



# THE ENVIRONMENTAL AUTHORITY

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## ENVIRONMENTAL AUTHORITY OPERATIONAL POLICY #2

### 2. WASTE WATER DISPOSAL AND TREATMENT

#### Change Record Form

Rev.	Type of Change	Author	Date
1	First Issue	Mr Mark Rowe (Hydrogeologist)	19 <sup>th</sup> Feb 1997
2	Second Issue (for PATI and Siting)	Dr Geoff Smith (Environmental Engineer)	March 2015
3	Third Issue -Effluent Quality changes	Dr Geoff Smith (Environmental Engineer)	July 2019

#### 1. PURPOSE

To prevent adverse effects on human health or the environment caused by the disposal of waste water into public waters, including into sea water.

*This operational policy is utilised by the Environmental Authority and the Department of Environment & Natural Resources as guidance in the consistent application of requirements for new construction or re-development with respect to minimizing the environmental impact through effective wastewater management. This is an uncontrolled guidance document and confirmation of the level of treatment must always be sought through the Department of Environment & Natural Resources (DENR).*

#### 2. JUSTIFICATION

##### **The Water Resources Act 1975 Section 34 ‘Pollution of public water and sea water’ states:**

- (1) Any person who, save under the authority of this Act or any other statutory provision, interferes with or pollutes or fouls any public water, commits an offence:  
Punishment on summary conviction: the penalties specified in section 37.
- (2) For the purposes of this section the polluting or fouling of public water shall include the discharge into, or in the vicinity of, any public water, or in a place where public water is likely to be of any matter or substance likely to affect the quality of public water or to cause injury whether directly or indirectly to livestock, animals, birds or marine life, or to crops, orchards or gardens which are irrigated by such water or to any product in the processing of which such water is used or which occasions, or which is likely to occasion, a nuisance.
- (3) For the purposes of this section the polluting of or fouling of public water includes the polluting or fouling of sea water.

##### **Also for aerated sewage treatment plants that can pollute the ambient air the Clean Air Act 1991 Section 6 ‘Issue of Permits’ states:**

- (1) Subject to section 16 and 17, the Authority may issue or refuse to issue a construction permit.
- (2) The Authority may, as a condition precedent to issuing a construction permit, require a change in the location of the proposed controlled plant or in that plant’s plans or specifications.
- (3) The Authority may issue a construction permit –

- (a) subject to such terms and conditions as it may think fit, whether or not relating to the concentrations, weights or rates of emission of air contaminants referred to in regulations;

### **3. EXPLANATION**

#### **3.1 Disposal background**

The three systems for effluent disposal that are, or have been, typically used in Bermuda are:

- (a) Sea outfalls (pipes),
- (b) Soakaways (cesspits), and
- (c) Sealed boreholes.

##### **(a) Sea Outfalls**

Discharge of untreated effluent into surface waters (the sea, a pond or a marsh) through a short outfall or by overland flow is not permitted for existing or new developments. Long outfalls discharging screened, but untreated, effluent are operated by the Corporations of St George's and Hamilton. No new developments (including major re-developments) are permitted to operate in this way.

##### **(b) Soakaways (cesspits)**

Soakaways, or cesspits, remain the accepted means of disposal of small quantities of waste water from individual households. However, the disposal of large quantities of effluent into a soakaway can significantly derogate ground water quality. Percolation of the effluent to the water table can cause direct contamination of the upper (fresher) levels of the ground water resources, which are developed for individual domestic supply (*i.e.* non-potable) and public supply with treatment (*i.e.* potable). It can also cause seepage of contaminated ground water along shorelines, posing a threat to health and the environment. The Bermuda Residential Building Code 2015<sup>1</sup> addresses this environmental risk by requiring cesspits to be greater than 40 feet horizontally from the mean high water mark and with a minimum of 4 feet vertically of natural ground between the floor of the cesspit and the mean high water mark. Cesspits are also prohibited over cave systems.

##### **(c) Sealed Boreholes**

Disposal of effluent into a sealed borehole reduces the risk of contamination of useable ground water and, at coastal sites, will pose less of a threat to the immediate shoreline environment than would a soakaway. Effluent injected at depth will tend to flow within or below the transition zone (brackish mixing zone) towards the nearest coast. Filtration, dilution and dispersion within the limestone reduce the impact of effluent at its destination. At a minimum, wastewater must be treated to a primary level in an approved<sup>2</sup> septic tank system prior to borehole disposal that is licenced with a Water Right<sup>3</sup>. Note that boreholes can only be used within Cave Protection Areas if an approved sealed liner system is employed to protect the caves, otherwise sand filters are required.

