Big Ravine Preserve

Design Report [DRAFT]

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Overview

As stated in the contract with the Town of Bayfield, this draft design report for the trails network within the Big Ravine presents details of the proposed routes, estimated materials and labor costs, construction methods, and other information requested in the RFP. This report is to be delivered by January 3rd, as stated in the RFP.

After spending time in the Big Ravine, walking up the creek, exploring the ravine walls, and hearing from community members at the Trails Forum, I have flagged out the best routes for each of the proposed segments. In the following report, I have broken the entire network down into each individual segment of trail. There is a brief narrative of the specific section of trail, and then a description of recommended construction techniques required for any construction other than basic tread. Each segment will also have a recommended materials list based on construction requirements, as well as suggested trail signage. I have included a spreadsheet that totals all of the signage for the proposed trails, as well as the individual segments. At the end of each trail segment, a cost estimate is presented for that particular section of trail.

Within the cost estimate, the section is broken down into separate labor and materials estimates. Assuming that trail builders will itemize their contract, the labor estimates are calculated by adding up the cost/foot for different types of trail (basic tread, elevated tread, boardwalk, rock armoring, etc.). Included in this draft report is a spreadsheet that consolidates all the cost estimates and materials lists in one place, and I will include a breakdown of the different types of trail and cost/foot for each type that I anticipate will be needed to build the trail system. These costs are based on prices that I charge for building projects through Trails Anonymous. Prices may vary among other trail building companies.

Due to the fact that the ravine walls are made up of predominantly sandy soil, care has been taken to keep that in mind when scouting possible trail routes. In cases where it was not possible to keep the basic tread from climbing too steeply, alternative construction methods have been suggested to prevent erosion (ex. stairway, boardwalk, rock armoring, etc.). Attention was also given to cost by planning routes that kept more expensive construction methods to a minimum. The steep, sandy walls of the ravine present a challenge when planning a sustainable trail system, but the suggestions given in the following report are the best options for a sustainable trail system within the Big Ravine Preserve.

Other important aspects that were considered while planning out new trails within the preserve were the aesthetic of the trail and how it fits into the natural surroundings, as well as user accessibility and enjoyment. With input from city representatives, I strived to design a trail system that would allow the user to experience the natural wonder and beauty of the ravine. This is accomplished by keeping the trail tread to a moderate width, varying the perceived difficulty of the trail by building in grade changes, and by creating a corridor that flows with the terrain rather than works against it. The ravine is an amazing place, with walls that tower over you as you hike along the creek bed, so I wanted to design trails that would help the user experience this as they climb in and out of the ravine.

Due to unexpected early snow accumulations, accurate gps data and measurements for some specific sections of trail were unable to be made, therefore it was necessary to make rough measurement and distance estimates of the proposed trails. After the snow melts, and I am able to attain more accurate gps data and measurements, total trail lengths will be included in the final report, as will more refined cost estimates and materials lists. Included in this draft report is a map that includes all of the proposed trails. When my gps data is updated, I will be making “to scale” maps of each trail that identify any place that requires more than basic tread (stairs, boardwalks, rock armoring, etc.), as well as suggested locations for

signage. After I receive feedback from the Town of Bayfield, and other representatives invloved in this project, I will continue to refine my designs and cost estimates.

Trail Segments

There are eight separate trail segments that run up the creek, connect to town streets, extend up into the ravine, and eventually connect with the East and West Rim trails. I will describe each segment starting with the trails closest to the existing trailhead on Washington Ave., and ending with the East and West Rim Connectors.

Rice Avenue Connector

Trail Narrative

The existing "social" trail is already well established and drops from the bridge down to the existing trail underneath the Iron Bridge with only a quick change in direction halfway down the steep slope. I explored several different options, but quickly ran into a seep that presented a challenge in trying to build a less steep and sustainable trail. After considering some alternative routes, I felt it was best to combine two of the options I had considered. I will also be looking at building a staircase only, rather than combining a short staircase with some trail, once I am able to make more accurate measurements with the snow gone.

