Endpoint Selection Standard

Saskatchewan Environmental Code

April 5, 2024

Saskatchewan

A PRELIMINARY MATTERS

Objective

(1) This standard sets the manner in which the appropriate endpoints may be selected for environmentally impacted sites in Saskatchewan. Elimination of exposure pathways in this standard typically deal with PHC's and BTEX, however, the standard may be used as guidance when eliminating exposure pathways for other SOPC's.

Definitions

(2) In this standard the following words and phrases have the following meanings:

(a) "**administrative control**" means a legal or administrative tool to safeguard against unacceptable exposures to substances of potential concern for specific pathways;

(b) "**ambient conditions**" means the concentrations of the SOPC normally found at a site that is not linked to discharges from any known anthropogenic source;

(c) "**aquifer**" means groundwater-bearing formations sufficiently permeable to transmit and yield water in usable quantities;

(d) "**BTEX**" means benzene, toluene, ethylbenzene and xylenes;

(e) "**CCME**" means Canadian Council of Ministers of the Environment;

(f) "**coarse-grained soil**" means soil having a median grain size of greater than 75 micrometres, as defined by the American Society for Testing and Materials in ASTM Test Method C136 and C117;

(g) "**contamination**" means presence of a substance that is anthroprogenically generated that is:

(i) above the tier 1 endpoint values listed in the SEQS according to, land use and soil type; or

(ii) above the tier 2 endpoint values listed in the SEQS according to, land use and soil type;

(h) "**down gradient**" means any direction within 45 degrees either side of the direction of groundwater flow;

(i) "**endpoint value**" means the value of the chemical to be achieved by the corrective action plan and the corrective actions;

(j) "**engineering controls**" means the engineered and constructed measures put in place to safeguard unacceptable exposures to substances of potential concern for a specific pathway;

(k) "**exposure scenario**" means the route by which a receptor comes into contact with a contaminant;

(l) "**fine-grained soil**" means soil having a median grain size of less than 75 micrometres, as defined by the American Society for Testing and Materials in ASTM Test Method C136 and C117;

(m) "**groundwater**" means water beneath the surface of land;

(n) "**hazard quotient**" means the ratio of estimated site-specific exposure to a single chemical from a site over a specified period to the estimated daily exposure level, at which no adverse health effects are likely to occur;

(o) "**hydraulic conductivity**" means the proportionality factor between hydraulic gradient and flux in Darcy's Law. Hydraulic conductivity measures the inherent ability of a porous medium to conduct water;

(p) "**ministry**" means the Saskatchewan Ministry of Environment;

(q) "**natural attenuation**" means the natural, physical, chemical and biological processes that retard movement, reduce concentrations and reduce mass of contaminants present in a medium;

(r) "**organic soil**" means soils that contain an organic carbon content greater than 17 per cent;

(s) "**PHC**" petroleum hydrocarbons that consist of a mixture of organic compounds found in or derived from geological substances such as oil, bitumen and coal. For the purposes of this document, PHCs are subdivided into four fractions, according to specified ranges of equivalent carbon number (ECN). The four fractions are:
  (i) F1: ECN from C6 to C10 minus BTEX and PAHs;
  (ii) F2: ECN from C > 10 to C16 minus PAHs in this range;
  (iii) F3: ECN from C > 16 to C34 minus PAHs in this range;
  (iv) F4: ECN from C > 34 to C50 minus PAHs in this range;

(t) "**PAH**" means polycyclic aromatic hydrocarbons;

(u) "**physical controls**" mean natural features at an environmentally impacted site that may be relied upon to reduce unacceptable exposure to substances of potential concern for a specific pathway;

(v) "**potable water aquifer/domestic use aquifer**" means a hydrostratigraphic unit that:
  (i) has a bulk hydraulic conductivity of 1×10^{-6} metres per second or greater;
  (ii) has sufficient thickness to support a sustained yield of 0.76 litres per minute (1.2667×10^{-5} m^3/s) or greater for a minimum of 20 years;
  (iii) is currently being used for domestic purposes; and
  (iv) does not contain chemical constituents that make the water unsafe for human consumption or contain constituents that render the water undesirable aesthetically unless those constituents can be removed.

