Municipal Sewage Regulation

Environmental Impact Study Guideline - A Companion Document to the Municipal Sewage Regulation

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Ministry of Environment, Lands and Parks

Pollution Prevention and Remediation Branch

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Disclaimer

This guidance document does not replace the *Waste Management Act* or its regulations. It does not list all provisions relating to municipal sewage discharges. If there are differences between this document and the *Act*, or any omissions in this document, then the *Act* and its regulations, apply.

1. INTRODUCTION

This Guideline should be used as a companion document to the Municipal Sewage Regulation (MSR). Dischargers are advised to ensure their familiarity with the requirements of the MSR. Discharges must be registered in accordance with the MSR and dischargers are advised to undertake a number of pre-registration activities. While it is recommended that an Environmental Impact Study for the discharge and the facility be undertaken as part of the pre-registration activities, note that it must be completed at least 90 days prior to commencement of construction of any facility.

1.1 Purpose of Guideline

Condition 8 of Schedule 1 of the MSR sets out in general terms the requirements for an environmental impact study (EIS) that must be completed at least 90 days prior to construction of any facility discharging to the environment or providing reclaimed water for use. In several sections of the MSR (see Appendix 1 of this Guideline) an EIS is required to be conducted by a qualified professional with expertise and experience in conducting environmental assessments.

The purpose of this document is to provide guidance to the qualified professional for developing an appropriate scope of work for an EIS that will satisfy the requirements of the regulation. It is not intended to be a comprehensive document detailing exactly what an EIS must contain. This is the responsibility of the qualified professional. (The definition of qualified professional is provided in the MSR.)

It is important to note that the completed EIS should ascertain the extent to which the proposed discharge or use of reclaimed water will affect human health and/or the environment. If the effect is unacceptable, the proposed discharge should be modified to ensure that no adverse effects will occur, or the proposal should be withdrawn.

This guideline has been structured to identify and explain the requirements in the regulation for environmental impact assessment. The guideline provides comments on each section of the regulation that relate to environmental issues. The guideline then concludes with direction on the use of qualified professionals and provides examples of typical scopes of work for less complicated EISs that are suited to a prescriptive format.

Requirements for more complicated EISs need to be established on a project-specific basis by the qualified professional as highlighted in Section 1.3.

1.2 General Requirements for EIS

An environmental impact study (EIS), conducted by a qualified professional, is required under the regulation to determine whether a discharge of effluent or the use of reclaimed water will substantially alter or impair the usefulness of the environment or adversely affect human or

ecological health. The EIS requirements apply to: use of reclaimed water, discharges to water, discharges to ground, combined sewer overflows, and sanitary sewer overflows.

The EIS must also determine whether the standards and requirements of the MSR for the receiving environment conditions (e.g., minimum dilution requirements for an outfall, minimum subsurface travel time for ground discharges) are met by the proposed discharge.

The objectives of an EIS for discharges to the physical, chemical and biological environment and for use of reclaimed water are to:

- establish pre-discharge conditions in the receiving environment using existing data and/or by conducting adequate sampling of water, sediment and biota;
- establish, before and after discharge commences, receiving environment monitoring locations, and sampling parameters and frequencies;
- assess existing and potential uses of the receiving surface water or groundwater, by humans, plants and animals, including reference to blue and red species lists;
- determine whether receiving water quality guidelines are and will be met and under what conditions;
- carry out analysis, as appropriate to the nature of the discharge and the receiving environment, to determine if the proposed treatment, reuse or disposal system will adversely affect human health or the environment; and
- provide recommendations to ensure that the proposed treatment, reuse or disposal system will protect human health and the receiving environment, or to recommend against the proposed discharge.

Note that "water quality guidelines" is a broad term used in the MSR to define water quality guidelines (formerly criteria), water quality objectives, where established for a particular water body, and any other water quality standard approved by the Minister. See Appendix 2 of this Guideline for more information.

In addition to the EIS requirements associated with use of reclaimed water and discharges of effluent to the environment, an EIS is required for new or expanded sewage treatment facilities.

With reference to section 20 of the MSR, an EIS may be required to assess the impact of non-domestic waste discharges into a municipal sewage collection system (in the absence of a source control bylaw), and to assess the impact of semi-solid waste discharges to a treatment facility. The impact of these discharges on the final effluent quality and resulting biosolids quality needs to be assessed in these studies.

The EIS must be completed 90 days before construction of any facility commences and the report must be retained for inspection by the Ministry of Environment, Lands and Parks (MELP) Regional Pollution Prevention Manager (Manager).

The Manager must be notified when the study is completed.

Listed in Appendix 2 of this Guideline are some of the information sources that should be reviewed when preparing an EIS.

1.3 Structure of EIS

An EIS forms a component of an overall project involving a discharge of effluent or use of reclaimed water. The discharger must engage a qualified professional to complete the EIS. For more details concerning qualified professionals, refer to section 4 of this Guideline.

Where the scope of work requires an extensive EIS, such as a major new discharge to the environment, then the qualified professional should develop the study program to adequately address, but not be limited to, the following issues:

- requirements of the Environmental Assessment Act guidelines, as appropriate,
- aspects of treatment plant and discharge location siting,
- documentation of background and existing ambient conditions, prior to the proposed discharge, including consideration of any existing discharges that may contribute to any adverse cumulative effects,
- establishing an adequate baseline inventory of physical, chemical and biological attributes, and the range of potentially affected ecosystem components and uses,
- statistical/experimental design considerations, including data quality objectives, and a field and laboratory Quality Control (QC) and Quality Assurance (QA) program,
- determine the aquatic resources at risk in the receiving environment, if any, as well as downstream or downgradient drinking water sources potentially affected,
- all potential impact pathways and mechanisms,
- all potential means of mitigating residual hazards, and,
- final determination of the acceptability of any predicted impact, hazards or risks.

Certain cases that involve an expansion of an existing treatment plant with an existing discharge, can be exempted from a full EIS. (See the MSR for details.) For some existing discharges, an EIS may be required, in which case, a more focussed EIS, rather than a full EIS as required for a new discharge may be appropriate. (Contact the appropriate Regional Pollution Prevention Manager for further information.)

2. PRE-REGISTRATION ACTIVITIES (MSR section 3 (2), (3))

Well in advance of registration, meetings should be held with the MELP Regional Pollution Prevention Manager and other agencies, as appropriate (e.g., Environment Canada, Department of Fisheries and Oceans, Ministry of Agriculture, Food and Fisheries, Local Health Authority, Municipality, First Nation, etc.). This is important to determine the appropriate scope, level of detail, and schedule for the EIS and because the Manager has considerable latitude under the regulation regarding the necessary study and monitoring requirements to demonstrate protection of the receiving environment. In general, this guideline and the direction provided by the Manager should be adhered to when conducting the EIS. As well justification should be provided to the Manager for any deviations. Dischargers should be aware that the MSR enables the Manager to impose additional requirements, including specific requirements to be addressed by an environmental impact study.

