

## *the problem*

As clean water becomes more difficult to acquire, the need for secure water containment and transport grows. This problem is exacerbated by urban water demands and increased agricultural production in remote areas around the world. There is a demand



for vast amounts of water in areas where water does not naturally exist at the levels needed. To mitigate this problem, canals have been constructed to transport water from the source to where it is needed. Historically, many of these canals have been either earthen or concrete lined. Earthen canals, while relatively inexpensive to construct, lose 50 percent or more of the water they transport to seepage. They also are prone to erosion, vegetative growth and other problems that greatly reduce their effectiveness over time. Concrete canals solve the problems of erosion and vegetative growth, but are more costly to construct and prone to cracking over time, resulting in significant loss of water to seepage. In fact, a concrete lined canal may still lose 30 percent of water to seepage – a lot of money is spent with not a lot of resources gained.

## *the solution*

Geosynthetics (geomembranes, geotextiles, and geogrids), either alone or in conjunction with a concrete veneer, can greatly increase the effectiveness of a canal lining system. The “Canal-Lining Demonstration Project Year 10 Final Report”, published in



November 2002 by the United States Bureau of Reclamation, indicates that seepage can be reduced from 50 percent or more for earthen canals to 10 percent for geomembrane lined canals and less than 5 percent for canals using geomembrane in conjunction with a concrete cover. Not only are erosion and vegetative intrusion mitigated, but leakage is greatly reduced as compared to a concrete alone system. While the concrete veneer may still crack over time, the geomembrane remains in place underneath the veneer to prevent seepage until the concrete can be repaired. In addition to geomembranes, geotextiles may be used underneath the geomembrane to cushion it from rocky or uneven subgrade. Geogrids may be used to support the lining system over poor subgrade.

## *covered and exposed geomembranes*

Geomembrane canal liners may be left exposed or may be protected with a concrete cover. Most geomembranes are UV stabilized and can remain exposed for an extended length of time with no decline in their level of performance. However, because exposed geomembranes are more susceptible to dam-



age from such things as rocks, debris, equipment, animal intrusion and vandalism, most geosynthetic lined canal systems should be protected with a concrete cover or, at minimum, an earthen cover for ballast. For such applications, the protective concrete covering may be cast-in-place with reinforcing steel, pumped into geotextile forms, pre-cast in panels or spray applied.

## *relining of existing canals*

Geomembranes are well suited not only for new construction, but also for lining over existing earthen or concrete canals that may be cracked and leaking. Different sections of the canal may be repaired over time to reduce leakage at the critical points if the current budget does not allow for a complete relining.

# Table 1

## Cost, Lifetime and Effectiveness of Three Types of Canal Lining Systems\*

Type of Lining System	Concrete Alone	Exposed Geomembrane	Geomembrane with Concrete Cover
Construction Cost (\$/ft. <sup>2</sup> )	1.92–2.33	0.78–1.53	2.43–2.54
Anticipated Lifetime (years)	40–60	10–25	40–60
Maintenance Costs (\$/ft. <sup>2</sup> /yr.)	0.005	0.010	0.005
Seepage Reduction (% Effective)	70	90	95
B/C Ratio	3.0–3.5	1.9–3.2	3.5–3.7

\* see following panel for table details.

## costs and lifetime considerations

The table on the previous panel, from the executive summary portion of the “Canal-Lining Demonstration Project Year 10 Final Report”, details the construction and maintenance costs for the various systems as well as life expectancy, effectiveness of seepage reduction and benefit/cost (B/C) ratios. The B/C ratio is defined as the amount of water saved per dollar spent. Additionally, the B/C ratio for maintenance is 10–12 for all types of systems. That is, for every \$1 spent on maintenance, the end user conserves \$10–12 worth of water.

## for more information



To find out more about how canal liners can provide solutions for your

company, contact the Geosynthetic Materials Association at 1801 County Rd. B W.; Roseville, MN 55113; +(1) 651/225-6942; fax +(1) 651/631-9334 dfhalloran@ifai.com or visit [www.gmanow.com](http://www.gmanow.com).

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## Canal Lining with Geosynthetics



Educational Series