A Unique Camouflage Floating Cover

Andrew Mills, Layfield Environmental Systems Corp, USA, amills@layfieldgroup.com
Stephen Roades, Burke Industries Inc., USA, steveroades@burkeindustries.com
David Ott, Layfield Environmental Systems Corp, USA, dott@layfieldgroup.com

ABSTRACT

The 41 year old Santa Ynez Reservoir in Pacific Palisades, CA was an open water reservoir up until recently when the Los Angeles Department of Water and Power (LADWP) decided to cover the reservoir in order to conserve water, to decrease water contamination, and to switch from using chlorine to chloramines to treat the water. The reservoir is situated on about 9 acres of land and is approximately 70 feet deep. When full it holds nearly 120 million gallons of potable water and serves both Pacific Palisades and the Highlands. The reservoir also functions as an emergency water resource for fire crews during Southern California's fire season.

1. INTRODUCTION

1.1 The Santa Ynez Reservoir

The Santa Ynez Reservoir is tucked between two mountains in the Topanga State Park just north of Santa Monica, CA. The reservoir is overlooked by thousands of homeowners in an upscale neighborhood. The surrounding community was very concerned with the change in the visual appearance of the reservoir as this is a main focal point for most of them.

Figure 1: The completed reservoir blends nicely with its surroundings.

In order to meet the stringent visual requirements set forth by the community, the Los Angeles Department of Water and Power (LADWP) worked with the material supplier and the installer to find a custom material color that would blend in with the surroundings. The material supplier proposed the use of a Chlorosulphonated Polyethylene (CSPE) cover material in a special mottled green camouflage color. They produced several large samples of the cover material in different combinations of colors. After a thorough review by the community council and the local homeowners a green/black camouflage color was chosen.

The Santa Ynez Reservoir was completed in time to bring it back online for Southern California's fire season, the community expressed their approval of the final appearance of the project and LADWP added another covered potable water reservoir to their portfolio.

1.2 Background

This project approval process for this project started in 2002 with a floating cover originally proposed for installation in 2006. The upgrade to the reservoir was part of a response to the US Environmental Protection Agency's (USEPA) Stage

2 Disinfectants and Disinfection Byproducts Rule (S2DBPR 2006) and the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR 2006). These two rules were delayed in their release until 2006 which in turn delayed the Santa Ynez project.

The (LADWP) chose to address the S2DBPR rule by switching from chlorine disinfectant to a chloramine disinfectant. This change reduced the undesirable disinfection by-products. Disinfection by-products are also reduced by adding an opaque floating cover as sunlight can react with disinfection chemicals to form undesirable by-products. A floating cover also addressed the LT2ESWTR surface treatment rule as the cover effectively isolates the stored water from surface run-off and rainwater.

With the choice to add a floating cover made the next steps were to choose a material and to obtain approval from the local community.

2. COVER SELECTION

2.1 Material Selection

Chlorosulphonated Polyethylene (CSPE) was originally chosen as the floating cover material. CSPE has been used successfully in municipal reservoir service for other floating covers in California and has shown excellent longevity and performance. CSPE was also available with a 30-year warranty against normal weathering. Finally CSPE was available in a variety of colors all with extended weathering resistance. This selection of colors would be the key to moving this project forward.

Geomembrane and floating cover materials are not known for their wide selection of colors. In order to achieve long term UV protection the standard color is usually black. Black pigments, and the most common black pigment carbon black, provide excellent UV protection to thermoplastic geomembrane and floating cover materials. As soon as you move away from black the UV resistance falls off rapidly. CSPE is unusual in that it is a thermoplastic at the time of manufacture but then crosslinks in service to become a thermoset rubber product. As the material cross links it becomes more resistant to chemical attack and more resistant to UV degradation. This means that CSPE can be stabilized in a range of colors much more easily than regular thermoplastic geomembrane and floating cover materials. The manufacturer of the CSPE had developed a wide range of colors in the roofing industry and this color palette was brought in to satisfy the aesthetics of this job.

2.2 Aesthetics

For 41 years the Santa Ynez reservoir provided a visual focal point in the hills across from the Pacific Palisades community. The community association was very sensitive to the appearance of the reservoir and had participated in a number of aesthetic upgrades over the years. Some of these aesthetic upgrades included specific plantings above the reservoir and in the dam face to make the area appear more natural. The color of the service road had also been chosen to better blend with the surroundings.

Figure 2 and 3: Naturalized concrete slope above the reservoir. Construction (left) and finished slope (right).

