Turbidity Curtain: Only as Strong as its Weakest Anchor

New turbidity curtain installed on site. Image courtesy of GEI Works.

Turbidity control curtains are an important part of any waterside job site's SWPPP. While many believe that the challenge lies in choosing the right curtain for the site conditions, what is often more important is not only the curtain type but also that it is correctly installed and anchored in the water. Mooring can play a critical role not only where water is fast moving, but in any area that is dealing with current, wind, tides, waves or fluctuating water. A recent project showcases some of the ongoing challenges contractors face when dealing with turbidity control in moving waters.

The Project

The project, still ongoing, involves

the construction of a retirement village on a small riverfront property surrounded by water on three sides. Due to the proximity of the structure to the shoreline and narrowness of the land, curtains were required around three discharge/outfall areas and a subsequent piece of shoreline adjacent to the building of a seawall. The work area was close to both a natural manatee habitat and sensitive water resources, making the control of any site discharge and turbidity essential.

Our GEI Works team was called to the Florida jobsite following a site inspection. Inspectors determined that on-site turbidity curtain anchoring had failed, causing potential risk to the surrounding environment. While the amount of curtain used in each area was relatively small, the effectiveness was critical to ensuring that the project stays within compliance. After multiple attempts to secure the curtain, contractors reached out to our team to offer consultation and assistance in anchoring the curtain. Although the curtain being utilized was not our manufactured product, our goal was to offer support and expertise by surveying the existing curtain on site, assessing the damage and quickly re-deploying the barrier to ensure compliance.

Above: Turbidity curtain out of position due to ineffective anchoring. Below: Installed T-posts failing to hold the curtain in place. Images courtesy of GEI Works.

BMP On Site

When controlling turbidity in the water, the most commonly specified BMP is a Floating Turbidity Curtain. Turbidity Curtains, also known as Silt Barriers, are designed to act as a temporary protection barrier that controls turbidity or displaced silt and allows particles enough time to settle. They are often required in areas performing marine maintenance, dredging, or in locations where traditional erosion control, silt fence or perimeter controls are not sufficient.

For most sites, the amount and type of particles leaving the site is not particularly harmful to the area. However, the amount is usually larger than normal and significant enough to change the quality of the water. Most particles, when given enough time, will naturally settle towards the bottom of the water. However, when large amounts of unfamiliar particles enter into the water, currents, waves or tides may pick up these particles before they are given enough time to settle. The goal of a turbidity curtain is to stop the spread of surface particles and temporarily confine them to a specified area. By preventing free flow, particles are given the time required to allow them to settle.

The existing Floating Turbidity Curtain BMP on site was a Type 3 DOT Curtain featuring a top float, top tension cable, top connection plate and a permeable bottom skirt. Type 3 DOT Curtains are usually specified for moving water areas with currents up to one and half knots and waves up to two feet.

Site Conditions

Any time a floating barrier is being used on site, our first step is to assess the conditions of the site. Having an accurate understanding of potential influences is critical in determining the right layout and curtain type. When assessing a site, we evaluate the current velocity and direction, wind speed and direction, wave height and frequency, tides, duration of the project and any other relevant site conditions. Our initial assessment provided us with the following conditions:

- Site Conditions: The project was located along a river featuring mild current, northerly winds and low waves. Water depth in the area ranged anywhere from three to five feet.
- Sandy Bottom: The location featured a sandy bottom that was subject to frequent movement and resettling, causing a mild level of instability along the bottom.
- Surrounding Area: The job site was on a piece of land protruding out into the river and surrounded on three sides by water. The shoreline was lined with large rocks present both on the beach and in the water.
- Duration of the Project: Curtains were implemented for the first portion of the project that involved preparing the site through ground levelling, ground water discharge, and the building of a seawall. When we arrived on site, the project had curtain scheduled for approximately one additional month.
- Additional Factors: While a majority of the curtain was placed in standard portions of the river, the south side of the project was additionally located in close proximity to a marina. With boats moving frequently in and out of the area, consideration was given to ensure proper navigation could continue.

Initial Assessment

When arriving on site, we were met with several sections of curtains that had been completely removed from the water and were washed up and sitting along the shore. Due to the anchoring procedure that had been implemented, the curtain had come in contact with several rocks causing tears in various locations along the barrier. The curtain's skirt was additionally weighed down with sand, creating tears between the bottom skirt and top float. The first goal was to understand what anchoring had occurred, assess why it had failed and implement a new anchoring pattern to try to secure the curtain.

Anchoring

Existing anchoring and position control of the curtain was being achieved through two methods. The first anchoring being utilized was a series of T-fence posts placed in front of the barrier. Posts were driven into the sand periodically in front of the curtain creating a wall in front of the curtain. The goal was to prevent the curtain from moving past the stakes and onto the shoreline. However, due to the weight of the curtain, the force of the current and instability of the anchors, many of the stakes began to slant and fall causing them to be overcome by the curtain and ultimately useless.