In an effort to keep people from continuing down the social trail, a combination of stairs and new trail should be considered. Starting with a stairway at the top of the ravine, the trail then traverses across the ravine before switchbacking and dropping down to the base of the Iron Bridge where it will meet with the existing trail. Initially I had considered having a stairway that follows the social trail, but after making some calculations, found that the stairway alone would not work, as it would have been too steep, and the stairway not conducive to users. Because of this, special care should be made when building the new trail to completely obliterate and naturalize the existing social trail, including placing natural obstacles that may deter users from cutting the switchback further down the trail.

*Note: There is a large standing dead tree that should be considered for removal as it is a potential hazard to users. Once felled, the tree may be used as a barrier to prevent users from cutting the switchback.

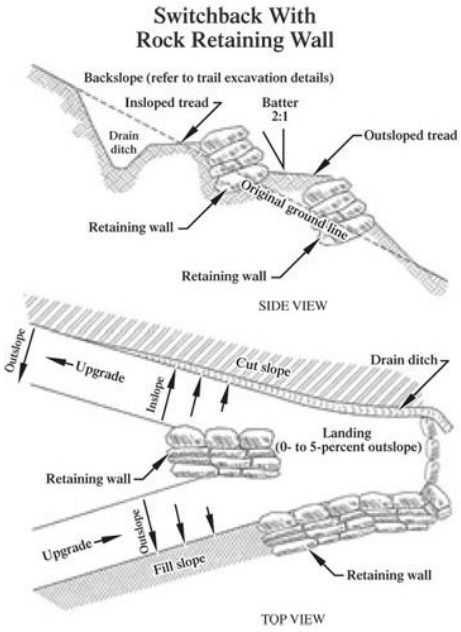
Construction Techniques

In order to keep things simple, a stairway made of 4x4 lumber can be used here. Using 4x4 timbers, you build the step and a side wall in the shape of an L, anchoring them with rebar to the ground. The rise of the step is cut to the desired tread width, in this case somewhere between 24-36 inches. Stairs should overlap each other and rebar used to connect them, as well as to anchor each level to the ground. The depth of each step should be somewhere between 13-18 inches (long enough for an entire foot to fit on the step). From the base of the stairway the trail traverses the ravine before switchbacking towards the bridge again. Care should be taken when building

the switchback, and the downslope leading into and out of the switchback should be cribbed. Rock cribbing is ideal, but if no rock is available for the cribbing, then wood can be used in its place. The tread leading to and from the switch back should be steeper than the rest of the basic tread, which will help deter users from cutting the switchback.

Example of stairs:

Example of Switchback construction[1]:



Materials List

- 4x4 lumber
- ⅝” Rebar
- ⅜” x 6” washer head lag screws

Signage

At the top of the stairway, as it drops into the ravine from Rice Ave., there should be a sign post with the name of the trail (Rice Ave. Stairway/Connector), and a directional arrow with the name of the trail that Rice Avenue leads too. I would also recommend a signpost at the bottom of the stairway that informs users to their location in the Ravine. I don’t think this needs to be a map, but it should have directional arrows directing the user towards the Washington Ave. Trailhead, further up the ravine to the waterfalls, and up the stairway to Rice Ave.

Cost Estimate

[1] (Hesselbarth, Vachowski, & Davies, 2007)

A cost estimate of the materials needed for the Rice Ave. Stairway is $350.00-$616.00 (if wood is used for the switchback. This does not include labor, which I estimate to be about $2,031.00.

Waterfall Route

Trail Narrative

This particular section of trail diverts from the already existing trail and follows the creek on the east side up to the base of the waterfalls. It then climbs up the east side of the waterfall to the top of the falls. From there it crosses the creek to the west side, where it meets the base of the proposed rock armored staircase that comes down from the viewing platform on the existing trail. At the base of the staircase it turns and continues up the ravine, where it crosses the creek to the east side once again, and follows the existing social trail alongside the creek. It begins to turn away from the creek and climbs gently away from the creek to where the Sweeny Ave. and Broad St. Connectors converge.