For a large discharge to a sensitive receiving water, several years of environmental monitoring may be needed to support the requested discharge. Depending on the circumstances, monitoring of in-situ biological indicators may be appropriate for discharges to surface waters. For marine environments, the tidal effects (reversals, slack water) should be taken into consideration in the data evaluation. For a small discharge to a large receiving water, a brief, limited scope EIS may be adequate.

The EIS should include a receiving environment monitoring program, designed by a qualified professional with expertise and experience in conducting environmental assessment as well as in monitoring and assessing aquatic biological communities and systems. The purpose of the monitoring program is to determine pre-discharge conditions and to predict or assess the potential impact of the discharge on the long term ecological health of the environment. The monitoring program should include several downstream or down-gradient sampling locations and must include at least one control sampling station located upstream, up-gradient, outside the influence of the initial dilution zone (IDZ) of the effluent, or outside the influence of the effluent or any other discharge. The EIS must adequately characterize and document pre-discharge conditions. The use of predictive modeling tools is normally required. If seasonal variations of parameters of interest which influence characteristics within the receiving environment are considered to be significant by the Manager, pre-discharge monitoring over all critical period(s) of the year may be required.

The scope of the environmental monitoring and the EIS should be reviewed with the Manager and other agencies early in the pre-registration phase to ensure that environmental impact concerns are addressed and to allow the proponent sufficient opportunity to meet their construction timing without delays.

3. REQUIREMENTS FOR EIS

3.1 Effluent Disinfection (section 8 (1))

The EIS must determine if disinfection is needed to meet water quality guidelines. Disinfection will normally be a requirement when the effluent is discharged to a water-course that supports a domestic water supply, or recreational use, or is used for irrigation, or when a domestic water well is

within the influence of a discharge to ground. Disinfection may also be necessary if shellfish growing areas will be impacted.

All efforts must be made to use a disinfection method other than chlorination and de-chlorination, particularly if the discharge goes directly to fish-bearing waters.

3.2 Toxicity (Section 9 (2) (c) (e) (g))

All discharges, except those identified in Section 9 (2) (a), (b), (d) and (f) of the MSR, must comply with the 96 hour LC50 bioassay requirement, unless an EIS demonstrates to the satisfaction of the Manager that the receiving environment will not be adversely affected.

In addition to the exemptions noted above, the 96 hour LC50 bioassay requirement may be waived under specified circumstances providing an EIS demonstrates to the satisfaction of the Manager that the receiving environment will not be adversely affected. This will require that water quality guidelines (particularly ammonia) are met outside of the IDZ and that IDZ conditions do not impact significantly on known aquatic resources. (In other words, subject to the exemptions provided by Section 9 of the MSR, the final effluent must be able to pass an "end-of-pipe" 96 hour LC50 bioassay test and no acute toxicity effects will be acceptable within the IDZ). Three particular circumstances where exemptions apply are:

- if a discharge is equal to or less than 5000 m^3/d and if it can be demonstrated that the receiving environment will not be adversely affected;
- if a minimum 100:1 dilution ratio can be achieved within the IDZ and if it can be demonstrated that the receiving environment will not be adversely affected; or
- regardless of dilution ratio or discharge quality, if it can be demonstrated that the receiving environment will not be adversely affected.

3.3 Use of Reclaimed Water (section 10 (1) (d), Schedule 2 – Appendix 1 – Notes 6, 18)

If the reclaimed water use impacts surface water or groundwater, then the items to be addressed in the EIS are as outlined in Sections 3.4 and 3.5 of this Guideline. As appropriate to the nature of the reclaimed water use and with reference to the Code of Practice for the Use of Reclaimed Water - A Companion Document to the MSR, the following issues need to be examined for environmental and human health impacts:

1. how the use of reclaimed water will affect (potential benefits and detriments) the quality and quantity of any groundwater or surface water, or both, including any impacts on groundwater or surface water that alternate methods of managing surplus volumes of reclaimed water may have;
2. if remote areas of parks, school grounds during vacation periods, and golf courses are proposed to be included under the restricted public access category, then an EIS must determine to the satisfaction of the Manager whether there will be adverse environmental or health impacts;
3. the treatment requirements to maintain water quality guidelines; the temperature effects on the ecosystem; and the effects of nutrient loading when reclaimed water is used for wetland

or stream augmentation, impoundments for boating or fishing, and snow making for skiing and snowboarding;

4. irrigation or impoundment of reclaimed water within 30 m of a domestic water well will require an EIS to determine if lesser or greater setbacks may be acceptable to the Manager;

3.4 Discharges to Water (section 11 (1) (b), Schedule 3 – Appendix 1 – Note 3, Note 10, Note 12, Schedule 7 – Appendix 2, Note 3)

As appropriate to the nature of the discharge and the receiving water, the EIS should address the following items:

3.41 Physical Environment

1. characterize bathymetry in lake or marine environments;

2. assess currents and seasonal or other stratification, including current meter and drogue study results, wind analysis and conductivity/depth/temperature profiles;

3. minimum available dilution in the receiving water, both 7-day low flow, seasonal low flows and lowest seasonal water levels (see the MSR for definitions);

4. location of outfall (depth, flow and distance) for flows less than 5000 m^3/d are specified in appendix 2 to schedule 7 of the MSR. For flows greater than 5000 m^3/d, the EIS must determine, in conjunction with computer modeling of the discharge, the optimum outfall location, length and depth of the discharge and the diffuser arrangement;

5. effluent plume modeling and dilution calculations;

6. assessment of flushing action or the lack thereof including the impact of any known backeddies;

7. the number, location and size of other discharges to the water body;

8. in addition, for lakes: limnology including stratification and overturn, average yearly lake outflow, theoretical detention time, and location, number, and size of other discharges to the lake;

3.42 Aquatic Resources

1. inventories of receiving water use, noting that the outside boundary of the discharge's IDZ must not be within 300 m of a commercial shellfish lease or known native or recreational shellfish harvesting areas;

2. inventories of important aquatic life, fisheries resources and fisheries habitat and seasonal habitat uses in the vicinity of discharge with special attention to rare and endangered species,

3. a benthic invertebrate assessment should be carried out in a manner consistent with methods used by MELP Regional offices. Specific collection and evaluation methods should be discussed with the Manager prior to conducting the assessment.

