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Innovations

Water Treatment

Clover Bar Ravine Clean Up, Edmonton, Alberta

The Clover Bar Ravine is located north of Edmonton, Alberta, in a moderate to heavy industrialized area. The ravine flows directly into the North Saskatchewan River and both are lively with fish and aquatic organisms. The City of Edmonton Risk Management Plan required water samples be taken from Clover Bar Ravine between 2004 and 2011 and tested for metal concentrations and hydrocarbons. The samples taken between 2004 and 2007 showed various metal concentrations that exceeded guidelines set by several regulatory agencies and departments to include the CCME (Canadian Council of Ministers of the Environment), AENV (Alberta Environment), and the Sewer Use Bylaw.

The source of the contamination was due to several industrial companies as well as surface runoff discharge. Analysis of samples from 2004 to 2007 indicated a continuous active source of metals located upstream in the ravine. The Clover Bar Ravine and the North Saskatchewan River are fish-bearing water bodies; therefore, an eco-friendly solution needed to be implemented to treat the ongoing metal and sediment contamination. The chosen treatment method was a passive system using environmentally safe, site specific Floc Logs® from Applied Polymer Systems, Inc. of Woodstock, Georgia. The Floc Logs® were installed to capture and reduce metal concentrations and turbidity levels without harming aquatic organisms.

Left: Water before treatment with Floc Logs.

Below: Jute matting was installed along the stream bed and banks.

Flog Logs® are anionic polyacrylamide based water clarification products. Floc Logs® are water soluble and must be placed within the flow of water to achieve adequate mixing and dissolution of the log components. As the logs dissolve they bind with suspended sediment, metals, and nutrients to form larger particulate that can be settled out or captured. Binding of particulate is achieved through flocculation in which large agglomerates are formed through the bridging of the polymer with two or more particles.

Left: Floc Logs were attached to sand bags, which added extra turbulence.

Right: Jute lining the creek bed and banks captured flocculated metals and sediment, preventing them from discharging into the stream and river.

These flocs are heavy and settle quickly out of the water column. Natural fiber matting, such as jute, is used in conjunction with Floc Logs® to provide an area of attachment for the polymer charged particles as well as added erosion control. Floc Logs® are composed of anionic, negatively charged, polyacrylamides. This charge repels against the negatively charged gill mucous of fish and other aquatic organisms, making them nontoxic even at high dosages and safe for use in the open aquatic environment, unlike cationic (positively charged) polyacrylamides or chitosan that can cause detrimental effects to aquatic organisms.

Above: Flocculated sediment and metals attached to jute matting result in clear water discharging from the treatment train.

The passive treatment system was installed in June 2007. The treatment system was designed with 34 Floc Logs® placed along the creek bed beginning at the outfall. Before the logs were installed, the streambed was lined with an open-weave jute matting to prevent further erosion and work as an area of attachment for flocculated particulate. The logs were placed 10 feet apart alternating between APS 703d#3 and 706b Floc Logs®. Sand bags were placed in the channel and the Floc Logs® were tied off to them. The sand bags kept the logs in place as well as increased the turbulence of the water flowing over and around the logs, increasing mixing which in turn improved the reaction and performance of the system. The only maintenance required for this passive treatment system was simple monitoring of the banks to ensure they were not washing out. The biodegradable jute matting was not removed; new layers were simply applied directly on top of existing layers.

Above: Success is evident with clear water exiting.

Once the treatment system was installed, water and sediment samples were taken before and after the Floc Logs®. These samples were analyzed to observe changes in levels of contamination before and after treatment. The metals of concern that were tested include Aluminum, Copper, Iron, Lead, Nickel, and Zinc. This treatment system was in place during the summer months of 2007, 2008, and 2010. In 2009, the system was not used due to beaver activity flooding the area; in 2011, the system was not used due to embankment repairs and the possibility of further work upstream that may have compromised the treatment system. As can be seen in the table below, the passive treatment system consistently reduced the metals of concern as well as turbidity.

	Before Floc Logs (2007)	After Floc Logs (2007)	Before Floc Logs (2008)	After Floc Logs (2008)	Before Floc Logs (2010)	After Floc Logs (2010)
Aluminum	0.218 mg/L	0.114 mg/L	4.08 mg/L	0.322 mg/L	11.6 mg/L	1.19 mg/L
Copper	0.055 mg/L	0.01 mg/L	0.085 mg/L	0.027 mg/L	0.036 mg/L	0.018 mg/L
Iron	2 mg/L	0.6 mg/L	5.19 mg/L	0.49 mg/L	20.6 mg/L	1.98 mg/L
Lead	0.0009 mg/L	0.0003 mg/L	0.0057 mg/L	0.0004 mg/L	0.0155 mg/L	0.0015 mg/L
Nickel	0.013 mg/L	0.0039 mg/L	0.012 mg/L	0.0052 mg/L	0.0373 mg/L	0.0058 mg/L
Zinc	0.12 mg/L	0.014 mg/L	0.259 mg/L	0.066 mg/L	0.248 mg/L	0.037 mg/L
TSS	20 mg/L	4.2 mg/L	95 mg/L	11 mg/L	1060 mg/L	44 mg/L

Analysis of the water samples taken during treatment years showed a clear reduction in metals as well as total suspended solids (TSS) after the Floc Log system was installed. Water collected downstream from the treatment system showed dramatic reductions in TSS levels. Sampling revealed TSS levels as low as 4 mg/L and clear visibility to the bottom of the stream. Large concentrations of collected sediment were observed within the treatment system and sediment samples from the first site showed large concentrations of metals within sediment that had accumulated around the Floc Logs®. There was then a gradual decrease in metal concentrations moving further downstream in the treatment system. The passive treatment system achieved turbidity levels and metal concentrations limits that were established by the regulatory agencies. These results are proof positive that the implementation of the polymer enhanced passive treatment system was highly successful and the eco-friendly solution to reducing turbidity and metal contamination within the Clover Bar Ravine.

