PROFESSIONAL PRACTICE GUIDELINES

CIVIL AND TRANSPORTATION INFRASTRUCTURE

ONSITE SEWERAGE SYSTEMS

VERSION 1.3
PUBLISHED MAY 24, 2018

ENGINEERS & GEOSCIENTISTS
BRITISH COLUMBIA

FUNDING WAS PROVIDED BY:

GOVERNMENT OF B.C.

BRITISH COLUMBIA
Ministry of Health

VERSION 1.3, MAY 24, 2018

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ABBREVIATIONS & ACRONYMS

The following abbreviations and acronyms are specific to these guidelines. An asterisk (*) indicates that an abbreviation or acronym is also a defined term.

ABBREVIATION OR ACRONYM	TERM
ADF	Average Daily Flow
ASTTBC	Applied Science Technologists and Technicians of BC
BC	British Columbia
BC SPM*	BC *Sewerage System Standard Practice Manual*
BOD*	Biochemical Oxygen Demand
CANSIS	Canadian Soil Information System
CTDS*	Combined Treatment and Dispersal Systems
DDF*	Daily Design Flow
EHO	Environmental Health Officer
EOCP	Environmental Operators Certification Program
HAR*	Hydraulic Application Rate
HLR*	Hydraulic Loading Rate
LLR*	Linear Loading Rate
LTAR*	Long Term Acceptance Rate
MWR	*Municipal Wastewater Regulation*
O&G*	Oil and Grease

ABBREVIATION OR ACRONYM	TERM
PF	Peaking Factor
ROWP	Registered Onsite Wastewater Practitioner
SSR*	*Sewerage Systems Regulation*
STEG	Septic Tank Effluent Gravity
STEP	Septic Tank Effluent Pumping
SWIS*	Subsurface Wastewater Infiltration System
TSS*	Total Suspended Solids
USDA	United Stated Department of Agriculture

DEFINED TERMS

The following definitions are specific to these guidelines. These defined words and terms are capitalized within the text of the guidelines.

If the definition is based on the *Sewerage System Regulation* (BC Reg.326/2004), it is indicated by including (SSR) at the end of the definition. Explanatory notes regarding the specific application of the definition for the purpose of the guidelines may also be provided.

See also the definitions contained in the SSR and the glossary in the BC *Sewerage System Standard Practice Manual* (BC SPM) (Province of BC 2014).

TERM	DEFINITION
Act	*Engineers and Geoscientists Act* [RSBC 1996] Chapter 116.
Association	The Association of Professional Engineers and Geoscientists of the Province of British Columbia, also operating as Engineers and Geoscientists BC.
Authorized Person	An ROWP or a Professional.
Basal Area	For sand mounds, sand-lined trenches, bottomless sand filters, and CTDS, this is the effective surface area available to transmit the treated Effluent from the filter media to the native receiving soils.
BC SPM	The BC Ministry of Health's *Sewerage System Standard Practice Manual*.
Biochemical Oxygen Demand (BOD)	A commonly used gross measurement of the concentration of biodegradable organic impurities in Wastewater. This is determined by the availability of material in the Wastewater to be used as biological food, and the amount of oxygen used by the microorganisms and chemical activity during oxidation. Normally BOD_5 is used, being the BOD over a 5-day period.
Biomat	Soil clogging layer at and below the Infiltrative Surface to soil, sand, or other media. The layer of biological growth, organic compounds, and inorganic residue that develops at the Wastewater soil interface and extends up to about 25 mm (1 inch) into the soil matrix. The term is used loosely to include all soil "clogging" effects, including pore size reduction, alteration of soil structure, and gas production by the micro-organisms. The typical black colour is due largely to ferrous sulfide precipitate. Also referred to as biocrust, clogging mat, and clogging zone.

TERM	DEFINITION
Breakout or Effluent Breakout	Visible movement of Effluent to the surface of the ground. Also used to refer to a place where there is a potential for Breakout.
Bylaws	The Bylaws of Engineers and Geoscientists BC made under the *Act*.
Cluster System	A Wastewater collection and Treatment System under some form of common ownership and management that provides treatment and dispersal/discharge of Wastewater from two or more homes or buildings but less than an entire community.
Compliance Boundary	A performance boundary with defined performance limits, e.g., a drinking water Well.
Conduct, to Conduct (and derivatives)	Action, manner, or process of carrying on, Controlling, or directing.
Construct (as defined in the SSR)	Section 1 of the SSR defines Construct as follows: "construct" includes: (a) to plan or Conduct a site assessment in respect of a sewerage system; (b) to install, repair, or alter a sewerage system; and (c) in the case of an Authorized Person, to Supervise the doing of any matter listed in paragraphs (a) and (b).
Construction	The work undertaken and carried out by the Contractor to build the end product envisioned by the engineering or geoscience concept and documents. See also Construct.
Contractor	An entity hired under contract to carry out the Construction or Implementation; this role may also be taken on by the owner.
Control, to Control (and derivatives)	To order, limit, instruct, or rule someone's actions or behaviour; to manage, organize, be in charge of, have power over, be in command of, direct, and rule.
Combined Treatment and Dispersal Systems (CTDS)	In general, systems which provide treatment in media or through another process in the same cell or unit that disperses the Effluent to the native soil, used specifically in these guidelines to refer to proprietary units of this type. Where the unit is used as a Treatment System under the SSR, it will include provisions for testing of Effluent quality at a defined Point of Application to Type 2 or Type 3 standards.
Daily Design Flow (DDF)	The peak daily flow that the facility being served by an Onsite Sewerage System is permitted to discharge. This is the designer's estimate of the expected peak daily flow from the facility. It is also the estimated daily sewerage flow to be entered in the Filing of Sewerage System Form.

TERM	DEFINITION
Decentralized Systems, Management	Wastewater systems used to collect, treat, and disperse/reuse Wastewater from individual homes, clusters of homes, small communities, businesses, and institutional facilities. Water and solids are usually retained near the point of origin. Decentralized Wastewater management includes the operation, monitoring, and maintenance of the facilities (including management of biosolids) and a plan for the oversight and reporting of management activities.
Direct Supervision	The responsibility for the Control and Conduct of the engineering or geoscience work of a subordinate. Refer to the Engineers and Geoscientists BC *Quality Management Guidelines – Direct Supervision*.
Discharge Area, Dispersal Area (as defined in the SSR)	An area of land used to receive Effluent dispersed or discharged from a Treatment Method. See also Subsurface Wastewater Infiltration System (SWIS).
Domestic Sewage (as defined in the SSR)	Section 1 of the SSR defines Domestic Sewage as follows: "Domestic Sewage" includes: (a) human excreta; and (b) waterborne waste from the preparation and consumption of food and drink, dishwashing, bathing, showering, and general household cleaning and laundry, except waterborne waste from a self-service laundromat; Also referred to in these guidelines as Wastewater.
Effluent (as defined in the SSR)	Section 1 of the SSR defines Effluent as follows: "Effluent" means Domestic Sewage that has been treated by a Treatment Method and discharged into a Discharge Area. See also Treatment Method for Effluent standards provided in the SSR.
Engineering/Geoscience Professional	Professional engineers, professional geoscientists, and licensees who are licensed to practice by Engineers and Geoscientists BC.
Engineers and Geoscientists BC	The Association of Professional Engineers and Geoscientists of the Province of British Columbia, also operating as Engineers and Geoscientists BC.
Evapotranspiration	The combined loss of water from a given area and during a specified period of time by evaporation from the soil or water surface and by Transpiration from plants.
Field Review	Periodic review during the Implementation or Construction phase to confirm that the work is in general conformity with the engineering or geoscience concepts or intent reflected in the engineering or geoscience documents prepared for the work.
Field Saturated Hydraulic Conductivity (k_{fs})	See Hydraulic Conductivity.

TERM	DEFINITION
Greywater	Wastewater drained from sinks, tubs, showers, dishwashers, clothes washers, and other non-toilet sources. Meets the definition of Domestic Sewage in the SSR.
Groundwater Mounding	Localized increase in the elevation of a water table that builds up as a result of the downward percolation of liquid into groundwater. If under a dispersal field, mounding results in reduced Vertical Separation.
Health Hazard (as defined in the BC *Public Health Act)*	Health Hazard means: (a) a condition, a thing, or an activity that (i) endangers, or is likely to endanger, public health, or (ii) interferes, or is likely to interfere, with the suppression of infectious agents or hazardous agents; or (b) a prescribed condition, thing or activity, including a prescribed condition, thing or activity that (i) is associated with injury or illness, or (ii) fails to meet a prescribed standard in relation to health, injury, or illness.
Health Hazard (Prescribed Health Hazards) (as prescribed in the SSR)	Section 2.1 of the SSR states: (1) The following are prescribed as Health Hazards: (a) the discharge of Domestic Sewage or Effluent into (i) a source of drinking water, as defined by the *Drinking Water Protection Act*, (ii) Surface Water, or (iii) tidal waters; (b) the discharge of Domestic Sewage or Effluent onto land; (c) the discharge of Domestic Sewage or Effluent into a sewerage system that, in the opinion of a Health Officer, is not capable of containing or treating Domestic Sewage; (d) the proposed Construction or maintenance of a sewerage system that, if Constructed or maintained in accordance with the plans and specifications filed under Section 8 or the maintenance plan filed under Section 9, may in the opinion of a Health Officer cause a Health Hazard. (2) The Construction and maintenance of a holding tank or sewerage system described in Section 2 are prescribed as regulated activities.
Health Officer	An environmental Health Officer or medical Health Officer as defined by the BC *Public Health Act.*
Horizontal Separation (Setback)	The horizontal distance from a defined boundary, e.g., a Well, to a defined Onsite Sewerage System component, e.g., a septic tank. Defined separations may include distance to specific parts of a system component, e.g., the edge of a dispersal system bed.

TERM	DEFINITION
Hydraulic Application Rate (HAR)	Depth of Effluent applied to the Infiltrative Surface per dose (e.g., mm per dose), may also be expressed in terms of volume per area (e.g., L/m^2/dose).
Hydraulic Conductivity (Soil)	The ability of the soil to transmit water in liquid form through pores. This is termed "K" and is expressed in mm/day or other units of length/time. "K_{sat}" is saturated Hydraulic Conductivity and is normally the value intended when the term Hydraulic Conductivity is used loosely. "K_{fs}" is the Field Saturated Hydraulic Conductivity, in many cases this is approximately 0.5 K_{sat}.
Hydraulic Loading Rate (HLR)	Application rate of Effluent to the Infiltrative Surface, typically the trench or bed Infiltrative Surface area, expressed as volume per time per area, e.g., L/day/m^2 = litres per day per square metre, or as depth, e.g., mm/day.
Hydrogeologist	A Professional competent in hydrogeology. See also Professional.
Implementation	The execution of the engineering or geoscience concepts reflected in the relevant engineering or geoscience documents that have been prepared to guide the project or work to produce an end product or application that is consistent with the intent of the documents.
Infiltrative Surface	In drainfields, the drain rock-original soil interface at the bottom of the trench; in mound systems, the gravel-mound sand and the sand-original soil interfaces; in sand-lined trenches/beds (sand filter), the gravel-sand interface and the sand-original soil interface at the bottom of the trench or bed. See also Point of Application for CTDS.
Influent	Wastewater, partially or completely treated, or in its natural state (raw Wastewater, Sewage), flowing into a reservoir, tank, treatment unit, or disposal unit.
Large Flow System	Under the SSR, a system with DDF of over 9,100 L/day.
Linear Loading Rate (LLR)	The application rate of Effluent per length on contour for a dispersal system, or a dispersal system component. Expressed as daily design or average flow divided by length of the Onsite Sewerage System, e.g., L/day/m
Long Term Acceptance Rate (LTAR)	The long term stable rate at which Effluent of a particular strength may be applied to a soil without appreciable further degradation of the ability of the soil to accept the Effluent.
Mass Loading	See Organic Loading Rate. May also refer to Mass Loading to a treatment facility.
Oil and Grease (O&G)	Fats, oils, waxes, and other related constituents found in Wastewater. O&G content is expressed in mg/L. Previously termed "Fat Oil and grease" (FOG).

TERM	DEFINITION
Onsite Sewerage System	A system for treating Domestic Sewage that uses one or more Treatment Methods and a Discharge Area, but does not include a holding tank or a Privy. An Onsite Sewerage System collects, treats, and disperses to ground the Wastewater produced by a building or a small group of buildings on the same or neighbouring properties.
Organic Loading Rate (to SWIS)	The rate of application of soluble and particulate organic matter. It is typically expressed on an area basis as grams/m^2 or pounds of BOD_5 per square foot per day (lb./ft^2/day).
Performance-Based Design (of Onsite Sewerage Systems)	System or system component design to achieve selected Performance Objectives.
Performance Boundaries	The point at which a Wastewater treatment performance standard corresponding to the desired level of treatment at that point in the treatment sequence is applied. Performance Boundaries can be designated at a point of the Treatment System, e.g., septic tank, package plant, at physical boundaries in the receiving environment (impermeable strata, groundwater table, Breakout), at a point of use (groundwater Well), or at a property boundary. See US EPA (2002).
Performance Objective	The outcomes that a system must attain in order to be acceptable. See the AS/NZS 1547:2000 standard (Joint Technical Committee WS/13 2000).
Performance Requirement	The functions that a system has to perform in order to operate as defined. May be described as performance criteria. Also, a requirement established by the regulatory authority (or code organization) to ensure future compliance with the public health and environmental goals of the community.
Point of Application	For CTDS, the point at which the Treatment System produces Effluent at the defined quality level (Type 2 or Type 3). This will be the same point at which monitoring is carried out. This “point” will normally be an elevation in the Onsite Sewerage System, and will be used when considering application of the Vertical and Horizontal Separation standards.
Prescriptive Standards	Standards or specifications that are required by legislation for design, siting, and other procedures and practices for Onsite Sewerage System or Cluster System applications. Adherence to Prescriptive Standards is mandatory.
Privy	A structure used for disposal of human waste without the aid of water; it consists of a shelter built above a pit or vault in the ground into which human waste falls. The vault may be impermeable (vault Privy) or may include soil absorption (pit latrine or pit Privy). Pit Privies are not allowed under the SSR.

TERM	DEFINITION
Professional (as defined in the SSR)	Section 7 of the SSR states: (3) A person is qualified to act as a professional if the person (a) has, through education or experience, training in soil analysis and sewerage system Construction and maintenance, and (b) is registered as a fully trained and practising member of a professional association that (i) is statutorily recognized in British Columbia, and (ii) has, as its mandate, the regulation of persons engaging in matters such as supervision of sewerage system Construction and maintenance. For the purpose of these guidelines, a Professional must also be an Engineering/Geoscience Professional, as defined above. Section 3.1(1) of the SSR defines “Professional” for that section only as “a professional competent in the area of hydrogeology.” This is specifically for the purpose of providing advice with respect to Horizontal Separation to domestic water supply Wells. In these guidelines, a Professional competent in hydrogeology is referred to as a Hydrogeologist.
Risk(s)	The effect of uncertainty on objectives. In context to health Risk from Onsite Sewerage Systems, the potential that chemicals or micro-organisms will reach a person at harmful doses depending upon that person’s actual means of exposure and level of exposure.
Risk Assessment	Identification, assessment, and prioritization of Risks followed by coordinated and economical application of resources to minimize, monitor, and Control the probability and/or impact of events. In general terms, and as it applies to analysis of an Onsite Sewerage System, Risk Assessment is a means of organizing and analyzing the available scientific information that influences the question at hand. For the purposes of these guidelines Risk Assessment does not mean a rigorous quantitative process as is commonly used in contaminated site management or toxicology studies.
Sewage	See Domestic Sewage.
Small Flow System	Under the SSR, a system with DDF of 9,100 L/day or less.
SSR	BC *Public Health Act, Sewerage System Regulation*.
Standard Practice (as defined in the SSR)	Section 1 of the SSR defines Standard Practice as follows: “Standard Practice” means a method of Constructing and maintaining an Onsite Sewerage System that will ensure that the Onsite Sewerage System does not cause, or contribute to, a Health Hazard.

TERM	DEFINITION
Subsurface Wastewater Infiltration System (SWIS)	An underground system for dispersing and further treating pretreated Wastewater. The SWIS includes the distribution piping/units, any media installed around or below the distribution components, the Biomat at the Wastewater-soil interface, and the unsaturated soil below. See also Dispersal Area.
Supervision, To Supervise, Supervised (as defined in the SSR)	The SSR uses the term Supervision, to Supervise, and Supervised, which may have different meanings depending on the context used. Supervision of the physical work of installation and maintenance means Field Review, and Supervision of engineering or geosciences work means Direct Supervision as defined in the Engineers and Geoscientists BC *Quality Management Guidelines – Direct Supervision*.
Surface Water (as defined in the SSR)	Section 1 of the SSR defines Surface Water as follows: "Surface Water" means a natural watercourse or source of freshwater, whether usually containing water or not, and includes (a) a lake, river, creek, spring, ravine, stream, swamp, gulch and brook, and (b) a ditch into which a natural watercourse or source of freshwater has been diverted, but does not include groundwater or water in a culvert that is Constructed to prevent the contamination of a watercourse by Domestic Sewage or Effluent.
Suspended Solids	The residue that is retained after filtering a sample of water or Wastewater through a standard glass-fiber filter. The concentration of Total Suspended Solids is the weight of the dried solids retained on the filter, divided by the volume of the sample from which the solids were collected. This is normally expressed as mg/L.
Total Suspended Solids (TSS)	See Suspended Solids.
Transpiration	The process by which water absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface, principally from the leaves.
Treatment Method (as defined in the SSR)	Section 1 of the SSR defines Treatment Method as follows: "Treatment Method" means a Treatment Method for Domestic Sewage classified as Type 1, Type 2 or Type 3 where (a) Type 1 is treatment by septic tank only, (b) Type 2 is treatment that produces an Effluent consistently containing less than 45 mg/L of Total Suspended Solids and having a 5-day BOD of less than 45 mg/L, and (c) Type 3 is treatment that produces an Effluent consistently containing less than 10 mg/L of Total Suspended Solids and having (i) a 5-day BOD of less than 10 mg/L, and (ii) a median fecal coliform density of less than 400 colony-forming units per 100 mL

TERM	DEFINITION
Treatment System	A manufactured or constructed Treatment System that treats Effluent prior to discharge to the ground.
Vertical Separation (Native Soil)	The depth of unsaturated, original, undisturbed permeable soil below the Infiltrative Surface and above any limiting layer.
Vertical Separation (As Constructed)	The depth of unsaturated, original, undisturbed permeable soil below the Infiltrative Surface and above any limiting layer PLUS the depth of sand media between the Infiltrative Surface and the native soil.
Wastewater	Sewage, Domestic Sewage, Effluent. See Domestic Sewage.
Well (as defined in the SSR)	Section 3.1(1) of the SSR defines Well, for that section only, as “a well used to supply a domestic water system.”

1.0 INTRODUCTION

1.1 PURPOSE OF THE GUIDELINES

.1 These guidelines provide guidance on professional practice for Engineering/Geoscience Professionals who are qualified to design or advise on Onsite Sewerage Systems under the SSR (defined as Professionals in these guidelines).

.2 These guidelines address:

- typical project organization and responsibilities of the various stakeholders;
- professional services typically provided;
- quality control and assurance, including guidance on Field Review and Direct Supervision as they apply to Onsite Sewerage Systems;
- professional education, training, and experience appropriate to practice; and
- the process of engineering of Onsite Sewerage Systems, including guidance on the design process and level of effort.

.3 The intended use of these guidelines is to provide guidance to Professionals for design and Implementation of Onsite Sewerage Systems, to foster the development of professional excellence, and to encourage professional involvement in the management of Decentralized Wastewater systems and the development of sustainable infrastructure.

1.2 SCOPE AND APPLICABILITY OF THE GUIDELINES

.1 These guidelines apply to design, Construction, and maintenance of Onsite Sewerage Systems under the SSR, which regulates Onsite Sewerage Systems of under 22,700 L/day DDF. Should conflicts arise between the requirements of the SSR and the information presented in, or referenced by, these guidelines, the SSR will prevail.

.2 These guidelines are intended for use by Engineering/Geoscience Professionals practising in the Onsite Sewerage System field. These guidelines are not intended as a design specification, nor are they an instruction manual. These guidelines are not intended to duplicate general information and guidance on quality management, which are already covered by other Engineers and Geoscientists BC guidance documents. These guidelines do not endorse any particular source of Standard Practice, techniques, technologies, or certification agencies.

.3 An Engineering/Geoscience Professional's failure to follow one or more of these guidelines does not necessarily mean that he or she has failed to meet his or her professional obligations. Such decisions depend upon the Engineering/Geoscience Professional's exercise of professional judgment, including weighing facts and circumstances particular to a project. Determining whether an Engineering/Geoscience

Professional has met his or her professional obligations will involve a comparison of the Engineering/Geoscience Professional's services to these guidelines and the expected actions of a reasonable and prudent Engineering/Geoscience Professional in similar circumstances.

Additional information on when a Professional could be held responsible for contributing to a Health Hazard has been outlined in the policy document entitled "Sewerage System Regulation: Standard Practice and Health Hazards" (Province of BC 2017a).

1.3 ONSITE SEWERAGE SYSTEMS

.1 An Onsite Sewerage System collects, treats, and disperses to ground the Wastewater produced by a building or a small group of buildings on the same or neighbouring properties. These systems may serve one or two dwellings, may serve clusters of dwellings, or have other uses.

.2 Larger Onsite Sewerage Systems (serving more than one unit) utilize collection sewers with central treatment and dispersal; however, they are considered to be "Decentralized" infrastructure, in contrast to the traditional "centralized" sewer systems that serve entire communities and whose collection, treatment, and discharge approaches are typically different.

.3 Onsite Sewerage Systems rely upon soil dispersal of Effluent, with soil-based treatment providing a significant portion of the Wastewater renovation. Soil-based treatment utilizes natural soil processes to treat Wastewater to the point where the water returns to the hydrological cycle and nutrients are cycled into the soil, atmosphere, and biosphere.

.4 Ideally, the modern Onsite Sewerage System closes the loop between resource and use and back to resource. The Onsite Sewerage System treats Sewage and disperses Effluent back to the environment in such a way as to minimize Risk to health and the environment. Water is largely re-used in the environment, and some nutrients are returned to the soil. Onsite Sewerage Systems are designed for the long term and are considered as sustainable community infrastructure. As such, it is imperative that Onsite Sewerage Systems are managed properly to achieve this goal.

.5 Modern systems are designed following a performance-based approach rather than the more traditional prescriptive approaches, and design is related to treatment and dispersal in the soil component rather than to "disposal" to soil.

.6 While traditionally onsite and Decentralized Systems have been primarily a rural and occasionally a suburban waste management solution, there is an increasing application of Decentralized Systems in urban environments including heat, energy, and resource recovery from waste streams. Decentralized Systems may offer unique opportunities for sustainable design and water and resource conservation.

1.4 TYPE 3 AND LARGE FLOW SYSTEMS

.1 Under the SSR, two types of systems must be designed, constructed, and maintained by or under the Supervision of a Professional: all Type 3 systems, and all Large Flow Systems with DDFs of over 9,100 L/day. A Professional may also design, Construct, and maintain any other type of sewerage system under the SSR; the

BC *Sewerage System Standard Practice Manual* (BC SPM) (Province of BC 2014) recommends professional design in a number of situations.

.2 An ROWP or other person may install or maintain Type 3 and Large Flow Systems under the Supervision of a Professional.

1.5 LAYOUT OF THE GUIDELINES

.1 These guidelines are separated into five parts (**Sections 2.0 to 6.0**), plus references and additional resources (**Section 7.0**) and appendices. In general, the body of the text is brief and the appendices hold more detailed descriptions, checklists, and other resources. Contributors and reviewers are acknowledged in **Section 9.0**.