3.43 Impact Assessment

1. the quantity and quality of the discharge, including the contributions from upstream or nearby discharges. (Incorporate any source control measures and the effect of any institutional, commercial or industrial discharges to the collection system);

2. calculated nutrient loading to the receiving water, including all relevant nitrogen and phosphorus species, and annual phosphorus budgets for lakes;

3. assess the assimilative capacity of the receiving water, including the cumulative impact of upstream or nearby discharges. Comment on the potential for nutrient loading which may overly stimulate aquatic plant growth (e.g., algae, periphyton and macrophytes) or contribute to water body eutrophication, considering factors such as type of substrate, water depth, existing sediment load, forest canopy, water velocity and temperature characteristics;

4. existing receiving water quality for parameters listed in published water quality guidelines in addition to, or in the absence of published guidelines, parameters agreed upon with the Manager;

5. establish pre-discharge conditions of sediment biota and chemistry and toxicity concerns;

6. estimates of receiving water quality at the edge of the IDZ, including chronic impacts from nutrients or other contaminants such as heavy metals and organic compounds. Compare these estimates with the ministry's water quality guidelines. Contaminant loadings must be considered in order to assess compounds that may accumulate or bio-accumulate.

When the dilution ratio is less than 100:1, the EIS must determine if effluent quality needs to be improved beyond the requirements of schedule 3 of the MSR.

When the dilution ratio is less than 40:1 and the stream is used for recreation, domestic water extraction, seasonal discharge, or the stream contains fish, an effluent discharge is prohibited unless the EIS demonstrates to the Manager there is no unacceptable environmental impact and that there are no other practical solutions. A minimum dilution ratio of 20:1 may be authorized by the Manager for seasonal discharges and where the stream does not contain fish, and is not used for recreation or domestic water extraction. For low dilution ratio situations, the EIS must determine if downstream resources will be adversely affected.

The total and ortho-phosphorus limits in schedule 3 may be waived by the Manager, if the EIS demonstrates there will be no undesirable increased biological activity in the receiving water. Alternatively, the EIS may determine that a more stringent phosphorus limit or mass loading limit is needed to protect the receiving water.

For a proposed discharge to a lake having a surface area less than 100 ha, advanced treatment is required as prescribed by Schedule 5 of the MSR, and further, the EIS must determine what degree of advanced treatment, if any, will adequately protect the lake environment.

For ammonia, an "end of pipe" back calculation from the edge of the IDZ is required. Examples are included in Appendix 3 of this Guideline.

The EIS should predict or determine the impact of the effluent discharge for toxicity, oxygen depletion, microbiology (i.e., bacteria, viruses, protozoans), nutrient loading, thermal (temperature) effects, biodiversity and other parameters (e.g., any parameters of emerging concern such as endocrine disrupters). Comparison with water quality guidelines or objectives (where applicable) should be included to determine those parameters that may have significant impact on the particular watercourse.

3.5 Discharges to Ground (section 12 (b), Schedule 4 – Appendix 1 Note 1 – 1, 2, 3, Explanatory Note 8, Schedule 7-5 (3) (h))

As appropriate to the nature of the discharge and the receiving environment, the EIS should address the following items:

3.51 Physical Environment

1. the hydrogeological conditions of the area that may influence or be impacted by the discharge;

2. the vertical distance to any low permeability (hydraulic conductivity of $1x10^{-8}$ m/s, or less) layer beneath the disposal area;

3. the vertical distance to the highest seasonal water table,

4. the elevation to which the water table will be raised by the discharge, including mounding calculations during maximum hydraulic loading and wet weather conditions at least equivalent to an event with a 5-year return period;

5. the horizontal distance to the disposal site property boundaries, to the nearest established water bodies, to point of breakout on ground surface, and to any drinking water wells and community wells;

6. the time of subsurface travel before reaching the property line, a domestic or community well, a surface discharge or a water body;

7. the Maximum Infiltration Capacity[1] and the Natural Discharge Capacity[2] of the soils;

8. if percolation rates are less than 2 minutes per 25 mm, additional hydrogeological studies must be conducted to satisfy Schedule 4, Appendix 1, Note 8 of the MSR;

3.52 Aquatic Resources

1. identification and mapping of the aquifers, water wells, springs and surface waters and the water uses that may be affected by the discharge;

[1] The maximum rate (usually expressed in m^3/day) that wastewater can pass from a pond or seepage trench into natural ground.

[2] The maximum groundwater flow rate (usually expressed in m^3/day), in natural ground, from a wastewater discharge facility.

3.53 Impact Assessment

1. the groundwater quality, both background and existing, and the predicted quality following introduction of the discharge, including the predicted quality at the property line;
2. determine appropriate water quality guidelines to protect beneficial and downgradient uses;
3. determine whether water quality guidelines can be met at the property line;
4. the quantity and quality of the discharge, including the impact of existing or possible future up-gradient or down-gradient discharges to ground. Incorporate any source control measures and the affect of any institutional, commercial or industrial discharges to the collection system;
5. removal of nutrients that are determined to limit biological activity in the receiving environment (i.e., phosphorus or nitrogen species), unless it can be substantiated that the groundwater table will remain at least 3 m below the surface (or below the drainage trench bottom for sub-surface disposal) and percolation rates are slower than 10 minutes per 25 mm;
6. the minimum setback requirements set out in Table H of Schedule 7 and the specific need to determine the setback distance to protect water quality;
7. assessment of the assimilative capacity of the receiving ground to accept the proposed discharge, including the cumulative impact of upgradient or nearby discharges, soil and/or sub-surface attenuation characteristics;
8. determine if the groundwater/effluent flow will surface and its impact on property owners, residents and users;
9. if a drinking water well is within 300 m down-gradient, the potential effect of nitrogen, pathogens, and other contaminants on that well;

3.6 Advanced Treatment (section 13, schedule 5)

If the EIS indicates the need for more stringent standards to protect human health or the environment, the Manager may require the discharger to meet more stringent standards, or provide advanced treatment, or meet water quality guidelines or mass loading limits.

An additional, more detailed, EIS may be undertaken by the discharger to determine if alternative requirements to the 10 mg/L total nitrogen limit for discharges to ground are necessary. Any alternative to the total nitrogen limit must be authorized by the Manager, based on the EIS findings.

Advanced treatment to meet more stringent effluent quality is required for the geographical areas noted in schedule 5 of the MSR.

For discharges to the geographical areas noted in Schedule 5, Table 3; an EIS must be conducted to determine the level of advanced treatment needed to protect the receiving environment.