Construction Techniques

This section will be somewhat labor intensive, and will consist mostly of rock work, from more demanding rock armored staircases and cribbing, to stepstone creek crossings, like those that exist on the already established trail.

Example of rock staircase:

Example of step stone crossing:

Example of rock crib wall:

Materials List

This section of trail will need little in the way of materials, other than the rock that can be found along the creek bed.

Signage

There will need to be signage where the already established trail and the proposed Waterfall Route diverge. There should also be some signage that lets the user know that this section is wet and they should be prepared for the possibility of wet feet. This would be an ideal location for a map, as this would allow the user to view the multiple routes possible, as they travel further into the ravine. There should also be signage that points users in the right direction at the multiple creek crossings.

At the base of the rock armored staircase there should be directional signage that lets the user know which direction the trails lead in (ex. towards the viewing platform and towards the Sweeny Ave. and Broad St. Connectors). Once the trail climbs away from the creek bed and converges with the Sweeny Ave. and Broad St. Connectors, there should be directional signage that points the user in the proper direction. Having arrows pointing towards the Sweeny Ave. Connector, Broad St. Connector., Waterfall Route, and the Ravine Creek Extension would be necessary. This would also be a good location for a map that shows the user exactly where they are, giving them a reference point for the directional sign pointing to the multiple trails that converge at this point.

Cost Estimate

Although this section will be fairly inexpensive in terms of materials needed, rock work can be expensive, with contractors charging per square foot of rock armor. It may be possible to save some money by utilizing volunteer work. Building stepstone crossings, as well as the small amount of dirt work that is required to make the social trail more sustainable, would be something that a volunteer base may be able to help with. Volunteers may be able to build rock armored stairs and cribbing as well, but if you prefer to use a contracted builder an estimate for labor costs would be $3,750.00.

Creek Access (below platform)

Trail Narrative

This is the shortest section of new trail that is being proposed. It is clear that users of the already established trail have been accessing the top of the waterfall by climbing down the short steep slope below the viewing platform. In order to make this a more sustainable route it is necessary to build a rock armored staircase that allows the users to access the creek and the Waterfall Route without further eroding the steep embankment below the platform.

Construction Techniques

Refer to rock staircase image in construction techniques in the Waterfall Route section.

Materials List

As in the Waterfall Route section, this short staircase will not require much in the way of materials other than the rock occurring naturally in the surrounding area.

Signage

There should be a directional sign at the platform above the staircase that shows the user where the staircase leads to, as well as in the direction of the Ravine Creek Extension. This would be an ideal location for a map that shows the user where they are in reference to the multiple trails that lead away from the platform.

Cost Estimate

As stated in the Waterfall Route section, the cost for rock armoring is usually calculated per square foot. Again, the cost for this section may be eliminated if a volunteer workforce is available to build this staircase. If a contracted builder is used, an estimate of labor costs would be $600.00.

Sweeny Avenue Connector

Trail Narrative

The trail will leave Sweeny Ave. at the end of the road rather than at the back of the town dumping site. It will connect with the rim trail and follow along the rim going up towards Broad St., where it will then begin descending down into the ravine using the existing social trail. The trail will then converge with the Broad St. Connector and the Waterfall Route. From the point where the trails converge it will continue following the existing social trail towards the creek, where it will meet up with the Ravine Creek Extension.