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Innovations

Rolling M Ranch Pond Clean Up

Rolling M Ranch in northeast Georgia is nearly 500 acres of rolling green hills and home to more than 300 registered Angus cattle. Rolling M Ranch has a 4.5 acre pond that became contaminated with sediment during the construction of the Elba Express natural gas pipeline. This pipeline, owned by El Paso Corporation out of Houston, Texas, stretches 180 miles from Anderson, South Carolina to the Elba Island Liquefied Natural Gas terminal in Savannah, Georgia.

Marion McHugh, owner of Rolling M Ranch, was very concerned about the turbidity in his pond because his cattle were drinking the water and getting sick. Mr. McHugh contacted Erosion Tech to assist him with clearing the turbidity from the pond which, by that point, had reached 967 NTU.

Above: Rolling M Ranch pond before treatment, turbidity level over 900 NTU

Below: The L.I.P.V.A.C. System from Eco Pond Rescue installed at Rolling M Ranch.

Erosion Tech's first idea was to use a dewatering ditch, lined with Floc Logs, to treat the water and discharge it back into the pond. Then they thought about trying the new L.I.P.V.A.C.S with Applied Polymer Systems, Inc. Floc Logs which successfully flocculate and remove phosphorous and nonliving nutrients.

This particular pond required the 703d#3 and 706b Floc Logs to clarify the water. The pond contained approximately 18 million gallons of water, which would require 18 of each Floc Log to successfully treat the system. The 706b and 703d#3 L.I.P.V.A.C Logs, and two (2) L.I.P.V.A.C.S. were installed in late March.

The L.I.P.V.A.C.S. ran for approximately 24 hours a day for about 30 days. After treatment the pond's NTU had been reduced from 967 to 14.

Working together, APS, Erosion Tech, and Eco Pond Rescue found a solution for clarifying the Rolling M Ranch pond.

Mr. McHugh is happy to see that his pond is back to normal and there is no longer a threat to his cattle. El Paso Corporation is very pleased with the results and stated that they plan on using many more of these systems in the future.

Above: The turbidity level of the pond has been reduced dramatically and now the bottom of the pond is visible in places.

Below : After treatment with L.I.P.V.A.C. System and Logs, the turbidity level of the pond is now below 15 NTU.

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Innovations

Bank Stabilization

Lake Independence Dam – Bank Stabilization, Big Bay, MI

Lake Independence is a natural lake made larger by the construction of the Lake Independence Dam. Located in Big Bay, Michigan on the Iron River, it was built in the 1930's as a generator for hydroelectric power. Although no longer used for power generation, it is maintained by the Marquette County Drain Commission in order to monitor and maintain water levels to preserve the value of waterfront properties.

Through the years, substantial erosion has been occurring along the banks adjacent to the dam. Sand bagging was the normal practice to prevent scouring and channelization around the dam. It was feared that should erosion continue, the water would eventually cut a path around the dam, rendering it useless, and essentially draining the lake. This would alter the ecosystem as well as severely diminish property values along the lake.

Erosion of the shoreline is clearly visible in the bank along the right side of this photograph. The dam is seen on the upper left-hand corner of the photo.

The photo to the left shows the geosynthetic fabric laid on the bank and the sand beginning to be deposited. The photo to the right shows the excess fabric being pulled over the sand and fortified with rock, forming a containment for the sediment.

After several failed proposals drawn up to rectify the situation, the Marquette County Drain Commission and the DEQ, a division of the Department of Natural Resources, issued Applied Polymer Systems permits to implement a bank stabilization system. It aimed at protecting the Lake Independence Dam, as well as stopping bank erosion to protect lakefront property. The general plan was to lay down a geosynthetic material, add sand and topsoil, fortify with medium sized rock, and then add a seed polymer mixture to stop erosion and establish vegetation as quickly as possible.

Left: Completed bank structure consisting of sand, rock, and top soil.

Right Top: Polymer, seed mix, mulch, and straw matrix spread over rock.
Right Bottom: Clear lake water directly below newly stabilized bank.

The area was cleared of tall grasses and shrubs, and wooden stakes were placed at the low water line to establish a boundary. A non-woven geosynthetic fabric was then laid across the slope with enough overlap so it could be pulled over the soon to be added sand/soil material, forming a containment and preventing the fine material from washing into the lake. Once the sand was brought in and the geosynthetic fabric stretched over it, medium sized rock was used to fortify the newly contoured bank.

Next, a mixture of seed, mulch, and polymer was added to the rock bank. Establishing vegetation in rock and sand is very difficult. This was achieved using a seed mix of clover, perennial rye, tall fescue, and millet. The clover was used to produce nitrogen without the use of fertilizers. A site tested polymer, APS 705 powder, was used to bind all the materials together with the soil to form a matrix, keep it in place, and allow for a vegetative cover to be established.

