B.6 Design Criteria

Typically an OWTS is designed based on an expected or known hydraulic loading rate and a determined soil acceptance rate or application rate for a filter media. However, a hydraulic loading rate does not take into consideration the effect of elevated organic and solids loading on the soil or filter media. Therefore, to design an effective OWTS, raw wastewater should be accurately characterized, and the daily wastewater flow volume, and flow rate over the significant delivery period(s) should be reliably estimated.

B.6.a Wastewater Characterization

Raw wastewater from commercial and institutional facilities can generally be divided into two types; residential (average strength) and nonresidential (high strength).

Residential wastewater is typically generated by water using activities such as personal hygiene, food preparation and cleaning. Wastewater is discharged from various plumbing fixtures and appliances such as toilets, sinks, bathtubs and clothes washers from the following intermediate-sized facilities:

- Cluster housing and multi-home developments
- Apartment buildings
- Mobile home parks
- Other facilities that generate wastewater similar in characteristics to residential wastewater

Traditionally, the most important wastewater characteristics to consider when designing residential OWTS are biochemical oxygen demand or BOD (organic loading), total suspended solids or TSS (solids loading), and fats, oils and grease (FOG) levels. In specific cases, total phosphorus (TP) or ammonia (NH_4) discharges may need to be considered. Typical influent concentrations of these parameters in residential wastewater may range as follows:

Parameter	Concentration, mg/L[12]
BOD_5	155 – 286
TSS	155 – 330
FOG	70 – 105
TP	6 – 12
NH_4	4 – 13

Commercial and institutional facilities may generate nonresidential (high strength) wastewater from activities such as garbage disposal use, food preparation, food service, hair care, on-site linen service or sanitary dump stations. Nonresidential wastewater typically has higher concentrations of BOD, TSS and FOG than those listed above. High strength wastewater is generated by many types of facilities, including:

- Hospitals, nursing homes, and other medical institutions
- Hotels, motels, schools, and prisons
- Kennels, veterinary clinics, and animal shelters
- Sanitary dump stations serving roadside rest areas, campgrounds, or other recreational facilities
- Food-service establishments
- Laundromats or facilities with on-site linen laundry
- Supermarkets, butcher shops, and bakeries

The facilities listed above may generate other waste streams deserving special consideration due to elevated concentrations of wastewater constituents, toxics, or hazardous substances. Some typical activities include:

- Floor stripping[13]
- Cleaning and disinfecting[13]

[12] EPA 625/R-00/008-Chapter 3, Table 3-7, 2002.

[13] Frequency of floor stripping and type and frequency of disinfection of surfaces in institutional facilities is often mandated by law.

- Disposing of waste pharmaceuticals[14]
- Disposing of sanitary wastes from people receiving medical care (e.g., chemotherapy) [14]
- Disposing of food wastes with FOG concentrations two to five times that of residential (various cuisine types) [15]

Any of these components can interfere with the normal biological processes most on-site treatment systems use. These characteristics can vary daily or hourly and can have a major impact on system performance. It may be appropriate to provide pretreatment (grease interceptors or septic tank effluent filters) or advanced treatment (aerobic treatment units, or filtration) of the wastewater or reduce the effective hydraulic loading rate of the treatment system (by requiring time dosed pressure distribution) to compensate for toxic effects, elevated organic and/or solids loading in the influent.

Commercial and institutional facilities often generate a majority of their daily wastewater over significant delivery periods depending on the nature of the business, and also may not have a continuous base flow. For example, schools have high flows during only a few hours of the day, and no flow is present in the late afternoon and at night. Peak hourly flows generated during these times of the day should be accounted for in the design of the system components. Solids buildup and anaerobic conditions due to low flows should also be considered. If subsurface disposal is to be used, the treatment process should remove nearly all settleable solids and floatable grease and scum to enable efficient operation of the soil-based treatment and dispersal system.

Some facilities within the scope of this document may generate industrial wastes due to the nature of their activities. For example, schools may generate industrial waste from sinks or drains installed in science labs, auto repair, art, hair care or other vocational training. These wastes should be separated from the on-site wastewater treatment system. The separated wastes can then either be transported to a facility approved to treat the waste, or directed to an individual SPDES-permitted industrial wastewater treatment

[14] NYSDEC does not encourage disposal of any unused prescriptions into any wastewater treatment system. Information on proper disposal of household prescriptions and over-the- counter drugs can be found on NYSDEC's website.