.2 Definitions are provided at the beginning of the guideline (see the lists entitled **Abbreviations & Acronyms** and **Defined Terms**). Any definitions or concepts capitalized or abbreviated in the text will also be found in those lists. Note that the SSR includes definitions specific to the regulatory context; refer to the regulation for these definitions.

2.0 GUIDELINES FOR PROFESSIONAL PRACTICE IN ONSITE SEWERAGE SYSTEMS

2.1 FRAMEWORK

2.1.1 REGULATORY FRAMEWORK

2.1.1.1 General Considerations

.1 The SSR came into effect June 1, 2005 and falls under the BC *Public Health Act*. The SSR applies to the Construction and maintenance of the following:

- A holding tank
- Sewerage Systems that serve single-family residences or duplexes
- Sewerage Systems or a combination of Sewerage Systems with a combined design daily Domestic Sewage flow of less than 22,700 litres that serve structures on a single parcel
- A combination of Sewerage Systems with a combined design daily Domestic Sewage flow of less than 22,700 litres that serves structures on one or more parcels or strata lots or on a shared interest

.2 The SSR is a performance-based regulation. As the key performance statement, the SSR requires that Onsite Sewerage Systems must be constructed with the result of not causing or contributing to a Health Hazard. The SSR contains some Prescriptive Standards, particularly treatment standards and setback standards for Horizontal Separation to Wells. The SSR follows a professional reliance model.

.3 The SSR requires that system design, Construction, and maintenance only be undertaken by or under the Supervision of Authorized Persons. Authorized Persons are either Professionals or ROWPs. The regulation relies upon the Authorized Person to provide assurance that the Sewerage System is designed and constructed in accordance with Standard Practice, that is, will not cause or contribute to a Health Hazard. See **Section 2.2.2.2 – Role of the Professional in the SSR** for discussion of the role of the Professional under the SSR.

.4 The SSR requires the owner to ensure that the Onsite Sewerage System is maintained in accordance with the maintenance plan. Maintenance of the Onsite Sewerage System must be undertaken by an Authorized Person or under the Supervision of an Authorized Person. The owner is responsible for record keeping and ensuring maintenance is done in accordance with the time intervals defined in the Onsite Sewerage System maintenance plan.

.5 Note that maintenance of Onsite Sewerage Systems installed prior to May 31, 2005 does not require an Authorized Person, but a significant alteration or repair of these systems is subject to the SSR filing process, and the Onsite Sewerage System, once repaired, will need to be maintained by or under the Supervision of an Authorized Person.

.6 The SSR defines three methods of Sewage treatment as follows:

- **Type 1** is treatment by septic tank (note that the BC SPM further defines Effluent quality for Type 1 systems).
- **Type 2** is treatment that produces an Effluent consistently containing less than 45 mg/L of Total Suspended Solids and having a BOD_5 of less than 45 mg/L.
- **Type 3** is treatment that produces an Effluent consistently containing less than 10 mg/L of Total Suspended Solids and having a BOD_5 of less than 10 mg/L, and a median fecal coliform density of less than 400 colony-forming units (CFU) per 100 mL

2.1.1.2 Filing Process and SSR Documentation Requirements

.1 Before Construction, alteration, or repair to an Onsite Sewerage System can begin, the SSR requires that, as a minimum, the Authorized Persons file the information specified in the SSR Section 8 with the health authority in a “form acceptable to the health authority.”

.2 If there is a material change in the filed information prior to filing of the Sewerage System Letter of Certification, the Authorized Person must file an amendment with the health authority.

.3 Within 30 days of completing the installation of the Sewerage System, the Authorized Person must file with the health authority a letter of certification as outlined in Section 9 of the SSR (in a form acceptable to the health authority), record drawings and specifications, and a maintenance plan. The Authorized Person must also provide the owner with a copy of these same documents.

2.1.1.3 ROWPs and Their Role In the SSR

.1 The SSR defines ROWPs as Authorized Persons for Types 1 and 2 systems less than or equal to 9,100 L/day DDF (Small Flow Systems). The SSR establishes ASTTBC as their registering body.

.2 ASTTBC has established the following three categories of ROWP as Authorized Persons under the SSR:

- Planner, responsible for site and soil evaluation and design of systems
- Installer, responsible for installation of systems
- Maintenance provider, responsible for maintenance of systems

.3 ASTTBC also provides voluntary registration not mandated by the SSR for the following two categories:

- Installer, Type 3, and Maintenance provider, Type 3, as a guide for Professionals when selecting experienced ROWPs for work on Type 3 systems. Note that the installer or maintenance provider so registered must still be Supervised by a Professional for installation or maintenance of a Type 3 system.
- Private inspector, residential and commercial.

.4 The category is indicated on the ROWP's stamp. Within each category, the ROWP may be restricted to certain areas of practice; this restriction is indicated on the ROWP's stamp.

2.1.1.4 Role of the Health Authority and Environmental Health Officers (EHOs)

.1 Health authorities and EHOs have statutory authority under the *Health Authorities Act* to:

- administer and enforce the SSR;
- carry out legal remedies such as orders or tickets;
- accept sewerage system filing documents and letters of certification documents for systems and confirm that these meet the documentation standards of the SSR;
- confirm that only Authorized Persons plan, Construct, or maintain installed Onsite Sewerage Systems (or Supervise the same);
- inspect and take corrective action to alleviate Health Hazards related to an Onsite Sewerage System; and
- receive and respond to complaints about Health Hazards.

.2 Section 2.1 of the SSR prescribes Health Hazards. These include Onsite Sewerage Systems or proposed Onsite Sewerage Systems or maintenance plans that in the opinion of a Health Officer may cause a Health Hazard. This section of the SSR clarifies that Health Officers can intervene in the professional reliance model if a Health Hazard is anticipated.

.3 Health authorities are not required to routinely review filings.

2.1.1.5 Holding Tanks and Privies (Outhouses)

.1 Part 2 of the SSR regulates the use of holding tanks under a permit system. Any person may apply for a permit, and once a permit is issued, may Construct a holding tank system. Section 3.1 of the SSR includes prescriptive setback requirements from holding tanks to Wells. See **Section 6.14 – Holding Tanks** for further information on holding tanks.

.2 Privies are not covered by these guidelines as they are not considered to be sewerage systems under the SSR; therefore, their construction is prohibited, with certain exceptions noted as follows. Privies were permitted under the former Sewage Disposal Regulation (in effect until May 31, 2005), and a number remain in operation. Privies permitted under the former regulation are not required to be upgraded to the SSR standards unless required by a Health Officer, and particularly if they are considered to be creating a Health Hazard under the BC *Public Health Act*. Privies may still be authorized for use in temporary settings, such as industrial camps and community events like public fairs, in accordance with the *Industrial Camps Regulation* and the *Regulated Activities Regulation*, respectively.

2.1.1.6 Other Regulations and Authorities

.1 When designing an Onsite Sewerage System under the SSR, the Professional may need to also consider one or more of the following:

- The BC *Public Health Act* and its associated regulations:
  - *Health Hazards Regulation*;
  - *Industrial Camps Regulation*;

- *Public Health Act Transitional Regulation*;
- *Regulated Activities Regulation*;
- *Water Sustainability Act*, its predecessor, the *Water Act*, and its associated regulations;
- *Groundwater Protection Regulation*, which governs the drilling, Construction, flood-proofing, sealing, and closing of water Wells, including domestic water supply Wells; and
- where appropriate, requirements of the First Nations Health Authority, (see non-SSR-related roles in Table I-2, page I-14, of the BC SPM Version 3).

- The *Drinking Water Protection Act*, which covers all water systems, other than single-family dwellings, and outlines requirements for water suppliers in terms of ensuring that the water supplied to their users is potable.
- Maintained by the BC Ministry of Environment, the *Approved Water Quality Guidelines* and aquatic life documents (Province of BC 2017b), which are relevant to consideration of impact on water in the environment. These include water quality criteria for microbiological indicators that set water quality standards for pathogens related to the water use.
- The *Environmental Management Act* and its associated regulations:
  - *Waste Discharge Regulation* and applicable codes of practice; and
  - *Municipal Wastewater Regulation* (MWR), which should be considered when designing larger systems that may expand to and beyond 22,700 L/day DDF at a later date. Systems with DDFs below 22,700 L/day may be registered under the MWR, and this could be necessary for certain industrial waste streams and is necessary where discharge other than to ground is to be used.
- Siting, Construction, and maintenance of systems: the Professional should check compliance with all applicable local zoning and other bylaws, e.g., development permits.
- Local bylaws and zoning, including maintenance bylaws that may affect the design.
- Covenants, rights of way, ungazetted roads and easements that may restrict or affect the siting or use of Onsite Sewerage Systems: the Professional should check that any registrations on title are addressed.

.2 For lands under federal jurisdiction, Onsite Sewerage Systems—typically on First Nations reserve lands—are managed by federal Health Officers, and the SSR or MWR are not applicable; however, the policy of Indigenous Services Canada is that such systems on reserves should be constructed following SSR or MWR standards. These guidelines do not directly address federal lands; however, the practice guidance they provide is generally applicable.

.3 The above-referenced statutes and regulations were current as of the date these guidelines were updated in May 2018; they may have been amended or changed thereafter. It is the responsibility of the Professional to ensure the most current version of any legislation is used.

2.1.2 STANDARD PRACTICE AND THE BC SPM

2.1.2.1 Standard Practice As Defined In the SSR

.1 The SSR defines Standard Practice as a method of constructing and maintaining an Onsite Sewerage System that will ensure that the Onsite Sewerage System does not cause, or contribute to, a Health Hazard.

.2 Sections 8 and 9 of the SSR indicate that the BC SPM is a source of Standard Practice, and to determine whether the plans and specifications, system Construction, and Onsite Sewerage System maintenance plan are consistent with Standard Practice, an Authorized Person "may have regard to the Ministry of Health Services' publication BC SPM, as amended from time to time."

.3 Professionals are encouraged to use the BC SPM, as this standard of practice was developed for use in BC and forms the basis for industry standards of installation and maintenance. The Professional, however, may use other forms of Standard Practice as defined in the SSR. In doing so, the Professional must evaluate the appropriateness of using other forms of Standard Practice in BC. The Professional must also document the source or backing of any Standard Practice outside of the BC SPM (see **Section 5.0 – Design Approaches**).

.4 When filing a record for an Onsite Sewerage System, the health authority standard forms may require that the Authorized Person identify their source of Standard Practice.

2.1.2.2 The BC SPM

.1 The BC SPM provides standards of practice, which, if properly applied, are expected to result in a system that will not cause or contribute to a Health Hazard or adverse environmental impact.

.2 The BC SPM includes references to roles of the Professional beyond those of the SSR, and to situations where professional design or design review are recommended.

.3 It should be noted that the BC SPM is a living document and is subject to change from time to time.

.4 These guidelines are not a supplement to the BC SPM and are also not a replacement for the BC SPM.

2.1.2.3 Organizations

.1 Key organizations relevant to the Onsite Sewerage Systems field of practice and their roles and responsibilities are summarized in **Table 1: Organization Roles and Responsibilities**.

Table 1: Organization Roles and Responsibilities

ORGANIZATION	ROLE
Engineers and Geoscientists BC	• Registers and regulates the practice of its members and licensees.
ASTTBC	• Registers and regulates the practice of ROWPs.
Ministry of Health	• Responsible for the SSR and maintenance of the BC SPM. • Establishes policy for interpretation of the SSR and for health authorities.
Health Authorities and EHOs	• Maintains the filing registry. • Responsible for the administration and enforcement of the SSR and for the prevention and correction of Health Hazards caused by Onsite Sewerage Systems. • Responds to referrals for planned subdivisions in relation to Onsite Sewerage Systems. • Receives public complaints about Health Hazards.
Ministry of Environment	• Responsible for potential MWR systems.
Local Government	• May enact bylaws further Controlling siting of Onsite Sewerage Systems. • Has the authority to mandate system maintenance, inspection, and repair through local bylaws and enforcement activities. • May integrate Decentralized Onsite Sewerage Systems in their waste management planning. • Responsible for land-use planning.
Provincial Approving Officer	• Administers subdivision approval, considering adequate provision for Sewage management as a factor.
Health Canada Indigenous Services Canada First Nations Health Authority	• Responsible for Onsite Sewerage Systems on lands under federal jurisdiction, e.g., First Nations lands.
Authorized Person	• Responsible for the design, installation, and maintenance of the Onsite Sewerage System in accordance with Standard Practice.
System Owner	• Required by law to retain an Authorized Person (Professional or ROWP) to plan, install, and maintain the Onsite Sewerage System as outlined in the SSR. • Responsible for the operation and maintenance of the Onsite Sewerage System, including retaining an Authorized Person to undertake maintenance of the Onsite Sewerage System. The Onsite Sewerage System owner may be involved with system installations under Authorized Person Supervision as per sections 6(1)(b) and 6(3) of the SSR.

2.2 SCOPE OF PRACTICE

2.2.1 SCOPE OF SERVICES

.1 The Professional typically provides services for the design, Field Review of Construction, and maintenance of an Onsite Sewerage System under the SSR. Details of services for typical projects are covered in **Section 8.0 – Amplification to Previous Sections**. At times, the Professional may provide a more limited scope of services on projects, such as the following activities:

- Review of design by others, including Professionals and ROWPs
- Preparation of reports supporting designs by others, e.g., where an ROWP is not able to meet the BC SPM, or for an ROWP design where the BC SPM recommends professional design review
- Site assessments only, which typically include design recommendations or specification of design parameters
- Setback reduction assessments, including Well setbacks by a Professional with expertise in hydrogeology
- Inspection of existing systems, including performance, flow, and environmental monitoring

.2 **Section 6.0 – Additional Considerations** describes specialist professional services in detail. It also includes some services that fall outside the scope of the SSR but are commonly provided by Professionals practising in the Onsite Sewerage System field. These types of services include:

- land-use planning;
- subdivision assessment;
- land-use planning advisory role to local government and approving authority;
- studies pertaining to liquid waste management planning, watershed planning, and environmental health impact assessments;
- decentralized Wastewater system management; and
- in some cases, providing design-build and contracting services.

2.2.2 PROJECT ROLES

2.2.2.1 General Discussion

.1 In a typical project involving the provision of design services:

- the Professional will be the Authorized Person;
- the client is the owner of the building or development being served;
- the Contractor is the installer of the Onsite Sewerage System and is often an ROWP; and
- the local health authority accepts documents during filing process and administers the SSR.

.2 During installation, typically the Professional who designed and filed the Onsite Sewerage System will undertake Field Reviews, approve changes to the works if necessary, test and commission the Onsite Sewerage System, and provide a final letter of certification to the health authority, including submission of record drawings and a maintenance plan. The Professional will also provide the owner with a copy of the filed drawings and specifications, a maintenance plan, and a copy of the final letter of certification.

.3 In some cases, an ROWP will be the Authorized Person and the Professional will be providing specialist services, e.g., site assessment or design review/support. In this case, the Professional may or may not be involved in the review of Construction depending upon the nature of the service provided.

.4 Onsite Sewerage Systems may also follow a less traditional route. This is because projects under the SSR are often small in scale and constructed in rural or remote locations where typical Construction relationships are not practical, or where Construction companies are not available or are not cost effective. This may include installation of the Onsite Sewerage System by the owner (which is permitted under the SSR under the Supervision of an Authorized Person). In some cases, a Professional may install or maintain Onsite Sewerage Systems as well as providing typical engineering services such as design and Field Review.

.5 Once the project is completed and the Onsite Sewerage System is put into service, the owner assumes responsibility for use, operation, and maintenance of the Onsite Sewerage System in accordance with the filing documents and the SSR. It is the responsibility of the owner to engage a maintenance provider.

.6 The maintenance provider is typically engaged at the time of commissioning of the Onsite Sewerage System or is hired after the Onsite Sewerage System has been put in service. For Type 1 and Type 2 Small Flow Systems, the maintenance provider will typically be an ROWP. In the case of a Type 3 or Large Flow System, the maintenance provider must be a Professional or be Supervised by a Professional.

2.2.2.2 Role of the Professional in the SSR

.1 The SSR defines four roles for Professionals. See the **Defined Terms** list at the beginning of this guideline for the definition of the use of the word Supervise in the SSR.

2.2.2.2.1 Type 1 and 2 Small Flow Systems

.1 As discussed above, a Professional is allowed to design, install, and maintain any Onsite Sewerage System under the SSR.

.2 In the case where a Professional has filed the design of a Type 1 or Type 2 Onsite Sewerage System of DDF less than or equal to 9,100 L/day (a Small Flow System), a Professional must carry out Field Reviews and submit the Sewerage System Letter of Certification and final documentation. Installation is commonly carried out by an ROWP, with Field Reviews provided by the design Professional. However, the SSR allows for installation to be carried out by another person (owner or non-ROWP Contractor) acting under the Supervision of the Professional.

.3 In the event that a Professional has submitted a filing for the design of a Small Flow System and cannot continue as Authorized Person for the installation of the Onsite Sewerage System, it is possible for the Professional to terminate involvement with the project. In this case, the Professional must advise the owner or client and the health authority of the termination of his or her involvement and of the need for the owner to retain a new Authorized Person, preferably a Professional, for the provision of Field Reviews and preparation and submission of final documents.

.4 Because engineered designs are often performance-based and may involve features that require verification of critical soil conditions, it is strongly recommended that the design Professional carry the project through to completion.

2.2.2.2.2 Type 3 Systems

.1 Type 3 Onsite Sewerage Systems must be designed and filed by a Professional. A Professional must also Supervise the Construction and maintenance of these systems. A Professional may delegate Construction and maintenance work to an ROWP, but must supervise that work following the supervisory guidelines in this manual.

2.2.2.2.3 Large Flow Systems

.1 Onsite Sewerage Systems with DDF of over 9,100 L/day (Large Flow Systems) must be designed and filed by a Professional. A Professional must also Supervise the installation and maintenance of these systems. A Professional may delegate Construction and maintenance work to an ROWP, but must supervise that work following the supervisory guidelines in this manual.

2.2.2.2.4 Well Setback Reduction

.1 Section 3.1 of the SSR prescribes minimum horizontal setbacks from Onsite Sewerage Systems to Wells. These prescriptive setbacks can be reduced if a Professional competent in the area of hydrogeology provides written advice that the reduced setback would not likely cause a Health Hazard.

2.3 QUALITY MANAGEMENT

2.3.1 ENGINEERS AND GEOSCIENTISTS BC BYLAWS AND GUIDELINES

.1 The *Act* and Bylaws contain quality management requirements that are detailed in the various Engineers and Geoscientists BC quality management guidelines. For more guidance, the Professional should consult the following quality management guidelines:

- *Retention of Project Documentation* (Engineers and Geoscientists BC 2018a)
- *Direct Supervision* (Engineers and Geoscientists BC 2018b)
- *Documented Field Reviews During Implementation or Construction* (Engineers and Geoscientists BC 2018c)
- *Use of Seal* (Engineers and Geoscientists BC 2017)
- *Documented Checks of Engineering and Geoscience Work* (Engineers and Geoscientists BC 2018d)

2.3.2 SSR Use of the Term Supervision

.1 The SSR uses the terms Supervision, to Supervise, and Supervised in ways that, depending on the context, apply to either Direct Supervision or Field Reviews as described in the quality management guidelines. Refer to the **Defined Terms** list at the beginning of this guideline for definitions of these terms.

2.3.3 DOCUMENTS

.1 The SSR provides standards for minimum filing documentation; see **Section 2.1.1.2 – Filing Process and SSR Documentation Requirements**.

.2 **Sections 4.0 – Engineering of Onsite Sewerage Systems** and **5.0 – Design Approaches** of these guidelines, and their associated amplification checklists, provide minimum documentation standards for practice.

2.3.4 DIRECT SUPERVISION AND DELEGATION IN THE ONSITE SEWERAGE SYSTEM FIELD

.1 The Professional working in the Onsite Sewerage System field may delegate work to members of staff in a traditional consulting setting or develop working relationships with and use the services of others, e.g., ROWPs, in a non-traditional setting to perform various duties. These include field work for site assessments, assistance in the design process, Field Reviews during Construction, and provision of maintenance services. Where work is delegated, the Professional nevertheless remains responsible for the delegated work.

.2 Refer to *Quality Management Guidelines – Direct Supervision* (Engineers and Geoscientists BC 2018b). See **Section 2.3.6 – Field Reviews** for discussion of the provision of Field Review services and further discussion of Direct Supervision.

2.3.5 INSTALLATION AND MAINTENANCE

.1 Where the SSR specifies that a person must not Construct or maintain an Onsite Sewerage System unless Supervised by a Professional, and where the services of the Professional relate to the physical installation or physical maintenance of a Sewage system, the services to be provided by the Professional are intended to be restricted to Field Reviews only. See the list of Defined Terms for SSR definition of Construct.

.2 The Professional should be aware that services similar to those of Construction site Supervision are not covered in these guidelines and are not considered to be the practice of engineering and geoscience.

.3 The Professional should consider potential liability and insurance implications before undertaking installation, maintenance, or Construction site Supervision.

.4 Where the Professional is providing installation, maintenance, and Construction site Supervision services or is a design-build Contractor reviewing the Construction of their own design, there is a potential for conflict of interest. The Professional must ensure an adequate level of oversight is maintained and the requirements of the quality management guidelines for Field Reviews are met (Engineers and Geoscientists BC 2018c).

2.3.6 FIELD REVIEWS

2.3.6.1 General Considerations

.1 Field Reviews are required for all projects. Refer to *Quality Management Guidelines – Documented Field Reviews During Implementation or Construction* (Engineers and Geoscientists BC 2018c).

.2 The level of Field Review (scope of work) by the Professional of a person constructing or maintaining an Onsite Sewerage System is to be determined by the Professional, considering factors such as:

- the level of Risk and unknown conditions on the site;
- the size and complexity of the Onsite Sewerage System;
- any special or sensitive site and soil conditions;
- the level of detail of documentation prepared for the project;
- the experience and capability of the person undertaking the Construction or maintenance;
- whether the person undertaking the Construction or maintenance is an ROWP; and
- past experience with or reputation of the person undertaking the Construction or maintenance.

.3 Field Reviews must assess site and soil conditions encountered during installation to confirm consistency with the conditions observed during the site and soil evaluation. If conditions encountered during installation differ, amendments and adaptation of the design may be required and these amendments should be made by the Professional or the subordinate under his or her Direct Supervision.

.4 When reviewing Construction or maintenance by a non-ROWP or homeowner, the Professional (or subordinate) will need to have considerably more site presence, which may in some cases necessitate continuous presence by the Professional or subordinate (see **Section 2.3.5 – Installation and Maintenance** and **Paragraph 2.3.6.1.3** above).

.5 **Paragraph 2.3.6.1.1** above and related amplification includes examples of typical Field Review tasks and guidance on level of effort. **Section 8.2.8. – Field Review and Information for Record** provides a sample checklist for Field Review of installation, and **Section 8.2.13 – Maintenance** provides checklist recommendations for Field Review of maintenance.

2.3.6.2 Field Review and Supervision During Installation and Maintenance

2.3.6.2.1 Installation

.1 The cases and examples illustrated in **Table 2** and **Table 3** provide guidance on acceptable practice, comparing situations where an ROWP or a non-ROWP would be installing an Onsite Sewerage System designed by a Professional. See also **Section 2.3.6.2.3 – Homeowner Construction** for further discussion of installation by a homeowner or non-ROWP Contractor.

.2 Where the Professional is directly Supervising a subordinate, this subordinate may be either a technician or ROWP directly employed by the Professional or another ROWP, or a person with whom the Professional has a suitable working relationship (see **Section 2.3.4 – Direct Supervision and Delegation in the Onsite Sewerage System Field**).

.3 If a Professional is directly Supervising a subordinate in providing Field Review of installation, the subordinate must be a different person than the installer. This means that the Professional must not use the installer as a Field Reviewer of his or her own work.