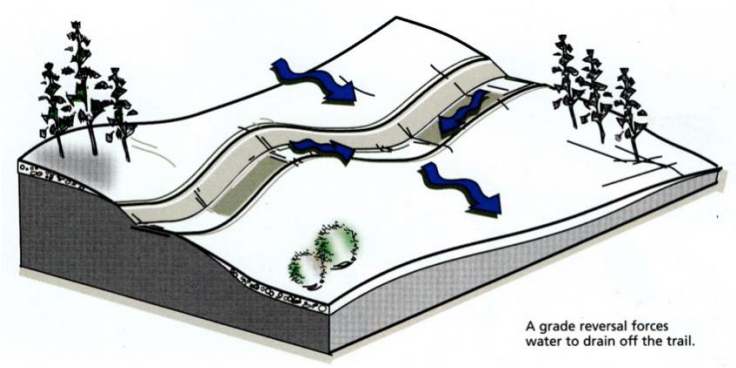
From the trail junction the trail that leads to the Ravine Creek Extension is a fairly well established social trail that only needs some slight drainage work in order to make it more sustainable. The only section that will require anything other than dirt work is a short creek crossing which can be crossed using a stepstone crossing similar to other creek crossings in the trail system.

There is not an obvious social trail from the Sweeney Ave. dump site, but because this has traitionally been where people enter the ravine, some considerations should be made to obliterate and naturalize the old social trail that leaves the dump site from the back. This will help people guide people to use the new proposed new trailhead.

Construction Techniques

Although the existing social trail is adequate as a route down into the ravine, it will require some rehab in order to create a more sustainable trail. There will need to be a short stairway at the top where the trail begins its descent from the rim trail down into the ravine (approximately 6-8 ft, see image in Rice Ave. section). From the base of the stairway it will be necessary to build several grade reversals in conjunction with some cribbing along the lower end of the trail before it turns away from the ravine towards the trail junction at the bottom.

Example of a grade reversal[2]:



Materials List

- 4x4 lumber
- ⅝” Rebar
- ⅜” x 6” washer head lag screws

Signage

There will need to be signage at the entrance to the trail off of Sweeny Ave. with the name of the trail (Sweeny Ave. Connector), as well as directional signage pointing to the trail in the ravine. As the trail leaves Sweeny Ave., it meets with the existing trail on the rim, where a directional sign pointing users towards the Ravine Creek Extension/Waterfall Route will be needed, in order

[2] (McBain, 2014)

to point users in the direction of the trail that descends down into the ravine. Once down in the Ravine, the Sweeny Ave. Connector meets with the Broad St. Connector, the Waterfall Route, and the trail that leads to the Ravine Creek Extension. Signage and a map will be needed here. Refer to the above signage section in the Waterfall Route description to find a description of suggested signage for the trail junction.

Cost Estimate

Although this section of trail will require less rerouting than other sections, it will require some work in order to make the existing trail more sustainable. A cost estimate of materials for this section is $400. A cost estimate for labor is $2,413.00.

Broad Street Connector

Trail Narrative

The Broad St. Connector starts at the corner of Broad St. and Lynde Ave., which is also where the existing Rim Trail leaves the road as well. From the road, the connector leads away to the left of the rim trail and drops down to a stand of trees where it switchbacks to the right across the steep slope of the ravine. It travels across the slope for about 70 feet or so, before switchbacking again. This next section drops to a slight nose, where the trail then drops down the nose using a stairway. The stairway drops down for about 20 feet before cutting to the right dropping quickly down to where it meets with a slightly travelled social trail. From there it is simple dirt work to rehab the social trail that follows the base of the ravine, leading the user to the trail junction where the Sweeny Ave. Connector, Waterfall Route, and the trail to the Ravine Creek Extension all meet.

Construction Techniques

Initially I explored an option that utilized many more switchbacks to reach the ravine floor, but felt that it would not be sustainable, as too many users might have started cutting switchbacks. Because of this, a stairway would be most advantageous. The dirt work required is fairly straightforward, mixing basic tread with common drainage techniques, such as grade reversals and knicks.