[15] Studies (R.L. Siegrist, CO; B. Lesikar, TX; B. Stuth, WA; and J.C. Converse, WI) show that wastewater from a restaurant is typically 2.7 and 2.8 times higher for BOD_5 and TSS, respectively, than residential wastewater. The influence of other factors such as a self-serve salad bar, types of oil used, dishwashing procedures, and restroom use should be considered.

system. The design of an industrial waste treatment facility is outside the scope of this document.

B.6.b Design Flow

The design flow rate is typically based on the flow rates determined using one of the following three methods:

- Using the typical per-unit hydraulic loading rates provided in Table B-3
- Obtaining metered daily wastewater flow data from existing and similar facilities
- Obtaining metered daily water usage data from existing and similar facilities

Method 1: Typical Per-Unit Hydraulic Loading Rates (Table B-3)

The flow rate determined by using Method 1 with the maximum expected operational conditions (i.e. maximum occupancy) is an acceptable design flow rate for septic tank or subsurface absorption systems. Typical per-unit hydraulic loading rates are presented in Table B-3. When an establishment includes several different types of uses from the table, each use should be computed separately. Except for the 110/130/150 gpd per unit values, the per-unit hydraulic loading rates in Table B-3 may be reduced by 20 percent for establishments equipped with water saving plumbing fixtures. A combination of high and low flow fixtures can also be considered on a pro-rata basis. Fixtures that use even less water are available and the reduction of wastewater flow attributable to these and other new technologies should be considered. The reduction allowance should depend in part upon the ability of the builder or owner to ensure adequate maintenance and/or replacement in-kind when necessary.

When using either Method 2 or Method 3, the design engineer should consider the average daily flow rate as well as the maximum daily flow rate, expressed in volume per unit time for determination of this system design flow rate.

Method 2: Wastewater Flow Data

A minimum of one year of data collected during similar operational conditions may be required by the Reviewing Engineer. If sufficient measured wastewater flow rate data is not available, Method 2 should not be used. The average of the daily (24-hour) flow over the duration of the data collection period is an acceptable method for determining the average daily flow rate. The largest daily (24-hour) measured volume during the same period expressed in volume-per-unit time is an acceptable method for determining the maximum day flow rate. The analysis should account for operational variations (e.g. peak seasonal, weekends, special events, delivery period,

etc.) and exclude extraneous data. There should be a reasonable explanation for the operational variations and any extraneous data excluded.

Method 3: Water Usage Data

A minimum of one year of data collected during similar operational conditions may be required by the Reviewing Engineer. If sufficient measured water usage data is not available, Method 3 should not be used. The average of the daily (24-hour) flow over the duration of the data collection period is an acceptable method for determining the average daily flow rate. The largest daily (24-hour) measured volume during the same period expressed in volume per unit time is an acceptable method for determining the maximum day flow rate. The analysis should account for operational variations (e.g. peak seasonal, weekends, special events, delivery period, etc.) and exclude extraneous data. There should be a reasonable explanation for operational variations and any extraneous data excluded.

For each of these methods, the peak hourly flow rate (largest hourly volume expressed in volume per unit time) should also be identified. When variation in the wastewater flow rate is expected to be substantial, it is necessary to examine the significant delivery period of the wastewater and base the system design upon this information to prevent an excessive rate of flow through wastewater collection and treatment systems. Flow equalization prior to treatment units should be considered to avoid hydraulic overloading of treatment units during peak loading periods (peak hourly flow and maximum daily flow).

Table B-3 Typical Per-Unit Hydraulic Loading Rates

Residential

Type of Use	*Unit*	*Gallons per Day*
Apartment	Per Bedroom	110/130/150[16]
Mobile Home Park	"Single-Wide" Home "Double-Wide" Home	220 330
Single Family Residence	Per Bedroom	110 / 130/ 150[17]

[16] 110 gpd for post 1994 plumbing code fixtures; 130 gpd for pre 1994 fixtures; and 150 gpd for pre 1980 fixtures. Homes over 1,000 gpd, community systems, or lodging establishments with high flow fixtures must account for any higher peak flow periods.