3.7 Design and Construction of Sewage Facilities (section 17, schedule 7,1)

An EIS is required to demonstrate that the sewage facility will not adversely impact the receiving environment or adjacent neighbourhood. As appropriate, the EIS should examine the following:

1. facility location, including possible future plant expansions;
2. implementation of buffer zones;
3. provisions for controlling adjacent development (through zoning restrictions);
4. odour potential and appropriate control mechanisms;
5. potential impacts on fisheries and wildlife resources;
6. site work, including location of roads, buildings, ditches or drainage, pipelines, excavations, berms and related issues such as slope stability;
7. archeological sites and First Nations lands;
8. impacts on the environment and serviced community;
9. potential impact on the receiving environment and the necessity for additional measures; and
10. monitoring during the commissioning period.

Following construction of a treatment facility, a 3-month long commissioning period is allowed during which the discharge does not have to meet the standards, providing monitoring and studies determine to the satisfaction of the Manager that there are no adverse environmental impacts. The Manager may also extend the 3-month commissioning period, providing an EIS demonstrates that no adverse impacts are likely to occur.

3.8 Monitoring (section 27, 28 (5))

Pre-discharge monitoring will normally form part of the EIS that is undertaken to assess the impact of the proposed discharge on the environment. Following commencement of the discharge, effluent and receiving environment monitoring results are to be evaluated: to determine whether water quality guidelines are being met outside the IDZ; to confirm that sediment biota, chemistry and toxicity are not adversely affected; and to test previous modeling and predictive assessments are correct.

The monitoring program, designed by a qualified professional, should include the following:

1. at least one sampling station upstream, up-gradient or outside the influence of the discharge and any other discharges in the area to serve as background water quality;
2. several downstream or down-gradient sampling sites, at and beyond the edge of the IDZ, sufficient in number and location to monitor any potential impact of the discharge adequately;

3. consideration and commentary on any unacceptable IDZ impacts such as acutely toxic conditions, objectionable sludge deposits and floating materials, harmful bioconcentration in biota or other accumulation effects, nuisance conditions, risks to human health through consumption or recreation, or impaired use of the water body;

4. determination of seasonal or any other temporal variations that need to be taken into account, and if so, do monitoring at most critical time(s) when water quality guidelines are mostly likely to be exceeded, or when sediment chemistry or biota are most likely to be adversely impacted;

5. normally, for a discharge to water, pre-discharge weekly sampling for a period of 30 days (i.e., 5 samples collected over a 30 day period) at each station during the most critical season;

6. normally, for a discharge to ground, pre-discharge sampling during the most critical season at each station,

7. documentation of pre-discharge conditions;

8. design of post-discharge monitoring program, including accounting for any seasonal variations; and

9. recommendations for analysis of post-discharge monitoring data using statistical and graphical methods acceptable to the Manager to determine trends and compliance with the guidelines.

3.9 Combined Sewer and Sanitary Sewer Overflows (schedule 1, condition 9, 15, 16)

An EIS is required to determine water quality requirements and treatment needed to protect the designated uses of the receiving waters at all CSO and SSO locations. The EIS should address the following:

1. quantify overflow events based on 5-year return period precipitation;

2. establish receiving water beneficial uses;

3. determine water quality guidelines to protect beneficial uses and aquatic resources at risk;

4. evaluate methods of treatment to achieve the water quality guidelines, but as a minimum, control of floatables and materials of obvious sewage origin; and

5. determine methods to eliminate dry weather overflows.

4. USE OF QUALIFIED PROFESSIONALS FOR EIS

Dischargers must retain a qualified professional with expertise and experience in conducting environmental assessments to undertake an EIS. Depending on the scope of work for the EIS, a

qualified professional team may be needed for larger and/or more environmentally sensitive projects.

Most projects require that options for treatment and disposal/reuse be developed and evaluated in terms of environmental impact, social impact and cost-benefit. Evaluation of the options requires that pre-design and EIS work be well co-ordinated and proceed concurrently. Liaison with the Manager during the pre-design and environmental impact study work is also essential to ensure the EIS complies with the regulation requirements.

For a small discharge to a large receiving environment, the EIS requirement will typically be limited in scope. The qualified professional who is responsible for the project may also be suitably qualified to undertake the EIS portion of the project.

For larger projects (where the contributory population equivalent exceeds 10, 000 people), or for an environmentally sensitive receiving environment, a team approach to completing an EIS is recommended. Normally, the engineering consultant responsible to the discharger for the project would co-ordinate the activities of the overall project team, including the qualified professional(s) with expertise and experience in conducting environmental assessments. Appropriate to the nature of the discharge and the receiving environment, the team should be selected from individuals or companies with expertise in the following disciplines (brackets indicate likely type of receiving environment where this expertise would be required):

1. agrology (ground, reclaimed water)
2. biology/ecology (fresh water, marine, ground, reclaimed water)
3. chemistry (fresh water, marine, ground)
4. engineering, including dilution, diffusion and dispersion modeling (fresh water, marine)
5. geology (ground)
6. hydrogeology, including dilution, diffusion and dispersion modeling (ground)
7. hydrology (fresh water)
8. limnology (fresh water)
9. oceanography (marine)
10. public health (fresh water, marine, ground, reclaimed water)

5. EXAMPLES OF TYPICAL SCOPE OF WORK FOR EIS

It is recognized that the EIS requirements are site specific for the particular discharge/reuse/receiving environment conditions. It is incumbent on the qualified professional to develop an appropriate scope of work for the EIS to determine whether the discharge of effluent or the use of reclaimed water will adversely affect human health and the environment.

The subsections that follow provide examples of typical scopes of work for various discharge/reuse/receiving environment conditions. Actual scope of work in any particular circumstance should be reviewed with the Regional Pollution Prevention Manager.

5.1 Lower Risk - e.g., Maximum Daily Flow <50 m^3/d with discharge to Open Marine Water or to Streams with Dilution Ratio >100:1

A limited scope EIS will typically apply to this small discharge (about 100 people or less) to a large receiving water. Items to be addressed will normally include, but not necessarily be limited to, the following study tasks. Generally, study tasks 1 to 10 will form part of the design phase for the project.

