

To: Washoe County – Community Services Department
From: Keith Anderson – Flood Defense Group
Date: 13 June 2019
RE: Review of installed HESCO Bastion Barrier Protection Systems

Dear Washoe County

This is a report that summarizes my review of the HESCO Bastion flood defenses around Swan Lake in Washoe County, NV.

Initial Introduction:

Flood Defense Group specializes in the supply, installation, and/or support of temporary flood defense measures throughout North America. As an organization, we represent largest variety of products and solutions within this region and cover the majority of designs regularly deployed within this market space. Our unique expertise lies in the ability to provide objective feedback on a broad variety of products and solutions unique to the needs of the end user or flood event in question. One of our options include the HESCO Bastion line of flood barriers.

Flood Defense Group has not been involved in any aspect of the HESCO Bastion built in Washoe County and I have been called out to review the current material in place based on experience and understanding of the product. I have had significant experience with building HESCO Bastion since 2003 and am currently listed on contract as a technical support responder for flood defense deployments by the USACE with this product which has remained their primary tool for flood defense since around 2004.

Initial Summary:

After reviewing the HESCO Bastion flood barriers installed within Washoe County, it is my belief that these barriers are fit for purpose and can expected to perform as designed and as floodwaters rise. These barriers appeared to be in good condition and built correctly except for some footprint issues along Lemmon Drive. Discussion on reinforcing this section and general repairs are detailed below but none of these issues cause concern for a catastrophic failure.

Below lies a detailed review of the HESCO Bastion flood defenses built within/by Washoe County. This includes aspects from product selection, product design, project construction, product performance, existing problems, corrective actions, general maintenance, and what to expect with regard to life span of this project and how to extend it as required.

Was HESCO Bastion the best solution and why?

Most flood barriers on the market can be made to work for this flood defense scenario but I believe HESCO Bastion to have been the preferred solution among all others for a variety of reasons which include:

- Robust Product – Upon inspection, I viewed damage to your existing HESCO Bastion from multiple vehicle impacts and possible vandalism. This product can sustain more significant damage without catastrophic failure compared to other barriers on the market.
- Expandable – This product can be stacked higher if/when/as required
- Easily Repaired – It is simple to repair this product
- Lifespan – This product can be left in place as a ‘temporary solution’ for many years as required
- Soil to Surface – The soil fill within these barriers sits directly on the ground. This creates great interlocking flood protection to the surface they are sitting on and lessens seepage in comparison to products which have a membrane between the fill material and the ground. This is an asset when water will be against the barrier for extended periods of time.
- Economical – This product is among the most economical options on the market in achieving significant heights for flood protection.

Discussion of designs we would eliminate

Woven Bags

Similar to our product ‘RIBS’, there are a variety of large soil filled bags on the market that are comprised of a woven geotextile similar to traditional sandbags while being large enough to fill with earth moving machinery. These products work well and are slightly less expensive but do not have a long-life span, are difficult or impossible to repair, and are undesirable to stack or expand upon.

Water Filled Tubes and Bladders

We find water filled tubes are more difficult to work with as protection levels rise and can experience significant under-seepage which can become problematic over long periods of time. They can move from wave impact unless anchored and vehicle impact / vandalism could quickly cause a catastrophic failure.

Water filled ‘Jersey Barrier’ type design

This type design is great but generally require a liner of plastic sheeting, can be cumbersome to store, and are significantly more expensive. We like this design but given the length of time your HESCO Bastion has already been deployed and amount of material deployed, we believe the HESCO Bastion factors of cost savings, robust design, maintenance requirements and lifespan outperform these options

Other excluding factors would be

- Products that are too low
- Products unable to withstand damage or high winds
- Products which are vulnerable the theft
- Products with limited lifespan
- Product price

Design and Construction Washoe County HESCO Bastion

HESCO Bastion built within Washoe County has been built to good standard throughout the area with some attention required where units are leaning or damaged. These areas can be repaired or reinforced with ease, should be reinforced in the near term, but this do not give me concern for immediate catastrophic failure should water rise to the full height of the barriers 'as is'.

These barriers can be expected to perform to their designed function of stopping up to 4' high of floodwater and withstand over-topping or stop up to 8' of floodwaters for areas of stacked configurations which were correctly built. Similar to most HESCO Bastion flood defense projects, additional units can be stacked higher when building on a level base as floodwaters and/or design requirements change.

HESCO Bastion can be filled partially or filled completely depending on the height of flood waters and the term of time in place. I have made recommendations below to top off the fill level of these units.