(w) "**proponent**" means the person who is required to prepare and carry out a corrective action plan;

(x) "**receptor**" means the person or organism exposed to a chemical;

(y) "**remediation**" means activities that remove, neutralize or reduce concentrations of SOPCs in order to prevent or minimize current or future adverse effects;

(z) "**risk assessment**" means the application of standardized methodologies to determine the nature, magnitude and likelihood of adverse effects from exposure to one or more substances of potential concern through various pathway routes of exposure;

(aa) "**risk management**" means the elimination of adverse effect by control of one or more risk assessment components (contaminants, receptor and pathways) at an impacted site;

(bb) **"SEQG"** means Saskatchewan Environmental Quality Guidelines. The SEQG are provincial guidelines of environmental quality. They are legally binding standards when referenced in legislation, regulations, permits or the Saskatchewan Environmental Code. Also referenced as the Saskatchewan Environmental Quality Standards (SEQS);

(cc) "**site characterization**" means the identification and characterization of source, pathway and receptor in a manner consistent with the Site Assessment Chapter;

(dd) "**source**" means the source(s) of the substance(s) of potential concern;

(ee) "**substance of potential concern (SOPC)**" means any anthropogenic substance found in soil, ground water or surface water which is present in a concentration at or above the value for a given land use as set out in the Saskatchewan Environmental Quality Standard;

(ff) "**vadose zone**" means the zone between land surface and the water table, within which the moisture content is less than saturation except in the capillary fringe and

pressure is less than atmospheric. Soil pore spaces also typically contain air or other gases. The capillary fringe is included in the vadose zone.

B GENERAL

Standard

(1) There are three acceptable endpoints to address environmentally impacted sites. Each successive endpoint requires a greater level of technical detail and a greater level of expertise to plan and carry out the remediation. The endpoints are:

- (a) tier 1 endpoint: is the application of the tier 1 values of SEQS based on land use and soil grain size;
- (b) tier 2 endpoint: is the application of pathway elimination and, or receptor controls to achieve the application of tier 2 values of the SEQS based on the applicable exposure scenario remaining after the pathway(s) have been eliminated, or receptor controlled; and
- (c) tier 3 endpoints: are, or are achieved by:
  - (i) obtaining acceptable hazard quotient with human health risk assessments and ecological risk assessment; or
  - (ii) site specific environmental quality standards; or
  - (iii) risk management; or
  - (iv) any combination of one or more of the above.

Information Note

The minister may refuse to accept an endpoint or corrective action plan when it is in the public interest to do so.

Land Use

(2) In order to select an endpoint, it is necessary to classify the land. All land shall be categorized in one of the following categories with the following attributes:

- (a) "**residential/parkland**" means land used primarily for residential or recreational activity but does not include wild land or areas that meet the definition of "natural areas", defined below;
- (b) "**agricultural**" means land used primarily for growing crops or tending livestock and includes agricultural lands that provide habitat for resident and transitory wildlife and native flora but does not include that portion of agricultural land used for a residence;
- (c) "**commercial**" means land used primarily for business activity and there is free access to all members of the public, including children. It does not include operations where food is grown;
- (d) "**industrial**" means land where the primary activity involves the production, manufacture or construction of goods. Public access is restricted and children are not permitted continuous access or occupancy.
- (e) "**natural areas"** means land that is away from human habitation and activities. The primary concern is ecological receptors. Natural areas land use must not be applied to areas that may reasonably be expected to be developed.

(3) If the land use does not fit within one of the five above categories, then tier 3 endpoints shall be used.

(4) In addition to applying the descriptions set out in section (2), when categorizing land, the following principles shall be considered:
   (a) the current use of the land and any known proposed future use;
   (b) subject to clauses (c) and (d), if the impacted area has a purpose different from the balance of the parcel of land, the area should be separately categorized. For example, the farm yard on a quarter section should be categorized as residential/parkland while the balance of the quarter can be categorized as agricultural;
   (c) how the land is zoned;
   (d) More restrictive SEQS values shall apply to a 30 metre buffer at the impacted site where any adjacent or adjoining land use is more restrictive.

Soil Type

(5) In order to select an endpoint, it is necessary to characterize the soil as either coarse-grained or fine-grained.

(6) When characterizing soils, the following principles shall be considered:
   (a) sufficient data needs to be gathered to support the characterization. For example, a relatively thin layer of coarse-grained soils may govern transport toward down gradient receptors, although it may not be the dominant soil type;
   (b) if the soils have not been characterized on site as fine or coarse grained then the lowest tier 1 value for the SOPC shall apply.

