Mansfield Township Wastewater Management Plan
Margolis Warehouse Distribution Facility
Lots 3.02, 9.01, 9.02, 11 and 12
Mansfield Township, Burlington County, NJ

The existing site (Figure 1) is comprised of farm fields split by the Crafts Creek stream corridor. The site is located between Route 295 and the NJ Turnpike. The Liberty Lake Camp Ground borders the southerly (upstream) property line of the property. Crafts Creek flows northwesterly, entering the area under the Turnpike flowing through Liberty Lake then through the property in question to the culvert under Rt 295. The 2002 Department GIS stream coverage indicates 3 tributaries flowing into Crafts Creek, and an examination of the site topo indicates another depression draining the easterly farm field near Rt 295.

Figure 1 – Existing site conditions

An examination of aerial photos dating back to 1931 shows that the farm fields on the site have remained relatively unchanged except for the construction of Rt 295 and the Turnpike. Liberty Lake appears to have been constructed sometime between 1963 and 1970, after the construction of the Turnpike but prior to the construction of Rt 295. The overall watershed is, and has been, primarily agricultural. The riparian corridor is vegetated and supports an extensive wetland complex that was cut by the construction of the Turnpike and Rt 295.

The proposed project (Figure 2) is to construct 4 warehouse buildings, totaling approximately 1.9 million sq ft of warehouse space, with associated infrastructure/parking (including a bridge to cross Crafts Creek), a stormwater management system and an onsite wastewater disposal system. The stormwater management system consists of 9 detention basins (some in series) discharging through 6 outfalls into Crafts Creek (4 on the western side of Crafts Creek from 4 basins and 2 on the eastern side of Crafts Creek from 5 basins). No details of the proposed wastewater system other than the location of three "septic" groundwater disposal areas were provided.