The stairway design for this segment will differ from the previous segments. This segment will be utilizing cable steps, which are ideal for steep sandy slopes when going straight down the slope. Using dead man anchors at the top, a cable wire is run down the slope, passing through the lumber used for the steps. It then terminates at two more dead man anchors at the base of the steps.

Refer to the West Rim and Rice Ave. Connector sections for a description and image of building techniques for a switchback.

Materials List

- 6 x 6 lumber
- ⅜” galvanized steel rope
- ⅜” wire rope clips

Signage

As with other connector trails, a sign that has the trail name (Broad St. Connector) and a directional arrow will be necessary at the entrance of the connector at the road where the trail enters the woods. This particular connector will also need a directional arrow for the rim trail that leads from Broad St. I would also recommend placing a map here to allow users to see their location in relation to other trails, since users could follow the rim trail all the way to the East Rim Connector from Broad St.

Cost Estimate

The cost estimate for materials is $800.00. The estimate for labor in this section is $2,250.00.

Ravine Creek Extension

Trail Narrative

The social trail that continues further up the ravine from the viewing platform above the waterfall is very well established until just before the East and West Rim Connectors. There are only a couple areas that need any major work, while most of the obvious existing trail needs only a little drainage work in order to make it more sustainable.

Right after the viewing platform, the social trail leads down to the creek. It will be necessary to build a short section of rock armored steps where the trail drops down to the creek. From there the trail crosses the creek, where it will be necessary to make a more obvious stepstone creek crossing. After the first creek crossing, the trail meets with the trail coming from the Broad St., Sweeny Ave., and Waterfall Route junction. From there, the trail follows along the creek where it splits, with one trail crossing the creek again onto a little pebble island, before quickly crossing back over the creek to the main social trail. The main social trail cuts right along the shoreline where it climbs up above the creek and continues along the east side of the creek. The pebble island trail is fairly well established, and does not need any work beyond building stepstone creek crossings. Shortly after meeting up with the pebble island trail again, the social trail cuts away from the creek to continue further up the ravine. This is where the most labor intensive rehab work will need to be done.

There is a seep that comes from higher up the ravine that collects and puddles right next to the social trail, creating a muddy section, which if not developed properly, will create sustainability issues in the future. A trench will need to be dug from the deepest part of the seepage puddle directing the water flow across the trail and down to the creek. Where the trench crosses the trail,

it will be necessary to create a rock armored drainage crossing in order to create a dry spot for users to cross the drainage.

Once the trail passes the seepage it continues up the ravine where only a few spots need some rehab work. Eventually the social trail begins to peter out, and it becomes less obvious where users should walk to continue up the ravine. This may be because people walk along the creek bed, but I felt that in order to create a more pleasant experience for the user, and in case of high water events, it would be best to make an obvious trail that does not utilize the creek bed.

In order to do this, I found a route that follows above the creek bed on the east side of the creek before dropping down to a creek crossing. There is already a large rock in the middle of the creek, so it would only be necessary to add several smaller rocks in order to create an adequate creek crossing. After crossing to the west side, the trail climbs up and away from the creek to an old road grade. It then follows the road grade along the bottom of the ravine where it meets with the West Rim Connector. From the trail junction, it continues to follow the old road grade before dropping back down towards the creek and another creek crossing.

A simple stepstone crossing similar to the other creek crossings in the trail system will suffice here. After crossing back over to the east side of the ravine, the trail moves away from the creek again, where it follows along the highest point between the creek and the ravine wall. It is fairly rocky here, and will be somewhat labor intensive to dig through this section, but much of the rock excavated can be utilized at the beginning of the East Rim Connector. The Ravine Creek Extension ends at the junction with the East Rim Connector.

Construction Techniques

As described in the trail narrative, beyond some rock work for creek crossings, the most labor intensive work will be the rock armored drain crossing for the seepage drain at the beginning of the extension. Beyond this particular section it will mostly be basic dirt work expanding some of the drainage on the existing social trail until the social trail ends and the need to build new trail begins. Where it is necessary to build new trail it will mostly just be basic dirt work, although due to the amount of rock at the bottom of the ravine it could be labor intensive.