The project took about two weeks to complete and the different types of grasses came up from within 3 days to 2-3 weeks. After a year, in the following spring, the grass continued to grow once again.

Using environmentally friendly and natural materials, erosion was stopped, the dam was protected, and fears of dam failure around the lake have subsided. The results are visually pleasing and the water is crystal clear.

This is another example of how APS polymers in conjunction with other BMPs (Best Management Practices) can help protect water resources and property with very little construction activity and minimal impact.

The following spring the bank was visually appealing and permanent. Note the grass growing between the rocks and the clarity of the water seen in the reflection of the tree..

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Innovations

In Pond & Lake Management

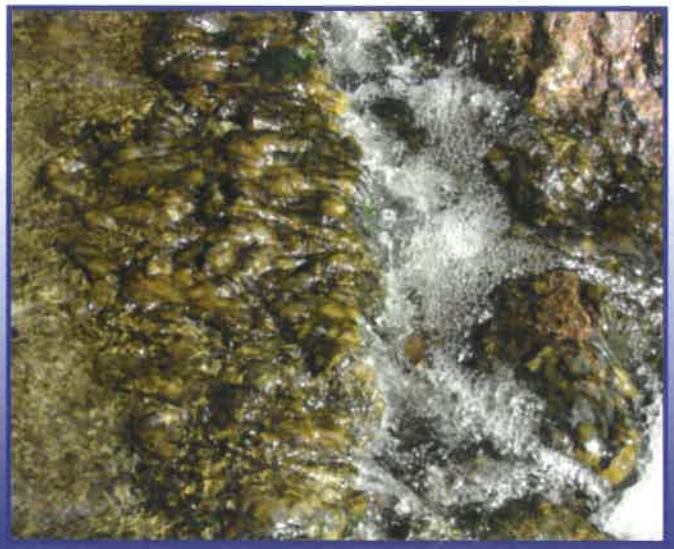
Lakeshore Park Place Condominiums

Lakeshore Park Place Condominiums are located in the City of Marquette in the Upper Peninsula of Michigan. The luxury condominiums are located across from Shiras Park, a picturesque and pristine beach located on the shores of Lake Superior, America's largest freshwater lake. Downtown Marquette is minutes to the south and to the north is Presque Isle Park another popular area for residents and tourists alike. The complex itself consists of 5 buildings, 51 units total, and boasts beautiful landscaping and gardens that includes two man-made, decorative ponds.

The ponds average about 1,800 square feet and 2 1/2 feet deep. As with many small ponds across the country, nutrients such as phosphorous (P) began to build up and algae growth increased with thick mats of it covering the rocks in the pond.

Above: Nutrient rich pond promotes excess algae growth and results in cloudy water and algal covering of rocks in the pond.

Below: Close up of dense algal mats covering the rock surfaces within the pond.



Applied Polymer Systems was enlisted to help remove the excess algae buildup and improve the appearance of the ponds. The pond water was tested in order to find a site specific Pond Log to remove nutrient and sediment from the ponds. Once the correct material was specified, Pond Logs were placed in the waterfalls (2 logs per pond). Placing the logs in the waterfalls facilitates mixing and dispersion of the polymer material. Once in the water column, the log material binds with P and other particulate and sediment to form heavier, larger conglomerates that settle out of the water column, thereby reducing algal growth and turbidity.

Innovations

In Pond & Lake Management

In a 1,000 day study by the Reedy Creek Water Management District beginning in 2005, Pond Logs have been found to reduce phosphorous by 75-90% using traditional methods of aeration and circulation. When placed in a waterfall, aeration, or other circulation system, Pond Log components are mixed and circulated throughout the pond. The phosphorous is reduced which starves out the algae preventing new growth, and the algae already formed are flocculated out.

An additional benefit to removing nutrient and turbidity is that Pond Logs are not harmful to fish or other aquatic organisms. All Pond Logs are toxicity tested by an EPA certified lab and are shown to be non-toxic to aquatic life (full reports may be found at siltstop.com).

After installation of the logs in the waterfalls (first photo), results were noticeable within the first month and Lakeshore Condominiums have been using the system for nearly two years. The logs are replaced about once a month (except in winter due to freezing of the ponds). The method is very simple, requiring little to no maintenance, with excellent quality water as an outcome. The rocks (second photo) after treatment are nearly clear of algal buildup, and the pond water itself (last photo) is clear and beautiful.

The results are clear...literally. Within a few short weeks, the ponds at Lakeshore Condominiums have become beautiful water bodies that all the residents can enjoy.

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Innovations

Polymer Enhanced BMPs: Tank Systems

Mole Constructors – Tunnel Project, Gwinnet County, GA

Mole Constructors is a tunneling contraction company based out of Solon, Ohio. In April 2007, Mole Constructors began a three year project in Gwinnett, County Georgia digging a 15,921 linear foot tunnel. In the beginning stages of the project Mole Constructors was faced with turbidity issues in their stormwater discharge. It was at this juncture that they sought out the assistance of Applied Polymer Systems.

APS worked with Mole Constructors to find BMPs that would resolve their issues and allow for offsite discharge. Many of APS performance tested Polymer Enhanced Best Management Practices (PEBMP's) were considered from the use of a tank system with particle curtains to a split pipe flume system. Mole used several BMPs to treat their issues and to achieve maximum results. The main system Mole uses is a three (3) tank system with particle curtains and 706b Floc Logs.
Using multiple Best Management Practices (BMPs) in a treatment train creates a system that is better suited to prevent erosion and keep stormwater discharge in compliance.