Table 2: Case Examples – Field Reviews of Installations

<table>
<tr><th>CASE</th><th>ACCEPTABLE PRACTICE DURING INSTALLATION</th></tr>
<tr><td colspan="2">CASE 1: ROWP INSTALLER INSTALLING A TYPE 1 OR 2 SMALL FLOW SYSTEM</td></tr>
<tr><td></td><td>• Professional clearly communicates key aspects of design and installation to the ROWP installer and requires that the installer notify the Professional prior to proceeding further should site conditions differ from those assumed in the design.
• Professional or subordinate provides Field Reviews of critical elements during the installation and at commissioning (including notification of the ROWP installer of the required schedule of Field Reviews).
• Professional makes decisions regarding changes to the design or installation based on differing site conditions. Professional may rely on description of conditions by the ROWP and discussions with the ROWP in order to do this.
• ROWP installer is responsible for carrying out the work in accordance with Standard Practice and Construction drawings and specifications.</td></tr>
<tr><td colspan="2">CASE 2: ROWP INSTALLER INSTALLING A TYPE 3 OR LARGE FLOW SYSTEM</td></tr>
<tr><td></td><td>Per Case 1 plus the following:
• Professional or subordinate provides Field Reviews of most elements during the installation and at commissioning (including notification of the ROWP installer of the required schedule of Field Reviews).
• Professional makes decisions regarding changes to the design or installation based on differing site conditions. Professional reviews site conditions in order to do this.
• A higher level of Field Review is expected for Type 3 and Large Flow Systems.</td></tr>
<tr><td colspan="2">CASE 3: NON-ROWP INSTALLER INSTALLING A TYPE 1 OR 2 SMALL FLOW SYSTEM</td></tr>
<tr><td></td><td>• Professional clearly communicates all aspects of design and installation to the non-ROWP installer including required outcomes and, where necessary, work methods.
• Professional or subordinate provides Field Reviews of most elements of the installation and at commissioning (including notification of the non-ROWP installer of the required schedule of Field Reviews).
• The Professional or subordinate is present during the installation of non-typical or highly technical aspects of the work and provides detailed information and explanations regarding the required outcomes.
• The Professional or subordinate is present to review site conditions to ensure they are consistent with conditions assumed in the design at critical stages during Construction.
• Where the installer is not suitably experienced, the Professional or subordinate is on site for the majority of the installation.
• Professional makes decisions regarding changes to the design or installation based on differing site conditions. Professional reviews site conditions in order to do this.
• Professional is responsible for confirming that the work is carried out in accordance with Standard Practice and in general conformance with the Construction drawings and specifications.</td></tr>
<tr><td colspan="2">CASE 4: NON-ROWP INSTALLER INSTALLING A TYPE 3 OR LARGE FLOW SYSTEM</td></tr>
<tr><td></td><td>Per Case 3 plus the following:
• Professional or subordinate provides Field Reviews of all elements of the installation and at commissioning (including notification of the non-ROWP installer of the required Field Reviews).
• The Professional or subordinate is present during the installation of all key components and provides detailed information and explanations regarding the required outcomes.</td></tr>
</table>

Table 3: Examples of Practice – Field Reviews of Installations

EXAMPLES OF PRACTICE
EXAMPLE 1: FIELD REVIEW OF A NON-ROWP INSTALLER INSTALLING A SMALL TYPE 1 SYSTEM
Facts: Mr. Eng. has prepared the design and filing documents for a Type 1 sand mound system to be placed on moisture-sensitive fine-grained native soils. The non-ROWP calls Mr. Eng. because the site is quite wet and he is worried that machinery will compact the soils and negatively affect the installation. **Unacceptable:** Mr. Eng. discusses the site conditions with the non-ROWP by telephone. He suggests that the non-ROWP wait for a few days of sunny weather and return to the site to proceed with Construction when the soils have "dried out enough." **Acceptable:** Mr. Eng. arranges to meet the non-ROWP at the site. Mr. Eng. reviews the soil conditions and declares that conditions are too wet to proceed at this time. He notifies the non-ROWP that Construction must not proceed until Mr. Eng. advises him that the conditions are acceptable. In addition, Mr. Eng. is present on site when the non-ROWP returns to start the work and reviews the soil scarification to verify that it meets acceptable standards. Mr. Eng. either stays on the site to review the scarification or returns to the site for a final review prior any placement of sand on the native soil.
EXAMPLE 2: FIELD REVIEW OF AN ROWP INSTALLER INSTALLING A SMALL TYPE 2 SYSTEM
Facts: Ms. Eng. has prepared the design and filing documents for a Type 2 system utilizing pressurized distribution laterals to be installed in subsurface trenches. The design calls for the infiltration chambers to be placed 35 cm deep in the loamy fine sand layer observed at that depth in the test pits. The ROWP installer calls Ms. Eng. to inform her that when excavating to the 35 cm depth the soils encountered were a loam and hence differed from the design. The ROWP also notes that test excavations in the trench lines indicate that the loamy fine sand is present at 45 cm deep. **Unacceptable:** Ms. Eng. has never met or worked with the ROWP installer before. Ms. Eng. does not discuss the soil conditions with the ROWP installer but instead replies "you are the Registered Practitioner and installer of the Onsite Sewerage System. Make sure your installation meets the BC SPM and take responsibility for your work." **Acceptable:** Ms. Eng. has worked with the ROWP installer on many projects and the ROWP installer has assisted Ms. Eng. in the past with test-pit logging and site assessments. Ms. Eng. has come to understand the ROWP's level of knowledge and experience, especially with respect to soil identification. Ms. Eng. discusses with the ROWP by telephone the presence and characteristics of the fine loamy sand and the consistency of the 45 cm depth observed in the test excavations. Ms. Eng. Notifies the ROWP that the trench depth will be revised to 45 cm and that the ROWP can proceed accordingly.
EXAMPLE 3: FIELD REVIEW OF A NON-ROWP INSTALLER INSTALLING A TYPE 3 SYSTEM
Facts: Mr. Eng. has prepared the design and filing documents for a Type 3 system utilizing ultraviolet disinfection of the Effluent. The design specifies the use of an ACME Model 400 UV unit. The non-ROWP installer calls Mr. Eng. to tell him he is confused about the UV unit and how to properly install it. **Unacceptable:** Mr. Eng. tells the non-ROWP that the installation is straightforward and that the non-ROWP should contact the ACME distributor for instructions on how to install the UV unit. The non-ROWP informs Mr. Eng. that he was only able to get sketchy information from the ACME sales representative who has never actually seen the unit installed. Mr. Eng. replies "work it out with your electrician and call me for an inspection when you've completed the installation." **Acceptable:** Mr. Eng. contacts ACME, discusses the installation with them and gets the manufacturer's installation manual from ACME. Mr. Eng. meets with the non-ROWP and the electrician on site to go over the details of the installation and the critical elements required for proper operation and performance. Mr. Eng. returns to the site as the installation of the UV unit is nearing completion to do a final review. Mr. Eng. also witnesses voltage and amperage tests made by the electrician and confirms that the UV lamp illuminates and that the UV fail alarm is working properly.

2.3.6.2.2 Maintenance

.1 **Table 4** provides guidance on acceptable practice, comparing situations where an ROWP or a non-ROWP is maintaining an Onsite Sewerage System under the Supervision of a Professional. In these cases, the Professional is the Authorized Person for maintenance under the SSR.

.2 The SSR requires that a Professional Supervise maintenance of all Type 3 and Large Flow Systems, e.g., a Professional must Supervise an ROWP maintaining a Type 3 system regardless of the ROWP's level of registration.

.3 The hands-on Implementation of maintenance is not engineering and geoscience services. Where a Professional is directly Supervising a subordinate undertaking maintenance and monitoring, the Professional will be directly Supervising the monitoring, inspection, data collection, and engineering appraisal of the Onsite Sewerage System but will not be directly Supervising the cleaning of system components, replacement of consumable items and parts, and similar items.

.4 See **Section 2.3.4 – Direct Supervision and Delegation in the Onsite Sewerage System Field** and **Section 2.3.5 – Installation and Maintenance**. Refer to *Quality Management Guidelines – Direct Supervision* (Engineers and Geoscientists BC 2018b).

Table 4: Case Examples – Supervision of Maintenance

CASE	ACCEPTABLE PRACTICE DURING MAINTENANCE
CASE 1: SUPERVISION OF AN ROWP MAINTAINING A TYPE 3 OR LARGE FLOW SYSTEM	
	• The Professional reviews the Onsite Sewerage System operation and maintenance plan. • The Professional reviews the ROWP's training and experience and ensures that the service provider is competent to undertake the work. • The Professional reviews key aspects of the design and key aspects of operation and maintenance with the ROWP. Wherever possible, the ROWP should be present at the Onsite Sewerage System commissioning. • The Professional makes a site visit at the first maintenance for the site. The first maintenance visit may coincide with commissioning and will include instructing the ROWP on specific maintenance and monitoring tasks for the site. • In the case of a large flow or other complex Onsite Sewerage System with extensive maintenance and or monitoring requirements and multiple tanks or collection system components, the Professional or subordinate makes site visits at a specified frequency to review maintenance in progress. • At every maintenance visit there is ongoing communication between the Professional and the ROWP, with opportunity for instruction prior to the visit and with reporting after the visit. Ideally, the Professional should be available for contact during the maintenance visit in case a need for direction arises. • The Professional reviews the completed maintenance and monitoring report and signs and seals the document stating that the maintenance was carried out under his or her review. • The Professional provides this report to the owner and sends copies to the maintenance provider.

CASE	ACCEPTABLE PRACTICE DURING MAINTENANCE
CASE 2: SUPERVISION OF A NON-ROWP MAINTAINING A SYSTEM	
	• The Professional reviews the Onsite Sewerage System operation and maintenance plan. • The Professional provides hands-on training sessions with the non-ROWP maintenance person at a number of sites until required competency and understanding of system operation and maintenance is achieved (an exception would be for an adequately experienced and competent non-ROWP maintenance provider, e.g., operator with suitable EOCP certification). • The Professional reviews key aspects of the design and all aspects of operation and maintenance with the non-ROWP. Wherever possible, the non-ROWP should be present at the Onsite Sewerage System commissioning. • The Professional makes a site visit at the first maintenance for the site, which includes instruction of the non-ROWP on specific maintenance and monitoring tasks for the site. • The Professional or subordinate makes a site visit to review maintenance in progress at a specified frequency during subsequent maintenance visits to ensure that all aspects of the maintenance are being done properly. This may be at every maintenance visit, with the frequency depending on the Professional's experience with the work and level of competence of the maintenance provider. • At every maintenance visit there is ongoing communication between the Professional and the non-ROWP, with opportunity for instruction prior to the visit and with reporting after the visit. Ideally, the Professional should be available for contact during the maintenance visit in case a need for direction arises. • The Professional reviews the completed maintenance and monitoring report and signs and seals the document stating that the maintenance was carried out under his or her review. • The Professional provides this report to the owner and sends copies to the maintenance provider.

2.3.6.2.3 Homeowner Construction

.1 Section 6 of the SSR indicates that an owner may Construct or maintain an Onsite Sewerage System classified as Type 1 or 2 on his or her land under the Supervision of an Authorized Person. The SSR also provides that any person may install any system under the Supervision of a Professional.

.2 It is not appropriate for the homeowner to undertake engineering and geoscience work under Direct Supervision by the Professional unless the homeowner is suitably qualified by training and experience. Regarding Construction and maintenance activities, Engineering/Geoscience Professionals are cautioned to approach these situations with extreme care, as the SSR requires a Professional to take responsibility for the work of an untrained person.

.3 The following points are provided as practice guidance in this situation. Similar considerations apply when considering Construction or maintenance of a system by an inexperienced non-ROWP Contractor. Reference to "the Professional" means the Professional or a subordinate under his or her Direct Supervision.

- The Professional should first ensure the written contract for the work clearly establishes roles and responsibilities for system Construction and maintenance, including responsibility for Construction Supervision, site safety, and project management.

- Site and soil evaluation:
  - The homeowner should only undertake simple tasks assisting the Professional, e.g., digging test pits.
- Design and filing documents:
  - The Professional must undertake the design and prepare the filing documents.
  - The design specifications and plans may need to include more details than where an ROWP is installing the Onsite Sewerage System.
- Installation of the Onsite Sewerage System and commissioning:
  - Construction could be undertaken by the homeowner with Field Reviews by the Professional.
  - The Professional will typically provide instructions and recommendations on installation techniques and methods.
  - The Professional should consult their insurance provider regarding liability coverage for Construction or Construction site Supervision.
  - The contract should clearly delineate the required site presence by the Professional during Construction of the Onsite Sewerage System.
  - The contract should state that the homeowner should not make decisions independent of the Professional.
  - The Professional must test and commission the Onsite Sewerage System. The homeowner may assist with this.
- Final documentation:
  - The Professional must prepare all documents that need to be submitted to the health authority.

Table 5: Example of Practice – Homeowner Construction

EXAMPLE OF PRACTICE
EXAMPLE 1: INSTALLATION BY HOMEOWNER
Facts: A homeowner engages Mr. P. Eng., a Professional, to act as the Authorized Person for Construction of a small Type 1 Onsite Sewerage System under the SSR. The Professional undertakes site and soil evaluation and design, and filing of the Onsite Sewerage System. Construction is to be undertaken by the homeowner. **Unacceptable:** Mr. P. Eng. is very busy and is not able to visit the site during Construction, relying instead on photographs provided by the homeowner and attending the site briefly at commissioning, making a cursory Field Review of the installed system. During Construction, he is not available when the homeowner tries to contact him for instructions on unspecified details of the design. **Acceptable:** Mr. P. Eng. schedules a series of Field Reviews during Construction, attending the site at initial system layout, inspecting soil conditions in the excavated trenches and tank excavation, inspecting piping and aggregate prior to backfill, and attending during watertight testing of the tanks prior to tank backfill and at commissioning. During installation, he provides instructions on installation techniques as well as clarified specifications and details for the homeowner in response to questions. Mr. P. Eng. commissions the Onsite Sewerage System.

2.3.7 DESIGN REVIEW

.1 In accordance with Engineers and Geoscientists BC quality management guidelines, Professionals are required to provide documented checks to their work (Engineers and Geoscientists BC 2018d). Professionals are also encouraged to have their work peer reviewed (independent checks) occasionally. Independent checking is of particular importance where using innovative design methods or where the Professional may lack suitable experience or expertise.

.2 In some cases, an equipment manufacturer or distributor may have an engineering department that will provide engineering review for designs or parts of designs utilizing their products. These engineers are often experts in their particular field and may provide a useful design and or design review input.

2.3.8 SPECIFICATION OF EQUIPMENT AND POTENTIAL CONFLICT OF INTEREST

.1 Full disclosure of any affiliation or financial benefit realized by the Professional as a result of the specification of treatment works or equipment must be made to the owner or client. Where a Professional has affiliations with suppliers, it is important that the design remains site- and project-specific and equipment selected is appropriate for the site and use. See the Engineers and Geoscientists BC Code of Ethics (Engineers and Geoscientists BC 2014).

3.0 QUALIFICATIONS

3.1 ASSESSMENT OF QUALIFICATION

.1 Section 14(a)(2) and (3) of the Association's Code of Ethics (Engineers and Geoscientists BC 2014) states, respectively, that members and licensees must "undertake and accept responsibility for professional assignments only when qualified by training or experience" and "provide an opinion of a professional subject only when it is founded upon adequate knowledge and honest conviction."

.2 It is the Association's position that only an Engineering/Geoscience Professional who has suitable knowledge, training, and experience in Onsite Sewerage System practice is appropriately qualified for the services covered in these guidelines.

.3 When considering practice in this field, the Professional should self-assess based on his or her:

- education and training in the particular field of practice;
- experience designing, installing, and maintaining Onsite Sewerage Systems;
- knowledge of the technology and applicable regulations for Onsite Sewerage Systems; and
- honest conviction in his or her ability.

.4 **Section 3.2 – Technical Ability: Core Competencies** provides guidance specific to core competencies for Onsite Sewerage System practice to assist the Professional in making this assessment.

3.2 TECHNICAL ABILITY: CORE COMPETENCIES

3.2.1 THE PROFESSIONAL

.1 Prior to practicing in the Onsite Sewerage System field, the Professional must have competency (through education, training, and experience) in several particular areas.

.2 Integration of multiple disciplines is critical to successful practice in the Onsite Sewerage System area. A typical project will require application of a wide range of engineering skills, which will be integrated in the site- and project-specific design of an Onsite Sewerage System.

.3 Before undertaking work as an Authorized Person in the Onsite Sewerage System field, the Professional should be able to demonstrate competency in each of the following areas:

- Decentralized infrastructure concepts
- Design flows and source characterization
- Performance of Onsite Sewerage Systems in the environment
- Soils and ecosystem concepts (physical, chemical, and biological)
- Soil and site evaluation
- Soil loading and distribution
- Soil as treatment, performance design
- Soil water movement, Groundwater Mounding
- Drainage and site preparation
- Industry-specific equipment and application
- Process selection skills

- Onsite Sewerage System and dispersal system hydraulic design, pumps, and controls
- Onsite Sewerage System installation
- Onsite Sewerage System operation, maintenance, and monitoring

.4 **Table A-1: Core Competencies for Onsite Sewerage System Practice** (see **Section 8.1.1 – Amplification to Section 3.0 Qualifications**) describes key content for these competencies and may be used to guide self-assessment. For specialist or advanced practice, additional skill areas are described in **Section 4.0 – Engineering of Onsite Sewerage Systems** and **Section 5.0 – Design Approaches**.

3.2.2 COMPETENCE IN HYDROGEOLOGY

.1 For Professionals considering providing services in hydrogeology to Onsite Sewerage System design, specifically drinking water Well setback reductions per Section 3.1 of the SSR, **Table 6** below provides a guide to particular areas of competency. The Professional is expected to meet all core competencies.

3.3 SUGGESTIONS FOR CONTINUING EDUCATION

.1 **Section 7.0 – References and Additional Resources** provides a bibliography and suggestions on available education resources. Typically, a Professional will develop knowledge through a combination of university courses, continuing education courses, industry conferences, and self-directed study. Training courses offered by industry organizations and academic institutions in BC for design, installation, and maintenance are recommended to Professionals who may lack experience or background in Onsite Sewerage Systems.

.2 During the development of a practice in the Onsite Sewerage System field, the Professional is encouraged to work with experienced subconsultants or with peer-review consultation to provide design review and assurance of quality of work in area where the Professional is lacking in expertise.

.3 Mentorship is an important source of support, and given the prevalence of solitary practice in the Onsite Sewerage System field, it is particularly important to develop professional association with others, including Professionals and knowledgeable or skilled non-Professionals.

.4 The science of Onsite Sewerage System design and performance has undergone significant development in recent history. The Professional is cautioned that there exists outdated information that may not be appropriate for use today.

Table 6: Core Competencies for Practice in Hydrogeology for Onsite Sewerage System Setback Considerations

	AREA	DESCRIPTION AND LEVEL OF COMPETENCE
1.	Design of Onsite Sewerage Systems	• If not practicing or experienced as a designer of Onsite Sewerage Systems, the Hydrogeologist should, at minimum, have a thorough practical knowledge and understanding of Onsite Sewerage System design.
2.	Soils and Soil/Site Evaluation	• Competencies per Table A-1, Rows 4 and 5, including experience in completion of site and soil evaluations and reports for Onsite Sewerage Systems. (See Section 8.1.1 – Amplification to Section 3.0 Qualifications.)
3.	Soil-Based Treatment	• The practitioner in hydrogeology should, at minimum, have a thorough knowledge and understanding of the concepts and processes of soil-based treatment of Effluent from septic tanks and Sewage treatment plants.
4.	Hydrogeology	• Completed at least one university level course in hydrogeology. • Training and experience in analysis of hydraulics of water Wells, including mapping or estimating Well capture zones. • Training and experience in analysis of hydraulics of groundwater movement from Dispersal areas and Groundwater Mounding.
5.	Groundwater Contamination	• Completed at least one university level course in groundwater contamination. • Training and experience of assessment of actual or potential pollution sources to predict the fate and transport of contaminants in the subsurface. • Knowledge of water quality criteria for different water bodies and water uses. • Understanding of public health Risk and Risk Assessment in the context of potential contamination by Onsite Sewerage Systems.

4.0 ENGINEERING OF ONSITE SEWERAGE SYSTEMS

4.1 DESIGN PROCESS FOR ONSITE SEWERAGE SYSTEMS

.1 Professional Onsite Sewerage System design must be site- and project specific, even when following semi-Prescriptive Standards. The design must include a design rationale that matches solutions to the use, site, and soils.

.2 The design must consider Performance Requirements (protection of health and the environment) and Performance Objectives that support those requirements, but often also needs to consider other objectives such as system cost, energy efficiency, sustainability, ecological impact, and aesthetics.

.3 This section provides guidance on the project and design process according to the flow chart outline in **Figure 1** below, and is supported by appendices with checklists, notes, examples, and references (see **Section 7.0 – References and Additional Resources** and **Section 8.0 – Amplification to Previous Sections**).

4.2 INTENDED USE

4.2.1 SOURCE CHARACTERIZATION

.1 The type of source (e.g., residential, commercial, institutional, recreational, industrial) should be described, with any special characteristics of the source.

.2 The type of operation being served can have a significant effect on the design and operation of Onsite Sewerage Systems. The following circumstances require special attention, and in some cases may fall under other regulations (see **Section 2.1.1.6 – Other Regulations and Authorities** and **Section 2.3.1 Engineers and Geoscientists BC Bylaws and Guidelines**):

- Non-typical discharges (e.g., food or beverage production wash-down and discharge of process water, high sugar content)
- High-strength waste from commercial and industrial facilities such as restaurants and food and beverage production
- Higher-than-normal-strength waste due to aggressive water conservation measures (see **Section 4.3.5 – Mass Loading and Concentration of Contaminants**)
- Domestic Wastewater containing potentially high levels of pharmaceutical drugs and medications or antibiotics (e.g., hospitals, clinics, senior citizen housing projects)
- Institutional, commercial, and industrial operations that use cleaning agents and other process chemicals that may be toxic to biological organisms in the Treatment System, or operations that discharge Wastewater that may result in low or high pH levels

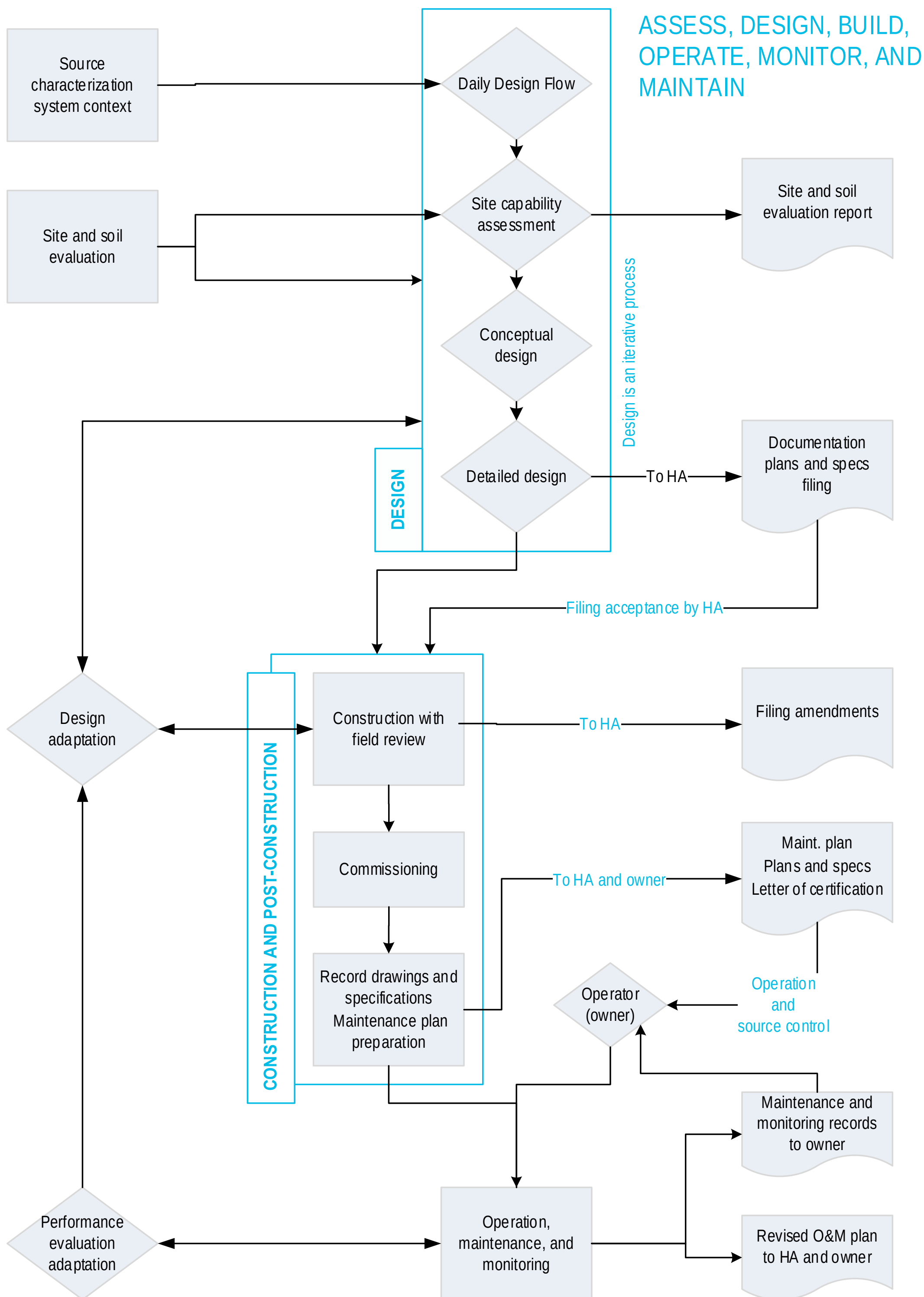

Figure 1: Flow chart describing the project and design process for the engineering of Onsite Sewerage Systems.

