GENERAL GUIDELINES
Dike Maintenance Act Approval for Pipe Crossings of Dikes

Under Section 2(4) of the BC Provincial *Dike Maintenance Act* (DMA), all proposed pipe installations that cross through or underneath a dike or dike right of way require the written approval of the Inspector of Dikes. This document presents the guidelines necessary for approval under the DMA;

1.0 General Requirements for Pipe or Conduit Crossings

- Pipe crossings must be designed by a qualified Professional Engineer.
- If possible, pipes should be configured to cross over the top of the dike.
- If it is necessary for a pipe to cross through or underneath a dike or dike right of way:
  - The pipe shall cross perpendicular to the alignment of the dike to minimize overall disturbance to the dike. Dikes shall not be viewed as convenient route for pipelines but as an essential public safety structure whose construction integrity shall not be compromised.
  - The design must include a clear means to retain and prevent the migration of soils along the path of the pipe surface. The purpose of this requirement is to provide a redundant safeguard against any loose zones, voids, or other preferred seepage paths that may be created through the pipe installation process. Please refer to Appendix A for additional information on granular filter zones to retain and prevent the migration of soils along the path of the pipe surface. Note that seepage collars are no longer accepted unless they are used in conjunction with a granular filter zone.
  - Cut and cover is the preferred method of pipe installation. Installations by directional drilling and/or pipe jacking are problematic since they disturb surrounding soils and make it difficult to obtain a watertight seal[1] along the conduit.

[1] September 2005 Federal Emergency Management Agency (FEMA) document entitled, "Technical Manual: Conduits through Embankment Dams" Pages 337 and 341 http://www.fema.gov/library/index.jsp

Ministry of Forests, Lands and Natural Resource Operations South Coast Region
Mailing/Location Address:
10470 152 Street
SURREY BC V3R 0Y3
Telephone:…(604) 582-5200
Facsimile: ….(604) 930-7119
Website:. www.gov.bc.ca/nro/

Revised October 6, 2014

2.0 APPLICATION REQUIREMENTS FOR PIPE OR CONDUIT CROSSINGS

2.1 Design Brief

The application should contain a design brief, prepared by a qualified Professional Engineer, which includes the following information:

- Details on the pipeline and pipe materials that include the design service life, strength to accommodate all applied loading conditions and foundation movements, and in the case of conduit have adequate access for inspection and cleaning
- Details on design and construction/installation methodology
- Details on measures taken to protect against internal erosion/piping caused by preferential seepage paths developing especially at the soil-structure interface
- Details on filters used which should include:
    - Summary of the analysis carried out to determine the size distribution for the granular filter material to ensure that it will be filter compatible with the soil used to backfill around the pipe, and
    - Results of the analysis including the design parameters used in the analysis
- References to the design standards utilized[2] (i.e. factors of safety, filter criterion, etc.).

2.2 Plan View Drawings

The application should include drawings in plan view depicting the following:

- The dike.
- Proposed new pipe or floodbox.
- Additional related improvements such as the headwall, flapgates, rip rap, etc.
- Details of the proposed measures to retain and prevent the migration of soils along the path of the pipe surface. (refer to Appendix A for additional details).
- All adjacent property lines.
- Limits of proposed or existing right of ways.
- Adjacent utilities.
- Turnarounds.
- Access ramps.
- All other relevant features.

[2] The design standards utilized in the design should be well established in engineering practice.

2.3 Cross-Sectional Drawings

The application should include representative longitudinal & transverse cross section(s) (at natural scales) through the dike depicting the following:

- Sideslopes and crest of the dike.
- Design flood elevation.
- Pipes, floodboxes, or utilities.
- Measures to retain and prevent the migration of soils along the path of the pipe surface.
- Pipe material (see constraints detailed in footnote)[3] and diameter.
- Details of pipe joints and gaskets (if applicable).
- Erosion protection measures.
- Other relevant information.

