18. Every water closet shall be of a design to the approval of the NWC and shall be provided with a siphonic waste preventing flush tank of satisfactory pattern approved by the NWC.

19. Every urinal and bidet shall be of a design to the approval of the NWC.

20. After pipes and other appliances for house sewers have been laid but before the pipe trenches have been filled in or before the pipes and other appliances have been covered or concealed in any manner, the applicant or his accredited agent shall give notice in writing (quoting the inspection fee receipt number) to the NWC that such work is ready for inspection and the NWC shall inspect and test the work.

All defects discovered by the NWC shall be made good to the satisfaction of the NWC before the pipes and other appliances are covered or concealed.

When the defects have been made good the applicant shall again give notice in writing to the NWC that such work is ready for inspection and the NWC shall again inspect and test the work.

If on account of the failure to remedy any defect or to complete the work or for any cause for which the applicant is responsible, the NWC finds it necessary to visit the work more than twice the applicant shall pay the component of the Application Fee for "House Sewer Inspection" again for each additional visit necessarily made by the NWC.

Where any work has been covered up before it has been inspected, it shall, on the request of the NWC, be immediately be uncovered and exposed at the cost of the applicant.

When the work has been inspected and tested by the NWC and the work found satisfactory, and the relevant "Consent to Discharge" has been duly signed, the final connection to the NWC's connecting sewer shall be made in the presence of an authorized agent of the NWC.

If such final connection cannot be properly made during normal working hours on the same day that the work has been found satisfactory by the NWC or on the immediately following working day, then the applicant shall pay the component of the Application Fee for "Final Connection" again.

NOTE - Immediately prior to final connection to the NWC's connecting sewer, the applicant for connection shall sign the "Consent to Discharge" applicable to the particular premises issued by the NWC. This form provides for specific regulation of sewage service to be provided by the NWC for the particular premises and will incorporate details of the "House Sewer Facilities" and of any pre-treatment facilities upon which the NWC's approval of the connection has been based. No final connection shall be lawful without the prior and proper signature and issuance of the relevant Consent to Discharge.

21. *Where a second lateral is required by any property owner for convenience of connection to any street sewer and the NWC consider it reasonable given all the circumstances, the NWC may provide same at the cost of the applicant within a reasonable time of a written application therefore.*

22. ***Every grease trap and oil/grease separator shall be cleaned out by the owner or occupier of the house sewer as often as necessary to maintain it in a sanitary condition and the material removed shall be properly disposed of other than by discharge into any public sewer***

Perhaps **the most important thing for NWC sewer customers to note** are those issues that relate ensuring that your house sewer facilities have been constructed properly and safely to serve you faithfully for many years. These include the NWC's inspection of the work as it proceeds and final pressure testing of the completed drains, particularly in regard to: -

- checking pipe joints BEFORE they are covered up *(to promote good and sound joint making - bad joints will allow groundwater inflows and will make root intrusion into your drains more likely and that could result in blockage of your drains in the future)* and checking to ensure that manholes are carried above the surrounding ground and are equipped with proper covers – *to exclude rain and surface water infiltration.*
- checking to ensure that any pumping installations are constructed properly and are safe - **sewer gases in confined spaces can cause asphyxiation and can be explosive**

CONGRATULATIONS – YOUR PROPERTY WILL BE PROPERLY CONNECTED TO THE NWC SEWER! NOW THE IMPORTANT THING IS FOR YOU TO USE YOUR HOUSE SEWERS IN THE PROPER MANNER AND TO MAINTAIN THEM IN GOOD CONDITION AT ALL TIMES!

APPENDIX

NWC FEES FOR SEWER CONNECTION APPLICATIONS

(for those applicants who have had their house sewer facilities designed and who will have them constructed under their own arrangements)

MAINTENANCE OF THE SEWAGE COLLECTION SYSTEM

A sewage collection system (whether on the customer's property or a part of the NWC's system) will normally comprise a system of sewers (gravity flow pipes), manholes and pumping stations / pumping mains.

Each element must be regularly inspected, checked, serviced and, as necessary, repaired.

Those parts of the sewage collection system for which the NWC is responsible (i.e. those elements outside of private property boundaries, in the public road reservation or specific public wayleaves) will be maintained by the NWC – ***BUT, if an NWC sewer or lateral becomes blocked because of prohibited discharges from a particular property (i.e. discharges not in accordance with the property's Consent-to-Discharge) and this can be clearly identified, then the NWC may charge the offending property owner/occupier for the full costs of any cleaning or repair costs incurred***.

