Alternative Coal Ash Pond Closure Design and Construction – Lessons Learned

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INTRODUCTION

Coal ash pond closures often face unique challenges due to location, available borrow soils, and construction constraints. These challenges can lead to alternative methods of closure to comply with Resource Conservation and Recovery Act (RCRA) Subtitle D and coal combustion residuals (CCR) regulations. This paper summarizes the construction of the first permitted ClosureTurf® cap used in the state of Illinois and briefly discuss the constructability benefits and challenges that should be evaluated during the design process of CCR pond closures.

DESIGN STAGE

At the beginning of the design stage, a site-specific feasibility analysis for alternative closure methods is suggested. When evaluating the capping in place method, the traditional soil/geomembrane cap should be evaluated against other methods such as turf products, and include potential reuse options such as solar power generation in the life cycle evaluation.

A typical RCRA Subtitle D cap includes a smooth subgrade, geomembrane (typically 40-60 mil HDPE), geonet (if required by slope steepness and storm water design), 2.5 feet (0.76 m) of cover soil, 0.5 feet (0.15 m) of topsoil, and a vegetative cover. Since these are the current industry standard covers, the design and approval process is relatively straight forward. Typical Subtitle D covers commonly have issues with erosion, high total suspended solids (TSS) in storm water runoff, and difficulties establishing and maintaining vegetation. The availability of borrow soils, lost air space, difficulties in building partial closures, impacts to the surrounding population centers, and limited land reuse options affect the cost effectiveness of the Subtitle D cover option.

Turf technologies have advanced to meet the performance requirements of RCRA Subtitle D regulations and provide flexibility in areas with poor quality soils or low soil availability, long term maintenance at decommissioned facilities, or economic challenges over the lifecycle of the project. Turf technologies require a high level of communication with regulators in states where they have not yet been used, but may net a significant amount of time and monetary savings over the life cycle of the project. ClosureTurf® is the turf product that Geotechnology has used in design and construction quality assurance for ash pond closures and will be the turf technology discussed herein.

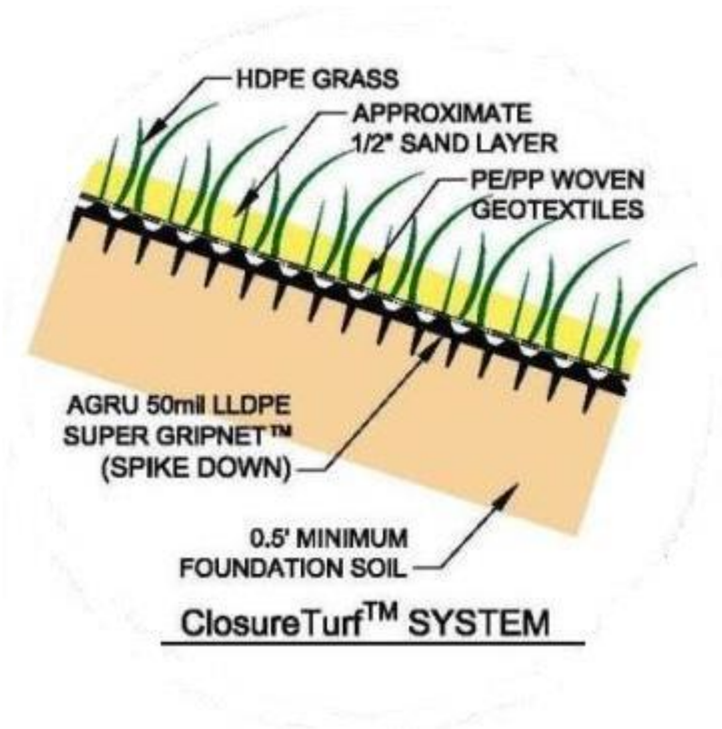

Figure 1: ClosureTurf® typical cross section

The ClosureTurf® system (Figure 1) involves a smooth subgrade overlain by an LLDPE or HDPE geomembrane (typically 40-50 mil thick), a geotextile with turf material, and a 0.5-inch (1.27 cm) sand or sand/concrete mixture. The geomembrane is either considered a Super Gripnet™ or MicroSpike™ depending on the surface water flow that needs to be controlled.

