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January 18,2020

I reviewed the following reports and my comments are presented by section as the Report was structured.

Narrative and Stormwater Management Report
Prepared for Institution for Savings
Prepared by Meridian Associates
January 8, 2020

State Street-Post
HydroCAD
1/14/2020

Review of Stormwater Management Report

Project Narrative

It is stated that the design presented will reduce peak flows from the 100-year storm by 15%. This statement is based upon the results of the HydroCADD report submitted with the application. I consider the modeling to be improperly done and therefore the reduction in peak runoff rates has not been proven.

I agree with the design engineer and the City's Engineer Jon-Eric White that infiltration of stormwater into the ground is not a wise thing to do in this area of the City.

Stormwater Management Standards

Standard 1 – No new stormwater conveyances

This standard is met.

Standard 2: Peak Rate Attenuation

Because the HydroCADD program was not properly run the applicant has not shown that this standard has been met. (See attached discussion of the HydroCADD modeling.)

Standard 3: Recharge - Loss of annual recharge to groundwater shall be eliminated or minimized

Given the location of the project, infiltration of surface water into the ground may well have an adverse impact upon other properties in the area, and for that reason compliance with this standard is detrimental to the City.

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The applicant has adequately addressed this issue in discussions with the City Engineer and the decision to not infiltrate is reasonable and not inconsistent with the intent of Stormwater Standards.

Standard 4: Water Quality

The project as proposed will improve water quality. Drainage from only approximately 1400 square feet of the property out of 40,000 s.f. will be untreated. The runoff from the remaining 97% of the property will flow to catch basins, Stormceptor or sub surface detention. Additionally, the parking lot which now drains untreated to street drainage will be covered by the new building and the roof water that flows off the building is considered clean by DEP. Furthermore, an oil/grit separator will be installed on the drainage from the parking garage and that drainage will be directed to the sewer rather than the drainage system.

While a TSS removal percentage rate is listed in the Stormwater Handbook as 25% the DEP does not assign an 80% removal rate for the Vortechnic Stormceptor units. In fact, the DEP leaves the decision on what removal efficiency to ascribe to proprietary units up to the local Conservation Commissions. The Commissions are supposed to read available literature and arrive at a determination of efficiency.

I have seen test data showing as high as 75% removal. The State of New Jersey only considers 50% removal reasonable.

The engineer should verify that the existing catch basins that are proposed to be reused in the project have the required 4-foot-deep sump and grease hoods to qualify for the 25% removal efficiency.

In my opinion the design has met the intent of the regulations but the engineer did not submit TSS removal calculations as required. Calculations of TSS removal rates should be submitted.

Standard 5: Land Uses with Higher Potential Pollutant Loads (LUHPPLs)

Stormwater Standard 5 is not applicable to this project.

Standard 6: Critical Areas

Stormwater Standard 6 is not applicable to this project

Standard 7: Redevelopments

This project does not qualify as a redevelopment project.

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Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan shall be implemented.

The plan is thorough with the following exception:

The Construction Entrance is shown on the detail sheet but the location is not shown on the Erosion Control Plan.

Standard 9: A long term Operation and Maintenance Plan shall be implemented.

The plan is complete but the section referring to the subsurface detention facility should be rewritten to reflect that it is detention only and not infiltration. Reference to a clogged bottom needs to be removed.

Standard 10: Prohibition of Illicit Discharges

An Illicit Discharge Compliance Statement must be added to the application as required by the DEP Standards.

Discussion – HydroCADD Model

I agree with the approach the design engineer has taken regarding stormwater control and if changes are made to the plans as noted in my comments, the project will not have a detrimental impact on stormwater in the project area. The peak rate of flow will be attenuated by underground storage. Infiltration of surface water into the ground is not reasonable in this area and could cause problems for neighboring properties and for that reason I consider the project exempt from that portion of State and local regulations. The use of Stormceptor units will reduce total suspended solids in the stormwater flow and overall provide cleaner drainage than discharged from the present site.

The project is designed using infiltration chambers as storage chambers. The construction detail in the plan is incorrect and needs to be modified to achieve the design intent of the engineer. (See my comments under plan reviews). The HydroCADD modeling submitted in the Stormwater Report and the supplemental HydroCADD report of 1/14/2020 are incorrect and do not reflect the actual performance of the drainage system.