HA = Health Authority

.3 Refer to **Section 6.4 – Special Source Characteristics** for additional special source and Wastewater characteristics.

.4 Sources not under the SSR:

(1) All non-Domestic Sewage sources fall outside the SSR. These may include:

- agricultural waste and agricultural processing waste;
- winery and brewery waste;
- slaughterhouse waste (offal and process water);
- seafood processing waste (offal and process water);
- dog kennel waste;
- industrial process waste;
- car washes; and
- self-service laundries.

(2) In these cases, the Professional should determine jurisdiction and applicable best management practice or industry code of practice (e.g., for wineries), and determine whether there are uses in the facility that must or could be separated to an SSR-compliant Onsite Sewerage System; for example, washrooms and showers in a slaughterhouse can be separated to an SSR system or be handled combined under the BC *Waste Discharge Regulation*.

4.2.2 PATTERN OF USE

.1 Patterns of use are an important consideration for both the design and operation of Onsite Sewerage Systems. The following parameters and their effect should be documented and included in the design process, and special operational requirements need to be included in the operation and maintenance manual:

- Variations in use throughout the day, including estimation of required flow equalization
- Variations in use during the week (e.g., schools and churches), including estimation of required flow equalization
- Seasonal variations: periods of high flow followed by very low or no flow (e.g., summer or winter residences, resorts)
- Special events (e.g., fairs, concerts, sporting events)

4.2.3 CLIMATIC INFLUENCES

.1 Climatic influences such as extremes in temperature and precipitation require special considerations in the design and operation of systems, and in some cases preclude the use of certain systems or provide opportunities for system selection. This includes the following:

- High rainfall rates:
  - Flushing of contaminants and pathogens from sands and coarse-grained soils
  - Effects on HLRs
  - Potential for short-term spikes in groundwater levels and reduced Vertical Separation
- Extreme cold temperatures and freezing conditions:
  - Effects of cold weather on Treatment System performance
  - Effects of freezing and prolonged snow cover on soil dispersal performance
  - Seasonal saturation during snow melt

- Measures to avoid freezing and blockage or damage to piping, e.g., self-draining laterals and drain-back of pump lines
- Digital control panel performance
- Areas of seasonal high temperature and low precipitation
- Opportunity for enhanced Evapotranspiration in Dispersal Areas and for design of Evapotranspiration beds or lagoons
- Risk of salt and or sodium concentration in soils

4.3 SEWAGE FLOWS, DAILY DESIGN FLOW

4.3.1 CONCEPT OF DDF

.1 DDF is the peak daily flow used for designing the Wastewater system. The DDF is the designer's estimate of the expected peak daily flow from the facility. It is also the estimated daily Domestic Sewage flow to be entered in the Filing of Sewerage System Form.

.2 The DDF is typically used for sizing septic tanks based on the number of days of retention time at DDF and assessing treatment plant hydraulic capacity. It is also typically used for calculating Infiltrative Surface area needed for Dispersal Areas and for packed bed Treatment Systems such as sand and textile media filters.

.3 The Professional should always clearly qualify the term "flow" (e.g., DDF, peak hourly flow, ADF) and should document the rationale for the estimation of DDF.

.4 For further information and references, see **Section 8.2.1 – DDF**.

4.3.2 AVERAGE DAILY FLOW

.1 The ADF is considered to be the expected daily flow from a facility averaged over a 30-day period. The ADF is often used for design with application of a peaking factor (PF) to determine DDF (i.e., DDF = ADF × PF). The BC SPM references a PF range of 1.5 to 2.0, which represents typical variation for residential flow.

.2 Both ADF and DDF are used during the design of various components of an Onsite Sewerage System. A complete design should typically consider the operation and function of each component of the Onsite Sewerage System under a range of flow conditions, including the ADF, DDF, and, in some cases, the minimum daily flow.

4.3.3 HYDRAULIC LOADING RATE AND DDF

.1 HLR tables in design standards (such as the BC SPM) are based upon typical organic contaminant concentration (BOD) in normal Domestic Sewage and defined as Type 1, 2, or 3 Effluent strength and are linked to matching DDF standards.

.2 Designers typically use the BC SPM, or another authoritative design manual, to select soil HLRs for the soil infiltration system. The selected soil HLR should consider the appropriate design flow (DDF versus ADF). For some projects, the designer should consider organic (BOD) loading rates, or other Mass Loading rates (see **Section 4.3.5 – Mass Loading and Concentration of Contaminants**) and may also need to develop custom loading rates (see **Section 6.2 – Development of Custom Loading Rates**).

4.3.4 ESTIMATION OF FLOWS

.1 Design flow estimation contains considerable uncertainty. Wherever feasible, design flows should be based on flow monitoring or review of flow data from similar facilities. Many tables and standards for estimating design flows for residential occupancies are available in standards from various jurisdictions and from reference literature. Information for commercial and non-residential facility flows is less comprehensive. Professional experience derived from similar sites should be used to supplement these sources of design flow estimates. Also to be considered are potential inflow and infiltration of water or groundwater into the collection system and subsurface tanks.

.2 In all cases, tables and standards should be used only as a guide for determination of design flows because the range of reported flows varies considerably.

.3 **Section 8.2.1 – DDF** provides guidance and references.

4.3.5 MASS LOADING AND CONCENTRATION OF CONTAMINANTS

.1 For Treatment System design, data must be available on the expected sustained peak Mass Loadings that are to be expected under varying loading conditions. In the absence of data, statistical curves (Crites and Tchobanoglous 1998) have been developed to estimate sustained loading rates. At a minimum, Mass Loading estimates for peak and average day design loadings and flows should be calculated and compared with Treatment System capacity and soil treatment capability.

4.4 SITE AND SOILS EVALUATION

.1 The site evaluation identifies site and soil characteristics that influence the design of the Onsite Sewerage System.

.2 As the most critical component for a successful dispersal system design, the site and soil evaluation should preferably be undertaken by the Professional or by a subordinate working in the field with the Professional. Where a trained subordinate is undertaking the work under Supervision, the Professional must consider the required level of Direct Supervision (see **Section 2.3.4 – Direct Supervision and Delegation in the Onsite Sewerage System Field**). It is recommended that the Professional visit the site in person at least once prior to designing the Onsite Sewerage System.

.3 A complete site evaluation report should:

- record overall site conditions (including topography and site-selection constraints such as building locations, potential Breakout points, and horizontal setback distances);
- record soil conditions in the proposed dispersal and receiving area, including the soil profile, soil characterization, water table depth, and soil permeability;
- identify site and soil constraints that affect the capability of the site; and
- comply with the appended checklists (see **Section 8.2.6 – Site and Soils Evaluation Checklists**).

.4 Based on the site evaluation, the design Professional should assess the site capability and constraints and develop a design concept that suits the site.

4.5 SITE CAPABILITY AND CONCEPTUAL DESIGN

4.5.1 SITE CAPABILITY ASSESSMENT

.1 Once the site and soils are characterized and the DDF is established, the designer will determine the capability of the site and receiving area for dispersal and treatment of the estimated quantity of Effluent at the proposed Effluent quality.

.2 The concept of site capability identifies and recognizes the key site and soil constraints, Risks, and opportunities. Constraints and opportunities will vary depending upon the type of Treatment System and soil treatment and dispersal system considered.

.3 This process leads to establishment of feasibility and a logical selection of system options to fit the site.

.4 The process may be addressed in five steps:

1. What are the characteristics of the site?
    a) Constraints to site capability and opportunities presented by the site
    b) Risks due to constraints
2. Is it feasible to use the site for the intended use?
3. Are changes to the proposed use necessary?
4. What system options would work best to fit the site?
5. What are potential solutions to mitigate Risks and constraints or to realize opportunities?

4.5.2 CONCEPTUAL DESIGN

.1 The designer chooses the type of design approach to be followed (see **Section 8.0 – Amplification to Previous Sections**) and establishes Performance Objectives. In many cases, site capability assessment and conceptual design occur as one process.

.2 Then, using the design solutions (options) identified in **Section 4.5.1 – Site Capability Assessment** and the selected design approach (**Section 4.1 – Design Process For Onsite Sewerage Systems**), the design moves to options analysis, which addresses conceptual design (selection of type) of the following system subcomponents:

- Collection systems
- Type 1 or 2 Treatment Systems
- Type 3 Treatment Systems
- Dispersal system and potential reserve area
- Soil infiltration and treatment component

.3 Conceptual design also includes development of a preliminary system layout plan and any mitigating measures such as drainage works, landscaping/aesthetics, and retention or enhancement of the site ecosystem.

.4 When reviewing options, the designer should consider the following:

- Sustainability
- Appropriateness of technology, including simplicity, reliability, and cost
- Preliminary equipment supply and system installation costs
- Operational cost projections
- Source control policy, potential source modification, or flow reductions

- Potential for negative impact to site, drainage, soils, and ecosystem by system Construction or operation
- Monitoring provisions
- Practicality of operation, maintenance, and monitoring

4.5.3 DOCUMENTATION

.1 The designer must record the rationale behind the selected design.

.2 This record is similar to a design brief on larger projects. The Professional should develop a suitable method of presenting this record; a simple table or spreadsheet can be used to demonstrate the linkage from site characteristics to potential solutions to selected solutions.

4.6 DETAILED DESIGN

4.6.1 REQUIREMENTS

.1 Detailed design involves development of the design with drawings and specifications for all components of the Onsite Sewerage System:

- Collection systems
- Type 1 or 2 Treatment Systems
- Type 3 Treatment Systems
- Dispersal systems
- Soil infiltration and treatment components
- Associated drainage, landscaping and other works

.2 **Section 8.2.7 – Detailed Design** provides references and further guidance.

4.6.2 DOCUMENTS

.1 The Professional must properly document the design.

.2 Design documentation should include the following:

- Drawings
- Specifications
- Design rationale

.3 **Section 8.2.9 – Documentation** provides example checklists for design documentation.

.4 Where required, and regardless of whether it is required by an authority having jurisdiction or the client, the Professional must seal his or her design. Refer to *Quality Management Guidelines – Use of Seal* (Engineers and Geoscientists BC 2017).

4.6.3 FILING

4.6.3.1 General Considerations

.1 Once final design documents are prepared, and prior to installation, the Professional will:

- fill out a filing form provided by, or in a form acceptable to, the health authority or other agency responsible for accepting filings under the SSR;
- indicate and, if necessary, document, the source of Standard Practice used for the Onsite Sewerage System design; and
- submit the form to the health authority or agency, together with the design documentation and plans as noted above and a fee.

.2 If there is an existing filing for the property, in accordance with the Association's Code of Ethics, the Professional should inform the other Authorized Person that they have been requested by the owner to provide services. Where provided by the other Authorized Person or made available from another source (e.g., a health authority), the Professional must review any relevant information.

4.6.3.2 Amendment of Filing

.1 Prior to or during the process of system Construction, if any material changes are made to the information filed, the Professional must file an amendment to update the filing.

.2 Minor changes do not require amendment of the filing and are simply recorded as part of the final record drawings and documentation.

.3 For amended designs, the Professional must retain documentation, including design rationale.

4.7 TYPE 3 SYSTEMS

4.7.1 GENERAL CONSIDERATIONS

.1 Type 3 systems, as defined in the SSR, must be designed, constructed and maintained by a Professional. Type 3 Treatment Systems (see **Section 2.2.2.2.2 – Type 3 Systems**) are designed to provide BOD and TSS levels of 10 mg/L, and partial disinfection of the Effluent to median 400 CFU/100 mL fecal coliforms.

.2 This treatment may also be achieved in a CTDS, and in that case, Type 3 refers to the Effluent quality achieved in the CTDS at the Point of Application. This Point of Application will normally be an elevation in the Onsite Sewerage System media/soil profile, and should be used when considering application of vertical and Horizontal Separation standards. Vertical Separation is measured from the Point of Application, not including the soil or media used as part of the Treatment System.

.3 In both cases, monitoring of Effluent quality and a defined sampling point and method must be specified.

4.7.2 APPLICATION OF TYPE 3 SYSTEMS

.1 Type 3 systems are typically selected where there is a need to reduce pathogen loading to the soil infiltration and Treatment System, in order to meet Performance Objectives or reduce the footprint of the dispersal system. Common applications include the following:

- Shallow Vertical Separation
- Very highly permeable soils
- Very low permeability soils
- Reduced critical horizontal setbacks
- Very small soil Dispersal Area (high HLR)

.2 For sites and soils with multiple severe to very severe constraints, the design Professional should consider using a guided Performance-Based Design (see **Section 8.2 – Amplification to Section 4.0 – Engineering of Onsite Sewerage Systems**). The Professional should be aware that it may not be not appropriate to rely on the use of a Type 3 system to solve all site-specific problems.

4.7.3 PATHOGEN ATTENUATION AND MONITORING

.1 Type 3 Effluent meeting the SSR standard is partially disinfected; therefore, it will still contain pathogens. In addition, partial disinfection has been shown in some cases to reduce indicator organisms more effectively than some pathogens (Abd El Lateef et al. 2006).

.2 Type 3 systems must not be relied on to protect health and the environment without a suitably designed soil infiltration and Treatment System.

.3 The Professional should make provisions for redundancy in the design of Type 3 systems to reduce Risks in the event of disinfection device malfunction. For example, this could include redundancy in Dispersal Area design, device alarms, and disabling of discharge pumps (where appropriate) as part of the Risk reduction strategy.

.4 It is recommended that monitoring intervals be based on the reliability of the partial disinfection process and the level of Risk.

4.8 FIELD REVIEWS AND SYSTEM COMMISSIONING

4.8.1 FIELD REVIEWS

.1 Field Reviews must be provided by the Professional in accordance with *Quality Management Guidelines – Documented Field Reviews During Implementation or Construction* (Engineers and Geoscientists BC 2018c). Refer to **Section 2.3.6 – Field Reviews** for guidance on Field Reviews and level of effort.

.2 **Section 8.2.8 – Field Review and Information for Record** provides examples of checklists for Field Review during the Construction phase.

4.8.2 COMMISSIONING

.1 The Professional, or his or her subordinate, must be present during commissioning. It is not adequate nor in conformance with the quality management bylaws to have the installer, for example, commission the Onsite Sewerage System and send a report to the Professional that this has been done.

.2 **Section 8.2.8 – Field Review and Information for Record** provides an example checklist for commissioning.

4.9 FINAL DOCUMENTATION

.1 Within 30 days after completing system Construction, the Professional must prepare and file:

- record drawings and specifications;
- an operation and maintenance plan; and
- a letter of certification;

and must provide the owner with a copy of this documentation. See **Section 2.1.1.2 – Filing Process and SSR Documentation Requirements**.

.2 Where another Professional or an ROWP has been responsible for part of the installation of the Onsite Sewerage System, it is recommended that the Professional who is submitting the letter of certification require a letter from the installer stating that the work substantially complies with the design documents and plans and Standard Practice.

.3 The letter of certification should also list aspects of the Onsite Sewerage System for which the Professional was not responsible, e.g., electrical code compliance.

.4 **Section 8.2.10 – Operation and Maintenance Plan, Record Drawings, and Final Documentation** provides a checklist for guidance in preparation of operation and maintenance plans and record drawings.

4.10 MAINTENANCE AND MONITORING

.1 After the Onsite Sewerage System is installed, the Onsite Sewerage System owner must retain an Authorized Person to maintain the Onsite Sewerage System in accordance with the maintenance plan, as prescribed by the SSR Section 10. For Type 3 and Large Flow Systems, this Authorized Person must be a Professional as per SSR Section 6(3). The Professional must either undertake or Supervise the maintenance and monitoring.

For the Professional to provide Professional assurance regarding Supervision of maintenance activities in Type 3 and Large Flow Systems, the Professional must undertake the following:

- Provide a maintenance plan that consists of the minimum information to be included as outlined in these guidelines (see **Section 8.2.11 – Operation and Maintenance Plan Checklist**).
- Establish the appropriate level of ongoing Professional involvement in maintenance within the maintenance plan. This could range from minimal involvement by the Professional, such as occasional review of records and the maintenance plan at specific periods, or to ongoing Field Review of maintenance following these by the Professional.
- Identify in the maintenance plan, the types and frequencies of the various maintenance activities to be carried out, the frequency at which the maintenance plan should be updated by a Professional, and the kinds of maintenance activities that would require Supervision by the Professional.

.2 The importance of maintenance and monitoring for system performance, longevity, and the protection of health and the environment cannot be overstated. The Professional is encouraged to be as proactive as possible to support the education of owners and clients and to refer them to knowledgeable service providers. For larger or community systems this may include the development of a management plan to ensure sustainability of the Onsite Sewerage System as a viable decentralized infrastructure.

If the Professional who designed the Type 3/Large Flow System is no longer available to oversee the maintenance activities, or for an existing Type 3/Large Flow System where there is no maintenance plan available from the owner, the Professional engaged to provide or Supervise maintenance services should retrieve from the health authority any sewerage permits (prior to enactment of SSR) or Filing and Certification documents to determine if there is information relevant to provision of maintenance service.

If no maintenance plan is available, the Professional should advise the owner that a plan should be created by a Professional; and if the Professional is engaged by the owner or the owner's representative to do so, the Professional must create a maintenance plan for the system in accordance with these guidelines.

5.0 DESIGN APPROACHES

5.1 INTRODUCTION

.1 A spectrum of design approaches is used in the Onsite Sewerage System field, ranging from prescriptive to innovative. **Table 7** below provides an overview.

.2 For any one system, a mixture of approaches may be used.

.3 Semi-prescriptive design often leads to simple systems with low design costs, but may result in conservative designs with relatively high installation costs. Performance-Based Design usually means higher design costs, but may lead to cost savings during installation, especially for "problem sites."

.4 The Professional will make a qualitative assessment of Risks as part of site evaluation and site capability assessment, and the resulting design choices will include Risk management. As the Professional becomes more competent, he or she is likely to move from semi-prescriptive design to guided performance design components.

.5 Regardless of the type of design approach used, the Professional must maintain documentation of design rationale (including, where appropriate, Risk management strategies). Filing documentation should include a brief rationale statement to assist in conveying an understanding of the design.

5.2 SEMI-PRESCRIPTIVE DESIGN

5.2.1 HISTORICAL CONTEXT

.1 Older design standards (e.g., the BC *Sewage Disposal Regulation* or the 1980 US EPA manual) provided a purely prescriptive approach to Onsite Sewerage Systems. These standards were based on scientific research and traditional practice, but limited the opportunity for science-based design to suit site conditions. US EPA (2002) states:

> "Although state [and province] lawmakers have continued to revise Onsite Sewerage System codes, most revisions have failed to address the fundamental issue of system performance in the context of Risk management for both a site and the region in which it is located. Prescribed system designs require that site conditions fit system capabilities rather than the reverse and are sometimes incorrectly based on the assumption that centralized Wastewater collection and treatment services will be available in the future. Codes that emphasize Prescriptive Standards based on empirical relationships and hydraulic performance do not necessarily protect groundwater and Surface Water resources from public health threats."

.2 As a result, regulation and standards are moving toward a performance-based approach. At the same time, there is demand for simple, prescriptive, conservative standards for common system design and Construction, particularly for smaller or cost-sensitive systems.

Table 7: Design Approaches

DESIGN APPROACH	ADVANTAGES	DISADVANTAGES
PRESCRIPTIVE		
Standard or manual without stated Performance Objectives	• Simplicity • Low skill requirements	• Inflexible • Not site- and project-specific • System may not achieve Performance Objectives
SEMI-PRESCRIPTIVE		
Standard or manual with stated Performance Objectives and prescribed design standards to meet these objectives, with method for non-standard designs	• Simplicity • Lower design cost • Risk management decided in the standard or manual • Clarity on acceptable departures	• Moderately flexible • May not suit difficult sites • May be overly conservative
GUIDED PERFORMANCE-BASED DESIGN		
Custom Performance-Based Design following standard approaches and research-based standards for design parameters	• Flexible • Site- and project-specific design may be more efficient • May be the only solution for difficult sites • System cost may be lower • Performance specifically designed according to system • Opportunity for adaptive design	• Higher design cost • May not suit small, simple systems or unconstrained sites • Potential for Risk and some need for adaptation of design after monitoring • More Risk management by Professional, increased professional liability
INNOVATIVE DESIGN		
Performance-Based Design, according to fundamental science/engineering principles; may involve use of innovative technologies or processes	• Very flexible • Similar advantages to guided Performance-Based Design	• Considerably higher design cost • Risk management entirely by Professional • Higher Risk, need for contingency plans

5.2.2 SEMI-PRESCRIPTIVE DESIGN MANUALS AND GUIDELINES

.1 The BC SPM and some other current design guidelines or standards are available as sources of Standard Practice that are performance-based, and combine Prescriptive Standards or recommendations with stated Performance Requirements and objectives. They may thus be considered "semi-prescriptive." The provided standards include some balancing of cost with Risk.

.2 These standards result in the Construction of systems that meet performance standards through a prescriptive approach, and where Risk is managed by prescription or guided by a manual.

.3 Caution should be exercised in terms of application of design standards from areas with dissimilar climate or soils to those of the site.

.4 **Section 7.2 – Design Manuals** includes some currently available design manuals that are suggested to the Professional.

5.2.3 DEPARTURES FROM STANDARD DESIGN

5.2.3.1 General Considerations and Example

.1 Departures from the manual or standard must be based upon a documented rationale that includes qualitative Risk Assessment and system performance considerations. For example, the BC SPM recognizes that other sources of standards of practice exist and includes processes for departure from the standards it provides, which include assurance of similar levels of system performance. This allows an Authorized Person to follow the BC SPM as a source of Standard Practice, while incorporating new or different techniques or while utilizing a Performance-Based Design approach.