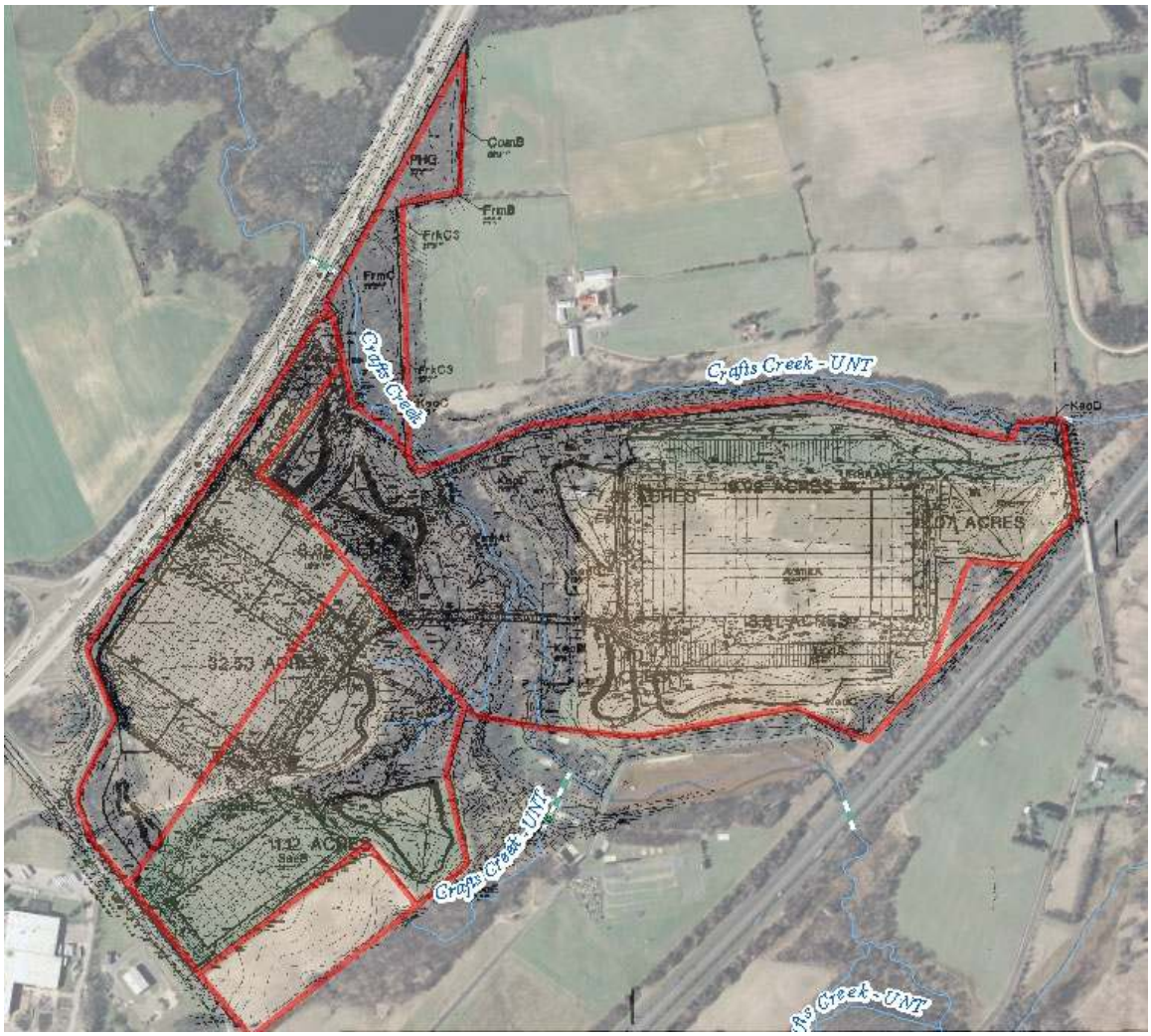

Figure 2 – Proposed warehouse development

The Division of Land Use Regulation (DLUR) reviewed this project and issued a Flood Hazard Area Approval, (including review under the Stormwater Management Rules) 0318-05-0001.1 FHA-070001, in March, 2007. DLUR also issued a Freshwater Wetlands GP7, 0318-05-0001.1 FWW 070002, for filling a manmade ditch, a GP 10B, 0318-05-0001.1 FWW 070003, for a minor road crossing, a GP 11, 0318-05-0001.1

FWW 070004, for the outfalls and a GP 6, 0318-05-0001.1 FWW 070001, for fill in the wetlands, in September 2008. The Flood Hazard Area Approval was originally issued referencing the project as a "residential subdivision", but this description was amended in a letter dated August 21, 2009 to refer to the "four building commercial complex".

Site Conditions

According to the January 26, 2006 letter from French & Parrello to the Property owner summarizing the Phase I Summary Report – Hydrogeologic Evaluation for the site which was submitted as part of the WMP application, based on the subsurface exploration the most suitable area for on-site disposal is an approximate 14 acre parcel located in the area west of Crafts Creek because the depth to groundwater is at or below 6 feet, the majority of surficial soils contain less than approximately 20 percent silt and the underlying clay layer is at a depth of approximately 13 feet. The map showing this recommended area is not included in the submission, also given the level of development on the site it would appear that this area is mainly being used for the proposed buildings. The area on the easterly side of Crafts Creek was found to have a seasonal high water table ranging from 1 to 5 feet below existing grade with more granular soils and perched water tables.

A field inspection was performed on December 11, 2009. The stream corridor onsite is a valley floodplain/wetland, the farm fields rise thirty to forty feet above the floor, that narrows causing a constriction under higher than normal flow conditions. Normal flow is carried through the area in a channel that meanders through the valley first hugging the easterly side of the valley then crossing over and running along the westerly side, approximately in the center of the Margolis property. Normal low flow is conveyed through this channel. However, once flow comes out of bank the channel becomes the valley floor and floodwaters will flow straighter through the valley ignoring the meanders and ponding behind the stream constrictions and ultimately the Rt 295 Culvert at the downstream end of the property.

