

## **Category 2 – Meeting the Challenge of a Difficult Job – Specialty Contractor**

**Contractor: Fiore & Sons, Inc.**

**Project: 70 Ranch Reservoir**

**CONTRIBUTION TO FARMING AND RANCHING** - Located 6 miles east of Kersey, Colorado, 70 Ranch Reservoir, named for the distance in miles from Denver in the early 1900s, is an off-channel, raw water storage reservoir, nestled on a sandy-silty alluvial bench above the South Platte River, and below the confluence of the St. Vrain and Cache La Poudre Rivers. (Photo #1) Partnering with the Platte River Water Development Authority, this 5,500-acre-foot (1.8 billion gallons), \$22 million storage facility is used to store water to support 70 Ranch's cattle and farming operations and to provide storage for local agricultural and municipal water providers.

The reservoir and diversion are in the rolling terrain of the South Platte River valley where deep alluvial (water deposited) and Aeolian sands (windblown) dominate the porous soils, susceptible to wind and rain erosion. Agricultural land on the owner's property, west and north of the proposed reservoir, was filled and reclaimed with the excess material excavated from the Reservoir.

**CAPACITY AND FUNCTION** - With a maximum surface area of 163 acres and a maximum active storage depth of 44 feet, the bottom and sides are lined with a geomembrane and open cell aggregate filled slope revetment in the active pool zone. It has two resources for water delivery and is partially filled by gravity from the Latham Ditch while water can also be diverted from the South Platte River through a new side channel diversion structure feeding into a pump station.

The primary purpose of 70 Ranch is to provide augmentation water (backfilling the river). The pipeline delivery system consists of a combination of 2,100 lf of reinforced concrete pipe and 5,175 lf of ductile iron pipe. The Reservoir outlet (Photo #2) works allow for gravity flow of reservoir releases back to the South Platte River at the same location as the diversion location. Releases are made at a single gated inlet/outlet structure measured with purpose-built concrete Parshall Flume equipped with Smart Gates and a pressure transducer stilling well apparatus.

**RESERVOIRS AND DITCHES** - Colorado agriculture is largely made possible through local irrigation ditches that allow water to be taken from the main stem of a local river for delivery to farmers. 70 Ranch has multiple irrigation ditches running through its lands including the Riverside Intake Canal, Illinois Ditch, Lower Latham Ditch, Hardin Seep Ditch and Empire Canal. The Reservoir will allow for storage during wetter periods, and for release during drier months. Water rights and State Dam Safety rules are overseen by the Office of the State Engineer of Colorado, lead agency and authority for project reviews, permitting and construction. Water diverted from the river upstream in an agricultural ditch is used to fill the reservoir to provide storage for water rights holders during the dry part of the year.

**WATER QUALITY** - Protecting and preserving water quality was a top priority. Submerged below groundwater, the supply pipeline installation required de-watering resources to divert 400,000 gallons/hour of water for six months during construction. A State Construction Dewatering Permit required water volume be tracked and samples routinely obtained and tested at Colorado Analytical Labs for water quality. The permit specified constituents of Total Suspended Solids, pH, Arsenic, and Manganese to ensure water being returned back to the South Platte system was suitable and not encumbered. Well points penetrating beneath the excavation, filter socks, and inverted pipe splash down to reduce erosion at the outfall, were all deployed in relocating the localized ground water. Over 115 water tests and 55 site inspections were completed. Field staff were trained to recognize water quality issues and carefully track and obtain samples.

Field supervisors, project managers and engineers, and company inspectors were trained to recognize sediment and erosion issues, manage the Compliance Wise tracking software, perform field inspections and execute Fiore & Sons, Inc.'s Safety program. A detailed, ever-evolving Sediment and Erosion Control Plan was developed and put in place. Daily logs, combined with weekly and post-event inspections, ensured practices were in place and additional ones were included in the Plan update. Berms at the top of slopes, diversion ditches, surface roughing, wattles, aggregate lined silt basins, temporary seeding, and riprap lined outfalls were deployed. Secondary containments for fuel, petroleum products and adhesives for the liner included round,

1,000-gallon, repurposed, galvanized cattle troughs or poly lined earth berm basins. Field staff completed training on spill kits and deployment.