The responsibility for the maintenance of sewage facilities that are within the boundaries of any private property rests solely with the owner/occupier of the particular property.

Properly designed and constructed house sewer facilities on a private property will usually give many years of trouble free service - **PROVIDED the facilities are used properly** *(remember grease and other traps must be cleaned out regularly)* **and only those things that should go down the drain or the toilet are disposed off in those ways!** However problems may still occur on the best constructed and best managed property system.

However, other than regular cleaning of grease and other traps, **the NWC strongly recommends that,** unless they have received professional training *(and so possess the particular, relevant skills needed)* **property owners/occupiers should neither attempt to undertake their own maintenance - nor any necessary repairs -** but rather employ competent professionals experienced in the field for such services.

The reasons for this advice are two-fold.

Firstly, we are dealing with sewage potentially contaminated with health threatening germs. *(Note that grease, grit and oil traps should not, if properly designed and constructed, receive any "foul" or "black" water discharges and therefore their cleaning does not carry the same level of health risk).*

Secondly, many of the problems that are often experienced relate to blockages and failures that can mean that raw sewage has been "detained" – in a sewer, manhole or pump sump - for some time and has turned "septic". This process of sewage turning septic can generate significant volumes of gases. These gases can be trapped inside the system (until someone opens a manhole or a pump sump cover) and they are either potentially explosive (e.g. methane) or can quickly create breathing problems for humans.

Sewage system maintenance is therefore NOT a job for amateurs.

If, you experience major problems with your house sewer facilities and have been unable to have them satisfactorily resolved, please contact your local NWC Sewage personnel – they are always willing to offer their professional advice and, under certain circumstances, as a paid service, may be able to offer you direct assistance.

However, this section of the manual is intended to inform NWC sewage customers of things to look out for when they have problems and the probable remedy for those problems that are frequently experienced.

However before reviewing some common problems and solutions, **SOME NOTES ABOUT HEALTH AND SAFETY**.

First, **remember that your system carries SEWAGE. Therefore proper hygiene and safety rules must be followed by all persons who interact with any sewage system** (even when doing simple inspections).

The most important rules are: -

- **DO NOT EAT, DRINK OR SMOKE WHILE WORKING ON ANY SEWAGE SYSTEM** – hands can easily become contaminated with sewage and any of the foregoing actions can readily transfer germs to the mouth.

- **DO NOT WORK WITH SEWAGE IF YOU HAVE ANY UNHEALED SKIN SCRATCHES, CUTS OR ANY OTHER LESIONS** – these can provide another ready point of direct access for germs into your body

- **WASH YOUR HANDS THOROUGHLY** (and any other parts of your body that may have come into contact with sewage) **AFTER WORKING WITH SEWAGE AND BEFORE YOU DO ANYTHING ELSE**

- **PARTICULAR CARE SHOULD BE TAKEN WHEN OPENING MANHOLES AND PUMP SUMPS** - to avoid the effects of sewer gases and the danger of explosion.

  Smoking or naked flames are a definite NO-NO! - after removing a manhole or sump cover always allow some minutes to elapse – to allow any accumulated gases to dissipate - BEFORE attempting to inspect the interior.

  Two persons should always be present – one to carry out the inspection and the second to watch out for the first (ready to assist in any emergency).

- Because of the slippery surfaces, the danger of being overcome by sewage gases and the potential for drowning, **PARTICULAR CARE MUST BE TAKEN WHEN A WORKER HAS TO ACTUALLY ENTER A PUMP SUMP.**

Anyone doing so must be securely attached to a safety rope held by the second person outside the immediate work area. The "safety" person should be alert to the potential dangers, stay in constant communication with the person working below and always be fully ready to respond to any indication of problems below by immediately pulling the worker below into the fresh air.

Now that those critical points have been dealt with let us examine possible sewerage problems and solutions.

Sewage system problems are usually related to: -

- Full or partial sewer blockages. These may occur for a variety of reasons including grease blockages, sand and grit accumulations, root intrusions through pipe joints or cracked pipes or simply because a sanitary towel (or similar item) has been flushed down a toilet and has become stuck in a pipe joint (resulting in other solids then accumulating).

- Pump blockages or failure of any of the mechanical and electrical equipment (pumps, motors, electrical power facilities, pump control facilities, valves etc.) associated with the pumping of sewage.

Manholes

When a sewer is blocked the first task is to identify the likely location of the blockage.