One of the most unique aesthetic features was a slope protection area on the slope above the reservoir. Naturally occurring springs had been washing out a section of the slope. By placing a concrete facing on the slope with weep holes the water seeping from the slope was removed effectively without causing additional slope damage. Although the concrete slope face was effective it did not meet with the aesthetic requirements of the community association. The solution was a treatment of man-made rocks that closely matched the surrounding area (figure 2 and 3). The construction of this rock face occurred at the same time as the new floating cover installation.

2.3 Color Selection

Choosing a cover with the active participation of the local community association was a very different experience. The first success was identifying that a cover could be used at all. It is a credit to the LADWP staff that they were able to make the case for a floating cover in the first place. The next step then was to choose a color.

Initially the CSPE manufacturer sent a selection of colors for review. From these initial color swatches a selection was chosen. From these initial colors selections 10 ft by 20 ft samples were prepared and arrayed on the slope behind the reservoir for the community to observe and rate. In reviewing these samples it was felt that a mixed color would be preferable to a solid color and that a dark green with a mottled appearance might work.

2.4 A Multi-Color Membrane

The CSPE manufacturer had available a rubber calendaring operation that essentially allowed them to “hand-make” specific colors and materials. By adding pieces of different material colors into the rubber at the last stage of mixing they were able to create a material with random streaks of color in an overall uniform shade. This is very similar to the multi-color patterns seen in resilient vinyl flooring tile. If the color is added early in the mixing stages it will be uniform, by adding different colors late in the mixing stages a series of streaks can be prepared.

Samples of the multi-color material were prepared for the community association and finally, after many samples and extensive consultation, a dark green material with black streaks was chosen. In the July/August 2011 issue of Land and Water the manufacture was quoted as saying, “The floating cover has been constructed of CSPE geomembrane panels that have been produced with a one-of-a-kind mix of black and green coloring in each panel. The color mix creates a large-scale camouflage that helps the entire reservoir mimic the changing shades of the hills and vegetation.” (Roades, 2011)

3. CONSTRUCTION

After draining the 117 million-gallon reservoir between October 2009 and May 2010, the old inlet/outlet tower and pipeline was demolished and the asphalt liner, which had served the reservoir well, was repaved (figure 4 and 5). New pipelines and appurtenances were then installed and the facility filled. Then, in October 2010 the reservoir was drained again to enable the last phase of reconstruction. This included the installation of the floating cover (work which began in January 2011).

Figure 4 and 5: Original reservoir (left) and after removal of tower and new asphalt lining (right).
Note the original concrete lined slope at back.

4. COVER MANUFACTURE

The cover for the Santa Ynez reservoir was truly a hand-crafted one-of-a-kind material. Manufacture of the cover starts with the blending of the ingredients. These ingredients travel through a number of blenders until they are fully dispersed into a batch of material that has the approximate consistency of cookie dough. About 50 lbs of this rubber dough are put onto a two-roll mill where they are heated and blended into a soft semi-molten state. An operator manipulates the rubber on the mill for a pre-set period, folding the material back and forth, until the material is blended and the colors are smooth and well-dispersed. Then the rubber batch is dropped onto a table and taken to the next two roll mill. This second mill makes sure that all the materials are up to temperature before being fed into the calendar.

In the manufacture of this unique cover material 50 lbs batches of dark green material were laid out onto a table after the first mill and three pieces of black were placed onto the rough sheet. This was then rolled back up and then transferred

Figure 6 and 7: Feeding CSPE into the two-roll mills. Mill #1 on left, Mill #2 on right. Tan CSPE shown.

to the second mill. On the second mill the operator did not blend the material but let the black form streaks in the surface. When the streaks had reached the right consistency the rubber batch was dropped onto a table and taken to the calendar to be fed into the machine.

The calendar squeezes the rubber batch into a thin film and then presses it onto the support fabric. The 45 mil material made for this project consisted of a 17 mil coating on both sides of a support fabric. The final product maintained a consistent color throughout the project. If you look at the pictures of the reservoir you can see that the color did not vary considerably from batch to batch.

5. COVER FABRICATION

Once the custom floating cover material had been made it was shipped to the fabricator's facilities in El Cajon California which is near San Diego. It is up to the fabricator/installer to create the drawings and layout details that will convert the designer's intent into a finished floating cover.

There are two guidelines that are followed for the design of floating covers in California. The first is M25 Floating cover guideline by the AWWA. The second is the CA/NV Floating cover guideline. The fabricator/installer prepared the cover drawings for this project as seen in figure 11.