General Conditions Where Tier 1 Endpoints are Not Applicable (Generic Assumptions)

(7) The proponent may choose to submit a Tier 3 endpoint if any of the following conditions exist; or the proponent may choose to submit a Tier 2 alternative solution for any of the following conditions if the pathway or exposure scenario described can be eliminated or controlled:
   (a) volatile SOPCs are closer than 30 centimetres to the foundation of an occupied building;
   (b) SOPCs are closer than 10 metres to a surface water body;
   (c) the soils at the site of the contamination are predominantly sands and gravels with a bulk hydraulic conductivity greater than 10^3 centimetres per second;
   (d) the land use does not fit within the five generic land use categories referred to in section (2);
   (e) groundwater flows to a stagnant water body from which the main route of water loss is by evaporation;
   (f) the contaminant source length or width in groundwater is greater than 10 metres;
   (g) water is used for irrigation or food processing;
   (h) SOPCs are found in fractured bedrock;
   (i) inorganic contaminants are found in organic soils;
   (j) rare and or endangered species reside at or frequent the environmentally impacted site.

Tier 1 Endpoints

(8) If a tier 1 endpoint is selected to address the SOPCs at the environmentally impacted site, the SOPCs shall be reduced to the tier 1 value for the applicable media, land use and soil type as set out in SEQS.

Information Note

The decision to select a tier 1 endpoint is a business decision. In general tier 1 endpoints are more restrictive and apply conservative assumptions in their derivation. Tier 1 endpoint selection is most used on sites of low complexity and smaller scale. It allows the proponent to proceed with corrective actions with no other analysis other than determination and delineation of the SOPCs, soil texture for soils and applicability of the generic assumptions.

Tier 2 Endpoints

(9) Subject to clauses (10) and (11), a tier 2 endpoint may be used if a pathway or receptor are eliminated or controlled to achieve the value from the next highest applicable pathway in the SEQS.

(10) A proponent who chooses tier 2 endpoints may:
- (a) eliminate or control exposure pathways by:
  - (i) placing or relying on engineering controls;
  - (ii) placing or relying on physical controls;
  - (iii) placing the site under a form of administrative control;
- (b) eliminate or control the receptor exposure to the SOPC by:
  - (i) placing or relying on engineering controls;
  - (ii) placing or relying on physical controls;
  - (iii) placing the site under a form of administrative control.

(11) The following soil exposure scenarios may be considered for tier 2 endpoints:
- (a) human health exposure scenarios:
  - (i) Direct soil contact as set out in section (12);
  - (ii) Vapour inhalation as set out in section (13);
  - (iii) Protection of potable groundwater as set out in sections (14) and (15);
- (b) ecological exposure scenarios:
  - (i) Direct soil contact as set out in section (16);
  - (ii) Livestock and wildlife soil and food ingestion as set out in section (17);
  - (iii) Protection of freshwater aquatic life as set out in section (18);
  - (iv) Protection of livestock water as set out in section (19);
  - (v) Protection of wildlife water as set out in section (20);
  - (vi) Protection of irrigation water as set out in section (21);
- (c) Other:
  - (i) Management Limits as set out in section (22).

Human Health Pathways

Human Direct Soil Contact

(12) The direct contact pathway may be eliminated if:
- (a) the SOPCs are PHCs or BTEX compounds and no other SOPCs are present at the site and;
- (b) the SOPCs are more than 1.5 metres below grade; and
- (c) one or more of the following are met:
  - (i) physical controls are present at the site;
  - (ii) engineering controls are present at the site;
  - (iii) appropriate administrative controls are established to reduce the risk of dermal contact.

Information Note

The direct contact pathway requires direct exposure to impacted media. The primary routes for exposure are soil ingestion, the ingestion of air suspended particulate matter and direct contact with the impacted media and subsequent transfer from hand to mouth. The most sensitive human receptors considered for direct contact are toddlers on sites classified for agricultural, residential/parkland and commercial land use and adults on sites classified for industrial land use. The primary routes of exposure are (1) deposition of air- suspended particles on the skin surface and (2) accumulation of contaminants on exposed skin by either direct contact with the soil surface or indirectly by transfer between media. Both routes of exposure presume subsequent absorption of the SOPCs into the skin.

Administrative, physical, and engineering controls may be used in combination to effectively control or eliminate the exposure pathway or receptor. Suitable controls are:

Physical Controls

Physical controls such as overburden greater than 1.5 metres.