As presently designed the outlet from the storage area is a 12 inch in diameter pipe with an invert level at the elevation of the bottom of the system. Such a large outlet provides little or no control for smaller storms and only provides maximum storage at the most intense part of a major storm. A more proper design would be to use a small diameter pipe as an outlet at the bottom of the system with a larger outlet at the top of the system. In this way the storage system would be full during the more numerous and frequent small rainfall events and only overflow in the few and less frequent major storms.

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Inlet and outlet manifolds would provide a hydraulic interconnection between the chamber rows. If the manifolds are not used interconnecting piping between the rows of chambers should be used.

See additional comments regarding the storage system design under **Review of Plan Set** below

As modeled the flows from subcatchments are routed through reaches and the reaches combined to form an inlet flow to the storage unit. As noted from the HydroCADD manual this approach is incorrect. From the manual

Although you can use a reach to model a pipe, this option is recommended only in very limited situations. (i.e. open-channel flow with no inlet restrictions.) For other pipe modeling options please read about pipes.

The flaw in the analysis can be seen when comparing the water level in the storage area during peak conditions and the water level in the incoming pipes from Reach 5 (PVCB1 to Cultec) and reach 8 (PDMH4 to Cultec)

Component	Water Level	Time
Storage chambers	97.39	12.14
Reach 5	96.15	12.09
Reach 8	96.27	12.09

One would expect the maximum water level in the pipes to be the same as the maximum level in the storage chambers to which they are connected and to occur at the same time. As can be seen neither is true. This is because the model was improperly constructed.

Below is a continuation of the HydroCADD discussion of proper modeling of pipes.

There are several ways to model a pipe, depending on the effects of the pipe on your drainage network, and the objectives of your analysis:

1) If the pipe always operates under normal open channel flow (Manning's flow), you can model it as a separate pipe reach. However, this approach does not evaluate inlet conditions, which often control the flow. A pipe reach is useful for long pipes with significant storage volume, which can produce significant attenuation of the peak flow. A short pipe reach will often have no effect on the inflow hydrograph, so there may be little benefit to including it in your model.

2) Another option for pipes operating under open-channel conditions is to model them as a flow segment within a subcatchment. This allows for the pipe's attenuation effects by including it in the subcatchment's time-of-concentration.

3) The most complete solution is to model the pipe as a culvert outlet on a pond, even if the "pond" is simply a catch basin or roadway impoundment. A culvert outlet provides a more

complete analysis of flow conditions, including inlet losses, headwater, and tailwater. The culvert analysis can also accommodate a level pipe or even an adverse slope.

4) If the discharge is limited by a separate outlet control device, such as an orifice, the overall structure should generally be modeled as a pond, using the "pipe storage" option for the pond storage. The outlet configuration would include the orifice (since it controls the flow) but not the pipe, since it's being modeled as storage and doesn't limit the outflow.

5) A pipe connecting two ponds can be modeled as a culvert outlet on the upper pond. This situation also requires a tailwater-sensitive routing procedure. But if the pipe is sufficient to equalize the ponds at all times, a more stable routing will be obtained by modeling both storage volumes as a single pond, including the pipe as part of the pond storage as described in scenario number 4, above.

The modeling should be redone following item 3 above and the entire system tied together through Dynamic-Storage-Indication Routing.

So, the model should be run with SC15 draining to Pond(PVCB2) with the pond having a storage volume from the outlet invert to the rim and the outflow pipe (with a Ke) discharging to Pond(PDMH5) and subcatchment 16 draining to the same pond. The flow would then travel through pond (PDMH4), Pond(Cultec), Pond (PDMH2) to PDMH1. All manholes or catch basins should be treated as ponds and a coefficient of discharge should be applied to each outlet pipe and because the drain into which the flow will discharge is existing drain and has flow within it, assume a tailwater at the spring line of the 15 inch pipe.

Review of Plan Set

I reviewed the following plans and my comments are presented by sheet of the plan set.

Permit Site Development Plans
93 State Street
Newburyport MA
Owner Applicant
Institution for Savings
January 8, 2020

Sheet 2 of 6 – Record Conditions and Demo Plan

The grades on the plan are based upon an assumed datum with temporary benchmarks shown on the plan. A 100 ft elevation is shown at the existing parking lot exit. The architect plan shows a proposed garage floor elevation at 100.00. The engineer should clarify if the assumed 100 ft elevations on the separate plan are equivalent.

Pipes and structures to be eliminated should be clearly marked. The extent of asphalt removal should be shown as well as the extent of asphalt surface grinding.