Manholes are a key component of any properly designed sewage collection system. They provide access to gravity sewers at regular intervals along their length and inspection of conditions in a manhole can often provide the first indication as to the location of a total sewer blockage or of the potential for a full blockage to develop within a short time in the future.

Manholes should therefore be regularly inspected to check for any evidence of surcharging. If debris is found on the tops of the "benching" (the smooth concrete forming the flow channels in the bottom of each manhole) or if the walls of the manhole are badly soiled, it is likely that the manhole has regularly been "surcharged" because of some partial blockage downstream restricting the free flow of the sewage.

Surcharging occurs because the speed with which sewage enters the manhole (through the upstream clear sewer) is greater than that of the sewage flowing

out of the manhole through the downstream "choked" sewer and hence the sewage "backs up" in the manhole itself.

If there is any evidence of surcharging of a manhole, the downstream cause should be identified and rectified.

Of course, if a manhole is opened and found to be full of sewage then it is clear that the downstream sewer is completely blocked and that blockage will need to be removed.

Additionally however, every manhole should be regularly inspected to check on: -

- The integrity of the manhole cover. The cover itself should be seated properly within the frame without rocking and the cover should effectively seal the manhole against the entry of surface water. There should be

no holes through the cover and cracked, holed or broken covers should be replaced.

- The integrity of the manhole walls. The walls should show no evidence of cracking (which would allow the infiltration of groundwater or leakage of sewage). Any evidence of cracking or other structural failure should be a further investigated and appropriate repair undertaken *
- The presence of debris in the manhole. The benched channels in the manhole should be clear and free of any debris. All debris in the manhole should be manually removed and any remaining debris flushed down the outgoing sewer as a part of regular sewer flushing programmes. Following debris removal and flushing the condition of the haunched channel surfaces should be visually examined and any scour damage to the (smooth and hard) concrete benching should be made good *.

* *To effect repairs to manholes walls or benched channels, any sewage flows must be "over-pumped" from the immediately upstream manhole (with a suitable barrier installed on that manhole outlet sewer to prevent flow into that sewer) to the next manhole downstream. This can be quite costly, as it requires potable pumping equipment and long lengths of pump discharge hoses. Once over-pumping has been established all internal surfaces of the manhole to which repairs are to be executed should be thoroughly washed down with a high pressure water stream.*

Sewers

As previously noted, full or partial sewer blockages may occur for a variety of reasons including: -

1. Grease blockages
2. Sand and grit accumulations
3. Root intrusions through pipe joints or cracked pipes, or,
4. Simply because a sanitary towel (or similar item) has been flushed down a toilet and has become stuck in a pipe joint (resulting in other solids then accumulating).

The exact location of sewer blockages and the reason for them can be determined by professional organizations using "closed circuit television" (CCTV) inspections – where a TV camera is used in a sewer to inspect internal conditions. CCTV equipment is however expensive.

Professional personnel can however remove most sewer blockages without specific CCTV inspections using a variety of techniques ranging from simple flushing with high volumes of water through "rodding and flushing" to high pressure "jetting" and rotary cutting.

Rodding, as the name implies, employs the use of lengths of flexible rods (screwed to one another as they are pushed into the sewer pipe) to dislodge the material causing the blockage so that it may be flushed through the sewer to the downstream manhole (where it may be removed) using water. While rodding can usually deal with the type of blockage referred to at item 4 above, it is not fully effective for the first three types of blockages noted above – as it cannot specifically fully remove grease or grit build up and cannot target plant roots intruding into sewer pipes.

Jetting employs a specially designed discharge nozzle fed by a high pressure water pump to "jet" grease build up off all sewer surfaces and to flush other accumulated debris out of the sewer. It is however a specialized technique - care is necessary to avoid over jetting of any particular

location as the high water pressures involved can quickly destroy certain sewer pipe by literally "blasting" a hole through the pipe wall.

If root intrusion is the problem, once again specialist equipment is available to allow rotary cutters to remove root material growing into the sewer. However such cutting is likely to have to be repeated at regular intervals as the roots will tend to grow back -- unless the offending tree or bush is physically removed from the ground above the sewer.

Maintenance of Pumps

The routine servicing and repair of electrical and mechanical equipment (such as pumps and their associated power supplies and control systems) should always be carried out by professionals skilled and experienced in these fields – NOT the homeowner or handyman.

Proper design/construction and observance of good "sewage" disposal practices are the keys to minimizing pumping problems.