[17] For individual household systems under 1,000 gpd, use design flows in the NYSDOH's *Wastewater Treatment Standards Residential Onsite Systems - Appendix 75- A.*

Campgrounds

Type of Use	*Unit*	*Gallons per Day*
Day Camp	Per Person	15
	Add for Shower	5
	Add for Lunch	5
Campground	Per Unsewered Site[18]	55(includes showers)
	Per Sewered Site – with water hookups	100
	Per Sewered Site – without water hookups	55
Campground Day Use	Per Person	5
Dumping Station [19]	Per Unsewered Site	10
	Per Sewered Site	5

Institutional

Type of Use	*Unit*	*Gallons per Day*
Assisted Living Facility/Complex	Per Bed[20,21] – add 10 gpd for in room kitchen	110/130/150
Group Home (residential-style building)	Per Bed[20] - add 150 gpd per house for garbage grinder	110/130/150
Nursing Home (hospital care)	Per Bed[20,21]	175
Hospital	Per Bed[20,21]	175
	Per Outpatient	30
Church	Per Seat[20]	3
Church Hall/Fire Hall	Per Seat[21]	10

[18] Additional wastewater flow due to food service or laundry shall be accounted for. Structures available for overnight occupancy other than those meeting the definition of a camping unit shall be based on 150 gpd / unit for design flow purposes, pursuant to NYSDOH – *Chapter 1 State Sanitary Code Subpart 7-3 Campgrounds*.

[19] The addition of flow for dump station sewage may be prorated by using an estimated percentage of sites suited for RV use based on historical data. No reduction for low flow fixture usage should be applied here.

[20] Add 15 gpd per employee

[21] Add for Food Service (e.g. 24-hour restaurant; refer to Food Service Operations Table)

Library/ Museum	Per Patron[20,21]	5
Public Park	Per Person (toilet only)	5
Prison / Jail	Per Inmate[20,21]	150
School – Day	Per Student	10
- or -	Elem./ Jr. High / Sr. High	7 / 9 / 12
- and -	Add for meals / showers	5 / 5
School Boarding	Per Student[20,21]	75

Commercial

Type of Use	*Unit*	*Gallons per Day*
Airport/Bus/Rail Terminal	Per Passenger[22] Per Toilet	5 400
Barber Shop / Beauty Salon	Per Station without and with hair care sink	50/ 200
Bowling Alley	Per Lane [22,23]	75
Bed & Breakfast	Per Room (see note under Residential)	110/130/150
Casino	Per Employee/shift plus Per Sq. Ft. for non-lodging customer use	15 0.3
Country Clubs & Golf Courses	Per Round of Golf [21,22] (add for bar, banquet, shower or pool facilities and golf tournaments)	20
Concert Hall / Arena / Assembly Hall / Theater / Stadium / Skating Rink	Per Seat [21,22]	5
Day Care	Per Child [21]	20
Doctors Office	Per Doctor	250
Dog / Pet Grooming	Per Station	500
Also see Kennel and Veterinary Office below.		
Dentist	Per Chair[24]	250

[22] Add 15 gpd per employee/shift

[23] Add for Food Service (e.g. 24 hour restaurant; refer to Food Service Operations Table)

[24] Dental offices must recycle mercury amalgam instead of washing it down the drain. NYSDEC's website has

Drive-In Theater	Per Car Space [25]	5
Factory / Distribution Warehouse	Per Employee/shift; add for showers	15 10
Fairgrounds	Per Visitor [25]	5
Health Club	Per Patron	20
Highway Rest Area	Per Traveler[25] Per Dump Station Vehicle	5 7
Hotel	Per Sleeping Unit [25] add for banquet hall, night club, pool/spa, theatre, etc.	110/130/150
Kennel	Per Kennel/Run/Cage	50
Laundromat	Per Machine	580
Marina	Per Slip [25] with shore side restroom facilities including shower; add per slip for dump station	20 7
Migrant Worker Housing	Per Person	50
Motel	Per Sleeping Unit; add for in-room kitchen; add for in-room jacuzzi/spa	110/130/150 10 20
Office Building	Per Employee[25]; add for showers	15 5
Service station/Convenience store	Per Toilet[25]	400
Shopping Center / Grocery Store / Department Store	Per Sq. Ft. [25,26]; add for deli, bakery, butcher	0.1
Swimming Pool / Bath House	Per Swimmer	10
Veterinary Office	Per Veterinarian	200

guidance referencing the 2002 law.

[25] Add for Food Service (e.g. 24-hour restaurant; refer to Food Service Operations Table)

[26] Add 15 gpd per employee/shift

Food Service Operations[27]

Type of Use	*Unit*	*Gallons per Day*
Ordinary Restaurant	Per Seat	35
24-Hour Restaurant	Per Seat (for cafeterias: pro rate flow in proportion to the hours)	50
Fast Food Restaurant	Per Seat	25
	Per Drive-Up Window	500
Lounge, Bar	Per Seat	20
Drive-In	Per Car Space	50
Banquet Hall	Per Seat	10
Restaurant along Freeway	Per Seat	75

B.6.c Infiltration, Inflow, Non-Sanitary and Prohibited Flows

Cooling water, roof drains, footing, sump and basement floor drains should not be discharged to the treatment system. Clean water from ice machines, water cooled refrigerators or coolers should also be excluded. Undetected leaks from plumbing fixtures, typically toilets and faucets, can waste significant amounts of water and subsequently increase the volume of wastewater to be treated. Simple repairs and routine operation and maintenance of plumbing fixtures can save water and increase the efficiency of wastewater treatment system.