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Sheet 3 of 6 – Site Layout Grading & Erosion Control Plan

The location of the Construction Entrance for erosion and sedimentation control is not shown.

Spot elevations should be provided for the exit driveway apron, the proposed curb and the reconstructed sidewalk.

Handicapped access should be shown at the proposed garage exit.

The limits of the new sidewalk should be shown

Sheet 4 of 6 – Site Utility Plan

The pipe sizes and materials of the proposed sewer and drain piping should be shown.

Pipes to be removed or discontinued should be indicated.

The inspection ports on the Cultec units should be shown.

The plan should indicate with notes if the paving is to be patched or repaved and the extent shown.

A sewer service for the sanitary service from the new building is not shown. If it is connected to the pluming in the existing building it does not need to be shown. However, if is connected to the sewer manhole in front of the "Brick Building" or directly into the sewer line on Prospect Street or into the pipe discharging from the Oil and Grit separator it should be shown.

You should discuss with the water department whether separate water services are needed for fire and domestic water or a single water line from the street as shown on the plan will suffice.

The inlet pipes to the Cultec units are shown to enter at three different locations. The detail sheet should show how those connections are to be made. I would recommend a piping system with an inlet manifold at the inlet end of the chambers and an outlet manifold at the outlet end of the chambers.

There is only 0.1 ft difference between the inlet and outlet inverts for PVCB1 as shown on the plan. The manufacturers standard is 0.25 ft.

Sheet 5 of 6 – Site Landscape Plan

The landscape plan is stamped by a Civil Engineer not a Registered Landscape Architect

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Sheet 6 of 6 – Site Details

The standard City of Newburyport details for sewer and water service connections and hydrant installation should be added.

A bituminous sidewalk detail should be added

The written report in the project narrative refers to Cultec 280HD units as does the Site Utility Plan and the detail. The HydroCAD report references a Cultec R-280.

The detail of the storage system contained in the plan set is for an infiltration system rather than a storage system. There is a handwritten note on the plans "40 mil impervious plastic membrane" to the right of the infiltration system. The elevations on the detail for the bottom of stone is 217.1 while the bottom of the stone in the HydroCAD analysis is 94.40. On the detail the stone under the chambers is specified as 1 to 2" whereas in the HydroCAD the stone is shown as 6 inches. The inlet pipes in the detail are shown as 4" entering the end of the chambers while in the plan view on the Site Utility plan the pipes are shown in two cases to enter the side of the units. In the HydroCAD analysis the inlet of the outlet device is at an elevation of 94.90 which is the bottom of the Cultec units which is at the top of stone. Therefore, the storage in the stone under the units cannot be counted in available storage.

For clarity of the plans and to ensure storage system functions as intended I recommend the details should include both a plan view and elevation view of the detention system showing the individual chambers and stone surrounding the chambers with an inlet and outlet manifold at both ends of the system with proper elevations specified.

See the comments above presented in **Discussion – HydroCADD Model**

The Site Utility Plan shows a proposed oil and grit separator. A detail should be added to the plans of the unit you proposed to be used. Ordinarily an MDC trap is used and is manufactured locally by SHEA Concrete. All traps have vents for release of volatile gases and the location of the vent line outlet should be shown. The inverts as shown on the plan should be corrected to reflect the requirements of the separator used.

Handicap ramp details should be added to the detail sheet and shown in the site plan at the new garage exit.

PDMH1 is a new manhole to be constructed into an existing drain line. You should specify if this will be a doghouse manhole and if so, include a detail in the plan set or if you intend to cut the line, install a standard manhole and reconnect the pipes that should be noted on the utility plan.

PDMH2 and PDMH5 show only a rim to invert difference of 3.2 and 3.4 ft respectively. The shortest base available is 2 feet in height and the shortest cone is 1.5 feet high. The pipe invert has to be 6 inches above the bottom of the base and the frame and cover are usually 8” high and

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a single layer of brick and mortar is 2.5 inches. It seems that for those manholes a flat slab top manhole should be added to the detail sheet.

A doghouse manhole detail should be included among the details for the construction of PDMH1.

The Vertical Granite Curb detail should be changed to show a sidewalk behind the curb rather than loam and seed. Since it will be set in an existing street the distance of cutback of the finish and base course asphalt should be specified and the proposed asphalt patching depicted

"Approved by Planning Board" under TEMPORARY STABILIZED CONSTRUCTION ENTRANCE should be removed.