EFFECTS OF CONSTRUCTION ON ADJACENT WATERWAY CONSTRUCTION

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Large construction projects upheave huge amounts of loose sediment, mainly sand and silt, which in turn wash easily into adjacent waterways during even light rainfall. This has historically caused issues with water quality management and environment conservation attempts; as a result, construction companies are required to conduct “best management practices” such as installation of sediment barriers, gabions, and retention ponds to minimize runoff. This study attempts to record sediment levels in the runoff waterway known as Bolton Branch that is adjacent to a future Costco warehouse construction site. A total of six numbered and measured aluminum rods were hammered into the riverbed at the connection of Bolton Branch to the construction site as a means of measuring sediment height, and another six approximately 2000 feet upstream. Measurements were recorded regularly and summarized to determine if sediment is being deposited at a faster rate due to best management practices being implemented poorly or being generally ineffective. Solutions are presented to reduce total sediment deposition into Bolton Branch from the construction site origin.

Keywords: sediment, construction, best management practices

Introduction

Commercial and residential construction has a well-documented effect on waterway sedimentation and erosion due to the upheaval of large amounts of sand and clay which can easily travel downstream during even light rainfall. These excess sediments can build layers over time and cause damage to local waterways or completely dam them in extreme circumstances; this can lead to more serious problems in extermination of wildlife or creation of flooding hazards for the surrounding area, and such sediment entering creeks, streams, rivers, and lakes is the nation’s number one water pollution problem (Agency 2003). Even without the danger of damming, simple sediment deposition can cause damage to the surrounding biome as “native macro invertebrates suffer as soil profile changes from native to layers of sedimentation. Accumulation of sediments in wetlands from upland erosion may decrease wetland volume,
decrease the duration wetlands retain water, and change plant community structure (Jurik, Wang and Van der Valk 1994).

To circumvent this, ecologically progressive construction companies have utilized conservation practices known as best management practices (BMPs) such as sediment barriers, rock gabions, grassed swales, retention ponds, and redirection of waterways in order to restrict pollutants and loose sediment from reaching local waterways and causing irreversible damage; although some companies are more efficient and thorough in their implementation. A local waterway, Bolton Branch, intersects a future Costco warehouse site (see Fig. 1) in which seemingly sufficient precautions are being taken in the form of silt barriers along the perimeter of the site, water pumps to remove excess drainage, multiple rock-and-wire gabions to resist erosion in the site directly, and a newly constructed outflow waterway covered with carpet grass:

![Figure 1. Future Costco site, managed by Hutton Construction, Inc.](image)
all to prevent excess sedimentation from forming downstream. This report will focus on the rate of formation of loose sediment layers that originates from the construction site and the success or failure of such best management practices.

**Research question**

How fast are sediment layers forming downstream from a construction site’s runoff waterway (see Fig. 2), and are the BMP’s which are being implemented at the origin adequately controlling the rate of sediment formation?

*Figure 2. Initial condition of site two on 23 Feb. Features contrast of adjacent branch with no construction at origin.*
Methods

This study was completely using two varying methods, referenced as versions one and two. Version one was intended to be a cost-effective and simple method in using numbered foot-long wooden stakes (see Fig. 3) that were hammered into the Costco runoff waterway bed; as sites one and two, roughly 2000 feet apart (see Fig. 5). These were measured every two weeks to document the rise or fall of the waterway bed, and hence, the sediment level. During the initial placement, an error was made in not documenting the starting levels. After four weeks, only 25% of the first set of stakes were remaining due to the rest being washed out with the current, presumably because the stakes were not hammered deep enough, and the wide rectangular shape creating resistance to the current. There was a need for a replacement set and a new system for data collection, therefore, version two was implemented.

Version two consisted of a more detailed placement schedule and a more robust data collection method with three-foot measured aluminum rods with numbered fluorescent tape (see Fig. 4) that were also hammered into the bed of the waterway; two rods were placed a foot from each bank directly at the origin of the waterway. Two more were placed roughly 50 yards downstream, then another two placed 200 yards from the origin of the waterway. This process was repeated roughly one mile downstream.
where Bolton Branch intersects Halls Mill Rd. Rods with the smallest diameter were selected to reduce water turbulence caused by resistance, and to limit collision with debris and vegetation. Initial measurements were recorded once the stakes were placed by measuring the distance from the top of the rod to the bed of the waterway. This was repeated each time measurements were taken with an expectation that the length from top to bed will decrease each time due to increasing height of sediment coming from the construction site’s runoff.

Figure 5. Map of construction site, featuring locations of study sites one and two (Google Maps 2014).