Table 8: Example of Practice – Departure from Standard Design

EXAMPLE OF PRACTICE
EXAMPLE 1: DEPARTURE FROM STANDARD DESIGN
A simple example of a departure from the BC SPM would be using a flow splitter tee instead of a D-box to split flows to two gravity system laterals. The BC SPM does not mention this technique; however, there are available academic papers describing the performance of these devices in relation to the D-box, which would be cited by the Authorized Person to support their use as a technique providing equal or better performance than the D-box.

5.2.3.2 Documentation of Departures

.1 If a Professional indicates in a filing that the Professional has followed the BC SPM, any departures from the BC SPM should be made following the BC SPM process. This means they should follow BC SPM standards for documentation of the alternate source of Standard Practice. Departures from the standard must consider system performance.

5.3 GUIDED PERFORMANCE DESIGN

5.3.1 CUSTOM SYSTEMS

.1 A custom system design based on performance may be undertaken with guidance provided by design manuals and guidelines.

.2 This approach provides advantages of site- and project-specific (custom) design while being less onerous than innovative design. However, it will still increase design cost in relation to semi-prescriptive design.

.3 The US EPA Onsite Wastewater Treatment Systems Manual (US EPA 2002) provides discussion and examples of Performance-Based Design. The AS/NZS 1547:2000 standard (Joint Technical Committee WS/13 2000) provides an example of a performance code with explanatory material and definitions.

5.3.2 KEY DESIGN STEPS

.1 The Professional should develop a template or checklist to assist with a guided design. The key steps for design are to:

- assess site capability including Risks and constraints;
- identify Performance Boundaries;
- quantify design objectives;
- predict performance;
- where appropriate, undertake pilot scale testing;
- complete design;
- monitor system in operation; and
- adjust design (adaptation), potentially including contingency plans pre-planned during design phase.

.2 **Section 8.3.1 – Guided Performance-Based Design** provides descriptions and checklists to provide guidance on this approach suitable for Onsite Sewerage Systems under the SSR as a source of Standard Practice.

.3 **Section 8.3.4 – Performance Objectives** provides information and guidance on Performance Objectives.

5.3.3 DOCUMENTATION

.1 The Professional using this type of design is expected to undertake his or her own literature review to establish the project design parameters and design methods.

.2 The Professional must ensure that the record of the stages of design, including selected Performance Objectives and design rationale, with references used, is retained as part of their documentation of the Onsite Sewerage System design.

5.4 INNOVATIVE DESIGN

.1 The Professional may choose to undertake all or part of a system design according to fundamental science and engineering principles. In this case, the Professional could develop a solution that addresses Performance Objectives using an innovative approach or using non-conventional technology. This process may include pilot or bench-scale trials. In this case, the Professional is, in terms of the SSR definition, developing his or her own "Standard Practice."

.2 As with all Onsite Sewerage System design, this must be based on Performance Requirements, including not causing or contributing to Health Hazards, and on defined Performance Objectives. The design must address the way in which monitoring will be used to provide assurance of performance.

.3 Since there is a potential Risk of an innovative system design not performing as expected, it is important to consider during the design phase contingencies that will allow for adaptation of the Onsite Sewerage System if Performance Objectives are not met. The client must be made aware of this Risk and the potential need for system adaptation.

.4 See **Section 2.3.7 – Design Review** with respect to independent documented checks.

.5 The Professional must ensure that a description of the developed Standard Practice and design rationale, together with any references used, is retained as part of his or her documentation of the Onsite Sewerage System design.

6.0 ADDITIONAL CONSIDERATIONS

6.1 SPECIAL SITE-CAPABILITY CONSIDERATIONS

.1 The BC SPM recommends Professional involvement based on particular site-capability constraints, in addition to situations where Type 3 treatment is used or where the planned design involves altering the BC SPM's critical standards.

.2 These sites and situations should be approached following a Performance-Based Design approach per **Section 5.3 – Guided Performance Design** or **Section 5.4 – Innovative Design**.

6.2 DEVELOPMENT OF CUSTOM LOADING RATES

.1 The Onsite Sewerage System engineer may need to custom-select soil or media loading rates, particularly in the following circumstances:

- Effluent with strength higher than normal residential
- Soils with very high and very low permeability
- Organic soils and peat
- Where the mounding of the water table is expected to be severe due to constraint to system length or for larger systems
- Where site conditions indicate the need for special concern over potential contamination of a water source or Surface Water body

.2 The Professional must approach selection of these rates from a performance-based perspective, and should consider Risk management and expected system lifespan. **Section 8.3.4.12 – Custom Loading Rates** provides checklists and notes for considerations when developing custom loading rates.

6.3 REDUCED SEPARATION TO CRITICAL SETBACKS

.1 When reviewing a reduced critical setback distance (including to Breakouts, water sources, and Surface Water bodies), the Professional must follow a performance-based approach. In the case of reduced setback distance to drinking water Wells, the Professional must have competence in the area of hydrogeology (see **Section 2.2.2.2.4 – Well Setback Reduction** and **Section 3.2.1.2 – Competence in Hydrogeology**).

.2 **Section 8.3.4.7 – Reduction in Horizontal Separation** provides further guidance and checklists.

6.4 SPECIAL SOURCE CHARACTERISTICS

.1 Some characteristics of the source and Wastewater may require professional design. The Professional will need specialist knowledge and competency or will need to engage a specialist to assist with design. These situations include the following:

- Special contaminants, including but not limited to:
  - wax strippers;
  - disinfectants; and
  - facilities where prescription drugs are used.
- High-strength Wastewater with higher strength than normal residential Wastewater.
- O&G above normal residential levels.
- Recreational vehicles and marinas.
- Special use patterns and unusual flow characteristics.

.2 The Professional must assess these situations and design the process and system to perform adequately while accepting contaminants or unusual flows, and should develop source control policies to mitigate impact on system performance and system cost.

.3 As with other design, the characterization and design steps must be documented, and operation, maintenance, and monitoring provisions must be adequate to assure system performance.

6.5 ALTERNATIVE COLLECTION SYSTEMS

.1 Alternative collection systems such as septic tank effluent pumping (STEP) and septic tank effluent gravity (STEG), or combinations of STEP and STEG, are pressure sewers that differ significantly from gravity sewers.

.2 Considerable experience and data from STEP and STEG collection systems in North America, including design criteria and guidelines, are available. References include Iowa DNR (2007); US EPA (1991); Ball and Bounds (2006); and Crites and Tchobanoglous (1998).

6.6 GREYWATER SYSTEMS, RE-USE, AND RECOVERY

.1 Society is currently prioritizing sustainability, and responsibly designed and operated Onsite Sewerage Systems may be considered as sustainable in terms of water recycling to the environment. Where particular emphasis is placed on closing the loop on resource use (Winblad and Simpson-Hébert 2004), Onsite Sewerage System design may be adapted (within regulatory constraints) to provide more directly functional re-use.

For example:

- Reclaimed water systems (outside of the SSR, see the BC *Municipal Wastewater Regulation* and the BC Building Code [BC Office of Housing and Construction Standards 2012a]).
- Greywater systems may be constructed in such a way as to provide for beneficial use of water and nutrients through subsurface irrigation of perennial landscape or tree crops and other approaches (Ridderstolpe 2004; Schönning and Stenström 2004).
- Treatment Systems may be constructed to enhance energy and nutrient recovery through the use of anaerobic digestion with biogas production, heat recovery, and other methods (Lettinga et al. 1998).

- Treatment System selection may consider biosolids management and the reduction in biosolids production by the Onsite Sewerage System.
- Land application of biosolids may be possible through a suitable district solid waste management plan.

.2 When designing a Greywater system, the Professional must characterize the source as per normal design, and confirm that the special characteristics of Greywater are adequately addressed by the Onsite Sewerage System design.

.3 For information related to the planning, installation, and maintenance of composting toilet systems and source-separated (Greywater) systems, see the BC Ministry of Health's Manual of Composting Toilet and Greywater Practice (Version 1) (Province of BC 2016).

6.7 REPAIR TO EXISTING SYSTEMS

.1 Special considerations apply to inspection, evaluation, and design for repair or replacement of Onsite Sewerage Systems. The Professional should undertake adequate inspection/ investigation to determine the reasons for failure and document the reasons. The Professional must complete filing, where appropriate, and amend or create a new operations and maintenance manual for the Onsite Sewerage System after the repair. The BC SPM provides guidance on situations where a filing is not required for minor repairs.

.2 See **Section 6.18 – System Inspections** for discussion of Onsite Sewerage System inspections and re-use of systems.

6.8 TEMPORARY SYSTEMS

.1 Temporary camp Onsite Sewerage Systems are constructed under permit from the health authority, following the *Industrial Camps Regulation*.

6.9 LARGE FLOW SYSTEMS

.1 Particular considerations apply to the design of large flow (>9,100 to <22,700 L/day DDF) systems, including more rigorous determination of:

- actual flows and peak/low flows;
- expected Effluent strength;
- flow equalization provisions;
- biosolids management provisions (may be included in collection system design; see **Section 6.5 – Alternative Collection Systems**);
- potential environmental impacts, including nutrient impacts; and
- dispersal system LLRs and potential Groundwater Mounding.

.2 The Professional should also consider system management, including assurance of system performance and emergency provisions, e.g., backup power systems, emergency offline storage.

.3 For systems that may in the future meet or exceed the 22,700 L/day DDF, the Professional should consider design to meet MWR standards.

6.10 NITROGEN AND PHOSPHOROUS REDUCTION

.1 The design Professional should consider the need for nutrient (N, P) reduction in the Treatment System and soil infiltration and Treatment System.

.2 Receiving environments that may be sensitive to nutrient loading include:

- domestic water Wells located a short distance down-gradient;
- public water supply Wells located a short to moderate distance down-gradient or a short distance up-gradient; and
- water bodies at Risk of eutrophication, particularly low dilution water bodies such as lakes and wetlands.

.3 A design for nutrient reduction must integrate the expected nutrient reduction in the treatment plant and the soil-based treatment component. The Professional may establish Performance Objectives for the Effluent from the treatment plant as part of a Performance-Based Design.

6.11 CUSTOM DESIGN OF TREATMENT PLANTS

.1 Custom design of treatment plants and review of those designed by others must follow recognized design principles including application of acceptable hydraulic and Mass Loading rates. (Crites and Tchobanoglous 1998; Metcalf and Eddy Inc. et al. 2002). See **Section 5.4 – Innovative Design**.

.2 Professional review of uncertified treatment plants designed and/or manufactured by others, i.e., out of province or in foreign countries, must follow the same principles including a thorough review of performance data and test results.

6.12 BC ZERO DISCHARGE LAGOON SYSTEMS

.1 BC zero-discharge lagoons disperse Effluent by infiltration and evaporation; the BC SPM provides empirical standards for design, Construction, and safety considerations. These systems are only suited to particular regions of the province.

.2 The Professional designing a lagoon on a steeply sloping site must consider slope and embankment stability, and may need to consult with a geotechnical Professional.

6.13 EVAPOTRANSPIRATION ABSORPTION AND EVAPOTRANSPIRATION SYSTEMS

.1 The BC SPM provides design guidance for these systems for areas with favorable climate; due to climatic variations, many parts of BC are not suited to the use of these systems without special design considerations.

.2 For special case design, the Professional must follow and document a Performance-Based Design approach for design of these systems, including undertaking a detailed water balance calculation.

6.14 HOLDING TANKS

.1 The SSR provides regulatory provisions for Construction and use of holding tanks. The health authority should be consulted on local requirements and a permit must be obtained prior to Construction and operation of a holding tank system. Some local governments may have a holding tank bylaw.

.2 Design calculations and documentation must address:

- expected flows, pump-out intervals, and related tank capacity; and
- frequency and cost for pump-outs, and optimization of tank size for minimum pump-out cost.

.3 At minimum, holding tanks should be:

- installed with drainage or anti-buoyancy provisions to prevent tank floating when pumped out;
- with a watertight lid constructed to be non-biodegradable and with child-proof access points;
- watertight tested after installation; and
- provided with level indicator for pump-out (with suitable reserve capacity) plus a secondary high-level alarm on a separate electrical circuit.

.4 Operation and maintenance plans must include provision for records of water flow to the interior plumbing of the facility and pump-outs from the tank, with a requirement for periodic review of these records by a Professional.

6.15 SUBDIVISION APPROVAL

.1 The Professional may be approached to consult on subdivision planning and approval, including site and soil evaluation. The subdivision approving officer typically refers Onsite Sewerage System provisions to the local health authority, although they may also accept a Professional assessment in some cases. The Professional should be aware of local health authority policy on subdivision review (typically provided as guidelines for subdivision assessment). In cases where multiple Onsite Sewerage Systems are proposed, the Professional should consider the potential cumulative impacts of developments.

6.16 LAND-USE PLANNING

.1 The Professional may be retained to assist in development of regional liquid waste management plans, and site capability assessment for development or regional planning purposes. For site capability assessment, useful references include Carroll et al. (2004) and EPA Victoria (2003). For liquid waste management plans, consult Giles (2003).

6.17 DECENTRALIZED WASTEWATER SYSTEM MANAGEMENT

.1 Management ranges from individual system operation, maintenance, and monitoring, to community systems, and to regional systems.

.2 Three main models are available for management systems, including privately owned and maintained with private inspection program; privately owned, operated, and maintained with publicly operated inspection program; and entirely publicly owned, maintained, and inspected. Generally, program component selection addresses high-, moderate-, and low-Risk circumstances. See US EPA (2005 and 1997) and Giles (2003).

.3 Regional management and enforcement of Onsite Sewerage System maintenance through Implementation of regional or municipal government maintenance bylaws is common in North America and a growing trend in BC.

6.18 SYSTEM INSPECTIONS

.1 The Professional may be asked to inspect existing Onsite Sewerage Systems for various purposes, including the following:

- Maintenance bylaw requirements
- Real estate transactions
- Modifications, alterations, or additions to buildings
- Changes in use of existing systems

.2 In general, it is not possible to assess an Onsite Sewerage System, particularly the soil treatment and dispersal system, with complete accuracy, since many components are underground. However, with the proper tools, knowledge, and experience, the operational performance and condition of the Onsite Sewerage System may be assessed.

.3 The Professional should consider following the normal design flow estimation, site, and soil evaluation process (or an adaptation of that process), in combination with and to supplement system inspection techniques. The level of detail for the site evaluation is determined on a site- and project-specific basis, but at minimum should include determination of soil depth to restrictive layer or seasonal water table in the Dispersal Area.

.4 For a Professional who is not equipped with the specialist tools needed for a thorough investigation of the Onsite Sewerage System, physical inspection can be difficult. The Professional may wish to retain a certified private inspector to assist with the inspection, and obtain a report from that inspector to support the Professional's overall assessment of the Onsite Sewerage System, use, site, and soils. ASTTBC registers ROWP private inspectors, and maintains on its website a Standard Practice guideline for inspections.

.5 Several United States jurisdictions have mature inspection programs; two guidance documents are those from Rhode Island and New Jersey (Riordan 2003; New Jersey Department of Environmental Protection Division of Water Quality 2003). For standard terms describing system operation and malfunction, refer to the BC SPM.

.6 In some cases, the Professional may also consider the use of environmental monitoring to establish actual Onsite Sewerage System performance. For example, for an Onsite Sewerage System where observed Vertical Separation and loading rates do not conform to Standard Practice, the Professional could install and sample shallow groundwater monitoring Wells in the receiving environment to establish the quality of shallow groundwater moving away from the Onsite Sewerage System.

6.19 NEW USES OF EXISTING ONSITE SEWERAGE SYSTEMS

.1 Where a new use will be made of an existing Onsite Sewerage System, a question may arise as to the suitability of the Onsite Sewerage System for the new use.

.2 In these cases, the Professional must determine the age of the Onsite Sewerage System, inspect the Onsite Sewerage System, and document the Onsite Sewerage System with a plan. The Professional should also make a site evaluation, including a description of the soil profile and usable soil depth. The level of detail for the site evaluation is determined on a site- and project-specific basis, but at minimum must include a determination of soil depth to restrictive layer or seasonal water table in the Dispersal Area.

.3 Based on this information, the Professional may make a site- and project-specific recommendation on the suitability of the Onsite Sewerage System for the new use.

.4 The BC SPM provides guidance on new uses of existing systems.

7.0 REFERENCES AND ADDITIONAL RESOURCES

7.1 REFERENCES

The following regulations and references are cited in the main guideline and in **Section 8.0 Amplification to Previous Sections**.

7.1.1 REGULATIONS

Drinking Water Protection Act. [SBC 2001]. Chapter 9.

Engineers and Geoscientists Act. [RSBC 1996]. Chapter 116.

Environmental Management Act. [SBC 2003]. Chapter 53.

Environmental Management Act. Municipal Wastewater Regulation. B.C. Reg. 87/2012.

Environmental Management Act. Waste Discharge Regulation. B.C. Reg. 320/2004.

Public Health Act. [SBC 2008]. Chapter 28.

Public Health Act. Health Hazards Regulation. B.C. Reg. 216/2011.

Public Health Act. Industrial Camps Regulation. B.C. Reg. 70/2012.

Public Health Act. Regulated Activities Regulation. B.C. Reg. 161/2011.

Public Health Act. Sewerage System Regulation. B.C. Reg. 326/2004.

Public Health Act. Transitional Regulation. B.C. Reg. 51/2009.

Water Sustainability Act. [SBC 2014]. Chapter 15.

Water Sustainability Act. Groundwater Protection Regulation. B.C. Reg. 39/2016.

7.1.2 REFERENCES

Abd El Lateef EM, Hall JE, Lawrence PC, Negm MS. 2006. Cairo-East Bank Effluent Re-use Study 3 – Effect of Field Crop Irrigation with Secondary Treated Wastewater on Biological and Chemical Properties of Soil and Groundwater. Biologia 61(0) (November 1): S240–S245. doi:10.2478/s11756-006-0165-y.

Ball ES, Bounds TR. 2006. Effluent Sewer Design Manual, A Design Aid for STEP (Septic Tank Effluent Pump) and STEG (Septic Tank Effluent Gravity) Systems. Sutherlin, OR: Orenco Systems Inc.

Benefield LA. 2002. Rule Development Committee Issue Research Report (Draft); Residential Flow Rates. Washington State Department of Health.

Bounds TR. 1997. Design and Performance of Septic Tanks. In: Bedinger MS, Fleming JS, Johnson AI (editors). Site Characterization and Design of On-Site Septic Systems. West Conshohocken, PA: ASTM. p. 217-234.

British Columbia (BC) Office of Housing and Construction Standards. 2012a. BC Building Code. [accessed: 2018 Jan 2]. http://www.bccodes.ca.

BC Office of Housing and Construction Standards. 2012b. BC Plumbing Code. [accessed: 2018 Jan 9]. http://www.bccodes.ca.

Carroll S, Goonetilleke A, Dawes L. 2004. Framework for Soil Suitability Evaluation for Sewage Effluent Renovation. Environmental Geology. 46(2): 195-208. doi:10.1007/s00254-004-1026-z.

Carter MR, Gregorich EG. 2007. Soil Sampling and Methods of Analysis. Second edition. CRC Press.

Crites R, Reed S, Bastian R. 2000. Land Treatment Systems for Municipal and Industrial Wastes. First edition. Mcgraw-Hill Professional.

Crites RW, Reed SC, Middlebrooks EJ. 2006. Natural Wastewater Treatment Systems. CRC Press.

Crites R, Tchobanoglous G. 1998. Small and Decentralized Wastewater Management Systems. Boston, MA: WCB/McGraw-Hill.

Dumanski J. 1982. The Canada Soil Information System (Can SIS): Manual for Describing Soils in the Field.

D'Amato VA, Bahe A, Bounds T. 2008. Research Digest: Factors Affecting the Performance of Primary Treatment in Decentralized Wastewater Systems, Final Report. Alexandria, VA: Water Environment Research Foundation.

Dane JH, Topp GC (editors). 2002. Methods of Soil Analysis. Part 4. Physical Methods. Vol. 5. Soil Science Society of America Book Series. Madison, WI: Soil Science Society of America.

Darrell V. 2002. Rule Development Committee Issue Research Report Draft - Organic Loading Rates. Wastewater Management Program, Washington State Department of Health.

Engineers and Geoscientists BC. 2018a. Quality Management Guidelines: Retention of Project Documentation. Version 1.3. Burnaby, BC, Canada: Engineers and Geoscientists BC. [accessed: 2018 Feb 7]. https://www.egbc.ca/Practice-Resources/Quality-Management-Guidelines.

Engineers and Geoscientists BC. 2018b. Quality Management Guidelines: Direct Supervision. Version 1.3. Burnaby, BC, Canada: Engineers and Geoscientists BC. [accessed: 2018 Feb 7]. https://www.egbc.ca/Practice-Resources/Quality-Management-Guidelines.

Engineers and Geoscientists BC. 2018c. Quality Management Guidelines: Documented Field Reviews During Implementation or Construction. Version 1.3. Burnaby, BC, Canada: Engineers and Geoscientists BC. [accessed: 2018 Feb 7]. https://www.egbc.ca/Practice-Resources/Quality-Management-Guidelines.

Engineers and Geoscientists BC. 2018d. Quality Management Guidelines: Documented Checks of Engineering and Geoscience Work. Version 1.3. Burnaby, BC, Canada: Engineers and Geoscientists BC. [accessed: 2018 Feb 7]. https://www.egbc.ca/Practice-Resources/Quality-Management-Guidelines.

Engineers and Geoscientists BC. 2017. Quality Management Guidelines: Use of Seal. Version 2.0. Burnaby, BC, Canada: Engineers and Geoscientists BC. [accessed: 2018 Feb 7]. https://www.egbc.ca/Practice-Resources/Quality-Management-Guidelines.

Engineers and Geoscientists BC. 2014. Code of Ethics. Burnaby, BC, Canada: Engineers and Geoscientists BC. [accessed: 2018 Feb 8]. https://www.egbc.ca/About/Governance/The-Act,-Bylaws-and-Code-of-Ethics.

Environmental Protection Authority (EPA) Victoria. 2003. Domestic Wastewater Management Series: Land Capability Assessment for Onsite Domestic Wastewater Management. (Information Bulletin; Publication 746.1; March 2003). Carlton, Australia: EPA Victoria.

Garza OA, Lesikar BJ, Persyn RA, Kenimer AL, Anderson MT. 2005. Food Service Wastewater Characteristics as Influenced by Management Practice and Primary Cuisine Type. Transactions of the ASAE. 48(4):1389–1394.

Giles G. 2003. Toolkit for the Development of Management Programs for Onsite Sewage Systems. Environment Canada.

Gill L, O'Súilleabháin C, Johnston P, Misstear, B. 2004. An Investigation into the Performance of Subsoils and Stratified Sand Filters for the Treatment of Wastewater from On-site Systems (2001-MS-15-M1). Literature Review. Ireland: Environmental Protection Agency, Ireland.

Gill LW, O'Sulleabhain C, Misstear BD, Johnston PJ. 2007. The Treatment Performance of Different Subsoils in Ireland Receiving On-site Wastewater Effluent. Journal of Environmental Quality. 36(6): 1843-1855. doi:10.2134/jeq2007.0064.

Hall S. 1990. Vertical Separation: A Review of Available Scientific Literature and a Listing from Fifteen Other States. Olympia, WA: Office of Environmental Health and Safety, Environmental Health Programs, Washington State Department of Health.

Hassan G, Reneau RB, Hagedorn C. 2008. On-site Waste Treatment and Disposal by Sequencing Batch Reactor-Drip Irrigation: Effluent Distribution and Solute Transport. Communications in Soil Science & Plant Analysis. 39(1/2) (January): 141-157. doi:10.1080/00103620701759095.

Iowa Department of Natural Resources (DNR). 2007. Alternative Collection Systems Technology Assessment and Design Guidance. Des Moines, IA: Iowa DNR. [accessed: 2018 Feb 8]. http://www.iowadnr.gov/Environmental-Protection/Water-Quality/Wastewater-Construction/Design-Guidance-Documents.