Since this reservoir was lined with an asphalt liner a chafer strip was used to prevent wear on the underside of the cover. The chafer strip is made from the same material as the floating cover and extends about 2/3 of the way down the slope. As the cover moves up and down in response to water level changes the chafer strip prevents wear against the asphalt liner.

Figure 8: Installing a 35 ft wide fabricated panel.

The fabrication step allows specialty materials, such as this specially colored cover material, to be made into large panels reducing the requirement for welding in the field. Prefabricated panels are prepared in the controlled conditions of the factory which eliminates weather risk on fabrication seams. By using prefabricated cover panels field installation times are reduced and overall seam quality improves.

This fabricator has a unique ability to make prefabricated panels up to 36 ft wide without folds using a specially designed 36 ft wide winder. Eliminating folds in prefabricated floating cover panels reduces wrinkling in the cover for a smoother appearance. The chafer strip panels were folded and fabricated into smaller bundles however the cover panels used the wide roll technique to make panels 35 ft wide.

Prefabrication welding was accomplished using hot wedge welders. The welders are uniquely set up with 3" wide wedges and adjusted so that there is no flap left on either the top or the bottom of the seam. Welding the seam down completely on both sides of the weld makes it easier to clean the cover when it is in service.

Panels were prefabricated according to a predetermined plan. Each fabricated panel was wrapped in a protective wrapper and numbered to match the installation plan.

6. COVER INSTALLATION

The layout of the cover is detailed in figure 11. The cover design is a defined-sump style that follows the design outlined in US patent 3,991,900. In this cover design a series of floats and weights are attached to the surface of the cover and create channels in the cover to collect rainwater. Pumps in these channels remove the rainwater and pump it off the cover.

Installation of the cover began in January of 2011 and was completed later that year. The first component to be installed was the chafer strip. This was placed on the asphalt liner and secured to the top of the slope using a small concrete wall and batten bars. Sand tubes and sand bags held the chafer strip in place against wind uplift until the floating cover was placed on top.

The cover material was then placed on top of the chafer strip and extended across the bottom of the reservoir. The cover material must be completely placed to reduce the risk of rain delays before proceeding with detail work. Once the cover material is complete and tested the detail work can begin. Details on this cover included the floats and weights that create the defined sumps, as well and hatches and vacuum relief vents.

Figure 9 and 10: Chafer strip installation (left). Cover panels being installed (right).

A defined sump floating cover uses a series of floats and weights to create channels in the surface so that water can be drained. The floats are made from expanded polyethylene foam. This foam is then protected from UV damage by using a float cover made from the same material as the floating cover. These float covers are laid out and welded to the surface of the cover after the cover is completed and tested. The floats are typically 9 ft long, 6" thick, and 12" wide on the floor and 3' long x 6" thick x 12" wide on the slopes.

The weights in the bottom of the sump channels are sand tubes. A doubled section of CSPE material is first welded down the middle of the sump where the sand tube will rest in service. This is the highest wear area of a floating cover. This is where dirt and debris will accumulate and it needs to be protected. Once this wear strip is placed a series of straps are welded to the cover that will hold the sand tubes in place. The sand tubes are 5 ft long and are 5 inches in diameter on the floor and 3 ft long by 5 inches in diameter on the slopes. The sand tubes are made from the same material as the floating cover. They are also perforated so that there is no air in the tube that will work against the weight of the sand.

The layout of the floats and weights is adjusted based on the final layout of the pond. Since the seams in the final cover may vary slightly from their planned positions on the drawings the final layout of the floats and weights needs to be adjusted to the as-built dimensions of the floating cover.

