Memorandum

To: Mike Winslow and Allie Dinwiddie (ACRPC), Valerie Capels (Town of Bristol)

From: Watershed Consulting

Date: February 21, 2019

Re: ***Stormwater Master Plan for Bristol, VT – Task 4 – 30% Concept Design – Sketch Level Concepts Summary***

ATTACHMENTS:

4.1 – Sketch Concept Drawings

1.0 Introduction

Watershed Consulting Associates, LLC (Watershed) has completed initial modeling and sketch-level design for the chosen 30% concept sites for the Bristol Stormwater Master Plan. These drawings are meant to showcase a suite of possible options for each site. The intention is to provide adequate detail for each potential option so that the Project Team can make a decision with respect to which option to pursue for final 30% design.

2.0 Methods

Practice Sizing:

Modeling for sizing of the system was conducted in HydroCAD 10.00-22, an industry standard model for sizing stormwater best management practices. The design storm used for each retrofit practice was the Water Quality volume (WQv) storm which is equivalent to 1" of rain in a 24-hour period. This amount of precipitation is thought to contain the most pollutants, while larger events are more dilute in terms of pollutant concentration. Within the parameters of this design storm, smaller events can also be modeled. The reason for doing this is that even though the full WQv may not be completely captured by a stormwater management practice, the smaller 'first flush' rain amounts can be captured. These 'first flushes' may contain a significant fraction of pollutants and are still worthwhile to treat. For that reason, we modeled out the full WQv, ¾ WQv, and the ½ WQv storms to present a range of size and cost options for each retrofit.

For the School sites, we modeled the Channel Protection volume (CPv) storm which is equivalent to approximately 2.25" rain in a 24 hour period. This storm is usually associated with erosive channel changing events in streams and rivers. The reason that we chose to model this storm for the school sites is that the downstream flooding experience by properties below the school may be a product of larger storms, such as the CPV storm which has a 100% chance of occurring annually. Infiltrating this volume will reduce the downstream effect of all larger storms (even storms above 2.25" in 24 hours). This may help alleviate the flooding experienced local properties.

Pollutant Load Modeling:

~~Pollutant load modeling and reductions associated with each practice were accomplish using WinSLAMM (Windows Source Loading and Management Module) v10.4.0. This software program makes use of stormwater pollution data derived from the Nationwide Urban Runoff Program (NURP). This program derives pollutant concentrations for a variety of different landuses from field measurements of actual runoff, as well as pollutant load reduction amounts association with stormwater management practices based on testing.~~

For this level of analysis we used the VT DEC's Stormwater Treatment Practice (STP) calculator, which uses pollutant washoff and treatment practice reduction values associated with the US EPA's Stormwater Management Model (SWMM). This is a method that the VT DEC is using to prioritize stormwater management practices throughout Vermont.

Cost Estimation:

At this level of design, cost estimation is very approximate and should not be regarded as a final cost. However, in order to provide some means of comparing the cost-benefit ratio of one practice versus another, we have created initial costs based on data assembled by the Cheseapeake Stormwater Network (CSN), which is currently being used by the VT DEC for preliminary cost estimation for stormwater Best Management Practice (BMP) prioritization. The exception to this is for costs associated with dry wells and sub-surface chambers, where we use costs supplied by the manufacturers of those systems as we have found them to be more accurate than the costs derived from CSN's data.

3.0 Potential Stormwater Management Practices – Descriptions

Note: Attachment 4.1 – Sketch Concept Drawings shows each potential option, drawn to approximate scale, for each site. Placement and details are not exact at this point, given the relatively early stage of design. Rather, this attachment should serve to illustrate the potential area taken up by each practice. Excavation associated with each practice will necessarily be larger than the final footprint.

ADS StormTech MC-4500 Chambers:

These chambers are approximately 5' tall and can be installed under parking lots or open space in situations where static and dynamic loading is occurring (traffic or parking). They require a minimum of 2' cover over them for structural rigidity, so excavation can be significant for these larger chambers, but they do provide the greatest surface area to volume ratio of any chambers that ADS manufactures. If the depth can be achieved at a site, these chambers are preferable and are typically more economical to install than shorter chambers.

The chambers act as storage voids with an open bottom that allows runoff to infiltrate into groundwater, providing pollutant reduction and groundwater recharge.

ADS StormTech DC-780 Chamber:

Similar to the MC-4500 chambers, the DC-780 chamber is only 2.5' tall and has a smaller individual chamber footprint. The surface area to volume ratio isn't as efficient as the MC-4500s, but these chambers can be used where excavation can't be as deep or there are other constraints such as high groundwater. While we don't prefer using these chambers, they may be necessary if underground utilities must be avoided, excavation depth is an issue, or soil or groundwater conditions dictate it.

