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MEMORANDUM

DATE: 2/20/18

TO: Michael Gross and Marin Villalpando, Zanker Recycling, John Doyle and Beto Ochoa, Z-Best
FROM: Ron Alexander, R. Alexander Associates, Inc. (RAA)

RE: Mulch Float Test Results

Background

Various regional landscaping specifications require the use of non-floatable mulches; especially where bioretention features are installed. The goal of these mulches is to function like any ornamental mulch, but not to excessively migrate off site in flooding conditions. However, strict numerical specifications for these mulches do not yet exist *(see Figure 1 – San Jose standards and comments).*

Figure 1 – City of San Jose (CSJ) Non Floating Mulches for Bioretention

CSJ Environmental Services Department, Watershed Protection Division
Nicholas Ajluni, QSP/CESSWI, Senior Environmental Inspector – Communications:

'We have not yet developed a spec. However, we do provide guidance that mulch should be composted arbor mulch with variable sizing to allow it to better net together and prevent it from being displaced during rain events. The specs that we use as a region are in the SCVURPPP C3 Handbook, and even then, the guidance is lacking detail. ***Essentially it says to use aged arbor mulch of a large size to prevent floating. Mulches with high fines content such as microbark and gorilla hair should be avoided.'***

Mulch Resources – from CSJ Handout:
Mulch provides several critical functions within a bioretention planter. It provides the initial capture and removal of sediment and debris. It also protects bioretention soil from compaction and erosion, inhibits weed growth, promotes water conservation, and promotes healthier plant growth by adding critical nutrients to the soil as it decomposes. ***All bioretention treatment systems require 3 inches of mulch applied to the basin, the side slopes, and upland areas. Mulch should be natural, composted/aged, arbor or wood mulch that does not contain high fine content or recycled materials.*** *Gorilla hair and micro-bark mulches are not permitted as they cause clogging of bioretention soil.*

Of course, most decorative and functional mulches are tree wood-based (carbon), and are therefore somewhat buoyant and can innately float to some degree. Rock mulches can be used as an alternative to wood or bark-based mulches, but they are ineffective in holding moisture or lowering the soil temperature, both of which improve plant establishment and growth. Further, mulches derived from recycled organic materials (e.g., wood, bark, yard trimmings) add organic matter to the soil over time, improving 'soil health'.

Several gardening sources suggest that stringier mulches, which can create a tight mat, seem to migrate and float the least. Other sources suggest that chipped (square) wood readily floats and migrates, and that wood and bark mulches derived from hardwood trees are denser and are thus less floatable. However, actual research on the floatability of mulch is limited, although one New Zealand study was identified, and forwarded to Z-Best/Zanker. This research found that floating of organic mulches can be suppressed by:

- Adding 25% (by volume) of compost or mineral type material to the coarse mulch, which increased its bulk density. The New Zealand research used crushed shell, but perhaps we could use sand. They found that the addition of compost was not as consistently effective as the addition of crushed shell.

- Increasing the mulches wet bulk density and speed of wetting. This could be done by increasing the content of fine particles, through composting of the mulch or by adding fine compost to it.
- Optimizing the stringiness of the mulch particles, which helps to create a well matted surface.

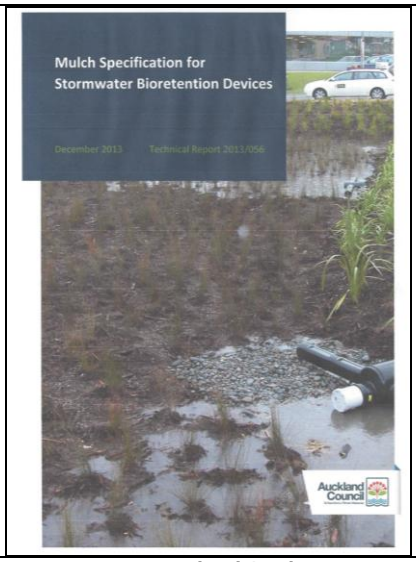
The research also suggested 3 additional practices to reduce mulch floating. They are:

- Thoroughly wet organic mulches at installation (irrigation),
- Design rain gardens / bioretention features to receive water as a sheet flow, or reinforce areas of concentrated flow with stone, and
- Ensure a dense cover of plants is achieved within 24 months, so re-mulching is unnecessary.

Research completed on the use of coarse compost as an erosion control blanket on slopes has illustrated the fact that stringier composts are more effective at resisting erosion (to the soil underneath it) and slippage of the coarse compost itself. These erosion control composts are a combination of coarse and fine particles.

To generate practical data on mulch floating in bioretention features, and in order to rate products currently produced by Z-Best/Zanker, RAA assisted company staff in completing related field research trials at their Gilroy composting facility (on 2/5/19).

Float Test Set-Up



New Zealand Study

Trial Set-Up and Methodologies

Four 4’ x 8’ frames were construction out of 2”x6” lumber. They were constructed to be bottomless, and to hold a mulch layer of approximately 3”. The frame sat on 2-3” layer of bioretention media.

Four Zanker mulches were tested in the trial for floatation and migration under different conditions. The mulches included:

1. Organic Mulch – which is derived from clean compost overs which are reground (2”) and screened (3/8”); the screening removes excess compost fines. This product is currently being marketed as a non-floating mulch.
2. Unscreened Organic Mulch – this product is the same as #1, but the product is not screened to remove the excess compost. This product is the primary component in Z-Best’s erosion control blanket compost used on Caltrans projects.
3. Organic Fiber Mulch – this product is experimental and not yet on the market, as it contains a large amount of film plastic. It is a very stringy product, but only contains a small amount of coarse wood. This product is a by-product of the Organic Mulch cleaning process.
4. Natural Mulch – which is produced from 2” ground yard trimmings and dimensional lumber, which is screened (3/8”) to remove excess fines.