Upstream of the Margolis property, Craft's Creek flows under the Turnpike then into Liberty Lake. The spillway of Liberty Lake discharges into a concrete channel then into the natural channel which narrows and takes a sharp turn just before the upstream property line. The channel section at the property line does not have the capacity of the upstream channel and therefore causes larger than normal flows to jump the bank in the turn and flow out into the lawn area and through the valley floor/wetlands. The flow in this area under low flood conditions is split by high ground and vegetation. The wetlands area to the east constricts causing a slight obstruction and causing a backwater effect. Below this area there is a wider wetland where the tributary coming in from the easterly farm fields enter. Flow from the westerly fields also flows into the channel in this area. Below this, approximately 1150 feet d/s of the property line, the channel flows across the valley floor from the westerly to the easterly side and makes an approximate 90 degree turn to follow the easterly foot of the valley. When flow is out of channel and through the wetlands area the bend in the stream becomes a significant control point where the split channel and wetland flows come back together along with the field flows.

Downstream of this point another constriction occurs at the Confluence with the tributary flowing along the northerly side of the Margolis property and below that is the Rt 295 Culvert.

This project was submitted as a facility in the proposed Mansfield WMP. Given the size of the project, the site conditions and the objection received from the Liberty Lake Day Camp expressing concerns over increased flooding, it was decided to look into the wastewater and stormwater systems proposed on site.

Wastewater

In the submission included in the WMP application there are no details of the type or location of the on-site treatment plant proposed, other than that it will be a groundwater discharge located on lot 9.01, on the westerly side of Crafts Creek. A 0.92 acre Septic area is shown on that lot. However, the submitted plans also indicate two additional Septic areas (each approximately 0.19 acres each for a total of 0.38 acres) on Lot 11 on the westerly side of Craft's Creek. The application needs to be amended to identify the type of treatment plant, the location of the plant and an explanation of the additional septic fields on Lot 11, including a breakdown of expected flows to each bed and a discussion of whether the additional daily truck traffic will have an impact on the expected flows. Given the concerns generated by the underlying shallow clay, our review should be done in conjunction with groundwater permitting to see if a groundwater discharge is even feasible in this area.

The following issues were identified from the limited information submitted and will need to be addressed.

Septic area on lot 9.01

In reviewing the available data it is clear that the underlying clay layer significantly affects the water table and the movement of groundwater through the site toward the stream. The test pit approximately 100 feet slightly NW of the proposed disposal field indicates perched groundwater at a depth of 1 foot, while the test pit approximately 160 feet to the NE found no groundwater to a depth of 15 feet. The test pit approximately 500 feet to the SE shows the restricting clay layer and groundwater seepage along the clay layer at a depth of 5 feet. Based on the submitted data no percolation tests were done, permeability is based on lab analysis of soil samples from the test pits with the closest test pit to the disposal area being the first mentioned above with a perched water table at a depth of 1 foot. Based on this information alone there is a concern over groundwater mounding occurring under the disposal field and a mounding analysis with a more detailed soil analysis in the disposal area will be required.

The impacts of the proposed grading and construction do not seem to have been considered in the design of the groundwater discharges. Building 1 is proposed to the SE

of the disposal field and proposes an infiltration structure at the base of the building facing the disposal field. Building 2 is proposed to the NE of the disposal field and proposes to excavate up to 12 feet of the existing ground to provide a level area for the building to be constructed, which is almost to the depth of the test pits in the area so no soil information below the proposed grade is really available, and an approximate 10 foot high slope will be created within 80 feet of the NE side of the disposal field is being created. The building layout effectively funnels all groundwater flow toward the existing gully on site. It will be necessary to provide an analysis to show that there is sufficient area to treat the expected flow, that there will be no seepage along the slope created for the construction of building 2, that groundwater flow from the septic area will not be intercepted or cause a mounding condition in the proposed infiltration structure, proposed along Building 1, or create a "piping" situation along the stormwater line discharging into detention basin no. 8.