**THE BASIN** - Water is a precious commodity in the West and especially in North Eastern Colorado where soils are deep and droughty. Reservoirs in the area are typically “leaky”, often losing up to 30% of their full capacity annually. To avoid this leakage, 70 Ranch is lined with a synthetic liner material that covers the bottom and sides of the reservoir and requires workers to pull the liner in place. (Photo #3) Due to the porous characteristics of the sandy material, over 7 million sf of RPP (Reinforced Polypropylene) liner covers the reservoir bottom and embankment slopes. (Photo #4) Classified as a Low Hazard dam, 70 Ranch is a homogenous earth fill dam requiring placing 3.1 million cy of native soil to form the embankment. The dam embankment is nearly 2.1 miles in length with a jurisdictional height of 47 ft. The embankment, at the toe of the slope, is over 400 ft wide with a crest width of 150 ft. Nearly 1.39 million cy of earth was placed for the embankment along with an additional 1.54 million cy of general cut fill to shape and create the basin. (Photo #5)

Aside from adequate protection at the riverside, and diversion of large rip rap and sheet pile to protect the structure from savaging floods, the reservoir has a unique revetment design. (Photo #6) The revetment, a four-part system made up of 8 oz. per sq yd Geotextile, atop 45 mil Geosynthetic pond liner, beneath GeoWeb open cells secured together tangentially with TP-67 Tendons and filled with 2-inch minus angular aggregate filler, was assembled on 4:1 slope in very sandy to gravelly soils. The project complies with stringent fine grading to 2” tolerance as required by CO State Engineer for jurisdictional impoundments & project specs. (Photo #7)

Construction of the revetment was a challenge. First, no weeds could be under the liner and as a water storage project, herbicide was considered “not acceptable”. The solution was manpower...a line of 30 men walking and hand picking/smoothing the ground...a highly physical challenge. Once fine graded, utilizing GPS heavy equipment, all liner and cells were placed by hand. Because the cells and grade beneath are easily damaged if driven on, a sand and gravel mining conveyor stacker was used for placement. Over 26,000 cy of aggregates was placed onto the slope and into awaiting pockets. A light skid steer (and hand raking) ensured

every pocket was filled to the correct height, all under inspector's watch. The break in slope, two-thirds up the dam face, created a narrow ledge that was covered with aggregates. The solution to this "limited access" problem was a conveyor/stacker (Photo #8) that delivered aggregates and soil to a waiting wide-track CAT Dozer that evenly applied material along the ledge to overlap with the now-filled cells.

An effective dry land seed mix suitable for the semi-arid and deeply sandy soils was developed: blue grama, little bluestem, prairie sand reed, sand drop seed, side oats grama, and western wheatgrass. All were applied with hydro-mulch through Finn Equipment truck-mounted applicators for slopes and with an agricultural seed drill and straw crimp for flatter terrain. Supplemental water, delivered by off-road water truck equipped with spray booms and monitors, was routinely deployed during establishment.

**INNOVATIVE SHORE EROSION CONTROLS** - The application of the pond liner underneath a cellular stone filled revetment is not common. Often their intended purpose conflicts with liners being smooth and revetment materials puncturing the liner thus reducing effectiveness. Although common to see filter fabrics underneath revetments, setting the cells atop a water proof liner is uncommon. Application of a multi-layer system of liner fabrics, open cells and strategically placed aggregate fillers is a unique application of all otherwise well-known products. Innovation about how to best integrate established and available materials in a large quantity to meet the ultimate goal of water conservation; slope erosion controls with a long service life; and meeting the budget for costs vs storage value, were all accomplished through the incorporation of this new idea. Innovation for the application of mining equipment with a conveyor stacker to carefully place the materials on the slope, in the cells and atop a narrow bench, helped ensure the installed system met design requirements. (Photo #9)