Example of rock armored drainage crossing:

Materials List

Beyond rock work required for the drain and creek crossings, not much in the way of building material will be needed.

Signage

As mentioned previously in the section on the Creek Access, a map and signage will be needed at the viewing platform. Once the user crosses the creek after the viewing platform, a directional sign will be needed across the creek where the Ravine Creek Extension meets with the trail coming from the Sweeny Ave. Connector. This sign should have directional arrows that direct users towards the East and West Rim Connectors, as well as towards the Sweeny Ave., Broad St., and Waterfall Route junction. The next sign required on the extension will be where the trail meets the West Rim Connector. Having a directional sign with arrows pointing up the West Rim Connector, back to the viewing platform, and towards the East Rim Connector will be necessary for this location. It would also be helpful to the user to have a map here in order for them to be able to see their location in relation to the trails in the system.

Although the East and West Rim Connectors are not very far from each other, it would still be helpful to the user to have a map located here for users to be able to see their location in relation to the other trails in the system. Another directional sign, similar to the directional sign at the junction of the West Rim trail will be required here as well.

Cost Estimate

As there are no sections that require any materials other than the rock that is readily available within the ravine there is no cost for materials. This section could primarily be done with volunteers as most of the building utilizes basic trail building techniques. Although if you were to go with a contractor, the labor cost estimate is $4,615.

West Rim Connector

Trail Narrative

This section, along with the East Rim Connector, have taken the longest to flag out. Having flagged out several different routes, I have settled on the longest of the routes as the best and most sustainable option. As the connector leaves the Ravine Creek Extension it makes a quick and moderately steep climb up and away from the bottom of the ravine. After climbing up a short distance, the trail switchbacks to the right where it bench cuts across the ravine wall for a distance.

After cutting across several ridges, it switchbacks to the left and climbs back across the ravine wall where it eventually crosses a fairly eroded drain, which will require a short boardwalk (about 6-8 feet) in order to keep the trail from eroding at that spot. The trail then makes another moderately steep climb up from the boardwalk before switchbacking to the right, where it crosses back over the eroded drainage, requiring another boardwalk (about 12-16 feet) to create a sustainable crossing for users. The trail then continues climbing up and across the ravine wall until it meets with a ridge line that comes down from the top of the ravine. From here it follows along the spine of the ridge, climbing up an existing social trail in a moderately steep ascent where it connects with the rim trail. Along the climb there are several sections on the spine where short sections of cable steps would be ideal for long term sustainability.

Construction Techniques

Most of this section can be built with a simple bench cut trail, utilizing basic drainage techniques. The boardwalks can be made with a simple footing system, although due to the steepness of the terrain, special attention will need to be made in order to keep erosion under control, either by cribbing the downhill side of the footings, or digging them into the backslope of the tread and anchoring with rebar, or both. If there are rocks within a reasonable distance, that could also be used in order to help with erosion control.

The smaller of the two boardwalks can be made with just two footings at the beginning and end of the stringers, using 2x6x8 treated lumber for stringers. The longer of the two boardwalks will require 2x12x14/16 lumber. Using a wider dimensional lumber for the longer boardwalk will eliminate the need to utilize a footing in the middle of the boardwalk where the erosion will be worse.

Where the trail makes a switchback, because of the sandy soil on the ravine walls, attention to erosion control will be very important. Crib walls will be necessary on the down slope of the switchbacks in order to keep the tread from eroding too quickly. A grade reversal before the turn, as well as an uphill drain will help to keep water running all the way through the turn and onto the lower section of trail. See example image of switchback construction in Rice Ave. section.