Engineering Controls

Engineering controls such as permanent barriers or caps.

Administrative Controls

Administrative controls such as ground disturbance policies, procedures or rules to ensure that if contaminated soils are exposed that there are procedures in place to safeguard exposure.

Vapour Inhalation

(13) The vapour inhalation pathway may be eliminated if:

- (a) the SOPCs are PHCs or BTEX compounds and no other SOPCs are present at the site; and
- (b) there are no occupied buildings within 30 metres of the site; and
- (c) one or more of the following are met:
  - (i) physical controls are present at the site;
  - (ii) engineering controls are present at the site;
  - (iii) appropriate administrative controls are established to reduce the risk of vapour inhalation.

Information Note

The vapour inhalation pathway does not require direct contact with impacted media, as the route of transport is through soil pore space, meaning the source may be at notable depth or distance from potentially effected receptors. The vapour inhalation pathway does not apply to metals or compounds considered non-volatile under normal ambient conditions such as F3 or F4 hydrocarbons. The most sensitive human receptors considered for vapour inhalation are toddlers on sites classified for agricultural, residential/parkland and commercial land use and adults on sites classified for industrial land use.

Administrative, physical, and engineering controls may be used in combination to effectively control or eliminate the exposure pathway or receptor. Suitable controls may be:

Physical Controls

A natural feature that eliminates or otherwise reduces an exposure scenario to acceptable level.

Engineering Controls

A positive pressure relative to the pressure in the soil in the building air space to prevent vapour intrusion. Such techniques are common for eliminating radon gas intrusion.

Administrative Controls

Administrative controls such as ground disturbance policies, procedures or rules to ensure that if contaminated soils are exposed that there are procedures in place to safeguard exposure.

Protection of Potable Groundwater

(14) The potable groundwater pathway for soils may be eliminated if:
- (a) the SOPCs are PHCs or BTEX compounds and no other SOPCs are present at the site; and
- (b) one or more of the following are met:
  - (i) sufficient physical controls are present to prevent the SOPC from reaching a potable water aquifer;
  - (ii) the groundwater present at the site does not meet the definition of a potable water aquifer as defined in Part (A) Section (2);
  - (iii) the SOPCs will be attenuated such that the concentrations will be below the applicable endpoint value before the SOPCs reach the potable water aquifer.

(15) Notwithstanding section (14), the potable groundwater pathway for soils may be eliminated within a city incorporated pursuant to *The Cities Act* if:
- (a) the impacted site is less than 500 metres outside the city boundary; and
- (b) there are no water wells within 500 metres of the site; and
- (c) water is supplied that is safe for human consumption.

Information Note

The route of exposure for potable groundwater is complex and dictated by the specific characteristics of the site and surrounding area. The dominant parameters with respect to groundwater flow are hydrogeological properties of the saturated zone, principally hydraulic conductivity and gradient. If impacts at a site have not yet reached the groundwater, soil properties in the vadose zone and capillary fringe and consequent connectivity of impacts with the water table are the primary determinant factors for the level of risk to potable groundwater resources.

The protection of a potable groundwater pathway is considered applicable in all cases where groundwater is, or has the potential to be withdrawn for domestic use. Thus, the applicability of this pathway is determined by whether or not a potable water aquifer (PWA) is present, and if an adequate natural geologic barrier exists between the contaminant plume and the PWA. The absence of existing water wells is not sufficient by itself to justify the elimination of the potable groundwater pathway, as potential future groundwater use must always be considered.

The proponent must use appropriate scientific and engineering methods and site assessment data to demonstrate that sufficient lateral and horizontal separation exist between the contaminant zone and the potential PWA. For example, given the climate and hydrostratigraphy of the northern regions of the province, a contaminant source would require a longer time for attenuation by biodegradation in such area. Contaminant transport may also be subject to preferential flow through bedrock fractures, thus diminishing the effect of attenuating mechanisms such as dispersion and adsorption. In this later case, only a tier 3 endpoint can be selected for such a site.

Administrative, physical, and engineering controls may be used in combination to effectively control or eliminate the exposure pathway or receptor. Suitable controls may include:

Physical Controls

Isolation of the aquifer by geologic unit that will ensure that natural attenuation will reduce the concentration of the SOPCs below the values in the tier 2 tables of SEQS.

Hydrodynamic containment of the SOPCs in a geologic unit such they will not contaminate an aquifer.