Photo of the tunnel dug by Mole Constructors in Gwinnet County, Georgia.

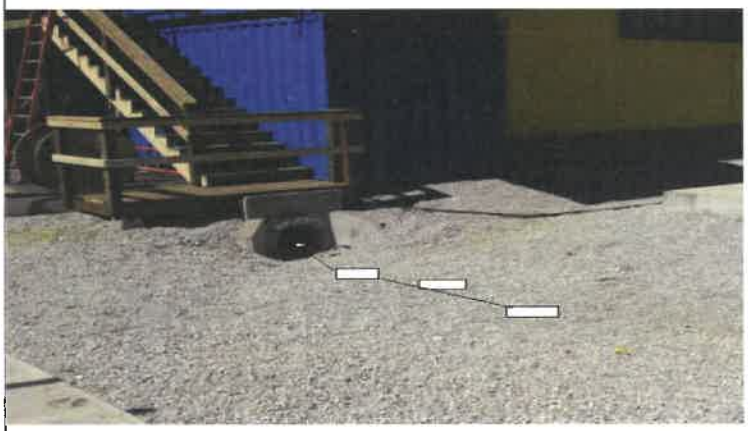
The system that Mole created was comprised of a mixing launder, three (3) tanks, and particle curtains. The mixing launder is a split pipe that sits on top of the three tanks. The launder followed the perimeter of the tanks on three sides and then discharged into the first tank. The first tank was used to capture the large particulate, while the second and third tanks contained particle curtains which work to capture finer particulate that has not settled to the bottom.

Three tanks make up the system and involve the use of Floc Logs and particle curtains to treat incoming water and remove sediments before discharge.

For a period of time it was necessary to insert custom pH logs to control a pH problem that Mole was experiencing. The pipe between the first and second tanks was retrofitted to accommodate a custom pH Floc Log that would dissolve and adjust the pH of the water flowing through the second and third tanks. After the water has moved through all three tanks it is then discharged into a pond prior to being discharged into the open environment.

The treated water is discharged from the third and final tank to a pond. The water is treated again with 706b Floc Logs inserted into the pond discharge pipe and other storm drain pipes to allow for offsite discharge. This is an extra measure to further improve water clarity and to catch any extra sediment that may be picked up after flowing from the discharge pond.

The tanks were monitored regularly to show the consistent reduction of turbidity.



Above: Particle curtain strategically placed to catch the particles that did not settle out by gravity.

Left Top: Floc Logs were places in the storm drains to further treat the water discharging off site.

Left Bottom: After treatment, water is discharged directly into the open environment.

In September 2008, samples were taken from each of the three tanks and the discharge pipe. Tank 1 measured 1.23 NTU, Tank 2 measured 15.20 NTU, and Tank 3 measured 6.98 NTU. The NTU in the discharge pipe measured 0.62. Upstream and downstream readings were also taken, with an upstream reading of 1.65 NTU and a downstream reading of 1.39 NTU. The downstream NTU is significant because Mole was given a discharge limit of no more than 25 NTU above background, or the upstream NTU value. Monitoring continued for months after the initial testing with discharge and pond NTU readings ranging from 5.0-20.0.

This is one of many examples where APS has been able to provide solutions to multiple issues using APS performance tested PEBMPs.

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Innovations

In Stormwater Control

Outstanding Florida Waterbody – Leitner Creek Annual Maintenance

Leitner Creek By-Pass Canal is an annual public works project to ensure flood control in the relatively flat topography of Lee County, Florida. This canal is over 4400 feet in length and the maintained portion discharges to an Outstanding Florida Waterbody (OFW) tributary emptying into Estero Bay. OFW's have the highest level of water quality protection in the state.

As if this were not difficult enough, water levels in the canal vary from several inches to over 4 feet in depth. Typical problems encountered in the past have been: high turbidity levels from the clean-out efforts, lengthy turbidity plumes moving downstream causing environmental and visual impairment, odor complaints associated with organic sediment and vegetation removal, and conflicts between the need for permit compliance and flood control maintenance.

Design: A movable metal box was designed for ease of mobility and mixing of the Floc Logs. Note the Floc Logs placed within the metal box.

Clarity: The actual NTU value of the discharge water was read at about 7.5 NTU. The clarity and color of the water speaks for itself.

Tony Pellicer and Leigh Simmons, Lee County Natural Resources Management Division, first heard about APS products while attending a local erosion control-training seminar. They later contacted the APS office and technical services personnel to inquire about using PAM products to control turbidity.

A site-specific water/soil sample test showed that APS 706b Floc Logs along with 712 powder could be used to provide flocculation and chelation of the fine mucky soil particles generated from the maintenance activities. The 712 powder could be used to stabilize the canal embankment and provide additional turbidity treatment as needed.

Above: Particle curtain strategically placed to catch the particles that did not settle out by gravity.

Below: With an NTU value between 10 and 14, the environment downstream from the work area remains unimpacted.

A metal box was designed and constructed to provide a movable mixing zone for the Floc Logs. Several were attached to this box and to the Water Spyder to allow agitation and current flow to dissolve the APS product for turbidity treatment. Particle curtains, made of PVC pipe and jute were constructed and placed downstream to capture fine flocculent material that did not gravity settle.