2.4 Drawing Details

Where applicable the project drawings shall include the following details:

- Landside filter zone including the dimensions of the zone and filter specifications.
- A section through the headwall showing the strategy to adequately found the structure and to provide erosion protection at the discharge.
- Gradation limits for filter materials, drainage materials, and general backfill materials to be placed within the foot print of the dike (for soils, the limits should include the percent passing the #200/0.075mm sieve).
- Specific instructions for placement and compaction of materials including lift thickness and minimum density criterion for compaction.
- Specifications for size distribution and thickness of proposed rip rap materials.
- Procedures for decommissioning of any pipes that will be abandoned (i.e. complete excavation and removal).
- A note specifying that the gradation of filter materials shall be approved by the project geotechnical engineer.

[3] More robust pipe materials such as steel, HDPE, and ductile iron are required for pipes crossing dikes. PVC, or corrugated metal piping may be permitted if you are able to provide a standard, code, or policy that requires their use for your project.

3.0 REFERENCES

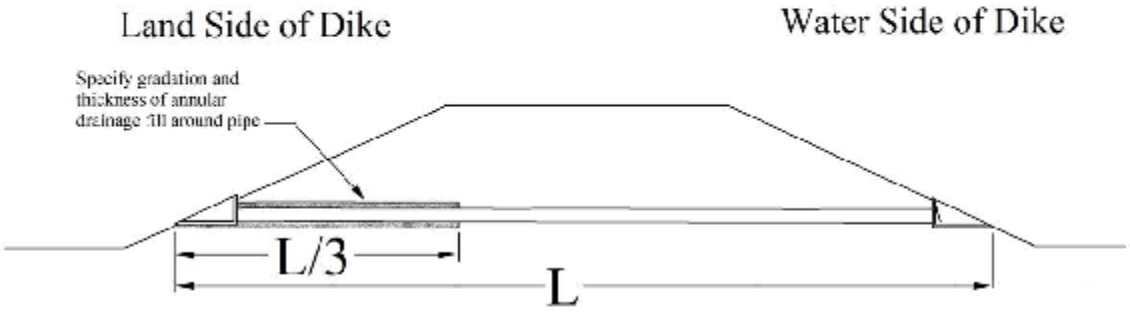
1. "Dike Design and Construction Guide: Best Management Practices for British Columbia" http://www.env.gov.bc.ca/wsd/public_safety/flood/pdfs_word/dike_des_cons_guide_july-2011.pdf
2. FEMA Publication 484. Technical Manual: Conduits through Embankment Dams. Sept 2005 http://www.fema.gov/media-library-data/20130726-1515-20490-8766/fema484.pdf
3. US Army Corps of Engineers. EM 1110-2-1913, "Design and Construction of Levees", Figure 8.1, Pg. 8-5. http://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-1913.pdf

APPENDIX A - MEASURES TO RETAIN AND PREVENT THE MIGRATION OF SOILS ALONG THE PATH OF THE PIPE SURFACE.

Overview – Loose zones, voids, or other preferred seepage paths may be introduced by the pipe installation process and such flaws can lead to internal erosion of the dike under design flood conditions. Such failures are well documented in case histories associated with earthen dams. The most common means of protecting against this type of failure is through the use installation of a granular filter zone as pipe backfill on the landside of the dike.

Landside Drainage Fill – The use of Landside Drainage Fills is described in the US Army Corps of Engineers document entitled "Design and Construction of Levees" and essentially consists of a nominal annular zone of free draining granular fill surrounding one-third of the landside pipe length. It is important that the size distribution of the granular material is designed to be filter compatible with the soil that was used to backfill the remaining water side portion of the dike. Drainage fills should be designed by an Engineer with experience in geotechnical engineering based on a clear knowledge of; soil conditions, groundwater conditions, design flood conditions, and pipe installation methodology.

CONCEPTUAL DRAWING FOR PIPE CROSSING
WITH ANNULAR DRAINAGE FILL



Seepage collars (or anti-seepage rings) – Assessment of past piping failures indicate that the presence of seepage collars often result in poorly compacted backfill[4] that can lead to dike failure and accordingly we do not accept the use of seepage collars as a means of preventing the migration of soils along the path of the pipe surface.

[4] US Army Corps of Engineers document EM 1110-2-1913 entitled "Design and Construction of Levees", page 8-4, paragraph 5: http://www.usace.army.mil/publications/eng-manuals/em1110-2-1913/entire.pdf