As the trail begins its climb up the spine of the ridge towards the rim trail, there are several spots where the spine is too steep to be sustainable with an increase in user traffic. It will be necessary to build some short sections of cable steps here in order to make these sections sustainable, and more easily accessed to a larger number of users. Although I looked at several other spots along

the rim to start climbing down to the bottom, I felt that this walk along the spine was the most interesting, and would provide an element of fun for the user.

Example of boardwalk:

Materials List

- 4x4 lumber for footings
- 2x6 lumber (for stringers, decking, and base plates for footings)
- 2x12 lumber (stringers for longer boardwalk)
- ⅜" x 6" washer head lag screws
- 5/16 x 3" washer head lag screws
- ⅝" Rebar
- 6x6 lumber, for cable steps
- ⅜" galvanized steel rope
- ⅜" wire rope clip

Signage

As mentioned in the Ravine Creek Extension, a directional sign and map should be placed at the base of the West Rim Connector. Due to the proximity of a map already existing on the rim trail, it may not be necessary to have a map at the junction of the connector and the rim trail. A directional sign should be placed at the junction pointing people in the direction of the parking lot at the ball field, the Ravine Creek Extension, and the rim trail that heads northeast away from the parking lot. It may be helpful to the user to also have names of other trails that connect with the rim trail further up the rim trail.

Cost Estimate

A cost estimate of the materials needed for this section is $750.00. The labor estimate is $8,516.00.

East Rim Connector

Trail Narrative

Starting at the end of the Ravine Creek Extension, the East Rim Connector climbs up quickly from the bottom of the ravine with rock steps to where the wall of the ravine levels out for a distance. From the shelf, the trail makes a moderately steep climb up and to the left before leveling out slightly and climbing across the ravine wall to another shelf in the wall of the ravine. It then switchbacks to the right and makes a steep climb to another spot in the wall of the ravine that levels out. The trail then switchbacks to the left again where it makes a longer cut across the ravine wall. It continues northeast along the wall to another spine that comes down from the rim. Initially, I flagged a route that switchbacked up the spine, but I felt that this initial flag line may not be sustainable in the future. The flag line that I finally decided on continues north east across the wall of the Ravine continuing to climb towards the rim at a sustainable rate.

At the end of this last bench cut, the trail switchbacks to the right again, beginning with a moderately steep climb away from the switchback to deter users from cutting the switchback. The trail then mellows out to a more sustainable climb with only a couple spots that become slightly steeper due to terrain. At the end of this last switchback, the trail meets with the top of the ravine where it cuts across a flat shelf for about 100 feet before it connects with the existing rim trail.

Construction Techniques

Refer to the West Rim and Rice Ave. Connectors Construction Technique sections for a description and image of building a sustainable switchback. In order to cut costs, it would be ideal if rock be used to build crib walls for the switchbacks, but if this is not possible, then using wood would be necessary.

Materials list

- 6x6 lumber, if no rock is available to build crib walls for switchbacks
- ⅝” rebar

Signage

I would recommend having directional signs and maps at the top and bottom of the connector, since these junctions are the furthest out from the main trailhead parking lot on Washington Ave. It would be helpful to have the map available to users in order for them to be able to see where they are in relation to the other trail sections within the system. A map is especially important at the top of the rim connector trail, as people can either hike back towards Broad St. or continue further up the rim trail.

Cost Estimate

If rock is not available to use for building crib walls for switchbacks, then the cost estimate for materials is $270.00. The cost estimate for labor for the East Rim Connector is $11,320.00.

Diagram Resources

Hesselbarth, W., Vachowski, B., & Davies, M. A. (2007, January 1). *Trail Construction and Maintenance Notebook.* Retrieved December 19, 2019 from U.S. Forest Service: https://www.fs.fed.us/t-d/pubs/htmlpubs/htm07232806/page12.htm

McBain. (2014, November 18). *Dirt Management: Good Trails- The Bare Necessities*. Retrieved December 19, 2019 from Riding Feels Good: https://www.ridingfeelsgood.com/dirt-management-good-trails-bare-necessities/

Map of Proposed Trails