##### **(d) Sand Filters**

When there is a risk of a borehole penetrating a cave system (*i.e.* Cave Protection Areas) then either a liner system, approved by DENR, shall be used with the borehole or a sand filter shall be used instead of the borehole. See Government guidance for septic tanks and sand filters<sup>2</sup>.

#### **3.2 The Need for Wastewater Treatment**

A wastewater treatment policy must include standards which ensure that effluent discharges do not have a detrimental or toxic effect on human, animal or aquatic life or degrade the aesthetic qualities of the receiving waters as a result of its:

- 1) Chemical content, bacteriological activity or temperature, alone or in combination;
- 2) Nutrient levels which promote the growth of harmful plant life or organisms;
- 3) Content of floating or settling solids, debris, persistent oil, grease or scum;

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<sup>1</sup> The Bermuda Residential Building Code 2015, Chapter 24 (Cesspits), Section 24.5. Department of Planning. Government of Bermuda.

<sup>2</sup> Design criteria for septic tanks in Bermuda. Government of Bermuda, Ministry of the Environment & Ministry of Health (<https://www.gov.bm/how-design-septic-tank>)

<sup>3</sup> Water Right Application form at: <https://www.gov.bm/online-services/apply-water-right>

- 4) Colour, turbidity or odour.

### 3.3 Treatment Options

Fundamental levels of treatment can be summarised as follows:

**Primary Treatment** is the settlement of fine organic and inorganic solids in a retaining tank as a result of reduced flow velocity. It can achieve approximately a 50% reduction of suspended solids for a detention time of 4 or more hours where the influent raw wastewater can range from 120 mg/l (low strength) to 400 mg/l (high strength) total suspended solids<sup>4</sup>. Septic tank systems<sup>2</sup> typically provide a 'Primary' level of treatment.

**Secondary Treatment** (*i.e.* Conventional Treatment) is the minimum level usually required to meet the stated quality objectives for larger flow rates or in sensitive environments. Secondary treatment generally achieves approximately a 90% reduction in gross pollutants (solid and dissolved) through the provision of a controlled environment (*i.e.* aeration) for bacteria to metabolise and stabilise organic waste (*i.e.* Activated Sludge). Basic Secondary Treatment typically relies upon settlement chambers to provide final clarification to the wastewater before it is discharged as treated effluent.

**Tertiary Treatment** is the use of more sophisticated clarification processes, such as membrane filtration, together with the aerated 'Secondary' treatment process described above. Tertiary treatment ensures that particulates and bacteria cannot physically be discharged in the treated effluent. Tertiary treatment can sometimes also refer to the use of post-treatment disinfection.

**Post-Treatment Disinfection** can be applied to the outlet of either Secondary or Tertiary treatment processes to provide improved options for water reuse. The Department of Environment & Natural Resources, Department of Health and the Environmental Authority reverts to the precedence of the US EPA Guidelines for Water Reuse<sup>5</sup> in order to condition treatment standards for operating licences for water reuse for purposes such as irrigation, toilet flushing and other uses where human contact with treated effluent is possible.

**Denitrification** is the removal of nitrates from the wastewater using either chemical processes or by encouraging biological processes. Nitrates have been shown to be increasing in the Bermuda's groundwater<sup>6</sup> to the point whereby concentrations have risen in places to 10mg/l nitrate. The risk of faecal bacteria and viruses in groundwater beneath cesspits also exists. It is, therefore, the position of the Department of Environment & Natural Resources that raw well water is not of a potable standard and as such shall not be used as drinking water. Removal of nitrate from the groundwater is only achievable by treatment processes such as reverse osmosis. Using groundwater for toilet flush, laundry purposes and irrigation (where nitrates can be beneficial) are appropriate uses of the groundwater. Addition of non-aerated (*i.e.* anoxic) denitrification stages of the secondary/tertiary treatment process are to be encouraged for new developments discharging treated wastewater to the groundwater or inshore waters. .

**Fats, Oils and Greases (FOG) and Food Waste** should ideally be removed at source from the kitchen areas before significant dilution in the wastewater renders treatment more difficult to achieve. Most wastewater treatment plants are not designed to treat significant proportions of these types of wastes. FOG and food waste can be detrimental to the operation of many treatment systems and can also pass relatively untreated through the plant where the impact to the receiving water body is significant. For disposal boreholes FOG can lead to blinding of the well-screen and aquifer pores resulting in a blocked borehole that is usually difficult to reinstate.