Joint Technical Committee WS/13 On-Site Domestic Wastewater Management. 2012. Australian/New Zealand Standard. On-Site Domestic Wastewater Management (AS/NZS 1547:2012) (published 27 February 2012). Standards Australia and Standards New Zealand. [accessed: 2017 Jun 19]. https://infostore.saiglobal.com/store/details.aspx?ProductID=359742.

Joint Technical Committee WS/13 On-Site Domestic Wastewater Management. 2000. Australian/New Zealand Standard. On-site domestic-wastewater management (AS/NZS 1547:2000) (published 24 July 2000). Standards Australia and Standards New Zealand. [accessed: 2017 Jun 19].

Kaplan OB. 1991. Septic Systems Handbook. CRC Press.

Laak R. 1986. Wastewater Engineering Design for Unsewered Areas. Ann Arbor, MI: Ann Arbor Science Publishers.

Lesikar BJ, Garza OA, Persyn RA, Anderson MT, Kenimer AL. 2004. Food Service Establishments Wastewater Characterization. In: Mankin KR (editor). On-site Wastewater Treatment X, Conference Proceedings (21-24 March 2004; Sacramento, CA). ASAE Publication Number 701p0104. pp 377-386.

Lettinga G, Field J, van Lier J, Zeeman G, Huishoff Pol LWH. 1998. Advanced Anaerobic Wastewater Treatment in the Near Future. Water Science and Technology. 35(10): 5-12.

Lindbo DL, Lynn J, Neal K, Amoozegar A. 2007. Applying Soil Morphology to Long Term Acceptance Rate Determination. In: Mancl KM (editor). Eleventh Individual and Small Community Sewage Systems Conference Proceedings (20-24 October 2007, Warwick, Rhode Island). American Society of Agricultural and Biological Engineers, St. Joseph, Michigan. doi: 10.13031/2013.24028

Lowe KS, Tucholke MB, Tomaras J, Conn KE, Hoppe C, Drewes J, McCray JE, Munakata-Marr J. 2009. Influent Constituent Characteristics of the Modern Waste Stream from Single Sources. Final Report. Water Environment Research Foundation, Project Report. London, UK: IWA Publishing.

Master Municipal Construction Documents Association (MMCDA). 2018. Design Guideline Manual. [accessed: 2018 Feb 9]. https://www.mmcd.net/documents/design-guidelines/.

McCray J, Geza M, Lowe K, Tucholke M, Wunsch A, Roberts S, Drewes J, Amador J, Atoyan J, Kalen D, Loomis G, Boving T, Radcliffe D. 2011. Quantitative Tools to Determine the Expected Performance of Wastewater Soil Treatment Units. Water Environment Research Foundation. Water Intelligence Online. Vol 10, 2011. [accessed 2016 Dec 2]. http://wio.iwaponline.com/content/10/9781843393955. doi: 10.2166/9781843393955.

McCray J, Lowe K, Geza M. 2009. State of the Science: Review of Quantitative Tools to Determine Wastewater Soil Treatment Unit Performance, Final Report. Water Environment Research Foundation. London, UK: IWA Publishing.

McKenzie N, Coughlan K, Cresswell H. 2002. Soil Physical Measurement and Interpretation for Land Evaluation. CSIRO.

Metcalf & Eddy Inc., Tchobanoglous G, Burton F, Stensel HD. 2002. Wastewater Engineering: Treatment and Reuse. 4th edition. Boston, MA: Mcgraw-Hill.

Minnesota Pollution Control Agency. 2016. Design Guidance for Large Subsurface Wastewater Treatment Systems (LSTS). Saint Paul, MN: Minnesota Pollution Control Agency.

New Jersey Department of Environmental Protection Division of Water Quality (NJ). 2003. Technical Guidance for Inspections of Onsite Wastewater Treatment and Disposal Systems. Trenton, NJ: New Jersey Department of Environmental Protection, Division of Water Quality, Bureau of Nonpoint Pollution Control. [accessed: 2016 Mar 3]. http://www.state.nj.us/dep/dwq/pdf/inspection_guidance.pdf.

Onsite Sewage Treatment Program, University of Minnesota. 2017. Manual for Septic System Professionals in Minnesota. [accessed: 2018 Feb 08]. https://septic.umn.edu/publications/manual.

Otis RJ. 2001. Boundary Design: A Strategy for Subsurface Wastewater Infiltration System Design and Rehabilitation. pp 245-260 In: Mancl KM (editor). On-site Wastewater Treatment Procedures: Proceedings of the Ninth National Symposium on Individual and Small Community Sewage Systems, March 11-14, 2001, Fort Worth, Texas, USA. American Society of Agricultural and Biological Engineers, St. Joseph, MI.

Poeter E, McCray J, Thyne G, Siegrist R. 2005. Guidance for Evaluation of Potential Groundwater Mounding Associated with Cluster and High-Density Wastewater Soil Absorption Systems. Project No. WU-HT-02-45. Golden, CO: International Groundwater Modeling Center, Colorado School of Mines. Prepared for the National Decentralized Water Resources Capacity Development Project, Washington University, St. Louis, MO. 136 pp.

Province of BC. 2017a. Sewerage System Regulation: Standard Practice and Health Hazards. Victoria, BC: Ministry of Health, Health Protection Branch. [accessed: 2018 May 2]. https://www2.gov.bc.ca/assets/gov/environment/waste-management/sewage/onsite-sewerage-systems/health_hazard_interpretation_guideline_2.pdf.

Province of BC. 2017b. Approved Water Quality Guidelines. [website]. Victoria, BC, Canada: Province of BC. [accessed: 2018 Feb 6]. https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines.

Province of BC. 2016. Manual of Composting Toilet and Greywater Practice. Version 1. (July 2016). Victoria, BC: BC Ministry of Health, Health Protection Branch. [accessed: 2018 Feb 2]. https://www2.gov.bc.ca/assets/gov/environment/waste-management/sewage/provincial-composting-toilet-manual.pdf.

Province of BC. 2014. Sewerage System Standard Practice Manual. Version 3. (September 2014). Victoria, BC, Canada: Province of BC. [accessed: 2018 Jan 30]. https://www2.gov.bc.ca/gov/content/environment/waste-management/sewage/onsite-sewage-systems/sewerage-system-standard-practice-manual.

Radcliffe DE, West LT. 2007. Modeling Long Term Acceptance Rates for OWMSS. In: Mancl KM (editor). Eleventh Individual and Small Community Sewage Systems Conference Proceedings (20-24 October 2007, Warwick, Rhode Island). American Society of Agricultural and Biological Engineers, St. Joseph, Michigan. doi: 10.13031/2013.23975.

Radcliffe D, West L. 2005. What Can Models Tell us About On-site Systems? [PowerPoint presentation]. 21st Annual On-site Conference, October 25-27, 2005. North Carolina State University, Raleigh, NC, US. [accessed: 2017 Jun 19]. soilphysics.uga.edu/media/NC%20Keynote%20Presentation.ppt.

Ridderstolpe P. 2004. Introduction to Greywater Management. (EcoSanRes Programme Report 2004-4). EcoSanRes Programme and Swedish Institute for Infectious Disease Control Stockholm, Sweden: Stockholm Environment Institute.

Riordan MJ. 2000. Septic System Checkup: The Rhode Island Handbook for Inspection. Rhode Island, MA: Office of Water Resources, Department of Environmental Management.

Schoeneberger PJ, Wysocki DA, Benham EC, Broderson WD, National Soil Survey Center. 2002. Field Book for Describing and Sampling Soils: Version 2.0. Lincoln, NE: Natural Resources Conservation Service, US Department of Agriculture.

Schönning C, Stenström TA. 2004. Guidelines On the Safe Use of Urine and Faeces in Ecological Sanitation Systems. (EcoSanRes Programme Report 2004-1). EcoSanRes Programme and Swedish Institute for Infectious Disease Control. Stockholm, Sweden: Stockholm Environment Institute.

Siegrist RI. 2007. Engineering of a Soil Treatment Unit as a Unit Operation in an Onsite Wastewater System. In: Mancl KM (editor). Eleventh Individual and Small Community Sewage Systems Conference Proceedings. (20-24 October 2007, Warwick, Rhode Island). American Society of Agricultural and Biological Engineers, St. Joseph, MI, USA. doi:10.13031/2013.24019.

Siegrist RL. 2006. Evolving a Rational Design Approach for Sizing Soil Treatment Units: Design for Wastewater Effluent Infiltration. Small Flows Journal. 7(2): 16-24.

United States Environmental Protection Agency (US EPA). 2005. Handbook for Managing Onsite and Clustered (Decentralized) Wastewater Treatment Systems: An Introduction to Management Tools and Information for Implementing EPA's Management Guidelines. (EPA-832-B-05-001). Washington, DC: US EPA Office of Water.

US EPA. 2002. Onsite Wastewater Treatment Systems Manual. (EPA/625/R-00/008). Washington, DC: US EPA Office of Water; and Cincinnati, OH: US EPA Office of Research and Development. [accessed: 2016 Nov 2]. http://www.epa.gov/sites/production/files/2015-06/documents/2004_07_07_septics_septic_2002_osdm_all.pdf.

US EPA. 1997. Response to Congress on Use of Decentralized Wastewater Treatment Systems. (EPA 832-R-97-001b). Washington, DC: US EPA Office of Water and Office of Wastewater Management.

US EPA. 1991. Manual: Alternative Wastewater Collection Systems. (EPA/625/1-91/024). Cincinnati, OH: US EPA Office of Research and Development, Center for Environmental Research Information, Risk Reduction Engineering Laboratory; and Washington, DC: US EPA Office of Water and Office of Wastewater Enforcement and Compliance.

Van Cuyk S, Siegrist RI, Lowe K, Harvey RW. 2004. Evaluating Microbial Purification During Soil Treatment of Wastewater with Multicomponent Tracer and Surrogate Tests. Journal of Environmental Quality. 33(1) (January 1): 316-329.

Washington State Department of Health. 2002. Hydraulic Loading Rates (Draft). Rule Development Committee Issue Research Report. Wastewater Management Program, Washington State Department of Health.

Wespetal MS, Frekot LLC. 2001. Development and Implementation of Performance Standards Assessing Performance Designs. pp 488-496. In: Mancl KM (editor). On-Site Wastewater Treatment, Proceedings of the Ninth National Symposium on Individual and Small Community Sewage Systems. (11-14 March 2001, Fort Worth, Texas, USA). American Society of Agricultural and Biological Engineers, St. Joseph, Michigan. 701P0009. doi: 10.13031/2013.6079.

Winblad U, Simpson-Hébert M (editors). 2004. Ecological Sanitation – Revised and Enlarged Edition. Stockholm, Sweden: Stockholm Environment Institute.

Winneberger JHT. 1984. Septic-Tank Systems: A Consultant's Toolkit. Stoneham, MA: Butterworth Publishers.

7.1.3 ADDITIONAL RESOURCES

Coughlan, K.; Cresswell, H.; McKenzie, N. 2002. Soil Physical Measurement and Interpretation for Land Evaluation. Australian Soil and Land Survey Handbooks Series 5. CSIRO Publishing. 392 pp.

Federal-Provincial-Territorial Committee on Environmental and Occupational Health and the Water Quality Task Group of the Canadian Council of Ministers of the Environment. 2002. From Source to Tap: The Multi-Barrier Approach to Safe Drinking Water. Health Canada. 11 pp. Available online at: h http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/water-eau/tap-source-robinet/tap-source-robinet-eng.pdf [accessed: 12/02/2016]

Health Canada. 2010. Canadian Guidelines for Domestic Reclaimed Water for use in Toilet and Urinal Flushing. Health Canada. http://healthycanadians.gc.ca/publications/healthy-living-vie-saine/water-reclaimed-recyclee-eau/alt/reclaimed-water-eaux-recyclees-eng.pdf [accessed: 12/02/2016]

Working Group on Soil Survey Data, Expert Committee on Soil Survey. 1983. The Canadian Soil Information System (CanSIS): Manual for Describing Soils in the Field, 1982 Revised. Ottawa, ON: Land Resource Research Institute, Research Branch, Agriculture Canada. LRRI Contribution no 82-52. 166 pp.

7.2 DESIGN MANUALS

This section presents useful design manuals with material relevant to the design, Construction, operation, and maintenance of Onsite Sewerage Systems (some of which are also referenced above). If conflicts arise between the prescribed requirements of the SSR and the information presented in these documents, the SSR will prevail.

Crites R. 2000. Land Treatment Systems for Municipal and Industrial Wastes. Chapter (McGraw-Hill Professional, 2000), Access Engineering.

Crites RW, Middlebrooks EJ, Reed SC. 2006. Natural Wastewater Treatment Systems. New York, NY: CRC Press.

Crites R, Tchobanoglous G. 1998. Small and Decentralized Wastewater Management Systems. Boston, MA: WCB/McGraw-Hill.

CSA Group. 2016. B65-12 (R2016) - Installation Code for Decentralized Wastewater Systems. [accessed: 2017 Oct 13]. http://shop.csa.ca/en/canada/plumbing-products-and-materials/b65-12/invt/27033772012.

Metcalf & Eddy Inc., Tchobanoglous G, Burton F, Stensel HD. 2002. Wastewater Engineering: Treatment and Reuse. 4th edition. Boston, MA: Mcgraw-Hill.

Onsite Sewage Treatment Program, University of Minnesota. 2017. Manual for Septic System Professionals in Minnesota. [accessed: 2017 Oct 13]. https://septic.umn.edu/publications/manual.

Province of BC. 2016. Manual of Composting Toilet and Greywater Practice. Version 1. (July 2016). Victoria, BC: BC Ministry of Health, Health Protection Branch. [accessed: 2017 Oct 13]. https://www2.gov.bc.ca/assets/gov/environment/waste-management/sewage/provincial-composting-toilet-manual.pdf.

Province of BC. 2014. Sewerage System Standard Practice Manual. Version 3. (September 2014). Victoria, BC, Canada: Province of BC. [accessed: 2017 Oct 13]. https://www2.gov.bc.ca/gov/content/environment/waste-management/sewage/onsite-sewage-systems/sewerage-system-standard-practice-manual.

State of Wisconsin. Private Onsite Wastewater Treatment Systems (POWTS). Madison, WI: Department of Safety and Professional Services. [accessed: 2017 Oct 13]. https://dsps.wi.gov/Pages/Programs/POWTS/Default.aspx.

US EPA. 2002. Onsite Wastewater Treatment Systems Manual. (EPA/625/R-00/008). Washington, DC: US EPA Office of Water; and Cincinnati, OH: US EPA Office of Research and Development. [accessed: 2017 Oct 13]. http://www.epa.gov/sites/production/files/2015-06/documents/2004_07_07_septics_septic_2002_osdm_all.pdf.

Washington State Department of Health. 2018. RS&G and Supporting Documentation. [accessed: 2017 Oct 13]. http://www.doh.wa.gov/CommunityandEnvironment/WastewaterManagement/FormsPublications.

7.3 WEB REFERENCES AND EDUCATIONAL RESOURCES

The following website and educational resources will be of interest to readers of this guideline:

Consortium of Institutes for Decentralized Wastewater Treatment (CIDWT). [accessed 2017 Oct 13]. http://www.onsiteconsortium.org.

National Environmental Services Center. Wastewater and Onsite Systems. National Small Flows Clearing House. [website]. [accessed: 2017 Oct 13]. http://www.nesc.wvu.edu/wastewater.cfm.

Province of BC. 2014. Sewerage System Standard Practice Manual. Version 3. (September 2014). Victoria, BC, Canada: Province of BC. [accessed: 2017 Oct 13]. https://www2.gov.bc.ca/gov/content/environment/waste-management/sewage/onsite-sewage-systems/sewerage-system-standard-practice-manual.

US EPA. Septic Systems (Onsite/Decentralized Systems). [website]. [accessed: 2017 Oct 13]. https://www.epa.gov/septic.

University of Minnesota. Onsite Sewage Treatment Program. [website]. [accessed: 2017 Oct 13]. http://septic.umn.edu/.

University of Tennessee. Center for Decentralized Wastewater Management (CDWM). [website]. [accessed: 2017 Oct 13]. http://onsite.tennessee.edu.

Virginia Department of Health. Training and Technical Resources. [website]. [accessed: 2017 Oct 13]. http://www.vdh.virginia.gov/environmental-health/onsite-sewage-water-services-updated/job-aid/.

Water Environment & Reuse Foundation (WERF). [website]. [accessed: 2017 Oct 13]. http://www.werf.org.

WateReuse. [website]. [accessed: 2017 Oct 13]. http://www.watereuse.org.

8.0 AMPLIFICATION TO PREVIOUS SECTIONS

.1 This section provides notes and appendices that amplify the materials contained in Sections 3, 4, 5, and 6.

8.1 AMPLIFICATION TO SECTION 3.0 – QUALIFICATIONS

8.1.1 CORE COMPETENCIES TABLE

.1 **Table A-1** below lists core competencies for Onsite Sewerage System practice, describes key content for these competencies, and may be used to guide self-assessment.

8.1.2 GUIDANCE ON LEVEL OF COMPETENCE

.1 The Professional is expected to meet all core competencies.

.2 For all core competencies, the Professional may be guided by the consideration that education and knowledge should be representative of a university level course, or equivalent continuing education courses or self-directed study, and be updated by continuing education, self-directed study, and conference and training attendance. **Table A-1** may be used to guide this self-assessment.

.3 Training and experience must include completion of design or Implementation representing practical application of this knowledge within the context of Onsite Sewerage System design, installation, and maintenance over a sufficient number of instances and in sufficient variety to give the Professional comfort that they are qualified to practice.

8.2 AMPLIFICATION TO SECTION 4.0 – ENGINEERING OF ONSITE SEWERAGE SYSTEMS

8.2.1 DAILY DESIGN FLOW (DDF)

.1 To assist the Professional, the following flow estimation options and considerations are presented.

8.2.2 TABLES AND STANDARDS (INCLUDING BC SPM AND OTHER REFERENCES AND STANDARDS)

.1 When using tabular values, the designer should take into consideration the actual proposed use of the facility and their Professional experience of similar facilities, and should not just rely on tabulated values, e.g., a summer vacation home with guests and extended family may have flows higher than tabular values for the house size.

.2 Caution should also be exercised to ascertain if the published data is based on average or peak flows, and whether the DDF will be suitable for use with any HLR standard that will be used for design based on consideration of Mass Loading to the soil treatment and dispersal system.

Table A - 1: Core Competencies for Onsite Sewerage System Practice

<table>
<tr><th></th><th>AREA</th><th colspan="7">SUBCATEGORIES AND DESCRIPTION</th></tr>
<tr><td>1.</td><td>Onsite Decentralized Infrastructure Concepts</td><td colspan="2">History and societal context, regulation, and standards of practice</td><td colspan="2">Decentralized infrastructure</td><td>Management</td><td>Physical, chemical and biological concepts for environmental processes</td><td>Wastewater treatment and contaminate fate in the onsite context</td></tr>
<tr><td>2.</td><td>Design Flows and Source Characterization</td><td colspan="2">Wastewater characteristics, chemical, physical, and biological</td><td colspan="2">Residential, commercial, special Wastewaters</td><td>Flow characteristics and calculations</td><td>Mass Loading impacts on system design</td><td>Flow equalization</td></tr>
<tr><td>3.</td><td>Performance of Onsite Sewerage Systems In the Environment</td><td colspan="2">Health, the environment, and Risk management concepts</td><td colspan="2">Selection of appropriate performance standards</td><td colspan="2">Analysis of potential environmental impacts and selection of boundaries for design</td><td>Fundamentals of groundwater hydrology</td></tr>
<tr><td>4.</td><td>Soils and Ecosystem Factors</td><td colspan="2">Fundamentals of soil chemistry related to Wastewater treatment</td><td colspan="2">Fundamentals of soil physics for water and contaminant movement</td><td>Fundamentals of soil microbiology and biology related to Wastewater treatment</td><td>Soil compaction and soil protection</td><td>Fundamentals of ecosystem factors for onsite dispersal system performance</td></tr>
<tr><td>5.</td><td>Soil and Site Evaluation</td><td colspan="2">Soil description following CanSIS or USDA standards (see Section 4.4 – Site and Soils Evaluation)</td><td colspan="2">Techniques for soils investigation suitable for Onsite Sewerage Systems</td><td>Soil permeability characterization for Onsite Sewerage Systems</td><td>Soil and aggregate physical characterization and interpretation of test results</td><td>Evaluation of site characteristics relevant to system performance, including vegetation identification</td></tr>
<tr><td>6.</td><td>Soil Loading and Distribution</td><td>LTAR</td><td>HARs</td><td colspan="2">Mass Loading rates</td><td>Selection of soil or media HLRs, including custom loading rates</td><td colspan="2">LLR (Groundwater Mounding/water movement), selection of site-specific hydraulic and oxygen LLR</td></tr>
<tr><td>7.</td><td>Soil As Treatment, Performance Design</td><td colspan="2">Vertical Separation (natural, constructed) and relationship to pathogen attenuation for system design</td><td>Dispersal system design</td><td>Subsurface flow paths</td><td>Saturated and unsaturated zone flow and gas transport</td><td colspan="2">Pathogen and nutrient attenuation and contributing factors related to system design, including soil, distribution and loading rate factors</td></tr>
</table>

Table A - 1: Core Competencies for Onsite Sewerage System Practice

	AREA	SUBCATEGORIES AND DESCRIPTION				
8.	**Drainage and Remediation**	Drainage design	Drainage and LLR	Site, ecosystem, and soil remediation/rehabilitation concepts		
9.	**Industry-Specific Equipment and Application**	Principles of operation and specific design application, troubleshooting	Collection, treatment, Effluent transport, dispersal, monitoring, drainage		Control panels, alarms, monitoring systems.	Equipment testing protocols
10.	**Process Selection Skills**	Fundamentals of small-scale and residential Wastewater Treatment Systems’ physical, chemical, and microbiological processes		Site- and project-specific selection		
11.	**System Hydraulic Design**	Hydraulic design for Treatment Systems and tanks, retention time, flow equalization design	Collection system design	Performance implications of method of distribution	Pressure distribution system hydraulics and materials/pump selection	
12.	**System Installation**	Sufficient knowledge and understanding of all aspects of installation and correct installation procedures and standard of practice to properly Supervise Construction		Experience in Construction and installation of underground services, excavation, earthworks, tanks, pump systems, and controls		Dispersal Area planting selection and landscaping
13.	**Operation, Maintenance, and Monitoring**	Sufficient knowledge and skill in all aspects of installation and correct maintenance and inspection procedures and standard of practice to properly Supervise maintenance		Operational characteristics of Onsite Sewerage System equipment, treatment plants and Dispersal Areas with adequate experience to support troubleshooting and interpret test results		
14.	**Operation, Maintenance, and Monitoring**	Experience with inspection and assessment of malfunctioning Onsite Sewerage Systems		Environmental sampling and interpretation of sample analysis		

8.2.3 MEASURED FLOWS AND FLOW DATA FROM SIMILAR FACILITIES

.1 Ideally, flow records should be of sufficient duration to quantify variations in flow and to adequately describe seasonal trends. A statistical analysis of the measured daily flows is used to arrive at the estimated design flow including application of appropriate peaking factors. See US EPA (2002) and Crites and Tchobanoglous (1998).

8.2.4 MASS LOADING

.1 Mass Loading represents the mass of material, e.g., BOD, TSS, TKN, NH_3, P, O&G, usually expressed in kg per day that must be treated. It is calculated by multiplying the constituent concentration by the flow rate. For residential Wastewater flow and mass characteristics refer to Lowe et al. (2009).

