TETRA TECH

MEMORANDUM

To: Paul Cincotta – New England Development

Fr: Nathan H. Cheal, P.E.

Re: **University Station**
Summary of Stormwater Management System Updates

Dt: January 18, 2013

This memo summarizes the major updates that have been made to the University Station stormwater management system since the November 30, 2012 site plan submission. These revisions are the result of multiple working sessions with representatives of the Town of Westwood and the BETA Group, Inc. (BETA) They are intended to address five "big picture" items, each of which is discussed in greater detail below.

Point of Analysis 3 Pre and Post-Development Conditions

Point of Analysis (POA) 3 comprised of the land to the north/northwest of the overall study area. This watershed generally drains northwest to southeast through as a combination of overland flow, piped stormwater collection and conveyance systems, and open channel/ditches. The network of pipes run north along University Avenue, through the northern portion of the site, and ultimately flows towards the Neponset River, north of the Amtrak/Route 128 station.

The University Station stormwater model was created by directly inputting the watershed information contained within the previous stormwater assessment. XPSWMM was utilized to analyze the stormwater flows associated with the previous site plan iteration. The current model utilizes HydroCAD. The conversion was made in an effort to provide a more accurate representation of the hydrology of each respective watershed. Through coordination with Town representatives and BETA the model has evolved to its current form.

The recent update includes the modeling of the street drainage system located with the Pear Tree Drive and Endicott Street neighborhoods. A small amount of runoff originating within the upper boundaries of this watershed is actually collected in the roadway drainage system that has an overflow pipe that diverts stormwater away from this point of analysis to a drainage system that is not tributary to the University Station hydrologic study area.. The record drainage plans for this area was provided in a recent meeting with BETA.

Much of the watershed associated with Point of Analysis (POA) 3 is collected and conveyed to its discharge point through a closed drainage system. In larger storm events downstream portions of the system will operate above its open channel flow capacity resulting in surcharged conditions. Under surcharged conditions, the hydraulic grade line within the pipe system is expected to exceed the rim elevation of the collection/distribution structures, causing water to flow out of the structures where it will continue to flow overland, as gutter flow, to POA3.

One Grant Street
Framingham, MA 01701
Tel 508.903.2000 Fax 508.903.2001

Catch basin inlet grates were modeled as overflow weirs to approximate the gutter flow. The current stormwater calculations and corresponding peak flow rates consider these conditions.

The original XPSWMM model does not appear as though it allowed for stormwater flows that exceeded the capacity of the collection system to continue through to POA3. Rather, the pipes acted as small detention structures, detaining water upstream of the system until adequate capacity was available in the pipes to allow runoff to continue towards POA3. As a result of this unintentional detention capacity, the pre and post development stormwater flows generated by HydroCAD for Point of Analysis 3 are generally higher when compared to the pre and post flows predicted in the previous model.

A comparison of the pre and post-development flows predicted by XPSWMM and HydroCAD is included in the table below.

Comparison of Pre and Post-Development HydroCAD flows for POA3

Rainfall Event	Existing XPSWMM Flow (cfs)	Proposed XPSWMM Flow (cfs)*	Difference (cfs)	Existing HydroCAD Flow (cfs)	Proposed HydroCAD Flow (cfs)	Difference (cfs)
2-year	23	15	-8	22.79	12.84	-9.95
10-year	36	29	-7	67.26	23.35	-43.91
25-year	39	33	-6	90.00	37.33	-52.67
100-year	41	38	-3	132.06	53.40	-78.66

*Based on Stormwater Management Report dated December 5, 2008.

In addition to the significant reduction in the peak rate of runoff, a reduction in runoff volume is also anticipated. Not only will the peak rate at which the stormwater is discharged be less than in the existing condition, the actual quantity of stormwater will also be reduced. This is a significant improvement and will assist in alleviating downstream flooding concerns. The reduction in runoff volume is a direct result of the proposed stormwater management system that infiltrates a significant volume of stormwater and will be constructed as part of the University Station project. The table below shows the difference in pre and post development runoff volumes for POA3.