CONSTRUCTION OBSERVATIONS

- Individual sections were correctly stretched out and joined
- Most sections are level to an acceptable degree. In areas where excessive leaning may take place, additional buttress or anchor cells can be installed for greater stability.
- Stacked configurations correctly pinned together at the base
- 2nd layer is correctly centered over base layer and connected with hog rings
- Geotextile flaps at bottom of individual cells were correctly positioned prior to filling
- Fill material appears compact
- Good examples noted which include a solid understanding of repairs, advanced joins, and correct modifications of the product

Suggested Points of Action:

Repair Damaged or Broken Units

You have a number of units that appear to be damaged from vehicle impacts. These are easily fixed with the following Sequence



Step 1



Step 2



Step 3



Step 4



Step 5



Finished View

Step 1: Identify the unit to be fixed

Step 2: Cut out damaged material and remove any soil that spills out such that a new panel can be freely attached without obstruction from the dirt. *NOTE: If the wire of the damaged unit is not significantly damaged, it can often be left in place and the repair panel simply overlaps the damaged panel*

Step 3: Prepare a single panel of the same size as the one being repaired by taking a single panel with extra fabric on each side and a coil which is attached or 'screwed on' to each side of the panel

Step 4: Attach the replacement panel (or panels) to the unit being repaired using coils and pins provided to create a join and ensure the extra fabric lines into the newly repaired basket to ensure a tight 'seal' from leakage of the fill material.

Step 5: Backfill and top off repaired cell with fill material.

Finished View: In this example, multiple coils were screwed together in creating this join as discussed during the inspection.

Photographs of Units Requiring Repair and Suggested Course of Action



Notes: I viewed common damage associated with a vehicle impact. Repair as detailed above. The green units will require multiple panels and a pair of bolt cutters to cut the panels to fit the now deformed units.



Notes: This is on the 'dry side' of the barrier and it would still function but I suggest you insert a coil to create a correct connection of the welded wire panels. Because the units are full, it may take a couple coils to tie it together.



Notes: This is common form of damage where a vehicle or some sort of equipment 'side swipes' the HESCO Bastion and is generally not a huge issue. This can be repaired by overlapping another panel without even removing the damaged panel or by spraying/spackling a cement mixture over the holes.



Notes: These are examples of what I believe to be vandalism and a great reason for using HESCO Bastion. They are difficult to compromise through vandalism as it would require actual work to do it. In this case, someone appears to have been repeatedly stabbing the units with something similar to a screwdriver. In some cases where a local municipality is installing flood defense barriers and there are members of the public who are opposed to it, vandalism is not uncommon.

Reinforce Leaning Cells with Buttress Walls

You have a section of HESCO Bastion along the road which is leaning toward the water and steps should be taken to reinforce this section from further leaning. I would take the following steps to reinforce this area.

- 1) Prepare a 2 cell section of HESCO Bastion
- 2) Butt it up to the leaning section on the wet side of the barrier and attempt to get at least a partial connection using the coils and pins provided
- 3) Fill
- 4) Repeat this process every 7-10 cells along your wall as desired along the leaning section

NOTE: This process could be also done on the dry side of the barrier instead, or in addition, to 'Anchor' this section from leaning toward the water. I believe there are footprint restrictions which may make this option unfeasible.

Examples of using additional cells to 'buttress' and/or 'anchor' a line of HESCO Bastion are below



Below is the leaning section at Swan Lake. It is not a disaster but can be reinforced as pictured above.



Ensure units are completely filled and discussion on project lifespan

Some end users will take for example, a 4' tall HESCO Bastion flood barrier and only fill it with 2' of fill material if the intention is to quickly recover the units with greater ease after defending against lower level floodwaters.

However, in the case of Washoe County, these units are left in place for what could be over a few years. If this is the case, filling the units completely is suggested and will extend the lifespan of HESCO Bastion

DISCUSSION OF LIFESPAN OF HESCO BASTION: The HESCO Bastion product has a 'design life' of at least 5 years in a harsh UV environment while it is my experience that this product lives much longer. It has been my experience that a completely filled HESCO Bastion unit with constant UV exposure will show the first signs of degradation at around the 7 year mark in the form of stress fractures along the geotextile staple line along the top of the unit as seen in the picture below. This first sign of degradation is typically isolated to the top of the unit and does not seem to result in catastrophic loss of fill or associated problems. It is roughly the 10 year mark that some areas of the world show a wide-spread breakdown of the geotextile itself.

If the units are not filled completely, the geotextile within this product which is above the level of the fill material will degrade about 3x faster. This is a result of air/wind and sunlight being able to pass through the fabric which exposed the environment and greatly accelerates degradation. Units that are filled completely do not allow passage of light and air in the form of wind from the outside environment and therefore live much longer. There are not signs of this degradation within Washoe County as your units are relatively new but if you want these units to be in place for potentially longer than a few years and upwards of 5-7 years, the units should be filled completely.

If your HESCO Bastion units are expected to be in place for longer than 5-7 years, they can be painted or a cement slurry application similar to stucco can be applied to protect the geotextile from the sun. In doing this, the product life span moves from the 5-7 year life of the geotextile to the 25 year design life of the wire which this product is comprised of.



Picture: Stress Tears – Initial Degradation



Picture: Cement Slurry for UV protection

Examples of HESCO Bastion units to be topped off below



NOTES: The GREEN units pictured are stacked and connected well. They would function as designed in their current state but the added fill simply extends the lifespan of the units. As mentioned above, the fill level of the BROWN units would do well at stopping water to the height of the fill material and would be easier to remove than full units but if you leave these in place, topping them off with fill material would be advised.

Is Moss a Problem?