Similarly, leaking sewer joints, pipe tank seals, tank riser seals, cracks in treatment tanks and manhole covers that are not watertight can be significant sources of infiltration of the system. These extraneous flows can cause periodic hydraulic overloads and affect treatment performance which can lead to system failure. Exfiltration from the system can have a negative impact on groundwater quality.

The discharge of swimming pool filter backwash wastewater should not be directed to a septic tank

[27] Garbage grinder use should be evaluated in the design phase of the project and accounted for in tank sizing per Section D.6 Septic Tanks.

intended as the primary treatment unit for sanitary sewage. In areas served by on-site wastewater treatment systems, the design engineer should consult local regulations for discharge of filter backwash wastewater. It may be permissible that smaller backwash or recharge discharges be directed to a grassed or vegetated area and larger discharges to a stone-filled trench, dry well or infiltration gallery to contain the discharge within the property limits. Discharges within 250 feet of a stream, pond, lake or wetland may be prohibited or require a SPDES permit.

Water Softener Discharge

Studies by soil scientists have found the volume or chemical composition of wastewater from the regeneration cycle (backwash, recharge, rinse) of a properly operated and maintained household-sized water softener is not harmful to a septic tank that is properly designed, operated and maintained. It was noted, however, the volume of wastewater can be reduced by:

- Activating the regeneration cycle based on need (not on a timer)
- Using a water softener with a large mineral tank
- Employing water conservation measures to reduce flow to be treated by the softener system

However, some proprietary enhanced treatment system manufacturers (e.g., aerobic treatment units) have warranties that are voided by the discharge of water softener wastewater due to problems cited in septic tanks/aerobic tanks with elevated chloride content (up to 100 times the normal non-softened concentration of 50 mg/L). The change in density caused by brine has caused discharge of solids from primary treatment tanks into secondary treatment units disrupting flocculation and settling.

The discharge of water softener recharge/regeneration wastewater to septic tanks, or aerobic or enhanced treatment units is not recommended for wastewater treatment systems treating more than 1,000 gpd. If softener backwash is to be added to any wastewater system with a design flow over 1,000 gpd, the design engineer will need to provide data showing the effluent will meet applicable water quality standards, or include design details for a treatment process that does. Alternatively, a dedicated soil absorption system may be designed by the engineer if it is deemed necessary or appropriate.

B.6.d Treatment Considerations and Effluent Limits

Acceptability of any discharge is contingent upon the ability of the proposed OWTS to meet applicable

water quality standards and criteria. The minimum degree of treatment required for the discharge of sanitary wastewater into nonintermittent surface waters is effective secondary treatment. Typical effluent limits are shown in Table B-4A below:

Table B-4A Typical Effluent Limits for Non-Intermittent Streams

Parameter	Type	Limitation	Units
BOD_5 [28]	30 -Day Arithmetic Mean	30	mg/L
BOD_5	7-Day Arithmetic Mean	45	mg/L
TSS [29]	30-Day Arithmetic Mean	30	mg/L
TSS	7-Day Arithmetic Mean	45	mg/L
Settleable Solids	Daily Maximum	0.3/0.1[29]	ml/L
pH	Range	6.0 – 9.0	SU
Fecal Coliform [30]	30-Day Geometric Mean	200	No. of colonies per 100 ml
Fecal Coliform [30]	7-Consecutive Day Geometric Mean	400	No. of colonies per100 ml
Total Residual Chlorine	Daily Maximum	[30, 31]	mg/L
Ammonia	30-Day Arithmetic Mean	[31]	mg/L as NH_3
Total Phosphorus	Site specific	[31]	mg/L as P

In all instances, a waste assimilative capacity analysis and allocation for setting water quality-based effluent limits is conducted. Such limits represent additional treatment, beyond secondary, to ensure that all applicable water quality standards and criteria are met.

An intermittent stream is defined as:

1. Any stream that periodically goes dry at any point downstream of the proposed point of discharge
    a. OR
2. Any stream segment below the proposed point of discharge in which the MA7CD10

[28] The 30 days average percent removal shall not be less than 85 percent, per 40 CFR 133.102.

[29] No Sand Filtration = 0.3 mg/L, Sand Filtration = 0.1 mg/L.

[30] Monitoring of these parameters only required during the period when disinfection is required.