### 3.4 Determining the Level of Treatment

Balancing the level of treatment of wastewater with the risk of environmental impact will be key for any wastewater management policy. Figure 1 shows in general terms how the level of wastewater treatment, environmental impact and cost change for each treatment option typically available in Bermuda.

The risk of environmental impact will be a function of the:

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<sup>4</sup> Metcalf & Eddy. Wastewater Engineering – Treatment and reuse. 4<sup>th</sup> Edition 2003.

<sup>5</sup> US Environmental Protection Agency (EPA) 2004 Guidelines for Water Reuse. EPA/625/R-04/108.

<sup>6</sup> Groundwater Quality Survey – Bermuda's freshwater lenses 2005. Dept. of Environmental Protection. Study contracted to BWC Ltd.

- Size of the development (*i.e.* amount of wastewater generated),
- Type of wastewater generated (*Residential Wastewater, Commercial Restaurants/ Kitchens, Laundromats, etc*),
- Proximity (laterally and vertically) to a sensitive receiving site. Sensitive sites include the marine environment (*enclosed bays, shallow inshore waters and poorly circulated waters*), ponds and marshes, freshwater lenses, and cave systems.

The level of treatment specified will therefore need to be dependent on the above environmental risks with large developments or commercial wastewaters requiring a higher level of treatment and with proximity to sensitive receptors being taken into account for all sites that generate wastewater.

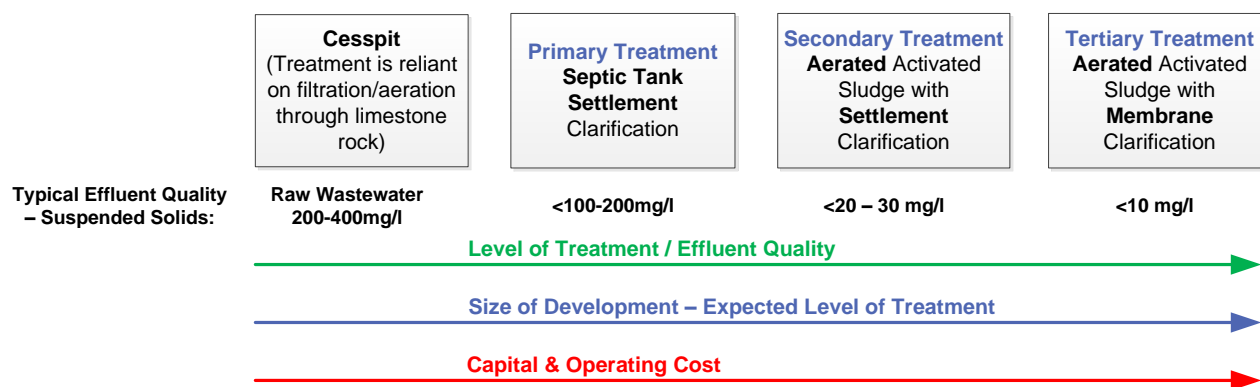


Figure 1. Comparison of the level of treatment achieved for different wastewater treatment systems

The Environmental Authority grants Water Rights under the Water Resources Act 1975 for boreholes that receive primary treated wastewater from septic tanks. The Authority also grants Construction Permits and Operating Licences under the Clean Air Act 1991 for secondary and tertiary wastewater treatment plants. The purpose of this Operational Policy is to ensure consistency in the requirements and application of the above Acts towards developments that generate wastewater.

Table 1 shows how the Environmental Authority sets requirements for the level of treatment of sewage-based wastewater relative to the rate of discharge and the location of the proposed discharge. Other types of wastewater (*i.e.* Laundromats, etc) are considered on a case by case basis.

Table 1. Reference guide for the Environmental Authority to consider the level of wastewater treatment required for different sized developments at different locations.

Amount of Wastewater generated		Cesspits Acceptable	PRIMARY Treatment (50% removal Suspended Solids)	SECONDARY Treatment (<20mg/l BOD, <30mg/l TSS)	TERTIARY Treatment (<10mg/l BOD, <10mg/l TSS)
Volume (Imperial Gallons Per Day - IGPD)	Approximate Bedroom Equivalent		Septic Tank	Aerated Wastewater Treatment Package	
<2,500	<25	YES	Voluntary	Voluntary	Voluntary
2,500 - 5,000	25-50	NO	YES	Voluntary	Voluntary
>5,000	>50	NO	NO	YES (Confirmed by the Authority)	YES (Confirmed by the Authority)
<b>Sensitive Sites:*</b>					
<1,000	<10	NO	YES	Voluntary	Voluntary
>1,000	>10	NO	NO	YES (Confirmed by the Authority)	YES (Confirmed by the Authority)

\* Sensitive Sites: 1) Water Resources Protection Area (i.e. <40ft to HWM, <4ft to water table †)

2) Cave Protection Area

3) Areas where there is a rock face below the base of the pit that is horizontally within 40 ft.