	
Organic Mulch	**Unscreened Organic Mulch**
	
Organic Fiber Mulch	**Natural Mulch**

In succession, the 4 cells were treated by applying water, as such:

1. Low velocity of water applied – filled the cells to visibly view any floating of the mulch.
2. High velocity of water applied – directed flow at mulch layer to visibly view mulch migration.
3. High velocity of water applied – directed flow at mulch layer (after the mulch was wetted, then drained) to visibly view mulch migration. Wood from the lower side of the frame was removed to allow mulch to easily migrate.
4. Reformed the mulch layers and redid #3.

Results

1. Low velocity of water applied – filled the cells to visibly view floating of the mulch. Each cell was filled to the top of the frame with water to view how and if the mulch floated, then water was added to overflow levels, to again view the behavior of the mulch.

With both the Organic and Natural Mulches, which contained greater amounts of large pieces of wood, individual pieces of mulch floated. The larger pieces of wood were more buoyant. Whereas the Unscreened Organic and Organic Fiber Mulches floated in more of a mass, still holding together, with few individual pieces migrating. The Unscreened Organic Mulch was the heaviest of the mulch products, containing the most fines, and although the Organic Fiber Mulch was light (lowest bulk density), it was very stringy and seemed to create the best mat.

	
Organic Fiber Mulch floating as mat	**Natural Mulch pieces floating individually**

2. High velocity of water applied – directed flow at mulch layer to visibly view mulch migration. Directed a high velocity stream of water at the center of the mulch mass to simulate a concentrated flow of water, and to see how easy/difficult it was to physically move the mulch.

In this situation, it was easiest to move the Natural and the Organic Mulches. However, as the picture below illustrates, the greatest volume of mulch was moved with the Natural and Organic Fiber Mulches. These 2 products possessed the lowest bulk density. The Unscreened Organic Mulch, which possessed the highest bulk density, was the most difficult to move and the lowest volume of this mulch did actually move. Although a significant volume of the Organic Fiber Mulch moved, it did so with the mat staying intact.

	
Unscreened Organic Mulch resisting directed water flow	**Natural Mulch being pushed en mass**

3. High velocity of water applied – directed water flow for 90 seconds at the mulch layer to visibly view mulch migration. This was done after the mulch beds were re-established using the mulch that was previously wetted. The wood from the lower side (slope) of the frame was also removed to allow for mulch to more easily migrate.

Once wetted, none of the mulch products readily moved. The Natural and Organic Mulches moved a little, with individual pieces migrating. The water percolated through the Organic Fiber Mulch, and it did not move,

whereas the Unscreened Organic Mulch moved significantly once the water flow created a rill in the bioretention media beneath it. Although this product initially resisted migration, once dislodged, its higher bulk density (smaller pore spacing) probably did not let the water easily percolate through its mass (creating greater resistance).

	
Organic Fiber Mulch well matted after wetting	**View of mulch movement**

4. Reformed mulch layers and redid #3.

Even after the water in the Natural and Organic Mulch beds pooled, little mulch migrated. The water pooled faster in the Organic Fiber Mulch bed than in the Natural and Organic Mulch beds and although the mass shifted a bit, there was no significant migration of the mulch particles. The water pooled the fastest in the Unscreened Organic Mulch bed, and the mulch aggressively migrated again, following the bioretention media rill created during the previous treatment.

	
Organic Fiber Mulch resisting migration	**Pooled water**

5. High velocity of water applied – directed water flow for 90 seconds at the mulch layer to visibly view mulch migration. This was done with new mulch beds created directly on the concrete, and with no bioretention media under it.

As expected, without the mulch beds being contained in a frame, more of the mulch mass migrated. Although the mulch beds shifted somewhat, it was apparent that water percolated more easily through the Natural and

Organic Mulch beds. Pieces of the Natural Mulch floated down slope from the mulch bed to a greater extent than any of the other mulch products. The Organic Fiber Mulch bed was densely matted and moved to the smallest degree. The Unscreened Organic Mulch bed was physically resistant to movement (possessing the highest bulk density) and the least amount of water appeared to flow through it (was the most absorbent).

	
Set-up	**Illustration of mulch movement**

Conclusions

- The field research confirmed much of the conclusions of the New Zealand research:
  - Mulches possessing higher bulk densities, resisted floating and migration.
  - The stringier mulches created better mats that were resistant to migration, and although they did float to some degree, they did so in a mat.
  - Wetted mulches are more resistant to floating (and migration), likely due to their increased bulk density.

- The Z-Best Organic Mulch appeared to be the best mulch, when considering all of the different treatment parameters. It is probably the most promising non-floating mulch.

- The Z-Best Unscreened Organic Mulch also worked well under most treatments, and may even be superior to the Organic Mulch in some conditions. Further, this product is likely to be the most effective erosion control mulch, where vegetation is required.

- The Z-Best Organic Fiber Mulch looks promising, if the film plastic can be removed from it. If so, it could possibly become a stand-alone mulch product, or be an ingredient in a non-floatable mulch product.

- These field trials showed that the composted products were superior to the uncomposted ground wood derived mulches, as far as resisting floatation and migration. Although additional testing should be completed, it appears that non-floatable mulch specifications should require a stringy textured material, and aging or composting to increase the products bulk density.

This technical report should be developed into a 1 page marketing piece

None of these field trial results were quantified, so additional product development work may be necessary.