Notes: Moss is not a problem and does not cause any sort of accelerated degradation of the HESCO Bastion geotextile. It actually provides a barrier against UV rays and seems to be more beneficial than harmful.

Addressing Seepage and Covering with Plastic

I was asked about seepage rates and if there were any signs for concern with the existing barriers. It is common for the general public to express concern at the sight of water on the 'dry side' of a flood barrier but a degree of seepage is to be expected. It is our belief that any temporary flood defense barrier on the market will experience a degree of seepage.

Compared to other barriers on the market who have been tested by the USACE, HESCO Bastion has a relatively low seepage rate. This is largely because of the bond of the soil to the surface the HESCO Bastion is sitting on. The point you will witness seepage of HESCO Bastion is where the two panels meet and are pinned together at the join between two units. During most flood events, seepage between two HESCO Bastion units or through the fill material itself significantly reduces as the fabric gets caked or clogged with dirt and fine particulate matter within the flood waters.

I do not believe seepage to be excessive or problematic in Washoe County, but steps can be taken to reduce seepage by covering the barrier with a plastic liner. Since Swan Lake does not have much dirt or particulate matter in the water to clog up any seepage, you may find a well-placed shovel full of lightly sprinkled dirt can be helpful in clogging any paths of seepage.

NOTE ON PLASTIC LINERS:

We are normally proponents of plastic as it is an inexpensive line of defense against seepage. In your case, I am not sure that you will need it as you have pumping capability and plenty of standoff from structures being protected. I believe you could easily keep up with any seepage and would enjoy avoiding the logistical burden of installing and maintaining a liner of plastic sheeting that quickly degrades in the sun. I assume you also experience a lot of wind which can create additional challenges with plastic sheeting. (However, you may find plastic sheeting helpful for seepage under any water tubes installed)



Good Work Noted by the Washoe County Installation

I want to make a special mention for these modifications below. They show your team understand the broader concept of modifying units, repairing units, ensuring good connections, and simply paying good attention. It uncommon for to see installation crews do this and I was delighted to see it. Good Job!



NOTE: This is likely were two sections came together and they took the time to modify a unit and create a good connection which was then correctly lined with geotextile.



NOTE: It looks like someone missed inserting a joining pin during the initial layout and the units were filled. Someone in your staff identified this and overlapped it with two face panels AND figured out the lesser-known technique of screwing the coil to the weldmesh itself to create a fantastic fix. I really appreciate the attention to detail in taking the time to fix it!

Good Repairs Conducted - Continued



Notes: Similar to the photo above, good fix!



Note: Someone within your staff created a buttress wall similar to what you require for your leaning section of HESCO Bastion. This person will be well suited to do the repair of your leaning units. This crew did well at taking note to create the best connections possible which is great to see.

HESCO Bastion Removal

You have two different types of HESCO Bastion. One type is recoverable which is done by pulling the joining pins found running down the spine of the HESCO Bastion and simply peeling each side of the HESCO Bastion away from the dirt. Photos of this product are below.

The other type of HESCO Bastion you have is a traditional unit that can be recovered and reused to a high degree when using the HESCO Bastion Recovery Beam to extract the units from the fill material. This report will be accompanied by the specifications for the HESCO Bastion lifting beam. This can be made 'in-house' based on the specifications or purchased from HESCO Bastion for about \$5,500. Both styles of HESCO Bastion can be recovered using a Recovery Beam and based on the amount of HESCO Bastion you have, I believe this to be a wise investment.

Other methods of removing the HESCO Bastion include simply using a backhoe to demolish the wall and extract the wire from the soil fill material.

Below: HESCO Bastion Recoverable Unit



Moving Forward

After reviewing the HESCO Bastion flood barriers within Washoe County, this is a summary of what actions I believe would benefit this project to keep it in good shape now into the future

- Repair damaged units
- Create a number of 'repair panels' for future maintenance and repairs
- Insert buttress cells along leaning section of HESCO Bastion
- Fill all units to the top if near term removal is not likely
- Determine life requirement of this project and evaluate painting or a cement slurry application if in place for more than around 7 years.
- Develop a semi-annual maintenance plan to monitor damage to or problems with the HESCO Bastion units. This can include conducting repairs, monitor for any movement/leaning of the HESCO Bastion, checking for vandalism, ensuring units remained fill with dirt, watch for any signs of degradation or problems with the units.

Summary

Apart from some required repairs and reinforcements, I believe the HESCO Bastion flood barriers installed within Washoe County are fit for purpose, are in generally good shape, and viable to keep in place for a number of years to come should the situation require it.

I believe the crew that installed this project are well suited to performing quality work and displayed exceptional capability in working with this product.

Flood Defense Group is happy to provide any supporting information, answer any questions, or otherwise qualify the opinions in this write-up.

All the Best,

Keith

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Disclaimer: This information is provided in good faith based on opinion through extensive experience in working with HESCO Bastion and temporary flood defense barriers at large but is given for evaluation and ultimate endorsement by the end user of the product in question. Flood Defense Group do not assume liability for the outcome or performance of any flood defense barrier or flood defense project.