1. Identify maximum daily and average annual effluent flow, including possible seasonal only discharge;

2. Identify influent and effluent sewage quality: BOD_5, TSS, Total P, NH_3 and fecal coliform levels;

3. Identify source control measures, as appropriate;

4. Locate on a marine chart or topographical map (1:50,000 or larger scale) and suitable larger scale site plan, the general location of the proposed discharge;

5. Identify any existing or proposed nearby discharges, including their quantity and quality;

6. Inventory receiving water uses, fisheries resources, commercial and shellfish leases, drinking water, recreational uses, irrigation, livestock watering, or other uses. Illustrate these uses on the marine chart or topographical map and site plan. Indicate applicable water quality guidelines;

7. Determine outfall depth/distance requirement using schedule 7, appendix 2;

8. Identify normal wind direction, tidal influences and marine/stream currents;

9. Estimate the initial dilution and subsequent dilution, diffusion and dispersion that will occur from the outfall diffuser, using worst-case values for seawater or stream temperature, pH, salinity and current or flows and effluent temperature and salinity;

10. Estimate the water quality at the edge of the IDZ and at any areas of concern (shellfish areas, beaches, water intakes, or others) for various treatment requirements (septic, primary, secondary as set out in schedule 3), using the most critical effluent quality parameters (e.g., NH_3 and fecal coliform levels), and compare these results with the water quality guidelines;

11. Based on the evaluation of the foregoing study task findings, recommend whether additional study tasks, including pre-discharge monitoring, are necessary;

12. Based on the evaluation of the foregoing study tasks findings, recommend the appropriate level of treatment and the optimum outfall location, depth and distance combination to ensure that there are no adverse effects on human health and the environment;

13. Recommend post-discharge effluent and environmental monitoring programs;

14. Summarize EIS findings and recommendations in a report with appropriate illustrations and supporting data and calculations.

5.2 Greater Risk - e.g., Maximum Daily Flow >10,000 m^3/d with Discharge to Open Marine Waters or to Streams with <100:1 dilution

An expanded scope and staged EIS, incorporating pre-discharge monitoring and site specific data acquisition, will typically apply to this larger discharge to a receiving water with a reasonably large, but limited, assimilative capacity.

Stage 1 of the EIS will utilize the available data base, possibly with some initial new data acquisition, to develop a preliminary impact assessment and to define additional monitoring and study tasks needed to complete the EIS in a subsequent stage(s) of work.

5.21 Stage 1 – Assessment of Available Data

Items to be addressed will normally include, but not necessarily be limited to the following study tasks:

1. Complete Section 5.1, Tasks 1 to 8, adding metals and other parameters of concern to Task 2 of 5.1 above;

2. Determine general location for outfall terminus based on providing protection to known fisheries resources, water intakes, shellfish areas, recreational uses and commercial foreshore uses, with due consideration for the siting of the treatment plant and the economics of effluent transport from the plant site to the outfall.

3. Complete Section 5.1, Task 9.

4. Estimate receiving water quality at edge of IDZ and at any areas of concern (water intakes, shellfish areas, beaches, etc.) for the 2 times average dry weather flow secondary treatment requirement set out in schedule 3 of the MSR and compare these results with the water quality guidelines.

5. Based on the analysis of the foregoing study items, recommend a pre-discharge environmental monitoring program, new data acquisition requirements, and the scope of work for Stage 2 of the EIS.

6. Summarize Stage 1 EIS findings in a report with appropriate illustrations and supporting data and calculations.

5.22 Stage 2 – Site Specific Data Evaluation

The specific requirements for Stage 2 can be defined when Stage 1 is complete. Typical requirements may include the following study tasks:

1. Initiate pre-discharge monitoring program.

2. For marine discharges, conduct drogue studies at proposed outfall terminus location(s) to determine the influence of thermal or physical-chemical stratification characteristics, normal

currents over a complete tidal cycle and whether currents are directed shoreward or toward important fisheries or recreational resources.

3. Based on drogue study results and bathymetry, locate outfall and, during the most critical period(s), conduct one month of current meter readings (at bottom, and at stratification level). Measure conductivity/temperature/depth (CTD) profiles to establish stratification levels. Confirm CTD profiles through appropriate current meter installation and data recovery procedures. Install wind meter during period of current meter deployment. For discharges to streams, determine channel cross-sections, low flows, flow velocities at low flows, and water depth.

4. Utilize computer programs (see Appendix 4 of this Guideline) with data collected in Item 3 to model the behaviour of the plume and to permit estimation of initial and "far field" dilution effects. That is, resulting dilution at areas of concern such as water intakes, beaches, shellfish harvesting areas, spawning and rearing habitat areas should also be determined..

5. Estimate impacts to water quality at edge of IDZ and at any areas of concern for the secondary treatment requirements set out in Schedule 3 and compare these results with the water quality guidelines;

6. Based on the foregoing study results, determine if secondary treatment requirements will adequately protect human health and the environment, otherwise, recommend what additional treatment or measures are needed.

7. Recommend post-discharge effluent and environmental monitoring programs.

8. Summarize Stage 2 EIS findings in a report with appropriate illustrations, supporting data and calculations.

5.3 Lower Risk - e.g., Maximum Daily Flow <37 m^3/d with Septic Tank Discharge to Ground Disposal Fields

A limited scope EIS will typically apply to this small discharge (about 80 people or less) to a site having favourable conditions for ground disposal. Items to be addressed will normally include, but not necessarily be limited to, the following study tasks. Generally, study tasks 1 through 9 will form part of the normal design phase for the project.

1. Identify maximum day and average annual effluent flow, including possible seasonal only discharge;

2. Identify influent and effluent sewage quality: BOD_5, TSS, Total P, NH_3 and fecal coliform levels;

3. Identify source control measures (e.g., education materials for system users);

4. Identify direction and velocity of groundwater flow and calculate the subsurface travel time;

5. Identify on a site plan the location of the proposed discharge and the topographic features of the site and adjacent area;

6. Identify any existing or proposed discharges (including quantity and quality) on adjacent property;

7. Locate wells in general vicinity (minimum – 300 m radius) of proposed discharge, in particular down-gradient wells and identify locations on site plan. Identify water uses.

8. Determine applicable water quality guidelines to be met at the disposal site property line;

9. Review the sewage treatment, reuse and disposal facility design report to confirm that the proposed site has appropriate ground conditions for disposal fields for the septic tank effluent in accordance with the requirements set out in Schedule 4 and Schedule 7 of the MSR. Note location of proposed ground disposal fields on the site plan.

10. Determine the setback distances from the proposed disposal fields to the nearest down-gradient wells and surface waters. Confirm that minimum setbacks (i.e., 60 m for domestic wells and 30 m for surface waters for disposal fields) are met and recommend additional setbacks, if necessary, to avoid adverse environmental impacts.

11. Based on the evaluation of the foregoing study tasks, recommend if additional treatment or study tasks, including pre-discharge monitoring, are necessary.

12. Recommend post-discharge effluent and environmental monitoring programs. The environmental monitoring program must address water quality, depth of unsaturated soil zone beneath discharge site, and any indications of seeps down-gradient of discharge site.

13. Summarize EIS findings and recommendations in a report with appropriate illustrations and supporting data and calculations.

5.4 Greater Risk - e.g., Maximum Daily Flow >200 m^3/d with Discharge to Ground Disposal Fields or to Exfiltration Basins

An expanded scope and staged EIS, incorporating pre-discharge monitoring and site specific data acquisition, will typically apply to this larger discharge to ground.