Figure 1: Different chambers made by ADS. The MC-4500 and DC-780 are the preferred chambers for this project.

Figure 2: Illustration of chambers installed under a parking lot. Installation under the park in Bristol would be similar.

Dry Wells

Dry wells are large concrete structures with perforations in the sides and bottom that allow collected runoff to leak out from the structure and into the surrounding soil, removing pollutants and facilitating groundwater recharge. These structures are load rated much like the chambers – that is, they can be installed under areas that will have traffic or parking and support the load to federal highway standards. The inlet to dry wells is the

same as the grated inlet to a catch basin and pipes can be installed from the dry wells back into the main stormwater drainage system so that the dry wells don't overflow into the street but rather into the drainage pipes.

Dry wells are generally a generic concrete structure and can be manufactured by any company that does pre-cast concrete products, such as Camp Precast in Vermont.

4.0 Designs

School St 001:

A system of sub-surface chambers is envisioned for the School St 001 site. These chambers would sit under the park and essentially be invisible, other than a manhole structure that would be used for operation and maintenance access. This structure would be flush with the ground. The table below shows the potential drainage area, impervious cover, and total amount of phosphorus washoff in pounds, annually.

Drainage Area (ac)	Impervious Cover (ac)	Total Phosphorus Washoff (annual, lbs.)
32.12	10.2	91.58

For this site we modeled three different storm scenarios – the full WQv, ¾ WQv, and ½ WQv – to potentially be treated by a series of ADS StormTech MC-4500 sub-surface chambers.

Treatment Practice	Cost Projection ($)	P Removed (lbs.)	Cost per Pound P Removed ($)
5x20 MC-4500 Chambers	$610,000	57	$10,600
2x25 MC-4500 Chambers	$305,000	35	$8,800
1x14 MC-4500 Chambers	$107,000	11	$10,000

Recommendation:

We would recommend pursuing treatment of the full water quality volume for several reasons. The first is that the cost to do so is competitive on a cost per pound P removed basis at this preliminary level. The second is that disturbing the area will result in some temporary loss of use, regardless of practice installed, therefore we believe that it's most effective to install the most effective practice possible from the beginning. Third, the treatment impervious area associated with this practice is 10.2 impervious acres. In light of the soon-to-be

issue stormwater general permit which will require all parcels with greater than three acres of impervious surface to obtain a stormwater permit, the treatment provided by this practice could be used by a so-called 3-acre site to obtain permit coverage in the event that conditions on the site prevent them from adequately treating runoff to the regulated level. 3-acre sites could potentially buy in to a project such as this to ensure permit coverage for their site. This could potentially help pay for operation and maintenance of the practice into the future.

North St 001:

A system of sub-surface chambers is envisioned for the North St 001 site. These chambers would sit under the park and essentially be invisible, other than a manhole structure that would be used for operation and maintenance access. This structure would be flush with the ground. The table below shows the potential drainage area, impervious cover, and total amount of phosphorus washoff in pounds, annually.

Drainage Area (ac)	Impervious Cover (ac)	Total Phosphorus Washoff (annual, lbs.)
190.26	16.09	511

For this site we modeled three different storm scenarios – the full WQv, ¾ WQv, and ½ WQv – to potentially be treated by a series of ADS StormTech MC-4500 sub-surface chambers.

Treatment Practice	Cost Projection ($)	P Removed (lbs.)	Cost per Pound P Removed ($)
8x20 MC-4500 Chambers	$997,000	103	$9,600
2x25 MC-4500 Chambers	$375,000	35	$9,300
1x14 MC-4500 Chambers	$123,000	11	$9,700

Recommendation:

Similarly to the School St 001 chamber system, we would recommend pursuing treatment of the full WQv for the same reasons listed previously. However, this system would be substantially larger than either of the smaller two system and therefore require a more onerous temporary loss of use of the park during construction. This project also has the potential to encounter additional challenges in the form of underground utilities or other conditions. Nevertheless, we believe that pursuing this design makes the most sense, though during final 30% it may have to be adjusted for conditions uncovered during that design phase.