† Height above water table cannot be made up using "fill" material to make >4 ft elevation. >4ft must comprise native limestone.

### 3.5 Siting Requirements for Wastewater Treatment Systems

The design and set-back requirements for wastewater treatment plants, including cesspits and septic tanks, are provided in the Bermuda Residential Building Code 2015, Bermuda Building Code 2014 and in the International Building Codes 2012. These codes are available from [www.planning.gov.bm](http://www.planning.gov.bm). Wastewater treatment plants that are considered to be 'Controlled Plants' under the Clean Air Act 1991 are those that can cause malodours to the ambient air. These include aerated wastewater treatment plants, such as those providing a Secondary or Tertiary level of treatment. Currently there are no siting requirements within the above codes to ensure that sufficient separation distance is provided between an aerated wastewater treatment plant and the nearest neighbour. For hotel and condominium developments it is considered that the nearest neighbour is the nearest off-site neighbour that is not part of the hotel or condominium development.

DENR has contacted neighbours of existing secondary WWTP's in Bermuda (i.e. Belmont, Newstead, Loughlands, etc) and has found that 40 metres appears to be the maximum, worst case, distance that odours from these plants can be a nuisance to neighbours. The amount of aeration required for WWTP's will be a function of the size of the plant and amount of waste to be treated, which in turn is a function of the number of persons-equivalent that the plant serves.

In order to provide some guidance to developers, architectural and engineering companies in Bermuda DENR has tried to find precedence from other developed jurisdictions of how the separation distance can be quantitatively set based on the level of treatment and the size of the plant. This guidance should therefore be used to help initially scope the general layout of the development and infrastructure facilities. It is noted that the final approval for a proposed location will require other considerations by DENR and the Environmental Authority, including proximity to sensitive sites, wind direction, topography and potential for increases to the catchment served by the WWTP.

Guidelines prepared by the Environmental Protection Agency in Victoria, Australia (Publication 1518)<sup>7</sup> provide 'Recommended separation distances for industrial air emissions, which includes different types of wastewater

<sup>7</sup> Environmental Protection Agency, Victoria, Australia. 'Recommended separation distances for industrial residual air emissions', Publication Number 1518, March 2013.

treatment plants.’ For the types of aerated wastewater treatment used in Bermuda these guidelines recommend the following calculation to set the separation distance from the WWTP to the nearest neighbour:

**Mechanical/Biological Wastewater Plants<sup>7</sup>**

$$\text{Separation Distance to nearest neighbour (metres)} = 10n^{1/3}$$

Where n = persons equivalent served by the WWTP.

In order to determine the ‘Persons Equivalent’ (*i.e.* pe) for the above calculation the developer should work with the supplier of the WWTP. As a rule of thumb the ‘Persons Equivalent’ served by the WWTP will include all bedrooms (multiplied by 2 persons per bedroom) for both hotel and condominium developments. Restaurants and other facilities that generate wastewater should also be factored into the estimate. For the numbers of staff at the site then a proportion of their wastewater (or persons equivalent) would be used, perhaps 25%.

**Example:** Therefore using the above calculation a development with, for example, 180 pe would require the WWTP to be located at a separation distance to the nearest off-site neighbour of at least:

$$10n^{1/3} = 10 \times 180^{1/3} = 10 \times 5.6 = \mathbf{56 \text{ metres}}$$

#### 4. POLICY STATEMENT ON WATER RIGHTS FOR DISPOSAL

- 4.1 Bermuda Building Code 2015 section 608.17 states *‘Ground water supplies or Boreholes. Ground water supplies or boreholes shall be located and constructed as regulated by the Environmental Authority and Department of Environment & Natural Resources.’*
- 4.2 A Water Right issued by the Environmental Authority is required for the construction of a borehole for effluent disposal. Application forms for Water Rights are available at <https://www.gov.bm/online-services/apply-water-right>.
- 4.3 Discharge of any waste which pollutes "public water" is an offence under the Water Resources Act 1975.
- 4.4 The level of treatment of effluent and the method of disposal are regulated by the Environment Authority. Where sealed borehole disposal is permitted, the specifications for prior treatment and borehole design are linked to: the environmental sensitivity of the receiving site, the type of effluent and the rate of disposal (See Table 1). Areas considered to be environmentally sensitive where sealed boreholes might be considered appropriate are those in proximity to: fresh ground water resources, inshore water bodies and embayments of the sea, ponds, marshes and land at low elevations.
- 4.5 The requirement for sealed borehole disposal is never automatic. In some cases it is an inappropriate method of disposal, for example in most cavernous areas. This is determined in the consideration of each application individually.
- 4.6 A limit on the rate of disposal of effluent is specified by the Environmental Authority as a condition of approval attached to each disposal Water Right.
- 4.7 Water Rights are generally valid for a period of five years. However, as with all Water Rights, approval to dispose of effluent is subject to review by the Environmental Authority and may be withdrawn, or the conditions may be modified, at any time in the interest of protecting the quality of "public water".

#### 5. POLICY STATEMENT ON LEVELS OF TREATMENT

- 5.1 Bermuda Building Code 2015 section 2901.1 states that *‘Private sewage disposal systems shall conform to a method agreed by the Department of Environmental Health, Environmental Authority and Department of Environment & Natural Resources and designed by a registered design professional.’*
- 5.2 Where treatment of wastewater is required, the type of plant, its location, capacity and specifications shall be subject to conditions attached to a Clean Air Act Construction Permit. Criteria for effective operation and management of the plant and effluent quality standards shall be specified in an annual Clean Air Act Operating Licence. Application forms for Construction Permits and Operating Licences under the Clean Air Act are available at <https://www.gov.bm/online-services/apply-construction-permit-and-operating-licence>.
- 5.3 Required levels of treatment associated with discharge into sealed boreholes are summarized in Table 1. Regardless of the proposed method of disposal, new cluster developments of 100 bedrooms, or more, will be required at a minimum to treat wastewater by a licensed (under the Clean Air Act) treatment process to achieve a standard of <20 mg/L Biochemical Oxygen Demand (BOD) and <30 mg/L Total Suspended Solids (TSS). Depending on the disposal environment, more stringent and more comprehensive standards will often be applied. Smaller developments (less than 100 bedrooms) are not automatically exempt.
- 5.4 **Effluent Quality:** Where secondary, or a higher level, of wastewater treatment is required, the following conditions shall apply at a minimum as part of Operating Licence\* (further conditions are attached to the licence with respect to proper operation, management and maintenance of the plant):
  - i. To eliminate specific harmful characteristics of an effluent, which pose a threat to a receiving water, standards additional to BOD and SS may be set for: chlorine residual (<1 mg/L), faecal coliforms (<440 per 100mL), oils and grease (<15 mg/L), phenols (20 mg/L), total nitrogen (<15mg/L), nitrogen as nitrate (<5 mg/L); total phosphorous (1 mg/L) and pH (6 to 9). The values in brackets are suggested minimum acceptable levels in the event that the given parameter needs to be controlled.

- ii. Details of the treatment process and the design of the plant shall be submitted in support of an application for a Construction Permit under the Clean Air Act 1991 to the Environmental Authority along with information which shall be persuasive as regards the plant's ability to achieve the required effluent standards.
- iii. The minimum recommended frequencies for testing of the above parameters which may be specified in the licence conditions regardless of whether standards have been set are: Suspended solids, BOD, chlorine residual, faecal coliforms, pH – MONTHLY.
- iv. Oils and grease, total nitrogen, nitrogen as nitrate, total phosphorous, phenols – QUARTERLY.
- v. Standards, which have been set for a given parameter, shall be met to a 90% percentile level of success over any 12 month period.
- vi. All effluent quality data shall be submitted to the Environmental Authority. The reporting period shall be as stipulated in the Operating Licence under the Clean Air Act 1991. At a minimum, an annual report of these data shall be submitted with the application to renew the operating licence.
- vii. A wastewater treatment plant operator's qualification or manufacturer's training certificate, as specified in the licence conditions, shall be held by staff who oversee plant operation on a daily basis. The details of plant operators' responsibilities and qualifications shall be submitted with the application for the Operating Licence and with each application to renew the licence.
- viii. An annual report to be submitted in support of an application to renew an operating licence shall include, in addition to effluent quality data, a report on the condition and maintenance of mechanical equipment as shall be specified in the licence conditions.