Turbidity values in the work area ranged between 423 - 1,000 NTUs. These were acted on by the Floc logs, which caused the mucky sediment to form floc materials and chelating bridges between individual particles. As these particles clumped together, they became larger and heavier. Gravity settled out most of these particles leaving the water very clear. Two hundred (200) feet downstream of the work area, turbidity was down to 7.5 NTUs. These levels continued to remain low and resisted resuspension, so that even more than 1,000 feet downstream of the work area, turbidity levels were between 10 - 13.5 NTUs.

The project was able to proceed with minimal changes to current procedure. Odor complaints were significantly reduced. A tremendous visual improvement was apparent in the canal. Water clarity improved so much that fish were observed feeding along the streambed. This is a testament to the turbidity control and non-toxic materials used in APS products.

Future uses will explore more efficient use of floc log mixing devices that are adaptable to different types of drainage maintenance equipment.

This is another example of how APS can help protect natural resources and allow needed canal maintenance to proceed without jeopardizing permit compliance.

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Innovations

In Soil Stabilization

City of Bartlett, TN
Richland Valley Subdivision
Soft Armoring Slope Repair
Fall 2006

In September of 2006, the City of Bartlett used part of a subdivision development to test the performance of the soft armoring stabilization technique.

Soft Armoring uses soft pliable matting such as jute, coir, coconut, hemp or burlap and an application of the correct soil-specific polymer to stabilize the soil. The polymer binds the soil together with the matting, creating a highly erosion-resistant surface. It provides crucial stabilization while the vegetation establishes.

The test slope had previously been stabilized with sod, but a portion of it had been undercut, the sod had failed and washed away. Massive rills and gullies had formed in the exposed slope. After consulting with Jason Painter of Jen Hill, it was decided to try a Soft Armoring application to repair the slope.

Just 3 days after installation of the jute matting and application of seed and soil-specific polymer powder, a large rainstorm dropped over two inches of rain on the site.

As shown in the photos below, even before the grass had germinated the slope is stabilized and showing no erosion or plumes of turbidity in the stormwater running through the silt fence and into the nearby steam.

How it was done

1) **Grade Surface**
   Fill in any rills or gullies caused by erosion. This ensures that the surface of the work area is even and the matting will lay flush to the surface.

Preparation work on the site involved re-grading the slope and filling in the rills. Since the area was very small, this was done by hand.

2) **Apply matting**
   Install open-weave geotextile matting (coir, jute, or other natural fiber) flush to the soil surface and secure in place.

3) **Apply Silt Stop powder + Seed + Fertilizer**
   The Silt Stop powder was added to the seed and fertilizer mix and applied as a dry spread with a hand seed/fertilizer spreader.

Over four months after the application, the grass in the area of soft armoring was well-established and showed no signs of erosion. The areas of sod on either side of the soft armoring had dried out and died. The polymer allows for better water penetration and retention in the soil, helping to ensure healthy, lush vegetation.

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Innovations

In Water Clarification

Kentucky Lake

Spring 2007

Kentucky Lake is the largest man-made lake in the eastern US. It contains over 2,000 miles of shoreline and 160,000 acres of surface water. It is part of the Tennessee Western Valley Watershed, which drains approximately 1,800 square miles and empties into the Ohio River. The watershed contains over 2,000 miles of streams and 100,000 acres of lakes in the Tennessee portion alone.

The lake was created in 1944 when the Kentucky Dam was constructed to provide flood control. The lake provides flood protection to 6 million acres on the lower Ohio and Mississippi Rivers and reduces the frequency of floods on an additional 4 million acres. It also has many other economical, ecological and recreational benefits as well. Numerous state parks, wildlife refuges, and recreation areas dot the shoreline.

Siltation is the deposition of sediment in bodies of water, and cause areas of deposit to become shallower. Such was the case in a privately owned cove on one of the inlets of Kentucky Lake. The sediment had filled in the cove, leaving only a few feet of water at the winter high points. The homeowner wanted to dredge out the cove, removing 450,000 cubic feet of accumulated sediment.

The dredge spoils discharged into the stilling pond through the pipe on the left and discharged through the riser pipe on the right.

The plan was to dredge out the cove and deposit the spoils into a large stilling pond where the sediment would settle out. The excess water would discharge from the pond, filter through a wooded area, and eventually return to the lake. The wooded land belonged to the Tennessee Valley Authority (TVA), and they had the project shut down over concerns of elevated sediment loads in the water returning to the lake as well as erosion through the woods due to the high volume and velocity of the discharged water.

The soil-specific Floc Logs were secured into plastic crates in the mixing/reaction portion of the treatment system where the polymer would react with suspended sediment.

With the possibility of fines for violations of discharge limits the contractor was urged to consider the use of polymers as part of the corrective actions to be taken. The contractor turned to the expertise of Applied Polymer Systems and Jen Hill for help to get the project back on track. Samples of the turbid water in the stilling pond were sent to APS labs to find the exact soil-specific polymers to treat the water. After consulting with Applied Polymer Systems and Jen Hill, a polymer enhanced flow-through chemical treatment system was designed to safely convey and treat the water coming from the stilling pond on its way back to the lake.

The treatment system consisted of two parts. The first part was the mixing/reaction portion, where the polymer reacted with the suspended sediment and caused flocculation. The second part was the particle collection portion, where the flocculated particulate was collected and removed from the water. The water entered the treatment system after settling reduced the sediment loads of the dredge spoils. The water discharging from the stilling pond into the treatment ditch flowed at a rate of 3,500 gallons per minute, and needed to be treated as a continuous flow to allow work to continue on schedule.