The knobs on top of the Super Gripnet™ and MicroSpike™ control the water flow down the slopes. The geotextile with turf material protects the geomembrane from impact and solar radiation that damages exposed geomembrane material, while breaking up wind uplift pressures (Figure 2). The 0.5 inches (1.27 cm) of sand provides protection to the geotextile and allows for light vehicles to drive on top of the system. The sand material can be replaced with sand/concrete or sand/epoxy mixes in channels where the maximum storm water velocity exceeds 4 ft/s (1.22 m/s).

Figure 2: ClosureTurf R cap installed components

The ClosureTurfR system eliminates issues such as soil erosion, high TSS in storm water runoff, difficulties establishing and maintaining vegetation, and long-term maintenance. In some areas, in-place ClosureTurfR systems have had solar systems installed on top for long term beneficial reuse. However, if borrow soils are readily available, the upfront cost of installing the ClosureTurfR system can be prohibitive.

POWER PLANT IN ILLINOIS

During the design of the CCR pond closures, a variety of alternatives including traditional RCRA caps and alternative caps were analyzed. During this process, consolidating ash within two basins and a ClosureTurfR cap was chosen. This preserved existing roadways and pipelines constructed on a bottom ash pond berm while minimizing the area of in place closure. The chosen method saved approximately $1,000,000-$2,000,000 in upfront costs versus the other closure methods considered, not including the additional long-term maintenance savings of traditional cap options. This is the first ClosureTurfR cap approved by the Illinois Environmental Protection Agency (IEPA) for use at CCR pond closures (Figure 3).

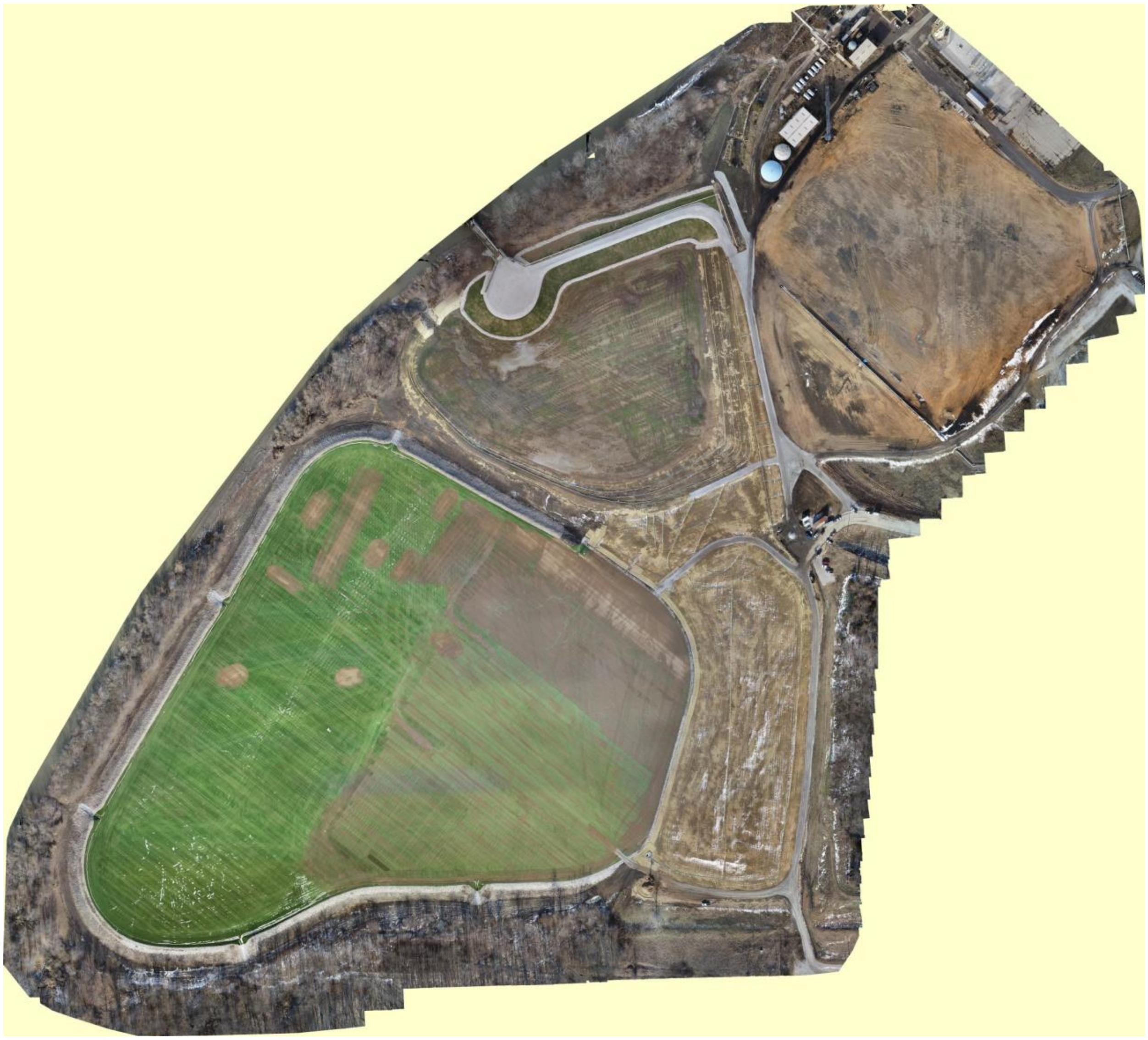
Figure 3: Ash ponds with ClosureTurf cap. Sand infill has begun.