Stage 1 of the EIS will utilize the available data base, possibly with some initial new data acquisition, to develop a preliminary impact assessment and to define additional monitoring and study tasks needed to complete the EIS in a subsequent stage(s) of work.

5.41 Stage 1 – Assessment of Available Data

Items to be addressed will normally include, but not necessarily be limited to, the following study tasks:

1. Complete Section 5.3, Tasks 1 to 7

2. Review the sewage treatment, reuse and disposal facility pre-design report to confirm that the proposed site has appropriate ground conditions for disposal fields/exfiltration basins in

accordance with the requirements set out in Schedule 4 and Schedule 7. Note location of proposed disposal fields or exfiltration basins on the site plan.

3. Determine setback distances from the proposed disposal fields or exfiltration basins to the nearest water wells and surface waters. Note if any setback distances are less than the minimum requirement:

   a) surface water = 30 m (150 m in Okanagan Basin)

   b) surface drinking water = 300 m

   c) water well = 90 m (300 m in unconfined aquifer)

1. Review the sewage treatment, reuse and disposal facility pre-design report to determine:

   a) if the existing hydrogeological data base is adequate to assess the assimilative capacity of the ground to accept both the proposed effluent quantity and quality and the existing and proposed up-gradient ground discharges, and maintain any designated water quality guidelines at the property boundary or location of surfacing.

   b) if the existing hydrogeological data base is adequate to assess sub-surface travel time and whether the discharge will surface within 30 m of the outer edge of the disposal field area or exfiltration basin.

1. If adequate data are available from the Task 4) review, and with regard to the setback distances determined in Task 3), evaluate the impact of the proposed discharge on the receiving environment and human health, including the cumulative impact from any up-gradient ground discharges. Determine if the environmental impact is acceptable, and if necessary provide recommendations regarding the need for additional treatment or additional study tasks.

2. Should Task 4) conclude that insufficient data exist to evaluate the environmental impact of the cumulative discharge, or if Task 5 determines the need for additional study, then recommend a scope of work for Stage 2 of the EIS.

3. Summarize Stage 1 EIS findings in a report with appropriate illustrations and supporting data and calculations.

5.42 Stage 2 – Site-specific Data Evaluation

Stage 1 will identify the requirements for Stage 2 work. Typical requirements may include the following tasks:

1. Install up-gradient and down-gradient monitoring wells at the property line to allow determination of pre-discharge baseline water quality.

2. Install piezometers to allow better determination of groundwater flow rates and directions of flow.

3. Estimate groundwater quality at the property line from the proposed discharge, with due consideration for the impact from up-gradient existing and future ground discharges, for the appropriate effluent classes noted in Table 1 of Schedule 4 of the MSR. In particular, estimate the impact of nitrate and pathogens, and the ability of the soil to assimilate nutrients and heavy metals.

4. Recommend a post-discharge effluent and groundwater monitoring program. The monitoring program must address water quality, depth of unsaturated soil zone beneath discharge site, and any indications of seeps down-gradient of the discharge site.

5. Summarize Stage 2 EIS findings in a report with illustrations, supporting data and calculations.

5.5 Siting of New Treatment Plant

In addition to addressing the applicable sections 5.1 to 5.4 of this Guideline, siting of a new treatment plant will typically consider a number of factors, including, but not necessarily limited to the following:

- the planning/design horizon;
- the optimum location for the facility in terms of minimizing environmental impact and protecting human health;
- the location of existing and potential sites for use of reclaimed water; and
- the physical site characteristics, the economics of sewage conveyance, treatment and disposal, and the social impact.

Generally, several treatment plant sites, discharge locations, and sites for use of reclaimed water need to be identified as options and evaluated in terms of environmental, social and financial considerations.

For each siting option under consideration, an EIS for a new treatment plant site and all related appurtenances should assess:

a) in general, potential impacts on fisheries, wildlife, and wetlands, traffic patterns, construction noise and air quality, and geotechnical hazards (e.g., potential for seismic activity or land slides); and

b) in particular, the following:

5.51 For the Treatment Plant Sites

1. impact of facility construction on fisheries and wildlife

   a) inventory wildlife that use or traverse the site

   b) inventory fish species in lakes and streams that occupy or traverse the site

   c) identify set back requirements from streams, lakes, wetlands, and wells

d) identify mitigation measures

1. impact of facility construction on quality of surface water and groundwater

a) determine baseline water quality

b) identify if facility structures will infringe on set-back requirements identified in schedule 7 of the MSR

c) determine if facility structures will alter groundwater, stream, lake, or wetland flow or quality

d) identify mitigation measures

1. impact of facility construction on air quality with particular reference to potential odour nuisance.

a) determine site seasonal wind and atmospheric conditions

b) identify buffer zones between the site (including future expansion) and land use around the site

c) identify odour mitigation measures to be employed (e.g., enclosed unit processes, odour treatment works)

d) depending on the available buffer zones, the adjacent land use and the proposed odour treatment works, estimate, using modeling as appropriate, the odour concentrations at the site property line for typical indicator parameters such as H_2S and NH_3.

1. impact of facility construction on archeological sites and First Nations lands;

a) determine if site is registered as an archeological site

b) determine if site is First Nations land or under active land claim.

5. Visual impact of facility on surrounding properties.

5.52 For the Influent and Effluent Pipelines

1. impact of influent and effluent pipelines to and from the site on watercourses or the intertidal zone of a marine foreshore;

a) identify existing fisheries resources in the waters intersected by the pipelines

b) identify construction details and methods to mitigate impacts, including works or undertakings that may result in harmful alteration, disruption or destruction of fish habitat.

5.53 For the Discharge Locations

1. typical EIS examples set out in Sections 5.1, 5.2, 5.3 and 5.4 of this Guideline apply.

APPENDIX 1 - REFERENCES TO EIS IN THE REGULATION

Reference is made to EIS requirements in the following parts, sections, schedules and conditions of the Regulation.

Part 2 – Exemption under Certain Conditions from section 3 (2) and (3) of the Waste Management Act for Discharge

Registration under section 2 for an exemption, section 3(2) (h) and (k).