[31] Limitation may be required depending on-site specific conditions.

stream flow is less than 0.1 cubic feet per second as estimated by methods other than continuous daily flow measurements

Discharge to an intermittent stream typically requires more stringent effluent limitation. Other methods of disposal should be considered first before proposing to discharge to an intermittent stream. Data should be supplied to show the discharge from any wastewater treatment facility would not contravene water quality standards. Typically, discharges to intermittent streams are required to meet the limits shown in Table B-4B.

Table B-4B Typical Effluent Limits for Intermittent Streams[32]

Parameter	Type	Limitation	Units
BOD_5	Daily Maximum	5	mg/L
TSS	Daily Maximum	10	mg/L
Settleable Solids	Daily Maximum	0.1	ml/L
Total Residual Chlorine	Daily Maximum	0.02	mg/L
Ammonia[33]	Daily Maximum or Average	2.2 in winter 1.5 in summer	mg/L as NH_3
Dissolved Oxygen	Daily Minimum	≥ 7.0	mg/L
pH	Range	6.0 – 9.0	SU
Total Phosphorus	Site-specific	Site-specific	mg/L as P
Coliform, fecal, when disinfecting	30-day geometric mean	200	Number of colonies per 100 ml
Coliform, fecal, when disinfecting	7 consecutive-day geometric mean	400	Number of colonies per 100 ml

Direct discharge of effluent from an OWTS to a receiving stream may be allowed contingent upon the design of the treatment system to meet applicable water quality standards and the applicant applying for and being issued a SPDES permit by NYSDEC. When deriving a water quality based SPDES permit effluent limitation from a surface water standard or guidance value, contributing factors like analytical

[32] Operational experience indicates a single-pass intermittent sand filter alone may not provide sufficient treatment to meet intermittent stream effluent limits.

[33] Consistently effective nitrification cannot be expected from buried sand filter treatment systems that operate on a seasonal basis.

detectability, treatability, natural background levels and waste assimilative capacity of the receiving stream are considered.

Preliminary effluent limitations can be obtained by contacting the Department prior to initiating design. An engineering report that addresses the capability of the treatment system to meet proposed effluent limitations should be included with the submission of design plans.

B.7 Groundwater Monitoring and Monitoring Well Requirements for Systems Greater than 30,000 gpd

Subsurface disposal is frequently the choice for smaller systems (30,000 gpd or less). Groundwater monitoring is required for systems discharging over 30,000 gpd to soil absorption systems. Surface discharges are more often selected for larger systems due to a lack of suitable soils of adequate depth or breadth.

Depending on the results of the site evaluation and what was agreed upon at the pre-application meeting with regional NYSDEC staff, groundwater monitoring and monitoring-well requirements may be necessary for the project. The following specifications and monitoring frequency should be discussed with the Reviewing Engineer. There also may be local requirements in some areas of the state, e.g. Suffolk County Department of Health Services, Nassau County Department of Health.

Monitoring Well Installation

Monitoring wells are to be designed to meet site-specific conditions of geology and hydrology with special considerations given to:

- Characteristics of soil and rock formation at the site;
- Depth to water table, bedrock, and any impervious layer;
- Aquifer thickness
- Rate and direction of groundwater flow;
- Seasonal variations in flow, depth and direction of flow;
- Potential for mounding of groundwater and its effects;
- Presence of and distance to nearby surface water;
- Presence of and distance to nearby water supply wells; and
- Other relevant site-specific considerations.

In general, monitoring well construction should follow the requirements for solid waste facilities as per 6 NYCRR Part 360-2 and the guidelines listed below:

- The well's inside diameter should be at least 2 inches
- The screen length should be at least 5 feet, but not more than 20 feet long
- The depth and length of the screen should be such that annual fluctuations of the water table do not result in a dry well.

Deviations from these requirements may require NYSDEC approval prior to construction. If there are any questions regarding these guidelines, or they are in conflict in some manner, please consult the Reviewing Engineer.

Driller's Log

A well driller's log should be submitted to the Department for each permanent monitoring well constructed, and may also need to be submitted to other agencies, such as counties that have their own well regulations. Well-completion logs should contain a diagram of the completed well, all pertinent details on well construction, a description of the materials used, and elevations of all well features and include:

- Monitoring well identification number and location
- Type of drilling equipment, driller, and drilling company
- Method of drilling, including size of borehole
- Type, size and placement of casing, including amount of casing above grade
- Type, size and placement of well screen
- Type, size and placement of filter pack
- Type, size and placement of annular seal
- Description of materials penetrated
- Depth to water table, and date and time measured
- Monitoring well development details