Pre and Post-Development Runoff Volumes for POA3

Rainfall Event	Existing Volume (acre-feet)	Proposed Volume (acre-feet)	Difference (acre-feet)
2-year	3.406	3.315	-0.091
10-year	7.821	6.253	-1.568
25-year	10.875	8.349	-2.526
100-year	15.546	11.282	-4.264

The differences between the two models were discussed with representatives from the Town of Westwood and BETA at a meeting on January 11, 2013. All parties were in agreement that the current HydroCAD model more accurately represents the conditions that are expected to occur for this point of analysis.

Existing Downstream Drainage Structures (Points of Analysis 3 and 4)

Through a series of comment letters and meetings, BETA has expressed concern regarding the ability of stormwater structures located beyond the limits of the property boundary to adequately convey post development stormwater flows, specifically at POA3 and POA4. As previously discussed, the watershed associated with POA3 terminates in a roadside drainage ditch at the intersection of Blue Hill Drive and University Avenue. Stormwater runoff flowing to POA4 is ultimately directed to an existing 48 inch drainage pipe running parallel to the existing railroad tracks at the northeast corner of the property.

Acknowledging that the project does not control structures located beyond the property boundary, the potential impacts of stormwater runoff associated with the University Station project can still be assessed at these locations. As such, Tetra Tech has incorporated these locations into the stormwater model as POA3 and POA4.

There are two conditions that can be analyzed to determine what, if any, impact the project may have at these points – the peak rate of runoff and the volume of runoff. In both instances at both locations the peak rate of runoff and total volume of stormwater is predicted to be lower when compared to the existing condition for all analyzed storm events. The offsite and downstream drainage system at POA 3 will see 60% reduction in flow rate and 27% reduction in volume is anticipated during the 100-year event. Similarly, at POA4, a 2% reduction in flow rate and 32% reduction in volume is anticipated during the 100-year event. Simply, this means that the project is sending less water at a lower rate of discharge to these points than in the existing condition. Not only is the project mitigating its impact, it is actually improving the downstream condition. The pre and post-development conditions associated with POA3 have been previously documented above. The table below compares the existing and proposed stormwater peak flows and volumes for POA4.

Pre and Post-Development Peak Rates of Runoff and Volumes for POA4

Rainfall Event	Existing Peak Flow Rate (cfs)	Proposed Peak Flow Rate (cfs)	Difference (cfs)	Existing Volume (acre-feet)	Proposed Volume (acre-feet)	Difference (acre-feet)
2-year	29.02	11.26	-17.76	2.321	0.945	-1.376
10-year	42.85	22.19	-20.66	3.984	2.228	-1.756
25-year	47.12	32.23	-14.89	5.135	3.200	-1.935
100-year	52.23	51.11	-1.12	6.670	4.510	-2.160

Stormwater Basin/Wetlands System Design (Constructed Stormwater Wetlands)

Two surface stormwater management areas are proposed to mitigate the stormwater flows associated with POA1 and POA3. They were originally designed as extended dry detention basins. However, discussions with the Town of Westwood, BETA, the Dedham Westwood Water District (DWWD), and a comment letter received from the Neponset River Watershed Association, the design of these surface basins has been further refined in order to achieve a significant improvement in the overall quality of the stormwater runoff directed towards the Neponset River at these locations. The two surface stormwater basins designed for the project have been modeled after a Basin/Wetland System design, as described in the Constructed Stormwater Wetlands section of the MA DEP Stormwater Handbook. The multi cell configurations consists of a forebay, rip rap spillway which disperses runoff through a low and high marsh system. The advantages with the basin/wetland include a decreased potential for downstream flooding and erosion at the receiving water and improved water quality by achieving a higher pollutant removal rate removing suspended solids, metals and dissolved nutrients. In particular, the basin/wetland system achieves a higher level of additional treatment, particularly for dissolved pollutants.

Pollutant Removal Efficiencies:

The basin/wetland represents one of the most effective types of detention system in terms of pollutant removal efficiencies. Based on MA DEP Stormwater Handbook, the expected pollutant removal efficiencies associated with the system is as follows:

TSS 80%
Total Nitrogen 20-55%
Total phosphorous 40 -60%
Metals –Lead, Zinc 20-85%
Pathogens (e-coli, coliform) –up to 75%

The design parameters incorporated into the systems include the following features in order to maximize the increase of pollutant removal efficiencies:

- Increasing the settling area through use of forebay;
- Dissipate velocity through use of wet basin
- Introduction of shallow ledges along the edge of the permanent pool to establish aquatic plants to trap pollutants and uptake of nutrients; and
- Inclusion of perimeter wetland areas created around the standing water locations to aid in pollutant removal.