Engineering Controls

Barriers such as buried drains, cut off walls or other engineered structures may be employed to ensure that SOPCs do not migrate, and impact the receptor.

Administrative controls

There may be an opportunity for the proponent to eliminate the protective of potable groundwater pathway if it can be shown that there is a restriction on use of the groundwater in an incorporated city or the groundwater underlying that city is not a viable aquifer for the municipality. Administrative controls are required for both physical and engineering controls, and may include land use restrictions, and ground disturbance rules.

Ecological Pathways

Ecological Direct Soil Contact

(16) The direct soil contact pathway may be eliminated if:

- (a) the SOPCs are PHCs or BTEX compounds and no other SOPCs are present at the site; and
  - (i) the SOPCs are more than 3 metres below grade; or
  - (ii) the SOPCs are between 1.5 and 3 metres below grade and all of the following are met:
    - (A) sufficient engineering controls are present at the site to prevent receptor exposure and there is no productive use for the soil at the impacted site;
    - (B) appropriate administrative controls are established to address exposure to the contaminated soils.

Information Note

The receptors considered for the direct soil contact pathway include soil invertebrates, plants/crops, wildlife/livestock and nutrient cycling, with particular receptors taken out of consideration for the appropriate land uses (for example, crops, wildlife and livestock are not considered for the industrial land use designation).

This pathway could be eliminated if the site is completely paved or capped, and no productive use of the soil system is anticipated. Should landscaped areas exist or be planned, ecological soil contact would remain an active pathway. PHC's and BTEX in soils less than 1.5 metres below grade are always considered to be accessible for direct contact by ecological receptors.

Administrative controls shall be put in place in the case of surface capping or maintaining isolation at depth. Administrative, physical, and engineering controls may be used in combination to effectively control or eliminate the exposure pathway or receptor. Suitable controls may include:

Physical Controls

The ecological direct soil contact pathway may be eliminated where PHC's and BTEX are 3 metres below grade. For PHC's and BTEX between 1.5 and 3 metres below grade, the ecological soil contact pathway may be eliminated where it is demonstrated that ecological exposure or ecological receptors are controlled or are not present.

Engineering Controls

Paving, sacrificial fill, and other methods that exclude exposure contact are forms of acceptable engineering controls.

Administrative controls

Administrative controls are required for both physical and engineering controls, and may include land use restrictions, and ground disturbance rules.

Livestock and Wildlife Soil and Food Ingestion

(17) The livestock and wildlife soil and food ingestion pathways may be eliminated, and are only applicable to Natural Area and Agricultural land uses, if:
- (a) the SOPCs are PHCs or BTEX compounds and no other SOPCs are present at the site;
- (b) the SOPCs are more than 1.5 metres below grade;
- (c) appropriate administrative controls are established to reduce the risk of soil ingestion; and
- (d) one or more of the following are met:
  - (i) physical controls are present at the site;
  - (ii) engineering controls are present at the site.

Information Note

Livestock and wildlife soil and food ingestion is only considered for natural area and agricultural land uses. The primary routes of exposure are the direct ingestion of contaminated soil, plant material and other food sources that came in contact with the impacted media and uptake and subsequent ingestion of air-suspended particles.
Administrative, physical, and engineering controls may be used in combination to effectively control or eliminate the exposure pathway or receptor. Suitable controls are:

Physical Controls
Overburden greater than 1.5 metres that prevent soils from exposure at surface.

Engineering Controls
Permanent barriers or caps to prevent impacted soils from exposure at surface.

Administrative controls

Ground disturbance policies, procedures or rules to ensure that if contaminated soils are exposed that there are procedures in place to safeguard exposure.

Protection of Freshwater Aquatic Life

(18) The protection of freshwater aquatic life pathway may be eliminated if:

(a) the SOPCs are PHCs or BTEX compounds and no other SOPCs are present at the site; and

(i) there are no permanent water bodies that sustain aquatic life within 500 metres of the site; or

(ii) one or more of the following are met:

(A) there are sufficient physical controls to prevent SOPCs reaching the permanent water body;

(B) natural attenuation of the SOPCs will reduce the concentrations to below the applicable environmental standards before the SOPCs reach the water body;

(C) it can be established there is no hydrologic connectivity between contaminated media and the water body.

(D) engineering controls with sufficient administrative controls are present to prevent receptor exposure.

