# 6.1 Lining of District Irrigation Canals

## *Applicability*

This BMP applies to any water district and serves as an integral part of the water distribution system designed to facilitate the conservation and efficient conveyance of water to a group of water users.

## *Description*

A fixed lining of impervious material is installed in an existing or newly constructed irrigation canal or lateral canal. The three most commonly used impervious liners for irrigation canals in Texas are Ethylene-Propylene-Diene Monomer ("EPDM"), urethane, and concrete. Each type of liner has benefits and detriments specific to the liner. EPDM is least expensive and concrete the most. Reinforced concrete liners have the longest durability but may have the largest seepage rate. Urethane has low seepage rates but uses hazardous chemicals during the installation. The U.S. Bureau of Reclamation report titled "Canal Lining Demonstration Project Year 7 Durability Report" provides a detailed description of these and other liners.

## *Implementation*

The canal considered for lining shall be of sufficient capacity to meet its requirement as part of a planned irrigation water conveyance system without overtopping, but with enough capacity to deliver the water needed to meet the peak consumptive use. The specific steps required to implement this BMP depend on the type of canal liner used and the existing conditions of the canal to be lined. Installation specifications, material specifications and detailed installation instructions for most types of canal liners are available from liner manufacturers and governmental agencies. In general, most canal lining projects require the following steps:

1. A site survey of the proposed canal being lined including length of canal and one or more typical cross-sections of the canal.
2. Development of a plan that details the installation and materials specifications.
3. Preparation of the canal bed, including removal of any vegetation, bed compaction, and bed shaping.
4. Installation of liner.
5. Finish work including inlets and outlets to lined canal.

## *Schedule*

The time required to line a canal depends on the size of the cross-sectional perimeter of the canal, the amount of work needed to prepare the canal for lining, and the type of liner used to line the canal. EPDM liners are usually the easiest and quickest to install. For a small canal with a top width of 15 feet, between 500 and 1,000 feet of EPDM liner can be installed per day with a crew of eight persons.

## *Scope*

Each type of liner has advantages and disadvantages. EPDM should not be used in a location where the canal is subject to large animal or other traffic that might tear the liner. Concrete liners handle most traffic well but are subject to crack formation due to soil heave, tree root pressure, or thermal expansion.

## *Documentation*

To document this BMP, the water district shall document and maintain one or more of the following records:

1. As-built drawings or photographs of the lined canal; and
2. Water measurement records from both the period before and after conversion to the water efficient irrigation system.
3. Copies of equipment invoices or other evidence of equipment purchase and installation; and
4. Any USDA Farm Service Agency or other governmental agency evaluation and assistance reports that may relate to the project.

## *Determination of Water Savings*

The seepage rate of a canal can be estimated by conducting a ponding test with a typical section of the canal prior to the canal being lined. A ponding test measures the rate at which the level of water ponded behind an earthen dam placed in the canal drops over two to twenty-four hours. The amount of the canal that is wetted by the pond behind the dam must be measured. The seepage rate can be calculated as acre-feet per mile of canal per day. The total quantity of water lost to seepage from the canal is estimated by multiplying the seepage rate times the number of days per year the canal is used to convey water. For example, a small farm canal with a wetted perimeter of 20 feet and a length of 1 mile is found to have a seepage rate of 1.5 acre-feet per mile per day assuming the canal is used to carry irrigation water for 270 days per year. The total seepage from the canal is 405 acre-feet per year (1 x 1.5 x 270). Lining the canal with an EPDM liner would result in minimal or no seepage. Seepage loss from a concrete lining depends on how the liner was constructed and the amount of water that seeps through cracks and expansion joints in the concrete.

## *Cost-Effectiveness Considerations*

The U.S. Bureau of Reclamation in June of 2001 published “Construction Cost Tables – Canal Lining Demonstration Project.” The cost table included material and installation cost for approximately thirty-five different types of liners or coatings. The cost for an installed EPDM liner was approximately $0.85 per square foot and $1.43 per square foot for urethane. The cost for concrete lining ranges from $2.50 to $3.50 per square foot. For the example above the cost per acre-foot of water salvaged in the first year for the EPDM liner would be $89,760 ($222 per acre-foot), for urethane liner $151,008 ($373 per acre-foot) and for concrete $316,800 ($782 per acre-foot). Because each of these types of liner has a different life expectancy a present value analysis of cost should be performed. For example, while the concrete liner may have the most expensive installation cost, it also has the longest life expectancy.

## *References for Additional Information*

1. *Conservation Practice Standard, Irrigation Water Conveyance, Flexible Membrane Canal and Canal Lining*, 9 p. Natural Resources Conservation Service, October 1980.
2. *Canal Lining Demonstration Project Year 7 Durability Report*, 156 p. U.S. Bureau of Reclamation- Pacific Northwest Region, September 1999.
3. *Canal Lining Demonstration Project - 2000 Supplemental*, 46 p. U.S. Bureau of Reclamation- Pacific Northwest Region, January 2000.
4. *Construction Cost Tables – Canal Lining Demonstration Project*, 5 p. U.S. Bureau of Reclamation, Pacific Northwest Region, June 2001.