**CDPHE CSEP INSPECTIONS AND SAFETY** - In a cooperative partnership between AGC and the Colorado Department of Public Health & Environment (CDPHE), Fiore and Sons, Inc. is the only heavy civil contractor in Colorado in the Stormwater Excellence Program (CSEP) program to best execute NPDES Discharge permit. The 70 Ranch project site received a Compliance Determination 1 (CD1), the highest possible achievable mark.







Photo #3



Photo #4



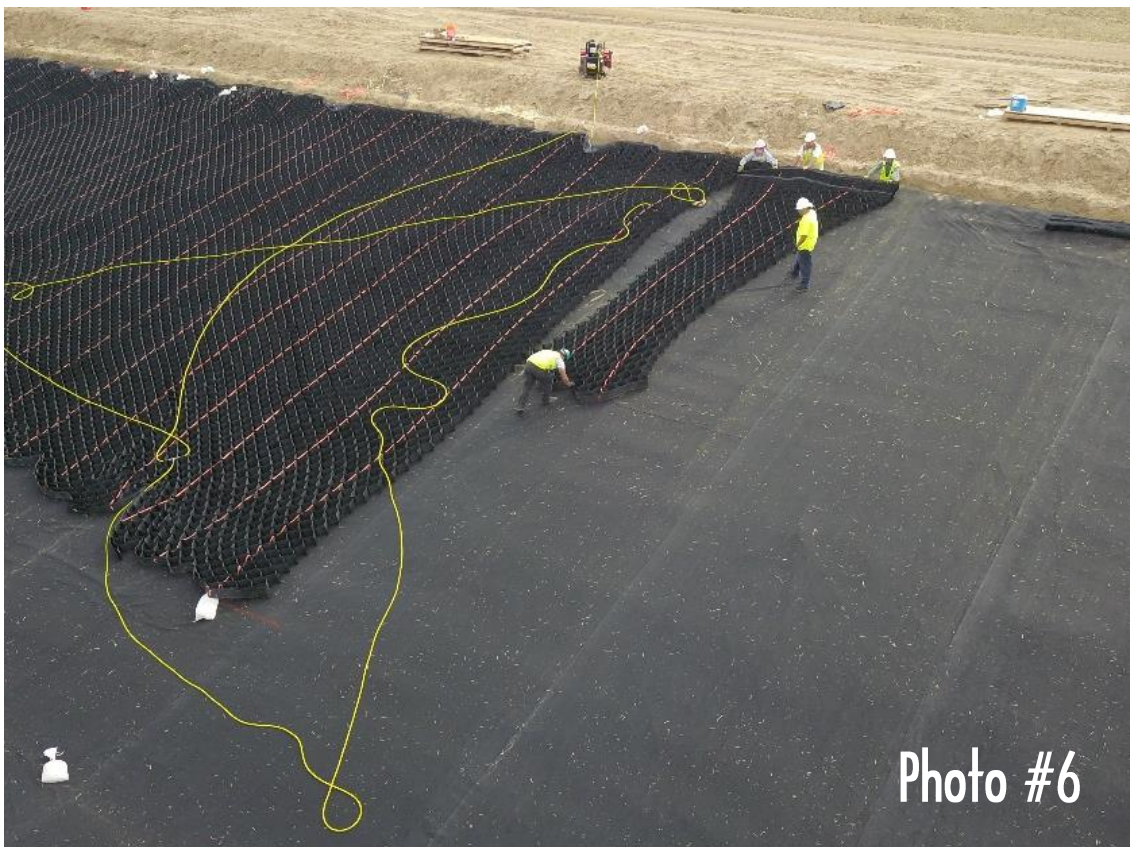










Photo #9



Photo #10