Septic field at the NW corner of Building 4

The test pits at this site indicate a perched water table between 5 and 5.5 feet and the clay restraining layer at 8 feet in the northwest corner of the disposal field. An excavated detention basin is located within 50 feet to the north, a truck parking area within 35 feet to the east, an access road within 12 feet to the south and open area with a drainage ditch within 40 feet to the west. The proposed infiltration structure along the base of building 4 is also within 140 feet of the disposal area. A mounding analysis will be required, along with information to show that there is sufficient area for treatment and that there will be no seepage into the proposed detention basin, drainage ditch or infiltration structure.

Septic field at the SE corner of Building 4

The test pits indicate a perched water table at 6-7 feet below grade. A truck parking area is proposed in fill 25 feet to the west of the area, an access road is proposed within 10 feet to the north, the Turnpike embankment is located approximately 90 feet to the east, within 60 feet to the south is a wetlands complex that is part of the existing drainage that eventually leaves the site and discharges into Craft's Creek just above Liberty Lake, which is used for swimming. The upper portion of detention basin 4 is located approximately 50 feet SW of the septic area. A mounding analysis will be required, along with information to show that there is sufficient area for treatment and that there will be no seepage into the southern drainage that could end up in Liberty Lake, detention basin 4 or the stormwater collection system to the north on the other side of the access road.

In reviewing the proposed Turnpike widening plans it is proposed for the Turnpike Authority to build a detention basin in the area that this septic area is proposed. It will be necessary to address the impact of the proposed Turnpike Expansion upon the overall design of the site.

Stormwater/flooding

Comments were received from the Liberty Lake Day Camp concerning flooding on their property and expressing concern that the proposed project will worsen the flooding that they already experience. Undated pictures from the spring of 2009 were submitted to show the flooding problem on the camp property. Examination of the pictures showed that the water was ponding in the downstream areas of the Camp, indicating a backwater effect from an obstruction/constriction, but it was impossible to determine from the submitted pictures and our aerial photography if the backwater was from the Route 295 Culvert or something further upstream. The amount of rainfall/runoff that caused the ponding was also unknown.

A storm on December 9th produced flooding at the Camp for which pictures were provided during the December 11th field inspection. NOAA records indicate that the watershed received a total of approximately 1.3 inches of rain on the 9th. Estimating from the photos and the site topo the water elevation on the site is approximately 23 feet and approximately 26 feet in Liberty Lake. The 100-year flood elevation, shown on the site plan was calculated to be approximately 29 feet. The storm also flattened existing vegetation giving a clearer indication of how the floodwaters flowed through the area.

Based on this information it appears that flooding that was evidenced at the camp is caused by the constriction to flow that occurs where the normal low flow channel crosses the valley floor and makes a roughly 90 degree bend. The narrowed channel cannot pass the flows and causes a backwater affect that creates a ponding condition that extends onto the camp property.

Flooding can be impacted through two basic methods, construction in the floodplain that can cause a backwater effect and stormwater runoff that can increase the rate and/or volume of runoff getting to the waterway which can cause increased flood elevations and/or durations if not properly timed. These aspects are regulated, respectively, under the Flood Hazard Area Control Act Rules and the Stormwater Management Rules, both of which were reviewed by DLUR under the above cited permits.

The only construction in the floodplain proposed beside the stormwater outfalls was the proposed bridge, which is located upstream of the constriction. The principle criterion looked at is that construction in the flood plain does not increase the 100-year flood elevation off site by more than 0.2 feet. According to the engineering report for the permit this criteria was proven following the standard practice of calculating the 100-year flood flow using the NRCS, TR-55 methodology and modeling the flow using the US Army Corp HEC-RAS model. The 100-year flow is of such magnitude that the low flow obstructions that are causing the frequent flooding at the camp are not an issue and the control point is the Rt 295 culvert which cases a backwater effect through the entire reach up to Liberty Lake. Given this backwater effect from Rt 295, the 100-year flood elevations at the proposed bridge is controlled by the downstream water surface elevation and therefore not an obstruction in the extreme event and therefore meeting the review criteria. Given that the flooding problems identified by the Liberty Lake Day Camp

occur as a result of storms well below the 100-year event, the effect of the bridge on that flooding condition was not looked at under the issued permits.