The dredge spoils entered the stilling basin with 15% solids. Within the stilling basin the heavy sediment (silt and sands) dropped out of suspension. However the water was still cloudy as the colloidal clays and fine sediment were still in suspension. The turbidity of the water discharging from the stilling basin through the riser pipe was measured at 500-600 NTU. As the turbid water reacted with the Floc Logs in the treatment system, and the reacted particulate was collected, the fine sediment and clays were removed and the turbidity dropped drastically to only 21.0 NTU. The clarified water slowly filtered through the remainder of the wooded area and reentered Kentucky Lake without any turbidity plumes.

The mixing/reaction portion of the treatment ditch was placed at the outlet of the riser pipe, and was constructed with two rows of straw bales placed 4-5 feet apart and covered with plastic sheeting. The mixing ditch was 140 feet long, and was built on top of a layer of geotextile fabric to protect the plastic sheeting from punctures.

The site-specific Floc Logs were secured in plastic crates and placed in a series running down the treatment ditch. The turbulence caused by the narrow ditch and the high flow rate ensured that the turbid water could flow over and around the Floc Logs allowing for dissolution. The dissolving polymer mixed and reacted with the suspended sediment, binding together to cause large particulate to form. The turbulence along the ditchline increased the mixing which increased the particle size and pulling the fine sediment and swelling clays out of suspension.

The treated water passed across the jute dispersion field before passing through the sediment retention barrier filled with straw and polymer where final polishing occurred.

After treatment and particle formation, the water discharged into a dispersion field where it spreads out and slowed down in a stabilized area. The particles that had formed in the reaction portion were collected and removed, allowing clarified water to return to the lake. By reducing the velocity, the erosive potential of the flowing water was greatly reduced to minimize the disturbance to the vegetated areas.

The clarified water re-entered Kentucky Lake without any turbidity impacts.

The dispersion field was stabilized with a Soft Armoring technique. Open-weave jute matting was laid in the dispersion field and applied with the appropriate soil-specific Silt Stop powder. The jute fabric provided a surface area for the reacted particulate to adhere to while providing structural support to the underlying soil surface to prevent erosion. The Silt Stop powder enhanced the particle collection capabilities of the jute matting and bound the jute matting to the soil surface to prevent cutting in the forest floor.

The treated water spread out and slowed down as it was discharged into the 8,100 sq. ft. dispersion field, ringed by a polymer enhanced Sediment Retention Barrier (SRB). The water pooled in the dispersion field, slowly filtering through the SRB and releasing at a greatly reduced velocity and returned to Kentucky Lake.

The project ran for 8 days straight, at which point the dredge had removed 450,000 cubic feet of sediment and completely filled in the stilling basin. Once the pumps had stopped, the treatment system was dismantled and removed without any lasting environmental impacts.

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Innovations
In Stormwater Control

Florida Urban Stream Restoration

Urban stream segments have been channelized, paved with concrete, and neglected for decades. Recently, the City of Gainesville has begun to restore them to a more natural system. Sweetwater Branch is a 2500-foot segment of an urban stream that discharges to an Outstanding Florida Waterbody (OFW). Paynes Prairie Preserve is the final receiving water for the Gainesville drainage basin. OFW's have the highest level of water quality protection in the state. Existing problems have been downstream water pollution (bacteria, nutrients, and metals) in the sediment runoff, habitat smothering and contamination, anoxic conditions, loss of wildlife usage, and turbidity. Sweetwater Branch flows through an active neighborhood and has been an aesthetic problem for the community.

That all changed this summer when Stewart Pearson, Stormwater Services Manager and Project Engineer, kicked off the start of the first of over thirteen stream restoration projects for Gainesville. Water quality improvements are the goal of the city's Watershed Master Plan. Coordination of this project for NPDES compliance was the job of Sally Adkins, Permit Manager. Sally and Bill Benson, Labor Crew Leader and Site Supervisor, first heard about APS products while attending a local erosion control-training seminar. They later contacted the APS office and technical services personnel to inquire about using their PAM blended products for this project.

A site-specific water/soil sample test showed that APS 706b Floc Logs along with 705 powders could be used to provide flocculation and chelation of the fine mucky soil particles generated from the construction activities. The 705 powder could be used to stabilize the canal embankment and provide additional turbidity treatment as needed. APS 640 liquid emulsion was applied to the slopes and embankments to stabilize the soil and control runoff during storm events.

Good BMP practices were utilized to take advantage of control techniques taught in the Florida Department of Environmental Protections training course, recently attended by project staff. Daily clearing was limited to small sections that were completed and stabilized at the end of each workday. Bypass pumping was done to allow stream work to be done in the dry. Multiple layering of BMP controls were employed to minimize soil movement and provide sediment trapping and turbidity control. Some of these controls were coir logs placed at the toe of slope, silt fence, floating turbidity curtains, inlet protection, slope stabilization with jute, erosion blankets, and grass seed or sod. Even with these BMPs in use, the potential for a turbidity release or slope failure was a daily risk.

Turbidity in the stream channel area was acted on by the Floc logs, which caused the mucky sediment to form floc materials and chelating bridges between individual particles. As these particles clumped together, they became larger and heavier. Gravity settled out most of these particles leaving the water very clear. Jute was placed downstream of the work area, to capture lighter floc and act as a surface area. Active management of this system kept turbidity within compliance levels throughout the project.