Part 4 – Standards for Effluent Reuse and Discharges to the Environment

Effluent disinfection, Section 8 (1)

Toxicity, section 9 (2) (c) (e) (g)

Use of reclaimed water, section 10 (1) (d)

Discharges to water, section 11 (1) (b)

Discharges to ground, section 12 (b)

Advanced treatment, section 13 (1)

Part 6 – Management and Operations

Commissioning new and upgraded sewage facilities, section 17 (2) (b), 17 (3) (a)

Non-domestic water connection to municipal sewage system, section 20 (5)

Semi-solid wastes, section 21 (1) (b)

Part 7 – Monitoring

Receiving environment monitoring, section 27 (1) (a) (b) (c), 27 (2)

Reporting requirements, section 28 (5) (a) (b)

Schedule 1 – Conditions for Exemption under section 2 of this Regulation

Water quality standards, condition 3 (2)

Managers directions respecting standards, condition 4 (2) (b)

Environmental impact studies, condition 8 (2)

Combined and sanitary sewer overflows, condition 9

Sewage facilities, condition 10 (b)

Combined sewer overflows, condition 15 (2) (e)

Sanitary sewer overflows, condition 16 (2) (e)

Schedule 2 – Permitted Uses and Standards for Reclaimed Water

Appendix 1; Note 6, Note 18

Schedule 3 – Standards for Discharges to Water

Appendix 1; Note 3, Note 10, Note 12

Schedule 4 – Standards for Discharges into Ground

Appendix 1 Note 1; 2 (b), 3

Explanatory Note 8

Schedule 5 – Geographical Areas Requiring Advanced Treatment

Appendix 1; Note 5, Note 6, Note 7

Schedule 6 – Monitoring Requirements

Appendix 1; Note 1, Note 8

Schedule 7 – Design Standards for Sewage Facilities

(1) General (1), (2) (c), (3)

(4) Outfalls (2) (a) (ii)

(5) Discharges into Ground (3) (h) Table H

Appendix 2, Note 3

Appendix 3, 1 Construction Criteria (4)

APPENDIX 2 - INFORMATION SOURCES

List of Information Sources

Contacts

The following are listings of agency contacts:

BC Environment Regional and Headquarters Offices

BC Environment Regional and Sub-Regional Offices

1) BC Environment
Vancouver Island Regional Office
2080-A Labieux Road
Nanaimo, British Columbia, V9T 6J9
Tel: 250-751-3100
Fax: 250-751-3103
Attention: Pollution Prevention Manager

2) BC Environment
Lower Mainland Regional Office
10470 152nd Street
Surrey, British Columbia, V3R 0Y3
Tel: 604-582-5200
Fax: 604-582-5334
Attention: Pollution Prevention Manager

3) BC Environment
Southern Interior Regional Office
1259 Dalhousie Road
Kamloops, British Columbia, V2C 5Z5
Tel: 250-371-6200
Fax: 250-828-4000
Attention: Pollution Prevention Manager

4) BC Environment
Penticton Office
201 - 3547 Skaha Lake Road
Penticton, British Columbia, V2A 7K2
Tel: 250-490-8200
Fax: 250-492-1314
Attention: Pollution Prevention Officer

5) BC Environment
Kootenay Regional Office
401 - 333 Victoria Street
Nelson, British Columbia, V1L 4K3
Tel: 250-354-6355
Fax: 250-354-6367
Attention: Pollution Prevention Manager

6) BC Environment
Kootenay Sub-Regional Office
205 Industrial Road G
Cranbrook, British Columbia, V1C 6H3
Tel: 250-489-8510
Fax: 250-489-8506
Attention: Pollution Prevention Officer

7) BC Environment
Omineca-Peace Regional Office
1011 - 4th Avenue
Prince George, British Columbia, V2L 3H9
Tel: 250-565-6155
Fax: 250-565-6629
Attention: Pollution Prevention Manager

8) BC Environment
Cariboo Regional Office
Suite 400 - 640 Borland Street
Williams Lake, British Columbia, V2G 4T1
Tel: 250-398-4530
Fax: 250-398-4214
Attention: Pollution Prevention Manager

9) BC Environment
Skeena Regional Office
3726 Alfred Street
Bag 5000
Smithers, British Columbia, V0J 2N0
Tel: 250-847-7260
Fax: 250-847-7591
Attention: Pollution Prevention Manager

BC Environment Victoria Headquarters Office	
Mailing Address:	Delivery address:
BC Environment Pollution Prevention & Remediation Branch Box 9342 Stn Prov Govt Victoria, BC V8W 9M1 Attention: MSR Contact Telephone: (250) 387-6663	BC Environment Pollution Prevention & Remediation Branch 3 – 2975 Jutland Road Victoria, BC V8T 5J9 Attention: MSR Contact Fax: (250) 953-3856

Websites

POLLUTION PREVENTION (MELP*)*

This Guideline

http://www.elp.gov.bc.ca/epd/epdpa/mpp/msrhome.html

Municipal Sewage Regulation (MSR) homepage

http://www.elp.gov.bc.ca/epd/epdpa/mpp/msrhome.html

Guidance on MSR

http://www.elp.gov.bc.ca/epd/epdpa/mpp/gomsr.html

Water Management (MELP)

Water (general)

http://www.elp.gov.bc.ca/wat

Water Quality Data

EMShelp@gems5.gov.bc.ca

Water Quality (objectives, guidelines)

http://www.elp.gov.bc.ca/wat/wq/

Groundwater (aquifers, well locations)

http://www.elp.gov.bc.ca/wat/gws/

Water Licences (locations)

http://www.elp.gov.bc.ca/wat/

MINISTRY OF AGRICULTURE, FOOD, AND FISHERIES

http://www.agf.gov.bc.ca

ENVIRONMENT CANADA

Water Quality and Hydrometric Station Information

http://www.weatheroffice.com/climhydro

Water Quality Data

Andrea Ryan: ph. (604) 664-4001 or andrea.ryan@ec.gc.ca

Hydrometric Data

Lynne Campo: ph. (604) 664-9324 or lynne.campo@ec.gc.ca

FISHERIES AND OCEANS

to come

OTHER RELATED WEBSITES

to come

List of Other Reference Materials

MELP Resource Inventory Committee

Guidelines for Interpreting Water Quality Data, 1997

http://www.for.gov.bc.ca/ric/pubs/aquatic/interp/index.htm

Guidelines for Designing and Implementing A Water Quality Monitoring Program In British Columbia, 1997

http://www.for.gov.bc.ca/ric/pubs/aquatic/design/index.htm

MELP Laboratory Management

BC Laboratory Manual and Field Sampling Manual

http://www.elp.gov.bc.ca/rib/lab&sys_web/frame_lab.htm

List of Abbreviations

IDZ	Initial Dilution Zone
MELP	Ministry of Environment, Lands and Parks
MSR	Municipal Sewage Regulation

APPENDIX 3 - EXAMPLES OF END OF PIPE BACK CALCULATION FOR AMMONIA

Calculation of allowable effluent concentration at discharge includes consideration of the environmental characteristics of the discharge sites. Discharges to streams will behave differently than to estuaries, lakes and the ocean. For all cases, the ratio of allowable concentration to initial discharge concentration can be determined through mixing models. Present provincial legislation requires that water quality guidelines be met outside of the initial dilution (regulatory mixing) zone. Concentrations of effluent at the boundaries of the initial dilution zone (e.g., 100 m from outfall diffuser) will vary non-uniformly across the cross-section, depth and length of the zone. Concentrations will show a decrease non-linearly as the effluent moves away from the source.