The location of the bridge just upstream of the primary low flow obstruction could have an adverse affect on the more frequent flooding depending on the cross section of the bridge openings, the grading done to put in the bridge and if it changes the flow pattern in this area. Details of the bridge were not included in the submission to this office. The dissimilarities in flow patterns between the small frequent flooding and the 100-year event, would potentially require a more detailed HEC-RAS model than the one used for the 100-year analysis to evaluate the impacts, however this would not have been required by DLUR for their review.

The WQMP Rules specifically require that plans be in conformance with the Stormwater Management Rules. Department policy normally defers the detailed review of the stormwater calculations to the DLUR or to the local municipality through local ordinance. In light of the concerns raised and time passed since the original Department approval the stormwater design was relooked at by this Bureau, however, no action to overturn the DLUR decision will be taken as a result of this review.

A copy of the stormwater management calculations were requested and a copy of the report entitled "Stormwater Management Report for Proposed Warehouse Distribution Center Lots 3.02, 9.01, 9.02, 11 and 12, Block 47.01 Township of Mansfield, Burlington County, New Jersey", dated December 29, 2006, prepared by French & Parrello, was submitted.

Non Structural Measures

The Stormwater Management Rules require an applicant to meet groundwater recharge, stormwater runoff quantity, and stormwater runoff quality standards and to the maximum extent practicable, to meet these standards by incorporating nonstructural stormwater management strategies into the design.

Looking at the proposed site plan there is no evidence of any non-structural measures being incorporated into the design. The site plan appears to have maximized the development on all buildable areas of the site with extensive regrading and a complete change to the drainage patterns. Instead of a disconnected system with vegetated open channels mimicking the existing drainage patterns, the proposed system provides a directly connected system from the roofs and other impervious surfaces to the stream channel, with a net loss of 12.1 acres of wooded area and 0.4 acres of wetlands.

The applicant showed compliance with the non-structural measures requirement by using the Department's Nonstructural Strategies Point System (NSPS) which is a non-regulatory spreadsheet developed to compare pre to post site land uses, evaluating the non structural strategies used by assigning "points" to the land uses and construction methods. The system was implemented with the non regulatory proviso that if the applicant passed the point system that DEP could not ask for additional measures to be

added and if the applicant failed the point system DEP could not deny the project and had to work with the applicant to implement non-structural measures to the maximum extent practicable.

To pass the spreadsheet, the post development score needs to be 95%, or greater, of the point score for the existing condition. As filled out, this project achieved 356 points for the pre-construction condition and a total of 368 points for the post-construction condition, achieving 103% of the points achieved in the predevelopment analysis.

The spreadsheet is meant to be an evaluation tool to explore different design options allowing the designer to evaluate different non-structural strategies in order to achieve the goals for non-structural measures set forth in the rule. Therefore, to be used correctly it requires an understanding of Low Impact/Non-Structural concepts along with being able to assess, based on specific site conditions, whether the intent of the section awarding points is being realistically applied.

In reviewing the submitted NSPS spreadsheet the following issues were identified:

1. The submitted copy of the spreadsheet shows that the area subtotals for each Hydrologic Soil Groups matches for the pre and post development conditions. However, for the post construction condition, the sum of the areas entered into the columns does not match the reported subtotal. The area subtotal for the B soils when added is 99 acres but reported at 99.1 and the area for the C soils when added is 66.8 but reported as 66.7. When entered into the spreadsheet for review the columns added correctly and an error message that was not on the submitted spreadsheet was generated pointing out the discrepancy. However, the 0.1 acre difference does not appear to affect the outcome.
2. The soils on site are listed as hydrologic soil groups (HSG) B and C in both the old county soil maps and the revised Web Soil Survey, with one area of unclassified “urban complex” which was considered as a HSG A in the submitted spreadsheet. The assumption to use HSG A, indicating a well drained soil, appears to have been made based on a lab analysis of a soil sample, even though the area was identified as having perched water and a seasonal high water table to within 1 foot of the surface, conditions indicative of a poorly drained soil. However, for the purpose of this spreadsheet the HSG classification is not as critical as it is for runoff calculations and since it was carried through from Pre to Post development this classification should not significantly affect the outcome of the calculation.
3. In the post construction condition, 34.6 acres are described as being “Unconnected Impervious with Large D/S Pervious”. A review of the site plan indicates that all stormwater discharge is through pipes in a concentrated flow into the stream channel or existing drainage paths and not onto pervious surfaces in a sheetflow condition. This credit appears to have been taken because the spreadsheet instructions allow roof runoff directed to a dry well to be considered as such. Normally a dry well will infiltrate the design storm under a lawn area and if it fails the resultant overflow will pass over a lawn area essentially acting in

the capacity of a disconnected flow. In this case the extensive earthwork and site conditions make the infiltration structures problematic and when they clog or back up the discharge will be into the concrete low flow channels in the basins and then directly into the discharge pipes so we do not have the disconnected condition with a large impervious area downstream. Correcting this in the spreadsheet causes the project to fail by only achieving 88% of the existing condition points instead of 103% as reported.

4. According to the spreadsheet the project is creating 63.4 acres of lawn/open space. A review of the plans indicates that the proposed detention basins account for the majority of this area, approximately 50 acres. The instructions for the NSPS spreadsheet directs the user to code structural measures in the post development condition as the predominant land use in the structure. However, the extensive regrading on the site and the extent of the concrete low flow structures precludes these basins from acting in a "natural" fashion as envisioned by the instructions.
5. To encourage the non-structural strategies of minimizing impervious cover and site disturbance, the spreadsheet awards extra points for the post construction condition if the percentage of impervious cover and percentage of disturbance is below the allowable maximums. As originally coded into the spreadsheet this project received an additional 56 points for being below the maximums. Adjusting for the correction in 3 above the 56 points is reduced to 49 points. However, approximately 34% of the site is virtually unbuildable because of wetlands, floodplain and lot shape/location. So while the maximum impervious and disturbance percentages were not exceeded it was not because of non-structural measures implemented in the design but rather by site limitations, so in this case this is not an effective measure of non-structural methods. Removing the restrictive areas from the total property area and redoing the calculations results in both maximums being exceeded.
6. Finally an additional 32 points were awarded for using lightweight equipment to grade the lawn areas for the purpose of minimizing soil compaction. This allowance assumes that only minor grading will occur in lawn areas that can be accomplished with lightweight equipment. Given the fact that the basins make up the majority of the "lawn" area and the extensive earthwork in and around the basins it is unlikely that this condition can be met on site.

Given the site conditions and level of development, the NSPS spreadsheet was not a reliable tool to evaluate the implementation of Non-Structural Measures on this site. While the assumptions made by the applicant generally followed the guidance given by DEP it failed to take into account the site conditions and LID concepts. The unconnected impervious issue noted in point 3 above is enough for the project to fail the spreadsheet. So the project really fails to provide Non-structural measures as required by the Stormwater Rules.

<u>Recharge</u>

The Stormwater Management rules require that 100 % of the preconstruction recharge is maintained in the post construction condition. The Annual Groundwater Recharge Analysis Spreadsheet was used to calculate the recharge deficit for the site and to check the effectiveness of the proposed infiltration system consisting of 30 and 24 inch perforated pipe in stone filled trenches. Given the site conditions and the fact that the Annual Groundwater Recharge Analysis Spreadsheet assumes that you have an unconfined discharge, this method may not be an accurate method for assessing the recharge impacts.