8.2.5 REFERENCES

.1 Useful general references on Sewage flows and constituent concentrations include Lowe et al. (2009); US EPA (2002); Crites and Tchobanoglous (1998); Laak (1986); and Benefield (2002). Recent studies of restaurant waste streams include Lesikar et al. (2004); and Garza et al. (2005). (See **Section 7.1 – References**.)

8.2.6 SITE AND SOILS EVALUATION CHECKLISTS

.1 The site and soils evaluation should include the following:

- ☐ Base information, including paper review, e.g., soils maps, reports, Well logs, owner declaration, lot legal description and confirmation of location of legal boundaries, covenants, and easements
- ☐ Identification and description of potential boundaries and Risk factors, including vertical and Horizontal Separation and other boundaries that may be considered
- ☐ Description and location of any Wells and water sources
- ☐ Identification of potential human and ecological receptors and exposure pathways of concern
- ☐ Site characteristics and configuration, including topography, bedrock outcrops, vegetation, and drainage
- ☐ Site history and development plans
- ☐ Buried infrastructure (both for safety at the time of Construction and Risks of preferential Effluent migration around existing buried structures)

.2 The soil evaluation should include the following activities:

- ☐ Logging the soil profile in test pits
- ☐ Describing the soil texture, structure, consistence, and colour (including mottling and gleying):
  - ☐ Including root size and quantity, coarse fragment type and quantity
  - ☐ May include laboratory testing, e.g., hydrometer testing, to determine soil texture
- ☐ Identifying the type and depth of flow restrictive layers
- ☐ Recording the depth of the water table or seepage
- ☐ Estimating the depth of the seasonal high water table
- ☐ Identifying the proposed location and depth of the discharge (the infiltration surface)

- ☐ Measuring soil permeability in the Discharge Area
- ☐ Estimating the direction of shallow groundwater flow in the Dispersal Area

.3 For additional guidance on site and soil evaluation, refer to the BC SPM and design manuals (US EPA 2002; Crites and Tchobanoglous 1998; Crites et al. 2006; Crites et al. 2000). For description of soils, refer to the USDA soil manual or CanSIS manual (Schoeneberger et al. 2002; Dumanski 1982).

.4 Many field techniques may be used to measure the field-saturated Hydraulic Conductivity of soils in the unsaturated zone. Field tests commonly used when designing Onsite Sewerage Systems include the following:

- Constant-head borehole permeameter test and other borehole permeameter tests
- Single- or double-ring infiltrometer tests
- Trench infiltration test (shallow trench pump-in test)

.5 References for field permeability testing include the BC SPM and McKenzie et al. (2002), Carter and Gregorich (2007), Winneberger (1984), Dane and Topp (2002), Crites et al. (2006), and Crites et al. (2000).

.6 The site and soil evaluation report should include the following:

- ☐ A site plan to scale showing existing and proposed structures and site constraints, e.g., rock outcrops, creeks, Well, topography, and test pits
- ☐ Tables or written text to summarize the site and soil information above
- ☐ For all field observations and tests, the date of the test and the name of person conducting the test
- ☐ The report may discuss implications of the site evaluation and may recommend a conceptual design. See **Section 4.5 – Site Capability and Conceptual Design, Section 4.5.1 – Site Capability Assessment**.

8.2.7 DETAILED DESIGN

8.2.7.1 Maintenance

.1 For all system components and system component installation, ease and safety for maintenance and monitoring should be considered. This should include safe and easy access to all maintenance and monitoring points.

8.2.7.2 Collection System

.1 The BC *Plumbing Code* (BC Office of Housing and Construction Standards 2012b) and municipal design specifications contain standards for collection system design. Engineering design standards include the Municipal Infrastructure Design Guideline Manual, available from the Master Municipal Construction Documents Association (MMCDA 2018).

.2 See **Section 6.5 – Alternative Collection Systems** for references on alternative collection systems.

8.2.7.3 Type 1 Treatment System

.1 Useful references for Type 1 system performance and proper sizing of septic tanks and Effluent filters include Lowe et al. (2009), D'Amato et al. (2008), Bounds (1997), and Winneberger (1984).

8.2.7.4 Type 2 and 3 Treatment System Selection

.1 Useful references for Type 2 and 3 system performance and design include Metcalf & Eddy Inc. (2002), Crites and Tchobanoglous (1998), and US EPA (2002).

.2 It is incumbent on the design Professional to be satisfied that the Treatment System specified is capable of meeting Type 2 or type 3 standards at discharge to the Dispersal Area or at a defined Point of Application. This can be through activities such as Professional experience, review of third party, or “real world” testing data. In essence, as the design Professional may be assuming professional responsibility for the Onsite Sewerage System performance, it may not be appropriate to accept the equipment vendor’s testimonial at face value.

.3 In many cases, the Professional will be selecting a packaged treatment plant; the US EPA manual (US EPA 2002) includes useful summary technology sheets on common treatment processes, with bibliographies.

.4 Treatment plant testing and certification is carried out under the BNQ (Bureau de normalisation du Québec) national standards for Canada, and also under NSF International standards. This testing and certification tests small residential systems. The testing protocols are intended to capture “off-the-shelf” or pre-engineered systems based on typical residential strength Influent. Influent flow and characteristics must meet the manufacturer specifications. It may not be appropriate to extrapolate these systems for larger flows or higher strength Influent.

.5 In the case of Influent with higher strength than residential, or with special characteristics (e.g., higher O&G levels), the Professional will either need to consider custom design of the treatment unit, or specification of suitable pretreatment to reduce Influent strength to meet manufacturer specifications. See **Section 6.4 – Special Source Characteristics**.

.6 The Professional should ensure that treatment plant selection includes consideration of key factors that will influence future performance and reliability. As with other aspects of system selection, the Professional must document the rationale for process selection and sizing, linking source characterization (see **Section 8.2.1 – Daily Design Flow (DDF)**) to the selection of preferred solution (see **Section 4.5 – Site Capability and Conceptual Design**) and to detailed design. Considerations for detailed design or specification include the following:

- ☐ Primary (trash) tank and flow equalization (if determined to be needed)
- ☐ Treatment System matched and sized to system use and design flow, flow characteristics
- ☐ Disinfection system suitable for Effluent quality parameters and flow rate (if determined to be needed)
- ☐ Need for discharge Effluent filter
- ☐ Type of discharge (gravity/pumped)
- ☐ Treatment System and design matched to source quality characteristics

- ☐ Treatment System and design matched to site and climate characteristics
- ☐ Performance certification and auditing by third party
- ☐ Performance records for other comparable installed and operating systems
- ☐ Capital and operating costs including energy costs
- ☐ Availability of preventative maintenance in future
- ☐ Provisions for monitoring and quality assurance

8.2.7.5 Soil-Based Treatment Component

.1 Useful references for design of the soil-based treatment component include the BC SPM and US EPA (2002); Onsite Sewage Treatment Program (2017); Minnesota Pollution Control Agency (2016); and Crites and Tchobanoglous (1998). Washington State also provides a number of useful RS&G for Onsite Sewerage Systems, and Wisconsin provides several design standards. See **Section 7.2 – Design Manuals**.

.2 The design of the soil-based Treatment System or CTDS should include the following:

- ☐ Properties of the soil at and below the infiltration surface
- ☐ Evaluation of natural soil Vertical Separation
- ☐ As-designed Vertical Separation (see note below)
- ☐ LLR or effect of water table mounding on Vertical Separation (both are related)
- ☐ HLRs for soil and for sand fill (if used)
- ☐ Dosing frequency or HAR (both are related)
- ☐ Design of distribution and dispersal system and component selection

8.2.7.6 Vertical Separation

.1 Vertical Separation is critical for performance. For further information on Vertical Separation, with consideration of LLR and Groundwater Mounding, see custom loading rates, **Section 8.3.4.12 – Custom Loading Rates**. For Performance-Based Design where custom or reduced Vertical Separation is needed for the design, see **Section 8.3.4.10 – Custom Vertical Separation**, and for guided Performance-Based Design, see **Section 8.3.1 – Guided Performance-Based Design**.

8.2.7.7 References to Vertical Separation

.1 Useful references include the main referenced design manuals and standards plus the following publications.

.2 Literature reviews by Hall (1990) for the Washington State Department of Health, and the Irish EPA Investigation into the Performance of Subsoils and Stratified Sand Filters for the Treatment of Wastewater from On-site Systems (Gill et al. 2004) present discussion and extensive references relevant to the selection of Vertical Separation for a small Onsite Sewerage System soil infiltration and treatment component.

8.2.8 FIELD REVIEW AND INFORMATION FOR RECORD

.1 The Professional should utilize checklists or other quality management methods to ensure reviews consider necessary points and document their review in Field Review reports.

8.2.8.1 Field Review Checklist

.1 Tank Installation

- ☐ Excavation, grade and safety
- ☐ Bearing capacity of sub-grade
- ☐ Tank bedding and grade
- ☐ Tank inspection and placement
- ☐ Leak testing, including risers and penetrations
- ☐ Anti-flotation measures (backfill, anchors)
- ☐ Tank backfilling
- ☐ Support to inlet and outlet piping, pipe grade
- ☐ Tank lid and access risers, including safety
- ☐ Building sewer and Sewage pump basins
- ☐ Tank and sanitary vents

.2 Treatment and Pumping Systems

- ☐ Treatment components and piping
- ☐ Aeration equipment, diffusers, and venting
- ☐ Media specifications for packed bed filters
- ☐ Effluent filters
- ☐ Pumps, valves, and related appurtenances
- ☐ Disinfection equipment
- ☐ Sampling ports
- ☐ Discharge assemblies
- ☐ Accessibility for maintenance, including safety considerations
- ☐ Control and alarm panels
- ☐ General overview of wiring and electrical connections (including control panel wiring and field wiring for floats, pumps, aeration blowers, and splice boxes)

.3 Discharge and Dispersal Area

- ☐ Clearing and vegetation removal
- ☐ Installation of interceptor drains
- ☐ Trenching, basal area preparation
- ☐ Placement of sand fill, drain rock, and other imported aggregates (review of sieve analysis and samples)
- ☐ Transport lines
- ☐ Manifolds and D-boxes
- ☐ Distribution (zone) valves
- ☐ Laterals, hole diameters, and spacing
- ☐ Line valves and flush-outs
- ☐ Backflow and anti-siphon control measures
- ☐ Infiltration chambers
- ☐ Observation, inspection, and monitoring ports
- ☐ Backfilling, soil cover, and finished grading
- ☐ Surface drainage control measures
- ☐ Planting of grass/vegetative cover
- ☐ Monitoring provisions

.4 System Testing and Commissioning

- ☐ Set float switches or transducers and test operation including alarm functions
- ☐ Set control panel (timers, data loggers, and programmable controls) and test operation
- ☐ Test pump, fan, and blower operation, including measurement of voltage, and run amperage
- ☐ Pressure test forcemains, including pressure Effluent collection mains
- ☐ Flush all lines in the treatment and pumping systems, transport lines, and dispersal system
- ☐ Test back-flow preventers, i.e., check valves
- ☐ Test and adjust D-box and outlet controls
- ☐ Perform residual pressure test (squirt test) for dispersal system laterals and Treatment System distribution piping if applicable, i.e., sand and textile media filters; adjust valves as required to equalize pressure; record distal pressures (squirt heights)

- ☐ Test and record pump discharge flow rate or draw down; record pump run amperage
- ☐ Record initial control panel settings, system operating parameters, and start-up data logs; note any changes to the design or operational settings
- ☐ Perform general review of system operation and verify that it is operating and functioning as intended and in accordance with manufacturer's specifications
- ☐ Perform baseline monitoring if applicable
- ☐ Put system into service; ensure breakers, switches, and valves are in operating position, that tank lids are secure, and that the site has been left in a safe and tidy condition

.5 Commissioning is a good opportunity to communicate with the home or facility owner about topics such as use and operation, source control, alarms, power outages, maintenance and monitoring, and dos and don'ts, and to inform the owner of requirements for maintenance under the SSR and provide contact for establishing a maintenance contract.

8.2.9 DOCUMENTATION

8.2.9.1 Documentation Checklist

.1 Minimum documentation for design and Construction of an Onsite Sewerage System (items capitalized as defined terms will not be necessary on all projects; for complex projects further documentation may be necessary):

- ☐ DDF selection and use evaluation
- ☐ Site and soil evaluation report
- ☐ Drawings and specifications
- ☐ System selection and design rationale
- ☐ Calculations, including system sizing and loading rates
- ☐ Documentation of Performance-Based Design
- ☐ Documentation of source(s) of Standard Practice
- ☐ Supporting opinions; reviews and reports by other Professionals e.g., Well setback review or peer review
- ☐ Regulatory filing form
- ☐ Field Reviews
- ☐ Field Review reports
- ☐ Testing results, e.g., watertight testing of tanks, pipeline pressure tests
- ☐ Design modifications
- ☐ Commissioning
- ☐ Record of key system operational parameters
- ☐ Record drawings and specifications
- ☐ Operation and maintenance plan
- ☐ Regulatory letter of certification

8.2.9.2 Drawing Checklist (Design Drawing)

.1 Drawings must meet normal engineering drawing standards. Where possible, a version or relevant parts of drawings should be reproducible in black and white on 8.5×11-inch or 11×17-inch paper size.

.2 The drawings should include the following:

- ☐ Key site and soil evaluation features, including:
  - ☐ important topographic and elevation information;
  - ☐ Wells, water sources, water bodies, water lines (including planned);
  - ☐ potential breakout locations, drains, buildings and structures, retaining walls (including planned);

- ☐ access, paths, and driveways (including planned);
- ☐ easements and covenants, statutory rights of way, existing and planned, where relevant;
- ☐ soil investigation test pits and permeability test locations; and
- ☐ existing systems including Dispersal Areas and receiving areas.

☐ Critical horizontal setbacks.

☐ Onsite Sewerage System features with acceptable level of detail, suitable to Construct the Onsite Sewerage System, including:

- ☐ a drawing created to-scale with all relevant features shown accurately with respect to the parcel boundaries;
- ☐ detail drawings of system as necessary to illustrate key aspects, setting, and features to the installer; and
- ☐ cross-sections showing proposed elevations of trenches or sand media depth (showing key information such as VS, restrictive layer/water table), which may include elevations to geodetic or an assumed datum noted on the drawing.

8.2.9.3 Specifications and Design Report

.1 The design report draws together and summarizes the record of design process. Refer to the checklist at the start of this section.

.2 The design report submitted with the filing documents need not be lengthy, but must help readers understand the Onsite Sewerage System and the Onsite Sewerage System selection and include:

- ☐ an attached site and soil evaluation report;
- ☐ DDF and use information;
- ☐ design rationale;
- ☐ supporting references and source of Standard Practice;
- ☐ Performance-Based Design documentation (if applicable); and
- ☐ system sizing and loading rates.

.3 The design report may be included in the specifications or be an assembly of other reports.

.4 The specifications may include instructions and requirements for Field Review (if these are not included on the drawings).

8.2.10 OPERATION AND MAINTENANCE PLAN, RECORD DRAWINGS, AND FINAL DOCUMENTATION

.1 Record drawings should include all relevant plan and detail information necessary for operation, maintenance, and repair of the Onsite Sewerage System. The plans should be readily understandable by a maintenance provider. The plans should include accurate location of system components and revised specifications where changes from the original design were made. System photographs may be a useful adjunct to the record drawing.

.2 Refer to *Quality Management Guidelines – Use of Seal* (Engineers and Geoscientists BC 2017) for guidance on sealing of record drawings which include as-constructed information prepared by others not under the Direct Supervision of the Professional.

.3 The operation and maintenance plan must be consistent with Standard Practice (as defined in the SSR), and should include sufficient information to allow a person unfamiliar with the Onsite Sewerage System to operate and maintain the Onsite Sewerage System. This should include general information on the Onsite Sewerage System (including detailed description of any uncommon Onsite Sewerage System processes) and information on the Onsite Sewerage System components, and should be more than an assembly of manufacturer manuals. The original design report should be appended to the plan, which will provide context and rationale. Photographic record of the Onsite Sewerage System may usefully be appended to the plan.

8.2.11 OPERATION AND MAINTENANCE PLAN CHECKLIST

.1 The following checklist may be used as a guideline when preparing operation and maintenance plans, and it is recommended that the Professional develop their own template plan.

- ☐ Operation manual for the Onsite Sewerage System and for subsystems, including the following:
  - ☐ Appended manufacturer information
- ☐ Maintenance plan and schedules, including the following:
  - ☐ Data to be recorded at intervals and how that data will be collected
  - ☐ Tables for data recording, and checklists or tables for maintenance steps
  - ☐ Data collected at commissioning, pre-filled in tables
- ☐ Troubleshooting guide for Onsite Sewerage System and subsystems
- ☐ Expected system component lifespan; recommended routine replacement timetable
- ☐ Recommended spare parts list
- ☐ Monitoring plan, quality assurance, and schedules, including the following:
  - ☐ Instructions for monitoring (system and environmental) and sample collection, analysis
  - ☐ Instructions for general inspection of dispersal and receiving area
  - ☐ Flow monitoring instructions
  - ☐ Instructions for actions based on monitoring data
- ☐ Quality assurance and emergency provisions
- ☐ Warranties for all relevant equipment
- ☐ Contact information and emergency contact information for system designer, installer, maintenance provider, electrician, etc.
- ☐ Process for maintenance plan review, including review period and when it is necessary to consult the designer
- ☐ Information for the Onsite Sewerage System owner that includes the following:
  - ☐ Explanation of general system function, operational expectations
  - ☐ Owner responsibility
  - ☐ Maintenance provider qualifications/skills required
  - ☐ Any items remaining to be completed after commissioning
  - ☐ Simple list of system “dos and don’ts”
  - ☐ A source control policy
- ☐ Sign off by the owner that the requirements of the plan have been received and understood

To meet the intent of Supervision in the SSR, the maintenance plan could include prescriptive instructions to an ROWP on what type of maintenance activities and under what prescriptive circumstances they can act in the absence of the Professional.

The maintenance plan should indicate that the ROWP should consult the Professional where professional engineering or professional geoscience decisions are required, or when an adequate level of instruction and support is required to understand the scope of issues that are not elaborated under prescriptive instructions.

8.2.12 LETTER OF CERTIFICATION

.1 Engineers and Geoscientists BC has worked with the BC Ministry of Health and the health authorities to develop a standard form of letter of certification and continues to be engaged in standardizing the forms.

8.2.13 MAINTENANCE

.1 A Professional performing maintenance or Supervising others undertaking maintenance should consider the following:

- ☐ Operation:
  - ☐ Owner's operation practice, use of system, and adjustments needed
  - ☐ Specialized operation actions, e.g., treatment plant operation
- ☐ Maintenance and monitoring following the operation and maintenance plan, and assessment of system performance:
  - ☐ Records of maintenance, record keeping, and provision of records to owner
  - ☐ Records of monitoring, including flow monitoring
  - ☐ System performance
  - ☐ Environmental performance
  - ☐ Analysis of performance to original Performance Objectives
  - ☐ Reports to owner
- ☐ Adjustments to design and installation following from monitoring results, with possible system repairs and upgrades following from outcomes:
  - ☐ Documentation
  - ☐ Repair filing, if necessary
  - ☐ Review and revision of the operation and maintenance plan based on outcomes
  - ☐ Providing the owner a copy of any amended operation and maintenance plan

.2 Where the Professional is Supervising other persons in these tasks, the guidance in **Section 2.3.4 – Direct Supervision and Delegation in the Onsite Sewerage System Field**, and **Section 2.3.6 – Field Reviews** should be followed. The Professional should develop a checklist based on the above and on the specific operation and maintenance plan to manage and document monitoring and maintenance.

.3 The Professional should also document steps taken to address issues with system performance, and must update the operation and maintenance plan as necessary to reflect changes to maintenance requirements. The updated plan must be provided to the owner. Sign off should be obtained from the owner on receipt of the revised plan.

8.3 AMPLIFICATION TO SECTION 5.0 – DESIGN APPROACHES, AND SECTION 6.0 – ADDITIONAL CONSIDERATIONS

8.3.1 GUIDED PERFORMANCE-BASED DESIGN

.1 For detailed discussion of Performance-Based Design, refer to the US EPA manual (US EPA 2002; Otis 2001) and to the AS/NZS 1547:2000 standard (Joint Technical Committee WS/13 2000).

.2 The Professional using this type of design is expected to undertake his or her own literature review to establish the parameters and estimating methods needed for design.

.3 The Professional using guided performance design follows a documented design procedure and principles, backed up by authoritative references (e.g., design manuals, published papers).

.4 Custom design is an advanced technical process, so the Professional should have thorough knowledge of the applicable scientific principles and of common industry design practices.

8.3.2 KEY STEPS FOR GUIDED PERFORMANCE-BASED DESIGN

.1 Following are the key steps for guided Performance-Based Design:

- ☐ Establish use and characterize Influent composition
- ☐ Assess site capability (see **Section 4.5 – Site Capability and Conceptual Design**)
- ☐ Identify Performance Boundaries (see **Sections 8.2.6 – Site and Soils Evaluation Checklists and 8.3.4 – Performance Objectives**), including the following:
  - ☐ Risk at the boundary
  - ☐ Location of the boundary
- ☐ Quantify design objectives:
  - ☐ Boundary Performance Objectives (see **Section 8.3.4 – Performance Objectives**)
  - ☐ Any Performance Requirements (regulatory standards, including Effluent type for SSR)
- ☐ Predict performance:
  - ☐ Performance of treatment components
  - ☐ Environmental performance of the soil infiltration and treatment component (see note below)
- ☐ Treatment component performance required as input to soil component:
  - ☐ Define Performance Objectives
  - ☐ Monitoring and quality assurance requirements
  - ☐ Other steps to meet performance needs, including the following:
    - ▪ Source control
    - ▪ Flow equalization
- ☐ Design considerations for performance of the soil infiltration and treatment component (see **Section 8.3.3 – Notes on Performance-Based Design**):
  - ☐ Soil characteristics
  - ☐ Loading rates (see **Section 8.3.4.12 – Custom Loading Rates**)

- ☐ Climate effects, including type of dispersal to soil
- ☐ Vertical Separation (see **Sections 8.2.7.5 – Soil-based Treatment Component and 8.3.4.10 – Custom Vertical Separation**), including the following:
  - ▪ Groundwater Mounding considerations, LLR (see **Section 8.3.4.12 – Custom Loading Rates**)
  - ▪ Capillary rise
- ☐ Vegetation and ecosystem considerations
- ☐ Nutrient reduction strategies in dispersal component and in receiving area
- ☐ Evapotranspiration considerations
- ☐ CTDS
- ☐ Site drainage
- ☐ Receiving environment

☐ Pilot scale testing for proof of concept (if appropriate), e.g., full-scale testing for water table mounding

☐ Design completion

☐ Monitoring of performance

☐ Design adjustment (adaptation)

8.3.3 NOTES ON PERFORMANCE-BASED DESIGN

8.3.3.1 Soil Infiltration and Treatment Component Performance Interactions

.1 The custom design must consider the complex inter-relationship between design variables; for example, HLR affects VS, design HS should relate to design VS, LLR affects VS. Siegrist (2007; 2006) presents an example of a tabular approach to considerations for soil component design.

8.3.3.2 Soil Infiltration and Treatment Component Performance Prediction

.1 Due to a lack of research data for calibration or establishment of empirical relationships, and the complexity of the soil system and wide variability of distribution methods, a Water Environment & Reuse Foundation (WERF) literature review for summary of current state of predictive approaches to soil treatment unit performance (McCray et al. 2009) concludes that current predictive models are unlikely to provide universally applicable, accurate numeric results.

.2 Siegrist (2007) discusses the concept of Performance-Based Design of the soil infiltration and treatment component. Radcliffe and West (2005) discuss the application of numerical modelling and indicate its potential role as a tool for comparison of options.

.3 **Section 8.3.4.12 – Custom Loading Rates** indicates some of the interrelationships between various loading rate factors.

