

FGI Webinar: Geosynthetics Case Studies

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Introduction

Aging water infrastructure, including reservoirs, lined storage systems, and treatment basins, faces critical operational and structural challenges. Leakage, sediment accumulation, ice formation, thermal cycling, and inefficient water management compromise system performance and increase maintenance demands. Conventional rehabilitation methods—such as partial concrete repairs, draining, and localized liner patching—frequently require prolonged service interruptions, heavy manual labor, and extensive site preparation. Geomembranes present a durable, flexible, and cost-efficient alternative, facilitating rapid installation, enhanced structural performance, and reliable long-term operation. This webinar outlined advanced site-specific rehabilitation strategies, prefabrication workflows, detailed installation sequencing, quality control protocols, and performance considerations under variable environmental and operational stressors.

Historic Urban Reservoir Rehabilitation

A large historic urban reservoir posed multiple technical challenges, including variable water depths, uneven subgrade conditions, restricted access, and continuous stormwater inflow. Prefabricated geomembrane panels were manufactured off-site to dimensional tolerances within $\pm 0.5\%$ to facilitate accurate alignment during staged transport. Panels were sequenced for installation in 10–15 m wide sections, using flotation techniques and temporary ballast systems weighing 50–150 lbs per linear meter to stabilize the panels before seam welding. Seam welding incorporated double-track extrusion, with 25–30 mm overlap per ASTM D4437, followed by vacuum and spark testing at 5 m intervals. Critical seams and anchor points were inspected by certified divers on a 2-week cycle post-installation to detect potential micro-leaks. Additional design considerations included UV-protective coatings applied at 20–25 mil thickness, thermal expansion joints every 30–40 m to accommodate $\pm 25^\circ\text{C}$ seasonal variation, and engineered anchoring at perimeter, inlet, and outlet structures to resist hydrostatic uplift under fluctuating

water levels. Long-term maintenance protocols emphasized quarterly inspections, puncture detection, and preemptive corrective interventions to maintain operational reliability.

Athletic Field Subsurface Liner Installation

A large-scale athletic field rehabilitation project integrated a prefabricated geomembrane liner beneath synthetic turf to enhance subsurface water retention, air circulation, and thermal regulation. Installation spanned multiple panels covering over 25,000 square feet, coordinated precisely with the turf installation schedule to minimize disruption. Factory-controlled panel fabrication ensured dimensional uniformity within ± 2 mm, reducing on-site seam deviations. Panels were anchored mechanically with stainless-steel spikes every 0.5 m along panel edges, and tensioning was applied using hydraulic spreader bars to achieve uniform stress distribution. Temporary ballast bags weighing 20–50 lbs per unit were strategically placed to prevent lateral movement before final seam welding. Seams utilized 25 mm overlap with dual extrusion welding, verified with vacuum testing at 5 m intervals and pull tests every 50 m. Drainage layers composed of ASTM #57 stone were installed beneath the liner to mitigate hydrostatic pressure, while interface friction was maintained at 0.45–0.50 to optimize panel stability. Post-installation verification confirmed water retention efficiency, seam integrity, and deformation tolerances within 5 mm over 100 m² test sections.

Hydroelectric Reservoir Liner Replacement

A hydroelectric pumped storage facility required replacement of a deteriorated geomembrane liner subject to ice formation, rapid drawdown, and temperature cycling. The replacement liner featured 45-mil CSPE with enhanced puncture resistance, tensile strength exceeding 3,000 psi, and UV stability of 7,000 hours per ASTM G154. Panels were prefabricated in 12–15 m sections, with welding performed in a staggered sequence to maintain continuous operation of the reservoir. Anchoring incorporated steel rods spaced at 1.0–1.5 m intervals at critical inlet, outlet, and structural junctions, while ballast weights of 75–125 lbs/m were applied during installation to counter buoyant forces. Seam verification included vacuum testing every 5 m, spark testing along exposed sections, and random pull tests on 10% of seams. Thermal expansion was addressed with expansion loops every 35–50 m, designed to accommodate ± 30 °C seasonal temperature variation. Inspection and maintenance cycles included bi-monthly diver inspections for the first year, followed by quarterly assessments for the subsequent five years, focusing on seam integrity, anchor stability, and localized material deformation.

Installation and Maintenance Best Practices

Prefabrication minimized on-site errors, maintained dimensional accuracy, and reduced seam inconsistencies. Ballast systems were engineered for site-specific hydrodynamic and wind conditions, with weight distribution and placement sequences tailored to prevent wrinkles, panel drift, or uplift. Mechanical anchors were installed in a pattern dictated by operational loading and panel geometry, often requiring temporary support frameworks during installation. Post-installation verification included diver inspections, vacuum and spark seam testing at 5 m intervals, and monitoring of panel deformation under initial fill. Long-term maintenance

incorporated drainage management, UV protective coatings, and periodic monitoring of anchor points, seam integrity, and surface wear. Continuous collaboration between engineers, installation teams, and operations personnel was essential to ensure performance and maintain operational continuity.

Material Specifications and Performance Considerations

Geomembrane selection accounted for chemical compatibility, tensile strength, puncture resistance, and UV exposure. Panel thicknesses ranged from 36-mil to 45-mil CSPE, selected based on expected hydrostatic pressure, operational loading, and environmental exposure. Seam welding followed ASTM D4437 standards, with overlapping extrusion of 25–30 mm. Tensioning applied during welding maintained uniform stress distribution to reduce potential creep or delamination. Subgrade preparation included compaction to 95% Standard Proctor density and placement of a free-draining aggregate layer 15–25 cm thick to ensure uniform load distribution and mitigate hydrostatic pressure. Anchoring strategies were designed for seasonal water level fluctuation, ice formation, and thermal expansion, with periodic verification through pull tests and diver inspections.

Operational and Environmental Considerations

Ice formation, rapid drawdown events, and thermal cycling were identified as critical stressors for geomembrane performance. Panel sequencing was designed to allow staged installation without disrupting reservoir operations. Anchors and ballast systems were engineered to resist uplift and lateral movement under hydrostatic load variations. Drainage layers prevented localized water accumulation, while UV protection coatings mitigated long-term degradation from sunlight exposure. Expansion loops accommodated thermal contraction and expansion, and critical seams were strategically reinforced with additional welding passes for areas subject to high stress or repeated freeze-thaw cycles.

Conclusion and Key Recommendations

Rehabilitation of reservoirs and water infrastructure demands a methodical, engineering-focused approach emphasizing prefabricated geomembrane systems, site-specific installation strategies, and stringent quality control. Key factors for successful implementation include precise panel placement, rigorous seam verification, engineered anchoring, optimized drainage, and ongoing maintenance. Integrating these components into a coordinated design and installation plan ensures long-term operational performance, reliability, and cost efficiency. Geomembrane systems, when applied with rigorous engineering and installation standards, provide durable, adaptable, and sustainable solutions for complex water infrastructure rehabilitation projects.