Recharge is that portion of the infiltrated rainfall that makes it past the root mass to replenish groundwater. On this site it has been documented that because of the confining clay layer there is no deep groundwater recharge and what water is not "perched" in depressions in the clay layer is directed along the layer and surfaces in the valley depression that splits the site. While it is obvious that the recharge from the area provides the hydrology for the stream and wetlands, it is not clear because of the perched water how much of the recharge actually makes it to the stream and wetlands. The recharge evaluation should also factored in the large volume of wastewater discharged to groundwater on site since it will also be surfacing in the stream and wetlands with the potential of over saturating the area and changing the nature of the wetlands/floodplain. In this case with the shallow confining clay layer affecting the groundwater flow, an evaluation of the existing and proposed site conditions in context of the purpose of requiring recharge may have shown that less or no recharge should be required on this site.

The proposed infiltration system is designed under the assumption that there is a normal unconfined and uncompacted soil profile below the system. The infiltration rate used is assumed as ½ of the lowest expected infiltration rate for the soil type as determined by lab analysis of soil samples taken from the test pits. There is no indication in the submitted information that any percolation tests were made.

The extensive site grading proposed to provide a level ground floor for the buildings results in the infiltration systems being constructed in some places 10-12 feet below the existing grade and up to 6 feet above the existing grade. Some of the systems are entirely above the existing grade in fill and located below the loading docks. The analysis failed to account for the potential groundwater mounding under the systems, compaction of the existing soils and proposed fill that would be required to provide a stable base for the warehouses and infrastructure, continual truck traffic over the system or proximity to the wastewater disposal fields and the potential to intercept the wastewater discharge.

Stormwater Quantity

To show compliance with this the stormwater quantity requirement it was chosen to design a detention system to reduce the pre to post peak runoff rates for the 2, 10 and 100 year events. The reductions are usually measured at the end of the outfall prior to discharging into the stream and compare the peak flow from the preconstruction

condition to the peak routed flow through the stormwater system assuming pre and post drainage areas and flow paths are roughly the same.

A complete set of construction drawings for the project and the referenced HEC-RAS model run was not submitted to this office so the calculations could not be fully verified. The submitted calculations appear to follow the standard practice for designing the required detention system but in reviewing the plans several hydrologic and hydraulic design assumptions and calculations raise issues that while not apparent in the material submitted may have been addressed in the DLUR review. The issues are as follows:

1) Instead of the standard practice of assessing the flow reductions at the end of the pipe before the flow enters the stream, this project proposes to access the reductions in stream close to the downstream end of the property. The instream flow portion of the routing is oversimplified in that it is just assuming a 4 fps velocity in the stream based on the HEC-RAS model and is just adding the outflow hydrographs shifted by the assumed travel time. This methodology ignores the stream conditions (obstructions), the existing flow in the channel and flow coming into the channel from the tributary north of the Eastern side of the property, all of which will influence the travel time in the channel and affect the peak flow. For example the flowpath in the channel is measured along the low flow channel, however, in reality when this flow enters the valley, flow will most likely be out of bank and follow a straighter and faster path than the calculations assume. To correctly evaluate the combined flows in the stream it will be required to perform a detailed routing including all flows and modeling the obstructions in the channel, or that the outfalls for basins 8 and 9 are located in a drainage ditch from the farm fields yet the velocity from the stream channel.
2) For the existing condition the site was divided into two sub basins, one each west and east of Crafts Creek. Based on the topography the westerly portion should have been divided into two drainage areas and the easterly portion into potentially 3 drainage areas. The time of concentration (flowpath) line shown on the easterly side does not follow the contours and shows the drainage farther downstream then the contours indicate. The lower portions of both time of concentration lines cross the valley floor wetlands to reach the channel. Since the channel only carries normal flow and flows come out of bank with small events the lines should be adjusted based on the flow levels in the stream for the different events.
3) For the runoff calculations, as per standard practice, the HSGs were determined from the USGS soil maps and lab analysis of the soils in the area marked as Urban Land. However, despite the soil types, the high and perched water tables would indicate a poorly drained soil which should have been taken into account when assigning the HSGs.
4) The underlying confining clay layer also intercepts groundwater and funnels it into the stream valley where it resurfaces. In this condition the hydrology of the stream is a combination of ground and surface water runoff, which would mean that calculating runoff using standard surface water hydrology (TR-55) would not correctly model the existing or proposed conditions. Groundwater flow should be evaluated to see how fast it contributes to flow in the stream.