In-place closure systems include removal of surface waters and isolation of the CCR unit, CCR grading, Construction Quality Assurance (CQA) services, and construction management activities during construction. Water management is variable between sites and between ash ponds on the same site (Figure 4). Having experienced contractors and providing comprehensive hydrogeologic information can mitigate construction issues associated with managing saturated material early in the project that affect the project as a whole.


Figure 4: Saturated CCR at one edge of an ash pond.

CQA services involve third party quality assurance activities. These include sampling and testing of the subgrade, soils, and geosynthetics both in the field and in laboratories. CQA activities for geomembranes and the geomembrane components of the ClosureTurf^{R} system are standardized and include air channel testing (Figure 5) and vacuum box testing (Figure 6). A traditional Subtitle D cap requires observation and testing of soil cover and vegetation while the ClosureTurf^{R} system requires observation of the turf seaming (Figure 7 and 8) and sand installation (Figure 9). Qualified contractors and geosynthetic installers can save an owner a significant amount of time and money associated with failed CQA testing and repairs during construction.

Figure 5: Air channel testing of geomembrane.

Figure 6: Vacuum box testing of geomembrane.

Figure 7: Geotextile component seaming using the sewing method.

Figure 8: Geotextile component seaming using the welding method.

Figure 9: Sand spreading.

Construction management services can be performed by the owner, design team, or CQA team. This includes managing the contractors on site, reviewing submittals, conducting safety programs, and addressing security issues. Depending on the size and complexity of the project, this may require a full-time person devoted to construction management activities who reports to the owner.

CONSIDERATIONS

There are two different ways to seam the geotextile/turf component; stitching (Figure 7) and welding (Figure 8). Most geosynthetic contractors are only certified in one of the two methods. While each method is approved by WatershedGeo and makes strong seams, there are differences in timing and weather requirements to consider before choosing a method. The welding method uses the same welding equipment as for the geomembrane liner but with some modifications and at different settings. The welding method does not require flipping the geotextile/turf and allows for multiple consecutive seams to be done at the same time. Unfortunately, welding is subject to the same weather issues as geomembrane, and cannot be used on wet material. Since the geotextile/turf component can't be quickly wiped dry like can be done on the membrane geomembrane, there may have longer delays than expected for the geomembrane to dry out. Stitching requires flipping the turf component, sewing it together, then unfolding the material. This typically allows for less seams to be joined at the same time, but this method can be done on wet material. The stitching method also keeps welding operators moving forward on geomembrane in good weather while a small crew works on the turf component behind the main crew or in bad weather cycles.

Geomembranes are affected by weather and will stretch or wrinkle in warm weather and shrink in colder weather. Therefore, another consideration is how to design the ditches so that temperature differences do not affect stormwater flow. This is an issue for any geosynthetic exposed to varying temperature conditions. Though this is typically only an issue for low sloping ditches, the effects of cold weather shrinking or hot weather wrinkling the underlying material is something to consider during the design process in regions where there are distinctly different summer and winter weather conditions. For instance, if the material is placed during the summer, you may want to "decouple" the liner material of the main cap and the liner material of the ditch line so that the shrinkage/wrinkling of the main cap does not affect the ditch material. The elongation or shrinkage of the smaller area of geomembrane in the ditch would not be enough to affect the drainage.

CONCLUSIONS

ClosureTurf^{R} is an effective way to close CCR ponds in place and can be cost effective in areas where soils are not readily available and long-term maintenance is an issue. Alternative methods require a high level of communication with regulators in states where they have not yet been used, but may net a significant amount of time and monetary savings over the life cycle of the project.