After this method failed, a second anchoring strategy was implemented using a combination of concrete filled bucket anchors and small fluke anchors. The bucket anchors were created using five gallon buckets that were filled with wet concrete. Each featured a hole in the top that allowed them to fill with water. However, because concrete loses a significant portion of its weight in water, the bucket anchor was unstable and subject to movement and rolling along the bottom. In addition, small light weight fluke anchors were being used along the curtain to help keep it in place. Similar to the buckets, these were too light leading to the movement of the anchor along the bottom.

Both the concrete filled bucket and fluke anchors were installed by attaching the anchor directly to the buoy with a short chain and the buoy directly to the bottom of the curtain with rope. There are two challenges with this method of anchoring in the location. The first is the short attachment of the anchor directly to the buoy. Buoys are subject to both waves and tides causing them to bob up and down in the water. Due to the light weight of the anchors, sandy bottom, and the buoy being positioned directly above the anchor, the anchor was easily pulled out of the sand. In addition, the attachment of the anchor to the bottom of the curtain caused an unnatural pull of the curtain towards the bottom of the water. With the anchoring pulling the curtain down and the waves pulling the curtain up, the opposing forces caused the barrier to tear between the float and the skirt.

Water Depth

Another significant factor in both the anchoring and the positioning of the curtain was the shallow water depth of the area. As a general rule of thumb, it is typically recommended that the curtain be sized to sit, at low tide, approximately one foot from the river bottom, ensuring there is no sediment build up on the skirt. In shallow or fluctuating areas, this can be particularly problematic as the skirt is often too long or too close the bottom. As materials begin to settle and build up in the area, the skirt will become trapped in piles of sediment creating added pressure along the bottom of the curtain. This leads to the collapse and failure of the curtain. Curtain depth can be addressed at the time of ordering or, if a curtain is on site already, adjusted on site through furling of the bottom skirt with rope.

Tear between the float and the skirt. Image courtesy of GEI Works.

Changing The Anchoring Method

With all of these considerations in mind, our team set out to reposition and anchor the curtain. The first step in remedying the existing site's curtain was to change the method and size of the anchors.

One of the major problems with the existing anchors on site was that they were simply too light to remain in place given the conditions. Rather than concrete buckets or light weight fluke anchors, our team installed a series of 22 pound fluke anchors. The correct weight of the anchors allowed them to properly deploy into the sandy location, securing and stabilizing the curtain in the best layout possible to perform in the conditions generated by northerly winds.

The second major issue on site was the way the anchor was attached to both the buoy and the curtain. When anchoring curtain, there are a lot of misconceptions that the curtain is supposed to act as a dam wall or coffer dam. This is not the case. Curtains are not designed to stop water, but to temporarily contain particles to a given area. The goal of curtain anchoring should not be to make the skirt a rigid wall, but to allow the curtain to contain turbidity as it moves with natural water flows.

Rather than installing the anchor directly beneath the buoy, our team attached the anchors to a chain and the chain to a long mooring line. This line was made eight times the length of the depth of water to give the anchor enough slack to accommodate water movement. A secondary painter line attached the curtain to the buoy at a distance of approximately five feet. This set up allowed the buoy to perform as a shock absorbent, reducing material fatigue on the curtain.

Attachment from the buoy to the curtain was additionally changed from the bottom to the top of the curtain. When anchoring a floating turbidity curtain, there are two schools of thought on how this can be achieved.

1. Anchor the curtain at the bottom ballast chain or connection plate
2. Anchor the curtain at the top connection or added anchor point

For most curtains, the recommended method of anchoring is through a top connection plate or dedicated anchor point. Top attachment helps keep the barrier in position without adding influencing weight or pressure to the bottom skirt. This is important to allow the skirt to billow with water movement. Since no existing anchor points were built into the curtain, the team installed anchor points manually on field by clamping the anchor point to the top of the curtain to ensure load transfer through tension cables to shore.

Upgrading The Curtain

For portions of the torn curtain, our team additionally provided the site with our manufactured heavy duty Type 3 barrier. The curtain featured all the same components, but altered a few portions to match the conditions of the site. The first was the movement of the tension cable from the top to the bottom of the float. The second was the addition of universal bulk slide connectors instead of top connection plates. These changes ensured the correct load transfer from the curtain to the anchor.

The Result

After re-anchoring the curtain, our team monitored the site and assessed the effectiveness of the new anchoring method. Although there were still significant forces acting on the curtain, the barriers controlled the turbidity plume generated by site work and ensured no stoppages to work on site.

As with any BMP, routine site maintenance and assessment of the barrier is essential, especially after a rain or storm event. In the weeks following our re-anchoring, the area went through some stormy winds and rains. The result created a build up of marine growth and materials that needed to be cleaned in order for the curtain to continue to operate effectively. Through continued monitoring of the site, our team is able to address issues as they occur. The process has reinforced for us the fact that all job sites are unique and require consideration, planning and continued monitoring when installing floating barriers. What is interesting about this case is that it is not dealing with a large project or fast waters, but a small amount of curtain on a small construction project.

No matter where they are used, turbidity curtains are often the last line of defense and the last chance for a site to contain sediment before it leaves the site. Even in all the right conditions with all the right anchoring methods, the barrier still remains outside and is still subject to uncontrollable weather conditions. Having a curtain that is installed properly and monitored regularly is essential to the curtain remaining effective at its job and the site remaining in compliance. **L&W**

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