.4 It is clear from the literature that models should be calibrated to local soils and climate, and to the type of distribution method proposed. All performance prediction models should be used with care, ensuring that the application matches to the model assumptions.

.5 For prediction of treatment performance in specific cases, some simple tools are available, which are of particular use for comparison of design approaches and visualization of performance, including the following:

- For prediction of pathogen attenuation and nutrient removal in sand systems, extensive sand filter research is available.

- For general estimates of pathogen attenuation in soil systems, a number of studies provide information relevant to specific types of application and specific soils. An example is a review by the Irish EPA (Gill et al. 2007). Hassan et al. (2008) and Van Cuyk et al. (2004) (with relevance to the use of coliforms as indicators) are also of interest.
- For fecal coliform attenuation in soil systems, the Minnesota Pollution Control Agency have developed tables of empirical relationships which may be applied to standard Onsite Sewerage Systems (Minnesota Pollution Control Agency 2016; Wespetal and Frekot 2001).
- For estimates of nitrogen treatment in soils, WERF has developed a simple spreadsheet tool from HYDRUS model studies calibrated from field research data, and which provides confidence levels for predictions (McCray et al. 2011). The experimental work and modelling reported include indications of pathogen attenuation, and it is likely that a future model will be available for this from WERF.

8.3.3.3 Monitoring and Quality Assurance

.1 Without the ability to monitor performance, a Performance-Based Design is incomplete. Monitoring must be possible, and there must be a process in place for actions in response to Performance Objectives not being met.

.2 Monitoring frequency or triggers should be specified in the operation and maintenance plan, and may be regular or may only be triggered in special circumstances or at the direction of the Supervising Professional.

8.3.4 PERFORMANCE OBJECTIVES

8.3.4.1 Introduction

.1 In all cases, the Onsite Sewerage System must comply with the *Health Act* and *Sewerage System Regulation* and, as such, must protect public health. The Onsite Sewerage System should also protect the environment.

.2 As an aid to meeting these Performance Requirements, the Onsite Sewerage System needs to be designed and operated in such a way as to meet water quality objectives (Performance Objectives) at a particular location (point, boundary) in the receiving environment (US EPA 2002).

8.3.4.2 Boundary Performance

.1 The following two types of boundaries may be considered:

- Design boundaries, for example, trench Infiltrative Surface, which are used for system design and form the basis for prescription of vertical and horizontal setbacks.
  - For these boundaries, in some cases monitoring is practical in others secondary monitoring or predictive methods may be adequate. For example, monitoring of Effluent quality at a pump chamber is more practical than monitoring the Effluent quality at the actual Infiltrative Surface.
- Compliance boundaries, for example, a drinking water Well. For these, environmental monitoring must be possible to establish whether the performance is being met. Ultimately, soil water at

compliance boundaries must meet water quality standards or objectives established for water quality, rather than Effluent quality.

.2 The level of renovation needed is related to the Risk and particular environmental water quality guidelines, objectives, and standards associated with the boundary under consideration.

Table A - 2: Example of Practice – Boundary Performance

EXAMPLE OF PRACTICE
EXAMPLE 1: BOUNDARY PERFORMANCE
Monitoring At the Infiltrative Surface and In the Vadose Zone It can be expensive or problematic to monitor water quality at the native soil infiltration surface or other points in the near receiving environment, since this is commonly in the unsaturated zone; for example, at a boundary between sand fill and native soil. As such, monitoring requires lysimeters, which may in some cases need to be of complex design to permit monitoring of soil water in unsaturated conditions without themselves contributing to attenuation of indicator bacteria concentrations. The SSR includes prescribed treatment levels which are indicative of Effluent quality to be applied to the Infiltrative Surface; in most cases this Effluent quality is used as the Infiltrative Surface design boundary objective.

8.3.4.3 Development of Site- and Project-Specific Performance Objectives

.1 When a Professional approaches their Onsite Sewerage System design using a performance-based approach rather than a semi-prescriptive approach, they will use a site-specific, project-specific, human health, and environmental Risk Assessment.

.2 This guideline is not proposing a formal quantitative human health Risk Assessment of the type developed, mostly by the US EPA, for use in managing contaminated sites. Instead, this guideline proposes an informal, qualitative (or semi-quantitative) Risk Assessment that is focussed on maintaining applicable water quality objectives at a point or points of compliance.

.3 This Risk Assessment examines the actual uses of water for that project, and establishes specific water quality criteria (objectives) at various points-of-compliance or boundaries, considering the following, at least:

- ☐ Type of human and ecological receptors at compliance points
- ☐ Volume, timing, and frequency of water use
- ☐ Background or baseline water quality
- ☐ Environmental water quality guidelines and objectives, particularly the *Approved Water Quality Guidelines* (Province of BC 2017b) and the *Drinking Water Protection Act*
- ☐ Processes that can be expected to change the concentrations between the monitoring point and the point of water use (for example, biodegradation, denitrification, vegetative uptake, dilution)
- ☐ Other considerations, such as cumulative impact when there are multiple septic systems in an area

8.3.4.4 Guideline Performance Objectives

.1 To provide guidance for smaller projects, **Table A-3: Guideline Performance Objective at Compliance Boundaries** summarizes generic, conservative Performance Objectives for common compliance and design boundary conditions.

.2 These are selected to represent environmental performance standards equal to or more conservative than those of the *Approved Water Quality Guidelines* (Province of BC 2017b) and/or the BC *Municipal Wastewater Regulation* (MWR). The sources referenced in **Table A-3** (see references below table) may change over time and the Professional should refer to the source documents for further information.

.3 **Table A-3 i**s primarily illustrative and is recommended as a guideline. For a simple Risk Assessment, Table A3 may be used in this form. However, experienced and knowledgeable Professionals may modify or expand this table by developing similar project-specific water quality objectives.

.4 **Table A-3** contains a set of recommended project-specific Performance Objectives. Table A-3 does not in any way, define a Health Hazard.

8.3.4.5 Design Boundaries

.1 The designer may wish to establish further design boundary objectives as part of the design process in order to achieve the desired Compliance Boundary performance. An example is provided in **Table A-4**.

8.3.4.6 Combined Treatment and Dispersal Systems

.1 Where a CTDS is used as part of the design, the Professional should provide for performance monitoring at a design boundary; for example, at the Point of Application to the native soil.

8.3.4.7 Reduction in Horizontal Separation

.1 **Section 5.3 – Guided Performance Design**, and **Section 8.3.1 – Guided Performance-Based Design** provide guidance on Performance-Based Design relevant to consideration of reduced critical Horizontal Separation. **Section 8.3.4 – Performance Objectives** provides guidance on the establishment of Performance Objectives at compliance boundaries suitable to consideration of Horizontal Separation reductions.

[continued]

Table A - 3: Guideline Performance Objective at Compliance Boundaries

BOUNDARY	WATER QUALITY OBJECTIVE			PERFORMANCE COMPLIANCE IN SAMPLE TAKEN FROM
	COLIFORM BACTERIA (CFU/100ML)	NITROGEN[1]	TOTAL PHOSPHOROUS	
Drinking water Well or other drinking water source[2]	Maximum fecal coliform bacteria <1	Maximum nitrate nitrogen <10 mg/L Median ammonia nitrogen <3.5 mg/L	NA	Water Well or source, or monitoring Well in same aquifer as Well
Breakout to drain[3]	Median <400	Median nitrate nitrogen <15 mg/L Median ammonia nitrogen <3.5 mg/L	Median <2.0 mg/L	Groundwater prior to Breakout
Surface Breakout[4]	Median <400	NA	NA	Groundwater prior to Breakout
Irrigation water not used as drinking water source	Median <400	Median nitrate nitrogen <30 mg/L Median ammonia nitrogen <3.5 mg/L	NA	Water Well or source, or monitoring Well in same aquifer as Well
Freshwater body, flowing, used for swimming or bathing[5]	Median <400	Median nitrate nitrogen <15 mg/L Median ammonia nitrogen <3.5 mg/L[6]	NA [6],[7]	Groundwater moving from the Discharge Area to point of interface with the body of freshwater, monitored at minimum 3 m from the water body[8]
Freshwater body, flowing, other[5]	Median <1,000	Median nitrate nitrogen <15 mg/L Median ammonia nitrogen <3.5 mg/L[6]	NA[6],[7]	
Freshwater body, standing, used for swimming or bathing[5]	Median <200	Median nitrate nitrogen <10 mg/L Median ammonia nitrogen <3.5 mg/L[6]	Median <1.0 mg/L[6]	
Freshwater body, standing, other[5]	Median <400	Median nitrate nitrogen <10 mg/L Median ammonia nitrogen <3.5 mg/L[6]	Median <1.0 mg/L[6]	
Ocean water, with swimming but no shellfish harvesting[5],[8]	Median <200	Median nitrate nitrogen <20 mg/L Median ammonia nitrogen <3.5 mg/L	NA	Groundwater moving from the Discharge Area to point of interface with the body of water, monitored at minimum 3 m from the interface[9]
Ocean water, with shellfish harvesting[5],[8]	Median fecal <14 to 90th percentile fecal <43	Median nitrate nitrogen <7.5 mg/L Median ammonia nitrogen <3.5 mg/L	NA	

NOTES TO TABLE A-3

FOOTNOTES

(1) Ammonia water quality objectives are based on the following rationale:
- (a) A properly operating aerobic soil-based Treatment System is expected to nitrify at least 95% of the ammonia nitrogen, leaving ammonia <3.5 mg/L; and
- (b) The BC freshwater aquatic life objective, for chronic exposure, is a limit of <3.6 mg/L, based on typical groundwater ambient conditions and a minimum dilution ratio of 2:1.

(2) Source, Guidelines for Canadian Drinking Water Quality, published by Health Canada. Where background nitrate levels are >10 mg/L the Onsite Sewerage System should not raise them above the background level.

(3) Includes Breakout to drain that discharges to a water body.

(4) Where Breakout does not flow to Surface Water or a water body.

(5) Background monitoring should be used to ensure contaminants are from the Onsite Sewerage System rather than other sources. See below for dilution rates.

(6) The design Professional should develop project- and site-specific objectives for situations where the receiving water body is sensitive to nutrient inflows.

(7) In most cases.

(8) 90th percentile means 9 out of 10 samples. Areas of discharge not used for food production (e.g., shellfish) and beach not accessible at low tide may meet freshwater body objectives. See below for dilution rates.

(9) This distance is not intended to be a Horizontal Separation, solely a monitoring location.

DILUTION RATES USED IN DEVELOPMENT OF THE TABLE

- (a) For flowing water and short-term (acute) exposure, a dilution ratio of at least 2:1.
- (b) For flowing water and long-term (chronic) exposure, a dilution ratio of at least 5:1.
- (c) For standing water, no dilution for fecal coliform densities and at least a 2:1 dilution ratio for nitrogen species.

BACKGROUND MONITORING

Background monitoring should be used to provide a record of background levels of the contaminant being monitored. Monitoring Wells/sampling should be located to collect samples representative of the travel of Effluent into the environment, and should not themselves cause or contribute to the creation of a Health Hazard.

Note: While the objectives set out in this table are based on performance standards and represent accepted water quality guidelines and objectives that indicate where Effluent water may be considered to be renovated and incorporated into the environment, they are only a guideline. See references to source documents, below.

The Professional should ensure that their design does not cause or contribute to a Health Hazard and meets all other requirements of the SSR. Professionals should evaluate this table in light of site- and project-specific conditions, and use their Professional discretion to determine whether the objective selected is suitable given their legal requirements under the SSR.

REFERENCES TO THE TABLE

The following source documents were used in preparation of Table A-3; these may be updated from time to time. The Professional should refer to the most recent version.

Health Canada. 2016. Canadian Drinking Water Guidelines. [website]. Ottawa, ON: Health Canada. [accessed: 2016 Nov 2]. http://www.hc-sc.gc.ca/ewh-semt/water-eau/drink-potab/guide/index-eng.php.

BC Ministry of Environment. 2016. Approved Water Quality Guidelines. [website]. Victoria, BC: BC Ministry of Environment. [accessed: 2016 Nov 2]. http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html

BC Ministry of Environment. Principles for Preparing Water Quality Objectives in BC. [accessed: 2016 Nov 2]. http://www.env.gov.bc.ca/wat/wq/BCguidelines/principles.html

- Note: this document forms the basis for developing site-specific water quality objectives.

Warrington, PD. 1988. Updated 2001. Province of British Columbia Water Quality Criteria for Microbiological Indicators Technical Appendix. Victoria, BC: Ministry of

Environment and Parks, Resource Quality Section Water Management Branch. [accessed: 2016 Nov 2]. http://www.env.gov.bc.ca/wat/wq/BCguidelines/microbiology/microbiology.html.

- Note: this is the supporting document for the microbiological standards in the Approved Water Quality Guideline.

Province of BC. 2012. BC Municipal Wastewater Regulation. [accessed: 2016 Nov 2]. http://www.bclaws.ca/civix/document/id/loo95/loo95/87_2012.

Nordin RN, Pommen LW, Meays CL. 1986 updated 2001. Water Quality Guidelines for Nitrogen (Nitrate, Nitrite, and Ammonia), Overview Report Update. BC Ministry of Environment, Water Stewardship Division. [accessed: 2016 Nov 2]. http://www.env.gov.bc.ca/wat/wq/BCguidelines/nitrogen/nitrogen.html.

- Note: The ambient water quality criteria for nitrate and ammonia are based on this document.

Hassan G, Reneau RB, Hagedorn C, Jantrania AR. 2008. Modeling Effluent Distribution and Nitrate Transport through an On-Site Wastewater System. Journal of Environment Quality. 37(5): 1937.

Lesikar BJ, Garza OA, Persyn RA, Anderson MT, Kenimer AL. 2004. Food Service Establishments Wastewater Characterization. In: Mankin KR (editor). On-Site Wastewater Treatment X, Conference Proceedings (21-24 March 2004; Sacramento, CA). ASAE Publication Number 701P0104. pp. 377-386.

Garza OA, Lesikar BJ, Persyn RA, Kenimer AL, Anderson MT. 2005. Food Service Wastewater Characteristics as Influenced by Management Practice and Primary Cuisine Type. Transactions of the ASAE. 48(4): 1389-1394.

Table A - 4: Example Performance Objectives at Design Boundaries

BOUNDARY (COMPLIANCE IN BOLD)	WATER QUALITY OBJECTIVE (COLIFORM BACTERIA, CFU/100ML)	WATER SAMPLE TAKEN FROM	NOTES
Water Table or Flow Restrictive Horizon	• BOD <2 mg/L • Median fecal coliform <100 to maximum fecal <400 • Median total nitrogen <20 mg/L	• Design boundary	• Where water table does not form part of an aquifer used for drinking water supply
Property Line	• Median fecal <50 to maximum fecal <400 • Median total nitrogen <12 mg/L	• Design boundary	
Infiltrative Surface, Type 3 Effluent	• Maximum fecal <400	• Discharge piping or pump chamber or Point of Application	• Where Type 3 CTDS is used, sampling at the Point of Application will be necessary

8.3.4.8 Drinking Water Well Setbacks

.1 In the specific case of reduced setback to drinking water Wells, the Professional Hydrogeologist should consider the following:

- ☐ The number, location, and separation distances of the Well or Wells at Risk
- ☐ Expected Well use, average and peak withdrawal volumes, timing, private versus public, irrigation versus drinking
- ☐ Depth and Construction details of those Wells, especially surface annular seals
- ☐ Barriers to horizontal and vertical groundwater flow
- ☐ Confined versus unconfined aquifer
- ☐ Options for relocating the Sewage system or the Well or Wells
- ☐ The soil profile, terrain, and hydrogeology of the site (typically based on a site reconnaissance)
- ☐ Benefits of additional site evaluation or testing of soil or groundwater, beyond the site evaluation by the design Professional
- ☐ Overall suitability of the site and soil conditions
- ☐ Overall suitability of the proposed system design for the site (this is not a formal review of the design, but a general review relevant to effectiveness of the Onsite Sewerage System in reducing Risks to Wells)
- ☐ Direction and rate of unsaturated zone seepage and saturated zone groundwater flow
- ☐ Identifying Sewage constituents of concern (typically pathogenic microorganisms and nitrate nitrogen):
    - ☐ Special considerations may be necessary depending on the source of the Wastewater
- ☐ Identify known information on the fate and behaviour of constituents of concern in the subsurface
- ☐ Expected concentrations of these constituents at stages in the treatment process, typically including the treatment plant Effluent, water table, and at the water Well
- ☐ Expected concentrations in the Well as compared with drinking water (or other) guidelines
- ☐ Other mitigation measures, if appropriate
- ☐ Recommendations for ongoing monitoring of groundwater quality, and of drinking water quality
- ☐ Recommendations for periodic review (check-up) by a groundwater Professional
- ☐ Documentation (report) of the review, including the rationale for the decision, with reference to Section 3.1 of the SSR

8.3.4.9 Other Critical Setbacks

.1 For other setback reductions, a Professional should follow a similar performance-based approach:

- ☐ Review human health and environmental Risks using an evaluation process similar to that outlined above for water Wells
- ☐ Evaluate the overall human health and environmental Risk resulting from the reduced setback distance
- ☐ If the Risk is unacceptable, evaluate one or more methods to reduce the Risk
- ☐ Select one or more Risk reduction measures and integrate these into the design
- ☐ Recommendations for ongoing environmental monitoring
- ☐ Documentation of review and rationale for decision

8.3.4.10 Custom Vertical Separation

.1 Development of custom Vertical Separation should consider performance, and must be undertaken following a Performance-Based Design approach (see **Section 5.3 – Guided Performance Design**).

.2 The Professional should develop a checklist or tabular method to assist with documentation of the strategies used and rationale. An example list is provided below; this would be expanded with record of site- and project-specific rationale.

Following is an example checklist:

- ☐ HLR
- ☐ Distribution method
- ☐ HAR and timed dosing
- ☐ Point of Application in the soil profile (deep versus shallow)
- ☐ Measures to reduce preferential flow and to improve lateral dispersal
- ☐ Use of Effluent with reduced pathogen load (Type 3 or other)
- ☐ Soil specific factors:
  - ☐ Soil type in terms of capillary rise
  - ☐ Pathogen attenuation potential with model predictions
  - ☐ Climate-specific factors
  - ☐ Provisions for monitoring of environmental performance and Vertical Separation

8.3.4.11 References

.1 Useful references include the main referenced design manuals, references for Performance-Based Design in **Section 8.3.1 – Guided Performance-Based Design**, plus the following.

.2 Literature reviews by Hall (1990) for the Washington State Department of Health and the Irish EPA Investigation into the Performance of Subsoils and Stratified Sand Filters for the Treatment of Wastewater from On-site Systems (Gill et al. 2004) present discussion and extensive references relevant to the selection of Vertical Separation for a small Onsite Sewerage System soil component.

8.3.4.12 Custom Loading Rates

.1 For selection of custom loading rates, the Professional may use these provided checklists.

8.3.4.13 Custom HLR

.1 Development of custom HLRs should consider the following:

- ☐ Organic (mass) loading (BOD and TSS)
- ☐ O&G loading
- ☐ HAR
- ☐ Pathogen attenuation
- ☐ Air transport to the Infiltrative Surface for the selected dispersal method
- ☐ Type of dispersal system
- ☐ System use pattern, e.g., alternating systems, seasonal use
- ☐ Soils (see also site and soil evaluation in **Section 8.2.6 – Site and Soils Evaluation Checklists** and guided performance design in **Section 8.3.1 – Guided Performance-Based Design**) including the following:
  - ☐ Soil permeability
  - ☐ Coarse fragment content of soil
  - ☐ For organic soils, the potential for long-term degradation of soil structure resulting from Effluent application

- ☐ Pathogenic micro-organisms or indicators such as fecal coliform bacteria and nitrate nitrogen, with defined Performance Objectives
- ☐ Whether the loading rate is for use with ADF or DDF
- ☐ Special climate and design considerations (rainfall, ET potential, temperature)
- ☐ LTAR, desired system life

8.3.4.14 References on Custom HLRs

- Lindbo (2007) provides an example of the development of a process for determination of loading rates.
- Some useful references for discussion of loading rates include Wespetal and Frekot (2001); Crites and Tchobanoglous (1998);US EPA (2002); Laak (1986); Winneberger (1984); Radcliffe and West (2007).
- The Washington State Technical Review Committee has prepared two literature reviews relevant to selection of HLR (Washington State Department of Health 2002; Darrell 2002).
- See also **Section 8.3.1 – Guided Performance-Based Design** and **Section 8.3.4 – Performance Objectives**.

8.3.4.15 Custom LLRs

.1 Based on the target long-term unsaturated Vertical Separation, development of custom LLRs should consider the following:

- ☐ Type of dispersal system, HLR
- ☐ Site slope and slope shape
- ☐ Landscape position
- ☐ Surface Water and shallow groundwater input from upslope
- ☐ Input from other dispersal systems (including storm water systems)
- ☐ Soils (see also site and soil evaluation):
  - ☐ Soil permeability and factors affecting permeability
  - ☐ Expected impact of changes in site use on soil characteristics (including vegetation cover)
- ☐ Type of flow expected away from Dispersal Area: horizontal, vertical, mixed
- ☐ Discharge point for groundwater flowing from the Dispersal Area (if identifiable)
- ☐ Performance Objective considerations (if any)
- ☐ System use pattern, e.g., seasonal use
- ☐ Whether safety factors are included in the DDF, or if the loading rate is for use with average flow
- ☐ Special climate considerations (rainfall, ET potential, temperature)
- ☐ Potential for interception and relief drainage:
  - ☐ Design
  - ☐ Testing, including pilot scale testing or pre-installation and testing
  - ☐ Monitoring

8.3.4.16 Notes on Development of LLRs

.1 Custom LLR may be developed using simple modelling (Darcy Law calculations, drainage calculations, mounding calculations) or more complex numerical models. As with all models, care must be exercised in model calibration and application; decision on the approach must be taken based on site- and project-specific considerations.

.2 Custom oxygen LLRs may be developed using oxygen transport models.

8.3.4.16.1 Site Evaluation and Pilot Scale Testing

.1 For establishment of parameters for custom LLR selection, more extensive site and soil evaluation may be necessary, particularly for larger systems. This may include large-scale infiltration (basin, area, pit, large ring) tests with associated calculations and direct observation of pilot scale trench tests.

8.3.4.16.2 Pilot Scale Trench Tests

.1 When estimating the amount of water table mounding with larger flow systems or smaller systems in very constrained sites, the Professional should consider using one or more pilot large-scale water table mounding tests (Crites and Tchobanoglous 1998).

8.3.4.16.3 References

.1 The National Decentralized Water Resources Capacity Development Project (Poeter et al. 2005) presents an overview of Groundwater Mounding analysis based on Risk management considerations. This report also includes a comprehensive bibliography. Resources for simple calculation of water table mounding include (Minnesota Pollution Control Agency 2005; Kaplan 1991).

9.0 CONTRIBUTORS

AUTHORS

Gilbert Larocque, CD, P.Eng., LLB, City of Surrey

Ron McMurtrie, P.Eng., Blue Island Onsite

Michael Payne, P.Eng., P.Geo., Western Wastewater Systems

Ian Ralston, Eng.L., TRAX Developments Ltd.

REVIEWERS

Rob Arden, P.Eng., Arden Consulting Engineers Ltd.

Rupert Benzon, Ministry of Health

Steve Carballeira, P.Geo., H2O Environmental Ltd.

Michele Gee, P.Eng., Metro Vancouver

Harshan Radhakrishnan, P.Eng., Engineers and Geoscientists BC

Craig Regier, P.Eng., Cleartech Consulting Ltd.

Mike Zemanek, P.Eng., Ministry of Health

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NOTES:

200 • 4010 REGENT STREET, BURNABY, BRITISH COLUMBIA, CANADA V5C 6N2
MAIN 604.430.8035 TOLL FREE 1.888.430.8035 EMAIL info@egbc.ca WEBSITE egbc.ca