Results

Initial testing with one foot wooden rectangular stakes proved unsuccessful; the one inch girth of the stakes created excessive resistance to the flow of the waterway and 75% of the initial stakes were lost. After four weeks. Also, the initial set of 12 stakes were not marked with
measurement guides, making data acquisition difficult, though what little data was taken shows rapid deposition of sand. The v2 set of aluminum rods create little resistance to current with a 0.3 inch diameter, and are able to be hammered much deeper into the waterway bed to resist washing away. Prior inch ticks are marked on the rods and fluorescent red tape with numbering are tied to the tops of the rods for ease of location each outing.

Current results show highly variable changes in sediment levels, especially after heavy rainfall; most likely due to high speeds of the water current. Set One currently shows an average decrease in sedimentation of 0.3 inches, caused by higher turbulence and greater current at the beginning of the waterway. Set two, being farther down, shows current slowing and deposition of sediment being possible with an average current rise in sediment of 1.5 inches (see Table 1).

\[\text{Table 1. Chart of study findings, including version one and two results. Features final averages for both study sites.}\]

<table>
<thead>
<tr>
<th>Set One</th>
<th>#1</th>
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<th>Change(in)</th>
<th>10-Mar</th>
<th>Change(in)</th>
<th>24-Mar</th>
<th>Change(in)</th>
<th>1-Apr</th>
<th>Change(in)</th>
<th>7-Apr</th>
<th>Change(in)</th>
<th>14-Apr</th>
<th>Change(in)</th>
<th>21-Apr</th>
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<td>1.1</td>
<td>4.6</td>
<td>2.4</td>
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<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
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<td>0.3</td>
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</tr>
<tr>
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Average: 0.3

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<th>Change(in)</th>
<th>24-Mar</th>
<th>Change(in)</th>
<th>1-Apr</th>
<th>Change(in)</th>
<th>7-Apr</th>
<th>Change(in)</th>
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<td>n/a</td>
<td>n/a</td>
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</table>

Average: 1.5

Legend:  
- Lost  
- Rise  
- Stake  
- Fall  
- Rod  

**Conclusions**

Due to inefficient data collection methods that have since been revised, results are inconsistent. The first half of trials were conducted with wooden stakes that inhibited accurate collection, along with being lost in the current after heavy rainfall. Several of the newer
aluminum rods were also lost in testing, though results taken with this medium are much more consistent and accurate. More revisions can be done for future testing, such as using waterproof ink whilst marking measurements on the rods, along with more rods to increase the number of samples. If more rods are procured, several could be placed along the width of the waterway to acquire a more consistent average rise or fall of sediment level, as well as increasing longevity of the project.

Following heavy rainfall, sediment levels rose as much as 16.8 inches at site two (see Fig. 1), which is a shocking amount compared to branches of Bolton Branch without relation to any construction site. At this point, the waterway widens and the water velocity decreases and the river “loses its energy or ability to carry the stream load thus allowing the sediment to slowly settle on the bottom,” accounting for the contrast from sites one and two (Leopold, Wolman and Miller 1995). Hutton Construction, Inc. has put in place all required best management practices to reduce sediment runoff, though it seems in an area with such heavy rainfall as Mobile, these practices are not sufficient (see Fig. 6). Even considering Bolton Branch’s generally low current speed in contrast with other much larger rivers, the rising sediment level causes the banks to widen and water level to drop to a low flow; as stated by Ta et al, “lateral channel erosion is a substantial sediment source of river sediments and leads to lateral channel shifts for sand-banked rivers, channel bank stabilization should be a priority in river management and flood control in sand-banked rivers” (2003). Low flows are detrimental to stream conservation, which can be caused by heavy amounts of sediment deposition, as one follows the other.
Apart from increasing the number of BMP’s Hutton Construction, Inc. could put in place, only two solutions stand out; one being the redesign of current constructed planar waterway slopes- conclave slopes are much more probable to occur in nature and yield less sediment than planar slopes, and would be of miniscule cost to the company (Jeldes, Drumm and Yoder 2015). The second option would be implementation of a sedimentation basin or several small basins to trap overflow from heavy rainfall and allow the sediment to deposit before being released into the outflow of Bolton Branch. Kalainesan et al.(2008) developed a plan for integrated sediment basins at location specific volumes and use a “revised universal soil loss equation [that] is used to identify sediment zone volume, and an overflow rate is determined to design basin surface area,” and will present “flexibility to choose the extent of particle removal and runoff capture, and to vary construction costs”. The flexible cost would provide a strong selling point to construction companies that are not already utilizing settling basins, such as Hutton.
Construction, Inc., and in successful use of such basins could lend evidence in having the EPA consider making sediment basins a required BMP.

References Cited