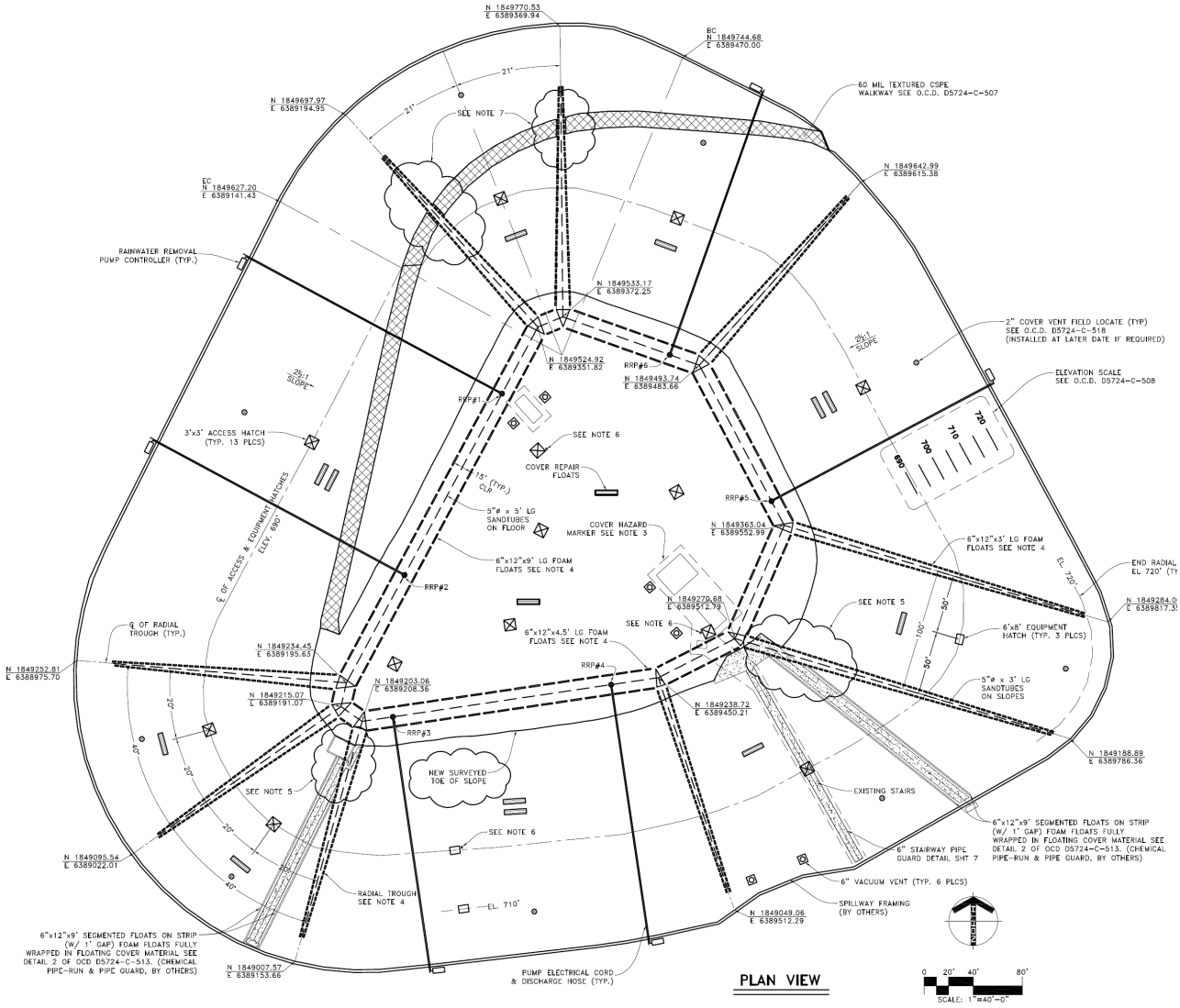

Figure 11: Layout design for the defined-sump floating cover.

The distance between the floats controls how deep the sump is in the cover when it is full. On figure 11 the distance between the floats can be seen to be wider at the bottom of the pond and then tapering to the top of the pond. There is less slack to account for at the top of the pond so the sump channels are not as deep. This design has been worked out by experience and results in a smooth, flat cover at all operating levels.

Finally, there is an overflow swale on the top of the reservoir that protects the cover against inadvertent overflows. This overflow swale was originally designed to have a stainless steel flap that would move out of the way in the event of an overflow. On this project the overflow flap was constructed from CSPE material and sand tubes as a cost saving

measure. A stainless steel frame was constructed and set into the concrete overflow swale. The chafer strip was then connected to the inside bottom of the frame while the cover was brought up over the frame and draped down the back. The draped section is then weighted with sand tubes to prevent the flap from opening unless there is an overflow.

Figure 12: View of the overflow swale.

7. CONCLUSION

The Santa Ynez floating cover project was an example of a standard cover that required non-standard attention to aesthetics and color. The final project is an attractive part of the local landscape while providing additional protection to drinking water in the area. The ability to select a "handmade" color on this project helped the local water district get the buy-in from the community they needed so that they could go ahead with the functional improvements needed. CSPE materials are one of the few geosynthetic barrier materials used for floating covers that has a broad color palette while maintaining long term UV resistance.

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Figure 13: The completed project filled and in service. Note the road colors, rock texture above reservoir, plantings on the slopes below the reservoir, and the mottled color of the floating cover.

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