In most instances, a well-designed outfall should be able to achieve an initial dilution of 20:1 or greater with ambient water within the initial dilution zone. Based upon this assumption, site-specific water quality parameters can be used with an assumed minimum 20:1 dilution ratio (for illustration only) to calculate the allowable maximum effluent concentrations. With respect to ammonia-nitrogen, critical temperatures and pH are summarized in Table 1 for four British Columbia river systems to illustrate the resultant critical 30-day chronic ammonia-nitrogen levels. Both temperature and pH vary seasonally, thus affecting allowable ammonia concentrations. Calculation outcomes using the critical temperature and pH values are shown in Table 1.

TABLE 1 - ALLOWABLE EFFLUENT AMMONIA CONCENTRATION

FOR 20:1 DILUTION IN INITIAL DILUTION ZONE

River	Critical Temp. ^{o}C	Critical pH	Allowable Receiving Water Concentration[(a)] mg/L	Allowable Maximum Effluent Concentration[(b)] mg/L
Elk (Southern Rockies)	10	8.4	0.461	9.22
Fraser (Central Interior)	16	8.2	0.651	13.02
Similkameen (Eastern Okanagan-West Kootenays)	17	8.2	0.606	12.12
Skeena (North West Coast)	15	8.1	0.874	17.48

(a) At edge of initial dilution zone, 30-day chronic NH_3 concentration.

(b) Assuming 20:1 dilution within initial dilution zone and negligible background ammonia concentrations.

In the following examples, dispersion equations and models were used to estimate dilution ratios at the boundary of the initial dilution zone. (See Technical Assessment Report (TAR) 2.1, Effluent to Surface Water (D&K 1993) for more details).

River Example

For example, the Kispiox outfall on the Skeena River is estimated to have total dilution ranging between:

Co/C = 337 to 1230.

Using the receiving water maximum ammonia concentration of 0.874 mg/L, then the effluent concentration should not exceed 295 mg/L.

Lake Example

Discharge to a lake may be represented by an outfall on Okanagan Lake (contained in TAR 2.1). Seasonal variations give a minimum summer dilution of 38:1 and a minimum fall dilution of 23:1 within the initial dilution zone. Temperature variations (4ºC in winter and 20ºC in fall) and a maximum pH of 8.1 gives a 30-day ammonia concentration for summer of 0.611 mg/L and 0.952 mg/L for fall (Nagpal, et al, 1998).

In turn, back calculating based upon summer dilution of C/Co = 38, The summer effluent ammonia concentration must not exceed 23.2 mg/L, and fall effluent ammonia concentrations must not exceed 21.9 mg/L. In this instance, the critical limit occurs in the fall.

Side Channel Example

A side discharge into the Cheakamus River can be used to illustrate the sensitivity that outfall location may have on dilution. Tabulation of the results and figures follow. (Note that equation (2.4) of TAR 2.1 has been modified to account for nearness of the shore boundary conditions, and is accurate only for Ymin = 0; immediate side discharge. If distance of the outfall into the river remains small, < 1 m, then the modified equation is a close approximation.)

A 30 consecutive day, 10-year low stream flow of 2.9 m^3/s is assumed in the example. The allowable 30-day average total ammonia concentration in the receiving stream is 1.64 mg/L and the background concentration is negligible. (The 1.64 mg/L is selected as an example for a stream pH of 7 and a stream temperature of 16^{o}C.) Four cases are considered for a 100-m long by 8.75-m wide (25% of stream width) mixing zone. The location of the side of bank outfall is changed by moving it slightly further into the river for three of the cases, while the fourth location has the discharge in the centre of the stream. For any discharge at or close to shore, the available dilution is less than an outfall located in the centre of the stream since the bank forms one of the boundaries of the mixing zone and limits the dispersion of the plume. The four cases are summarized as follows:

Case (a):The discharge at the shoreline, Ymax = 8.75, Ymin = 0.00 m:

- dilution available is 6.2:1

- allowable effluent would be: 6.2 x 1.64 mg/L = 10.12 mg/L.

Case (b): The discharge at 0.25 m from the shoreline, Ymax = 8.5 m, Ymin = -0.25 m:

- dilution available is 14.7:1
- allowable effluent would be: 14.7 x 1.64 mg/L = 24.11 mg/L.

Case (c):The discharge at 0.5 m from the shoreline, Ymax = 8.25 m, Ymin = -0.5 m:

- dilution available is 29.3:1
- allowable effluent would be: 29.3 x 1.64 mg/L = 48.05 mg/L.

For these three cases, the dilution 100 m downstream of the centreline of discharge plume (which is close to shore) results in an allowable concentration of 63.9 mg/L.

Case (d): The discharge is in the middle (centre) of the stream,[1] Ymax = 4.375 m,

Ymin = -4.375 m:

- dilution available is 77.9:1
- allowable effluent would be 77.9 x 1.64 mg/L = 127.7 mg/L.

When the outfall is located in the centre of the stream, the available dilution is effectively double that of a side discharge when measured 100 m downstream. Therefore, locating the outfall near to the centre of stream flow is critical if the available dilution potential of both the outfall and stream are to be maximized.

(1) The stream is not considered to be the mixing zone. The mixing zone is 12.5 percent of either side of the stream centreline, or 25 percent of the stream width.

REFERENCES

(Nagpal, et al, 1998), British Columbia Water Quality Guidelines (Criteria): 1998 Edition, Ministry of Environment, Lands and Parks, Water Management Branch, Water Quality Section, Nagpal, N.K., Pommen, L.W., and Swain, L.G., 1998.

(D&K 1993), Ministry of Environment, Lands and Parks, Municipal Sewage Discharge Criteria, Technical Assessment Report No. 2, Effluent to Surface Waters. Dayton & Knight Ltd., DRAFT, Dec. 6/93.

APPENDIX 4 - DILUTION MODELS

Dilution models suitable for estimating both initial and subsequent (far field) dilutions for marine, stream and lake discharges are described in USEPA/600/R-94/086 Dilution Models for Effluent Discharges (Third Edition). This document may be obtained from:

United States Environmental Protection Agency

Centre for Environmental Research Information

Cincinnati, OH 45268

USA

Models described include:

RSB – initial dilution

UM – initial dilution

PLUMES – model interface and manager for RSB and UM with two far field algorithms and CORMIX flow categorization scheme.