Information Note

Surface water bodies' role as recharge/discharge zones form a complex conceptual model with many factors to consider. At the impact source, connectivity with the groundwater is the primary consideration. After that, the hydrogeological properties of the site determine the ease of transport along the contaminant pathway, followed by the groundwater flow characteristics at a specific location that determine the propensity for the groundwater to discharge into the surface water body.

Permanent water bodies which sustain aquatic life must always be considered in application of this pathway. Seasonal water bodies may be excluded from consideration except in cases where they flow directly to permanent water bodies or are otherwise hydrologically connected.

Administrative, physical, and engineering controls may be used in combination to effectively control or eliminate the exposure pathway or receptor. Suitable controls may include:

Physical Controls

Isolation of the aquifer by geologic unit that will ensure that natural attenuation will reduce the concentration of the SOPCs below the tier 2 values in SEQS.

Hydrodynamic containment of the SOPCs in a geologic unit such that they will not reach the water body.

Engineering Controls

Barriers such as buried drains, cut-off walls or other engineered structures may be employed

Protection of Livestock Water

(19) The protection of livestock water pathway is only operative under agricultural and natural area land use and may be eliminated if:

(a) the SOPCs are PHCs or BTEX compounds and no other SOPCs are present at the site; and

(i) one or more of the following are met:

(A) there are sufficient physical controls to prevent SOPCs reaching the permanent water body or aquifer;

(B) natural attenuation of the SOPCs will reduce the concentrations to below the applicable environmental standards before the SOPCs reach the water body or aquifer;

(C) it can be established there is no hydrologic connectivity between contaminated media and the water body or aquifer.

Information Note

Ingestion of groundwater through livestock watering is considered an operative pathway under agricultural land use and in natural areas subject to grazing leases. The derivation of soil guidelines for the protection of groundwater for livestock is based on a leaching, mixing and dilution model that considers certain soil and hydrogeological parameters. Due to the potential to develop surficial dugouts for livestock watering, the pathway cannot be automatically ruled out for the agricultural land use.

Where contamination is clearly below the depth normally associated with a surficial dugout and where the underlying groundwater is not suitable for livestock watering, it may be possible to rule the pathway out in the event that there is a similar intervening layer between the contaminated aquifer and any aquifer that may be suitable for livestock watering, as defined for the drinking water aquifer.

Physical Controls

Isolation of the aquifer by geologic unit that will ensure that natural attenuation will reduce the concentration of the SOPCs below the tier 2 values in SEQG.

Hydrodynamic containment of the SOPCs in a geologic unit such that they will not reach the water body.

Engineering Controls

Barriers such as buried drains, cut-off walls or other engineered structures may be employed to ensure that SOPCs do not migrate and impact the receptor.

Administrative controls

Sufficient administrative controls are required to ensure that all engineered controls are maintained and effective.

Protection of Irrigation Water

(20) The protection of irrigation water pathway is considered operative under agricultural land use and may be eliminated if:

(a) the SOPCs are PHCs or BTEX compounds and no other SOPCs are present at the site; and

(i) one or more of the following are met:

(A) there are sufficient physical controls to prevent SOPCs reaching the permanent water body or aquifer;

(B) natural attenuation of the SOPCs will reduce the concentrations to below the applicable environmental standards before the SOPCs reach the water body or aquifer;

(C) it can be established there is no hydrologic connectivity between contaminated media and the water body and aquifer.

Information Note

Use of groundwater for irrigation is considered an operative pathway under agricultural land use. The derivation of soil guidelines for the protection of groundwater for irrigation is based on a leaching, mixing and dilution model that considers certain soil and hydrogeological parameters. This pathway is included in all agricultural scenarios. Due to the potential to develop surficial dugouts for irrigation, the pathway cannot be automatically ruled out for the agricultural land use. Where contamination is clearly below the depth that would normally be associated with a surficial dugout and where the underlying groundwater is not suitable for irrigation, it may be possible to rule the pathway out in the event that there is a similar intervening layer between the contaminated aquifer and any aquifer that may be suitable for irrigation, as defined for the drinking water aquifer.

Physical Controls

Isolation of the aquifer by geologic unit that will ensure that natural attenuation will reduce the concentration of the SOPCs below the tier 2 values in SEQG.

Hydrodynamic containment of the SOPCs in a geologic unit such that they will not reach the water body.