By maximizing the length to width ratio, short-circuiting of stormwater flow path is decreased while enhancing the sediment uptake. The linear flow path along the length of stormwater basin/wetland systems provide for increased resonance times.

The longer flow path also facilitates treatment relative to the pathogen removal since the ultraviolet light from sun exposure will inactivate pathogens. The further introduction of sediment removal and filtration through the shallow marsh stormwater wetland are other treatment mechanisms which will inactivate pathogens, a known pollutant in the Neponset River watershed.

System Components:
The basin/wetland systems were designed to meet stormwater quality and quantity control requirements. First and foremost, the stormwater wetlands were designed in accordance with the guidelines included in the MA DEP Stormwater Standards and include controlling peak discharge rates to levels below predevelopment rates.

The multi cell system components consist of the following:

Sediment Forebay- provides settling area for sediment laden runoff and provides retention of sediment in the smaller pool area, rather than the dispersion or sedimentation within the broader wetland areas. The forebay is the first cell in the treatment train and is considered a deepwater zone which supports submerged vegetation.

From the forebay, runoff is conveyed to the next cell by a rip rap spillway. From the spill way runoff enters the main section of the basin/wetland via into a plunge pool which allows for the flow to gradually spread out over the bottom of the wetland while minimizing the potential for zones with little or no flow and diffuses the flow to minimize embankment erosion. The plunge pool will outlet to a meandering channel that reduces width as it meanders through basin.

The channel will be flanked by low marsh, up to 18 inches in depth, and planted with suitable emergent species as shown on the basin sketches. The channel will be sinuous to increase retention time.

The low marsh will be surrounded by high marsh, up to 6 inches in depth, and planted with a diversity of wetland plant species as shown on the basin sketches

Prior to the stormwater wetland outlet, a micro pool will be constructed to allow for further settling of suspended solids and prevent potential clogging of the outlet structure. A reverse slope outlet pipe will be installed in the micro pool.

The transitional side slopes between the meandering channel and adjacent low marsh will contain coir logs to protect the side slopes from erosion until the vegetation is established. The

logs are often used for stabilization along waterways. The coir logs will decompose naturally over time.

Low and High Marsh Plantings

The plant species selected for the high and low marsh were chosen based on the following:
Non invasive status;
Native species;
Perennial;
Adaptability to sunlight and hydro periods;
High colonization and growth rates; and
Sustainability to continue through winter dormant season.

A suggested plant list along with planting density has been provided on each of the basin sketches.

Conformance with Design Criteria for Constructed Stormwater Basin/Wetlands:

In accordance with the MassDEP Stormwater Handbook, the stormwater management system has been designed in conjunction with the following recommended guidelines for Stormwater Wetlands:

Constructed Stormwater Wetland Minimum Design Criteria	Design Provisions Basin 30P	Design Provision Basin 52P
Minimum drainage area (≥25 acres)	76.4	94.6
Wetland surface Area/Watershed Area Ratio (≥0.01)	.03	.02
Length to Width ration (≥2:1)	3.8	3.8
Water Quality Volume Required	112,937 ft^3	76,654 ft^3
Water Quality Volume Provided	118,299 ft^3*	100,134 ft^3
Allocation of surface area (wet pools/low marsh/high marsh/semi wet-45%25%25%5%)	49/26/25/0	50/25/25/0
Sediment Forebay (required)	yes	yes
Micro pool (required)	yes	yes

*Provided water quality volume includes 27,389 ft^3 above the low flow orifice. The basin has been designed to drain this volume over a 24-hour period. The required water quality volume associated with the new impervious surface draining to this basin is 35,500 ft^3. 90,910 ft^3 is provided below the low flow orifice.

