16.0 DIVERSION STRUCTURES

16.1 General

Diversion structures are generally used to divert water from an existing natural watercourse into a water supply conveyance system. For large diversions, such as the headworks for an irrigation main canal system that normally require a headpond, the diversion structure can include a weir, sluiceway, intake, and fishway. Provisions for allowing the river to return to near natural levels in winter (i.e. in general, water is not diverted into the conveyance system during the winter period), permitting boat access, or for passing floating logs may also be required.

16.2 Structure Location and Layout

Generally, the diversion structure is located within a stable channel. Therefore, a channel of straight or moderate curvature is preferred over one that has an actively progressing meander since floods may cause the latter type of channel to erode and bypass the structure. The foundation conditions at the proposed site for the structure should preferably consist of competent soils or rock with adequate bearing capacity and relatively low permeability.

The intake structure is normally located on the outside bend of the channel to minimize the intrusion of sediments into the conveyance system. Locating a gated sluiceway immediately adjacent to the intake will also help minimize the amount of sediments and debris that may enter the conveyance system.

In general, the crest of the sluiceway is normally in-line with the crest of the weir (since both discharge into the downstream channel), while the adjacent intake is set at an angle (preferably 45°) in order to minimize vortex zones, head losses, and the tendency to trap floating debris.

In cases where provisions are needed to facilitate the movement of fish past the diversion structure, a fishway is provided as discussed in Section 16.7.

16.3 Seepage and Drainage Measures

Depending on the foundation conditions and structure arrangements, seepage control and drainage methods would typically include one or more of the methods described in Sections 6.3 and 6.4, respectively.

16.4 Weir Section

An uncontrolled weir structure, sometimes in conjunction with an earth embankment, may be provided across the watercourse in order to raise the water level sufficiently to permit water to be diverted through the intake structure.

Typically for the weir structure, an ogee weir configuration with a hydraulic jump stilling basin is

employed; however, in some cases a trapezoidal weir may be considered. Water flowing over the weir will cause a submerged roller to form immediately downstream that can be hazardous to boaters and swimmers. Consequently, when choosing a site for the weir, its proximity to a populated area and safety requirements should be considered.

16.5 Sluiceway

The sluiceway structure is ordinarily designed to prevent larger sediments from entering or being deposited in front of the adjacent intake structure. This may be accomplished by providing a radial (undershot) gate on the sluiceway that would be operated as needed to draw or flush the sediments away from the intake.

The potential for the sluiceway to also pass floating debris may be considered, depending on the specifics of the layout and expected operating conditions.

16.6 Intake Structure

The intake structure is ordinarily located immediately adjacent the sluiceway as noted in Section 16.2. For flow control, the intake structure may be equipped with either slide gates or radial gates depending on the required diversion capacity. The inverts of the intake gates are typically set above that of the sluiceway gate as an added measure to keep sediments out of the conveyance system.

A trashrack or fish exclusion system, as discussed in Section 21.0, may be required to keep floating debris or fish out of the conveyance system.

16.7 Fishways

16.7.1 General

Typically, a fishway is required to allow fish to travel past the diversion structure.

The type and design requirements of the fishway is dependent on a number of variables including: the species, size and numbers of fish expected to use the fishway; the range of discharge; water levels, depths, and flow velocities within the watercourse during the migratory period; the difference in water level across the structure; attraction and guidance flow requirements at the fishway entrance; and lighting conditions.

Special care is required to properly locate the fishway relative to the other structure components such that fish are attracted towards and can readily find the fishway, as well as in choosing the correct design so that fish can traverse the fishway. Particular care is also required in determining the attraction flow characteristics that will be needed to help fish find the fishway entrance, and similarly, the guidance flow characteristics needed for fish to make their way through the fishway. As a result, input from a fish biologist respecting the location, orientation, type, and design

requirements for the fishway is normally required.

Fishways have typically been comprised of hard-engineered structures constructed using concrete, metal or wood; however more recently, consideration is being given to the use of naturalized fishways constructed using natural materials such as large boulders.

16.7.2 Hard-Engineered Fishways

Engineered fishways generally include the following types:

- Pool and weir type. This configuration consists of a series of stepped pools that are separated by weirs or cross walls. Water flows from pool to pool over the crest walls.

- Pool and orifice type. This configuration consists of a series of stepped pools that are separated by weirs or cross walls. Water flows from pool to pool through a submerged orifice.

- Denil type. This configuration consists of a steep flume or trough which has vanes installed on the sides and bottom.

- Pool and jet type. This configuration is similar to the pool and orifice type except the orifice consists of a vertical slot that extends for the full height of the weirs or cross walls.

Partial blockage of the flow passages, particularly for engineered fishways, could result in unfavourable conditions such as reduced opening sizes and higher velocities. Consequently, consideration should be given to incorporating a trash rack at the upstream end of the fishway.

16.7.3 Naturalized Fishways

Naturalized fishways are a relatively recent development. They are gaining attention and becoming more acceptable to the public and regulatory agencies primarily because they are designed to simulate the natural stream and are constructed using natural materials.

Research on the design and performance of such facilities is ongoing, therefore a review of recent published technical literature should be considered as part of the design process. Natural fishways generally include the following types as outlined in Kells et al. (2000):

- Pool and riffle type. This configuration consists of a stair-step arrangement comprised of a short steep channel section followed by a pool section.

- Rocky ramp type: This configuration consists of a long sloping channel impregnated with large boulders to produce a “boulder garden” effect.

16.8 Low Level Outlet

A low level outlet conduit, normally gated, may be provided to allow riparian flows to be released particularly when the sluiceway gate is closed and low flow conditions exist within the watercourse.

Depending on the size and configuration of the structure, it may be appropriate to combine the low level outlet conduit as part of one of the other structure components.