For example, pumping equipment designs must include adequate protection against such circumstances as: -

- Supply voltage fluctuations (which can otherwise damage or destroy electrical components),
- Electrical over-current failures to protect the motor from trying to turn a jammed pump (which could otherwise cause the motor to "burn out")
- Dry running of the pump and motor (when the "water" falls below the minimum for safe pump operation)

Proper and appropriate designs must however be complemented by good quality components – a sewage pumping facility is not a facility on which to "scrimp and save".

However, mechanical and electrical equipment will eventually deteriorate with use and age. To ensure that maximum "life" is obtained from such equipment regular routine inspection and servicing is important

The NWC strongly recommends that sewage customers have this done – regularly – by trained professionals!

A message from your NWC sewage division .....

..... working to keep our sewers working and our environment clean !

Please remember - flush ONLY **and**

what you have already eaten in your

Don't treat your toilet as a garbage disposal - otherwise either it or our sewers are likely to become clogged.

Just because a product is called disposable doesn't mean it should be flushed down the toilet.

Use the wastebasket in the bathroom for such things as facial tissues, gum, all sanitary products (wrap them in tissue first), condoms (wrap these also in tissue first and don't forget the packaging), bandages and paper towels.

Disposable diapers don't belong in a toilet - unless you first remove the plastic liner (dispose of this in the wastebasket) and tear the paper diaper into small pieces.

Flushing a facial tissue down a toilet is unlikely to cause a problem, but it helps to develop a bad habit that creates the impression that a toilet can digest everything. Plus, flushing a toilet to dispose of a facial tissue is a real waste of water.

Also remember that hazardous chemicals may not harm your toilet, but they shouldn't be flushed away either.

TOILET TRAINING FOR NWC SEWAGE CUSTOMERS

The simplest, single most important guideline, for toilet usage is that the only material to enter the toilet - other than human waste - is ..... toilet paper. There simply should be no exception to the rule "toilet paper only".

BIN IT and then BAG IT

DON'T FLUSH IT

Provide an appropriate waste container in the bathroom or the restroom (both public and private) for **non-biodegradable** sanitary wastes and put them in your garbage. Do this for: -

- Facial tissues
- Sanitary napkins
- Tampons and tampon injectors
- Soiled disposable baby diapers
- Adult disposable diapers
- Baby wipes
- Used band aids, bandages and dressings
- Dental floss
- Condoms and their packaging
- Chewing gum and the wrappers

A message from your NWC sewage division .....

..... working to keep our sewers working and our environment clean !

SEWAGE & WASTEWATER - WHO DOES WHAT IN JAMAICA?

The **National Water Commission** is the agency of the Government of Jamaica charged with primary responsibility for the development and operation/maintenance of central **sewage**♦ collection, treatment and treated effluent disposal systems throughout the island of Jamaica.♣ As such the Commission arranges for the funding of such systems, retains consulting engineers to design them, employs competent contractors to build them (under the close supervision of the consulting engineers and/or the NWC's own staff) and then takes full responsibility for their ongoing operation and long-term maintenance.

However in all these endeavours the NWC must also meet the requirements of a number of statutory agencies each responsible for overseeing different sectors of the public interest.

The **Environmental Health Unit** (EHU) of the **Ministry of Health oversees the design and operation of public sewage systems** to ensure the protection of Public Health and natural resources. The EHU is responsible for environmental health issues and provides technical advisory services to the Ministry of Health. The Environmental Health Unit is also responsible for developing guidelines for sewage and industrial effluent, and standards for air and water under the Public Health Act. It evaluates, advises and approves the disposal facilities for solid waste, hazardous materials, water and wastewater treatment for island wide development projects

To ensure the environment in and around Jamaica is protected and conserved for the common good, the **National Resource Conservation Authority** (now part of the National Environment & Planning Agency, an executive agency of the Government of Jamaica), under a mandate from the Government**, has established and enforces standards relating to the quality of any wastewater** (i.e. both sewage effluent and industrial effluent) **that may legally discharged to the environment in Jamaica.**

♦ Note that ***"Sewage is used household or domestic water and water-carried solids"***. NWC sewage systems are not intended for the direct discharge of "industrial" wastewater. Subject however to proper pre-treatment (so that the quality of the wastewater approximates to that of domestic wastewater), the NWC may accept discharges from "industrial" customers into its sewage systems.

♣ Other land developers in both the public and private sectors in Jamaica undertake the development of central sewage systems for their discrete developments but the design and construction of such sewage systems must comply with the requirements of the NWC (and of other statutory agencies) as, ultimately, responsibility for the ongoing operation and maintenance of all central sewage collection and treatment systems falls to the NWC.