The project was able to preceed rapidly, due in part to good weather and an effective erosion, sediment, and turbidity control program. A tremendous visual improvement was apparent in the canal. Water clarity improved so well that fish were observed feeding along the streambed. This is a testament to the turbidity control and non-toxic materials used in APS products.

Final slope stabilization was with vegetation using various combinations of native plants, sod, and grass seed. Applied Polymer System's PAM blends have the ability to accelerate grass germination provided additional slope protection and stability.

This is another example of how APS can help protect natural resources and allow restoration projects to succeed without jeopardizing permit compliance.

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Innovations

In Stormwater Clarification

Florida Project

Winter 2006

The large unstabilized site contained 8 lakes and interconnecting key ditches that discharged directly into state waters. This meant that water discharging from the site was closely monitored to ensure it was within compliance. The large areas of bare ground and the highly erosive soil composition posed a potential problem with possible set-backs and fines.

A split pipe treatment system was created using 36 inch HDPE pipe cut in half and lined with jute matting. The site-specific Floc Logs were installed inside.

The project had been trying to control the discharge of turbid water by treating the lakes on a monthly basis, with poor results. It was decided to install a continuous flow-through treatment system to treat the turbid water before discharge off site. A split pipe treatment system was designed to clarify the water before discharging into state waters.

Samples of the turbid water on the site were sent to the APS lab for testing, free of charge, to determine the correct site-specific Floc Log to clarify the water. It was found that the 703d and 703d#3 Floc Logs would work best on the settled water from the final lake, and the 706b Floc Logs would work better with the higher sediment loads in the key ditches.

The sides of the key ditches were stabilized with jute matting and the 705 Silt Stop powder. Check dams were installed in the key ditches and covered with jute matting and 712 Silt Stop powder to help control the movement of sediment and reduce the sediment load in the turbid water.

The water was pumped out of the lake with a 6 inch pump and discharged into the 100 foot long split pipe system which was constructed using 36 inch pipe, cut in half.

Check dams made with rock bags were placed every 10 feet along the length of the split pipe; these checks helped increase the turbulence and create mixing conditions.

The site-specific Floc Logs were placed on the downstream side of the check dams, where the polymers would dissolve and react with the suspended sediment.

Above, Right: The sediment was reacted with the Floc Logs, binding the particles together and attaching them to the jute matting in the split pipe system.

Above: The clarified water was discharged into a section of stream protected by turbidity barriers and passed through particle curtains.

The split pipes were lined with jute matting, which provided surface area for the flocculated particulate to adhere to. The clarified water was then discharged off site.

Turbidity readings taken on the final lake, where the water was pumped into the treatment system, showed the turbidity to be at 40 NTU. The water being discharged was consistently measured at 18 NTU, well within compliance.

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Innovations

Stormwater Pond Clean-out

The City of Orlando has over 93 lakes and hundreds of Stormwater detention ponds. Periodically, the accumulated sediments must be removed from them. This used to be a very messy, time-consuming job. The sediments often contain a high percentage of organic mucky material. This muck behaves more like a fluid than a soil and is difficult to work with. During past clean-out efforts, water around and discharging from the work site would become very cloudy with turbidity.

Excavating equipment had to work longer time periods to remove this soupy material, because it was impossible to get full bucket loads. Completed projects often receive citizen and/or agency complaints about aesthetics and visual water impairment.

Spoil materials were often placed on desolate sites to allow for drying or were disposed of in landfills at a high cost. These were considered as waste or problematic soils.

Kevin McCann, City of Orlando Stormwater Division Manager, decided to try some Applied Polymer System (APS) blended polyacrylamide (PAM) to address these problems. He had learned of PAM's ability to thicken soil from a local erosion control training seminar.

First, a soil specific test was performed by the APS testing lab to match the PAM blend to the site. Kevin decided to use a backpack leaf blower to disperse the powdered PAM blend across the muck. This technique allowed for continuous application on the work site as needed.

Once applied, the PAM generally reacted with the muck within 10-20 minutes untouched. Having the equipment operator blend the PAM and muck back and forth with the machine's bucket until it began to set-up speeded up this process. Once thickened, the muck could be removed like any other soil.

Full bucket loads were easily achieved resulting in quicker removal time. Dump trucks could now be loaded full with no fear of sloshing. Water leaving the work area was cleaner as turbidity was controlled with this application. PAM treated muck is a tremendous topsoil amendment or soil stabilizer for landscape/turf grass applications. The City of Orlando conducted several turf grass application tests with the Florida Department of Transportation along Interstate 4 with this PAM treated soil. Accelerated grass germination results along with very lush growth were achieved in record time during this test.

The City of Orlando routinely uses blended PAM during muck removal on its ponds and lakes. This material is reused as a topsoil amendment whenever possible to reduce disposal and transportation costs and improve vegetation establishment, especially in sandy soils.

What was once considered a junk and problematic soil is now treated as a resource. This is just another example of how APS products can be used to protect water resources and improve job efficiency.