Engineering Controls

Barriers such as buried drains, cut-off walls or other engineered structures may be employed to ensure that SOPCs do not migrate and impact the receptor.

Administrative controls

Sufficient administrative controls are required to ensure that all engineered controls are maintained and effective.

Protection of Wildlife Water

(21) The protection of wildlife water pathway is operable under agricultural and natural area land use and may be eliminated if:

(b) the SOPCs are PHCs or BTEX compounds and no other SOPCs are present at the site; and

(i) there are no permanent water bodies within 500 metres of the site; or

(ii) one or more of the following are met:

(A) there are sufficient physical controls to prevent SOPCs reaching the permanent water body;

(B) natural attenuation of the SOPCs will reduce the concentrations to below the applicable environmental standards before the SOPCs reach the water body;

(C) it can be established there is no hydrologic connectivity between contaminated media and the water body; or

(D) engineering controls with sufficient administrative controls are present to prevent receptor exposure.

Information Note

Protection of groundwater for wildlife watering is applicable under natural areas and agricultural land uses, but may be excluded at Tier 2 if no surface water bodies are present within 500 m of the site. If the pathway is operative, certain soil and groundwater parameters are eligible for Tier 2 Guideline Adjustment

Physical Controls

Isolation of the aquifer by geologic unit that will ensure that natural attenuation will reduce the concentration of the SOPCs below the tier 2 values in SEQS.

Hydrodynamic containment of the SOPCs in a geologic unit such that they will not reach the water body.

Engineering Controls

Barriers such as buried drains, cut-off walls or other engineered structures may be employed

Management Limits

(22) Management limits are applicable for all land use scenarios and soil depths and cannot be eliminated.

Information Note

Management limits are meant to account for effects of PHC contamination that are not accounted for in other pathways, including:

- Free phase formation;
- Exposure to workers in trenches to PHC vapours;
- Fire and explosive hazards;
- Effects on buried infrastructure; and
- Aesthetic considerations.

Tier 3 – Site-Specific Risk Assessment, Risk Management, and Criteria Development

(23) Determination of tier 3 endpoints may be done by:

i. completion of a human health risk assessment;
ii. completion of an ecological risk assessment;
iii. development of site specific environmental quality values.

(24) No person shall select a tier 3 endpoint using a human health risk assessment or ecological risk assessment unless:

i. the assessments are conducted in accordance with and considering the references in Table 1: References for Human Health Risk Assessment or Ecological Risk Assessment (page 16) or other jurisdictions as applicable;
ii. the hazard quotient obtained from the assessments are less than 0.2; and
iii. a risk management plan that consists of engineering, physical, and administrative controls, is developed that provides sufficient management to ensure that the hazard quotients remain below 0.2.

(25) No person shall select a tier 3 endpoint using site specific environmental quality values unless the derivation of the values are developed in accordance with and considering the references in Table 2: References for Site Specific Environmental Quality Values (page 16).

Information Note

In certain circumstances it may be possible to implement risk management measures without any associated remediation. Examples of such situations include operating facilities where natural attenuation is being relied upon in the long term and sites where remediation can be accomplished only at the time of site closure or redevelopment. In these cases, a monitoring program shall be developed and implemented to ensure that conditions do not become worse with time and that the risk management measures are effective. In cases, particularly those in which active remediation is not contemplated, the non-toxicity-based considerations, including explosion hazard, aesthetic and avoidance of free product, must be observed and addressed.

Table 1: References for Human Health Risk Assessment or Ecological Risk Assessment

Canadian Council of Ministers of the Environment. A Framework for Ecological Risk Assessment: General Guidance. 1996. Available: http://www.ccme.ca/assets/pdf/pn_1195_e.pdf

Canadian Council of Ministers of the Environment. A Framework for Ecological Risk Assessment: Technical Appendices. March 1997. Available: http://www.ccme.ca/assets/pdf/pn_1274_e.pdf

For guidance on Human Health Risk Assessment, refer to the following website

http://www.hc-sc.gc.ca/ewh-semt/contamsite/docs/index-eng.php

Table 2: References for Site Specific Environmental Quality Values

Canadian Council of Ministers of the Environment. Canada-Wide Standard for Petroleum Hydrocarbons (PHC) in Soil: User Guidance. January 2008.

Canadian Council of Ministers of the Environment. Canada-Wide Standard for Petroleum Hydrocarbons (PHC) in Soil: Scientific Rationale – Supporting Technical Document. January 2008.