School 1 & 2:

A system of sub-surface chambers is envisioned for the School 1 (northern) and School 2 (southern) sites. These chambers would sit under the playground and essentially be invisible, other than a manhole structure that would be used for operation and maintenance access. This structure would be flush with the ground. Both of these systems may require additional drainage infrastructure (catch basins and pipes) to adequately convey runoff to them. This may complicate construction and increase cost, but not to a prohibitive degree. The system described for School 1 would also be able to treat runoff from the large area above Mountain Street. This could alleviate strain on the existing drainage infrastructure along that road. The table below shows the potential drainage area, impervious cover, and total amount of phosphorus washoff in pounds, annually.

School 1:

Drainage Area (ac)	Impervious Cover (ac)	Total Phosphorus Washoff (annual, lbs.)
59.59	2.00	158

For this site we modeled two different storm scenarios – the full WQv and the Channel Protection volume (CPv) – to potentially be treated by a series of ADS StormTech MC-4500 sub-surface chambers.

Treatment Practice	Cost Projection ($)	P Removed (lbs.)	Cost per Pound P Removed ($)
10x17 MC-4500 Chambers	$1,000,000	95.5	$10,700
1x11 MC-4500 Chambers	$80,000	35	$10,000

Recommendation:

We would recommend pursuing 30% design for the WQv sized system at this site, given the large increase in cost for treating CPv, where the benefits are only possible, and not assured, with respect to downstream flooding. Instead, if downstream flooding is the primary concern, there may be additional retrofits that can be pursued on Mountain Street (such as upgrading pipe sizes to more adequately convey larger storm events so that the upland areas don't negatively contribute to properties downhill of the school) that would be more cost effective.

School 2:

Drainage Area (ac)	Impervious Cover (ac)	Total Phosphorus Washoff (annual, lbs.)
2.54	1.25	7.5

For this site we modeled two different storm scenarios – the full WQv and the Channel Protection volume (CPv) – to potentially be treated by a series of ADS StormTech MC-4500 sub-surface chambers.

Treatment Practice	Cost Projection ($)	P Removed (lbs.)	Cost per Pound P Removed ($)
1x22 MC-4500 Chambers	$162,00	7	$23,000
1x12 MC-4500 Chambers	$92,000	6	$15,500

Recommendation:

Similarly to the practice for School 1, we would recommend only pursuing design for the WQv practice as the benefits of treating the CPv are not assured. This site would definitely require more drainage infrastructure to ensure that runoff makes it to the chambers, which may increase costs substantially, but would still be of benefit. Additionally, similarly to School St 001 and North St 001, there may be an opportunity to use the water quality benefits from this site to help another 3-acre site meet regulatory requirements.

West St 002 and 003 (Dry Wells):

A series of dry wells of different sizes could be used in this are to replace existing catch basins. The dry wells would capture runoff and slowly bleed it off through the perforations in the bottom and sides, with a grate and overflow pipe that would function similarly to a normal catch basin. Each of these structures would be sized to treat the WQv to the maximum extent possible (DW-1 and DW-2 can only treat up to 50% of the WQv). The table below summarizes the cumulative benefits of all five dry wells if installed.

Drainage Area (total, ac)	Impervious Cover (total, ac)	Total Phosphorus Washoff (annual, lbs.)	Total P Reduction (annual, lbs.)	Cost (dry well structures only)	Cost per Pound P Removed ($)
8.93	3.56	25.8	9.45	$15,000	$1,600

Recommendation:

We would recommend that the Town move to install these dry wells prior to the planned work on West Street by VTrans in the spring of 2019. While costs at this point are very approximate, we believe that, even if doubled, the effort is worth it as these relatively simple practices would treat a fairly substantial drainage area, with 3.65 acres of impervious cover and reduce a substantial amount of phosphorus, according to the DEC STP modeling procedure.

The Town should do its due diligence with respect to VTrans and if installation of these structures would, in any way, interfere with work planned. During 30% design, we will also take into account the planned VTrans project to the best of our abilities (based on plans developed for this project by VTrans, if any are available).

Next Steps

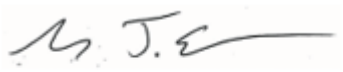
Please review these materials. The goal of material review is to select a sketch concept for each site to pursue to 30% concept design. We have provided our recommendations for each, based on our professional judgment and experience, but ultimately is the Town and ACRPC's decision as to which practices are ultimately designed.

We envision that, after review of the sketch concepts and memo, that we would arrange a time for a phone call, with possible screen share, to go over these designs and answer any remaining questions you may have. After that, we will pursue 30% concept designs, which will include detailed site survey, geotechnical assessment for infiltration potential, and screening for utility (or other feature) conflicts.

Watershed welcomes feedback on this task from project partners.

Please feel free to give us a call at (802) 497-2367 or email at dana@watershedca.com with any questions.

Sincerely,



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