For information on this or other Applied Polymer System designs or materials contact your local distributor or APS directly at 678-494-5998 or www.siltstop.com

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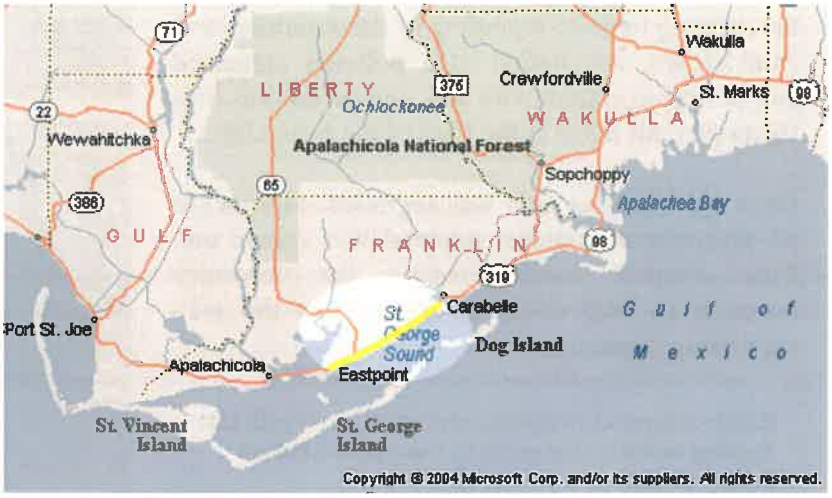
Innovations

In Soil Stabilization

US Highway 98
Summer 2005

On July 10, 2005 Hurricane Dennis raged through the Florida panhandle near Apalachicola and St. George's Island. It made landfall at 3 pm as a category 3 hurricane; with a maximum sustained wind near 140 mph and wave heights of 6 to 8 feet. US highway 98, a major tourism and transportation corridor that follows along the panhandle's coastline, felt the brunt of the hurricane's forces.



This 14 mile stretch of Highway 98 along the coast was the project area.

Damage was severe on approximately 14 miles of US highway 98, ranging from erosion of the shoulder to buckling and subsidence of the entire roadway. Immediately after the storm, the Florida Department of Transportation (FDOT) took action to reconstruct and open traffic on the stretch of damaged highway, awarding a construction contract to complete emergency repairs within 14 days. The travel lanes were quickly reconstructed and traffic soon resumed; however, within a month shoulder erosion was reoccurring, threatening to again encroach on travel lanes.

The movement of the highly erosive beach sands caused the roadway to collapse, in some places across the entire width of the two lane road.

FDOT immediately sought to implement a short-term (1-2 years) cost-effective solution to protect the roadway and minimize sheet erosion of the front slopes and shoulders until a more permanent plan could be developed. Due to the proximity of the highway to the ocean and high exposure to saline-laden moisture and wind, the vegetation used had to be a salt-tolerant species. The design chosen had to allow for possible paving of the shoulders in the future.

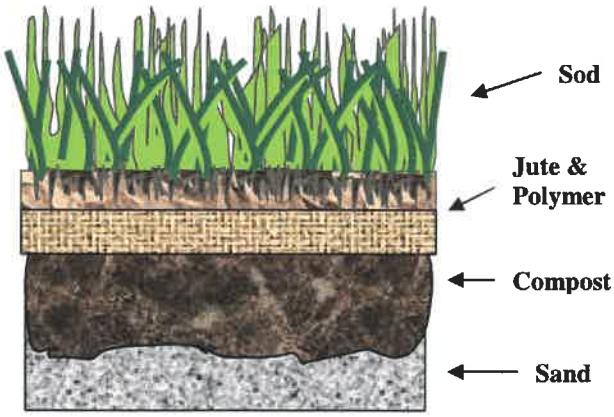
Initially considered was a turf reinforced matting (TRM) design, but it did not fulfill the project requirements or specific site challenges. It was also a costly option, with an estimated cost of $15 per square yard, or $765,000 for the TRM material alone.

Josh Boan and Michael Shepard with FDOT consulted with Applied Polymer Systems and developed a soft armoring countermeasure that was cost-effective while meeting all of the design objectives. This application was also much more cost-effective, with a total project cost of $744,650. The design consisted of the removal of the existing turf and regrading of the shoulders and front slopes, installation of a polymer enhanced soft armoring system with sod, and protection with temporary silt fence at the base of the front slope.

Once the shoulder area was regraded, two inches of nutrient-rich compost material was spread out. This compost layer provided the necessary nutrients to help establish and sustain the soil-stabilizing vegetation.

Right: A layer of compost material, covered with jute matting and Silt Stop powder, was applied before laying the sod.

Below: A cross-section diagram of the soft armor application.



Over the layer of compost, open-weave jute matting and the correct soil-specific APS 705 Silt Stop powder was applied at a rate of 50 pounds per acre. Bermuda grass sod was laid over the jute matting. The jute matting provided an initial attachment surface for the polymer powder, which immediately bound to the surrounding soil and compost layers, instantly creating a highly erosion-resistant matrix that provided structural support while the vegetation was established.

Over one year later, in August 2006, the soft armoring technique is still performing well, requiring little maintenance and successfully mitigating coastal erosion. The application sustained two major storm events, a category 1 hurricane as well as a tropical depression, with total survival of the road. This single application had added savings to FDOT because it prevented the road from having to be rebuilt or repaired after these storms.

Over time, the jute blanket has biodegraded and the sod vegetation has continued to establish root structure into the underlying topsoil. The shoulder areas along US Highway 98 are so well stabilized that they can now be used as access to the waterfront without fear of erosion. The level of performance of this type of soft armor application far surpassed the expectations of FDOT.

The shoulder of Highway 98, over 8 months after the application, is still stabilized and has held up to the extreme weather conditions of the Florida coast.