Target Allocations as a % of Surface Area:		
Sediment Forebay (0%)	0	0
Micro pool (5%)	6.8	5.3
Deep Water Channel (40%)	42.5	45.3
Low Marsh (25%)	26.1	24.7
High Marsh (25%)	24.6	24.7
Semi-Wet (5%)	0	0

The basins have been designed such that, at a minimum, the water quality volume associated with the new impervious surface area is stored beneath the basin's lowest outlet. The remainder will be slowly drained over a 24 hour period through a low flow orifice. The water quality volume is calculated as 1 inch over the impervious surface area contributing to the basin.

In addition to the significant treatment benefits for the project components, the basins are being designed to accommodate large areas of the existing watersheds that were previously being directly piped to the discharge points without notable detention and/or water quality treatment. This design results in a substantial improvement over the existing condition.

Sketches depicting each basin, their associated grading, anticipated planting configurations, and outlet control structures are included with this memo.

Infiltration of Rooftop Runoff and Impervious Surfaces

Infiltration of stormwater runoff is a major component of University Station's stormwater management system. As the majority of the site is located within the Water Resources Protection Overlay District, it is critical that stormwater be infiltrated to the maximum extent practicable. This will serve to protect the base flow of the Neponset River and to replenish the underlying aquifer system that supplies the DWWD well system. Another benefit of stormwater infiltration is its treatment component. Infiltration is widely recognized as one the best methods of pollutant removal.

A number of infiltration systems are located through the project. Some of the smaller systems are recent inclusions, incorporated to reflect conversations held with the Town of Westwood, BETA, and DWWD. All of the infiltration systems have been designed to exceed the MassDEP design standards. In fact, the two largest infiltration systems, located within the Core Retail portion of the project, can infiltrate up to a 2.5 inch storm event prior to discharging.

With one exception, each of the proposed rooftop areas are being directed to subsurface infiltration systems. The exclusion is Restaurant A, which is located immediately adjacent to a Zone I well head radius and the bottom of an infiltration system would be at or below the level of abutting wetland systems. This would prevent the system from achieving reasonable infiltration levels. As discussed at the January 11th working session, a drywell could be placed on the roof

drain, just outside the Zone I. Although not as efficient as a chamber or gabion infiltration system, this would allow for recharge of the smaller, more frequent rain events.

In addition to the infiltration of rooftop runoff, much of the project's runoff generated from other impervious surfaces will also be infiltrated. This runoff will be collected and treated to levels in excess of the MassDEP standards prior to discharge into the infiltration galleries. MassDEP policy requires that a minimum of 65% of the proposed impervious surface within the site boundary be directed to infiltration systems. The University Station project exceeds this standard.

In the Core Retail area, the infiltration systems have been arranged such that the runoff directed to the system closest to the Zone I well head radius is comprised solely of clean roof runoff. The other large gallery in the Core Retail area handles a majority of the paved surfaces. This was done in an effort to maximize the distance between the well head area and the stormwater that is being generated from those surfaces considered to have the highest potential for pollutant loading. This allows for maximum soil filtration outside of the well head radius. Also, these recharge areas were selected based on the ideal soil conditions. It has been suggested that smaller recharge systems located closer to building roof areas should be considered. This concept was considered early in the design process; however the presence of bedrock and poor soil permeability made this approach not feasible.

A figure is attached which depicts those sections of University Station that are being directed to infiltration systems.

Existing 60" Drainage Pipe

An existing 60 inch diameter RCP pipe conveys stormwater from the eastern edge of University Avenue to the limits of the property boundary, abutting the railroad tracks. The current watershed contributing to this pipe consists primarily of the developed areas west of University Avenue and portions of the developments abutting N-Star Way. This area is identified within the drainage analysis as POA2.

As part of the previous site plan, the development team agreed to run a new 54 inch diameter RCP pipe parallel to an existing 60 inch diameter RCP pipe. This was done in an effort to ease the pressure on the existing 60 inch pipe, which is believed to have sections of questionable condition. Much of the flow that is currently directed to the 60 inch line will be carried by the new 54 inch pipe in the future condition.

Accordingly, the current proposal includes a new 54 inch pipe running parallel to the existing 60 inch line. As the new 54" RCP is constructed, any connections to the 60" RCP that are crossed will be directed to the new 54" pipe. Any existing connections to the 60" RCP that are not crossed will be left as is. A plan is enclosed with this memo which details these pipe runs and the structure that will link them prior to the existing 60 inch continuing under the railroad tracks.