5) The proposed stormwater system was designed piecemeal using a simple spreadsheet pipe design to size the pipe network for a 25 year storm calculated using the rational method, and the Pond Pack program to rout flows through the basins using SCS methodology and the Delmarva Unit Hydrograph.
6) The pipe design relies entirely on normal depth calculations in the pipe and fails to take into account losses due to manholes and junctions or the friction losses due to the length of the pipes. It appears that the calculations also failed to take into account the fact that some of the outfalls at the stream will be submerged.
7) The rational formula calculations included a weighted average calculation to compute the runoff coefficient. In areas this small care must be given that the coefficients and areas averaged are not significantly different or the results will not be realistic and expected flows can be under or over estimated significantly. This will also apply for the CN number calculations in Pond Pack model
8) In the Pond Pack Model for the proposed condition, the model has the flows from Basins 2 and 3 meeting at Junction 2 in the stream. According to the site plan Basin 3 discharges into the outfall pipes from Basin 2 approximately 580 ft above the outfall (junction 2).
9) The basins are modeled in Pond Pack as having a free discharge for all flows. However, they discharge into a closed pipe system and most have a diversion structure immediately downstream to divert flow into a stormceptor system for water quality treatment. Backwater effects from the diversion and pipes should have been evaluated at the various flows to see if it impacted the outflows from the basins.
10) In the Pond Pack Model while flow into the detention basins was split to account separately for the pervious and impervious surfaces, but for 7 of the 9 basins the time of concentration for both the pervious and impervious surfaces was manually imputed at 0.1670 hrs (10 min). The time of concentration for basins 6 and 8 were coded to be calculated by the program.
11) With the exception of basin 1 the emergency spillways elevations on the basins are all set less than 6 inches above the peak design elevation, with the majority being between 0.12 to 0.6 inches above the peak design elevation. This provides little to no real factor of safety and given that the spillways discharge to slopes it increases the potential for erosion and sediment in the stream.

Stormwater Quality

To show compliance with the stormwater quality requirements, Stormceptor devices were added downstream of the detention basins draining impervious surfaces other than roof runoff. Using the Department recommended equations the basins in conjunction with the Stormceptors should provide the 80% Total Suspended Solids (TSS) removal required by the regulations.

Conclusion

The entire site is underlain by a confining clay layer that, according to the submitted information, is causing a perched water table on the site as high as 1 to 5 feet below the existing grade. The submitted soil borings show that the depth to the clay layer varies over the site and that the groundwater is moving along the top of the layer. The groundwater flow, not caught in pockets in the clay, inevitably flows along the clay and resurfaces in the valley depression that splits the site with Crafts Creek at the bottom, most likely having created and now maintaining the wetlands complex located there.

While the clay layer is acknowledged as causing perched water tables in the existing condition, the proposed design appears to ignore the presence of the layer and makes design assumptions for the wastewater disposal and stormwater management system as if the clay layer was not there and we had a more normal, unconfined groundwater condition. Given, the subsurface conditions, the extensive regrading and the compaction necessary to support the proposed construction, a more extensive analysis is required to determine if the proposed groundwater discharge is even feasible and if so how it will interact with the stormwater system and potentially how it will affect the stream flow.

The Liberty Lake Day Camp is constructed in the flood plain of Craft's Creek and as such will be subject to flooding. The camp's concern was if the proposed project will make the flooding worse. The flooding in the pictures submitted by the camp occurred under a relatively small rainfall event that normally would not be considered a problem or cause out of bank flow, but it does.

In the event of a 100 year flood, as looked at by DLUR it is unlikely that the proposed bridge structure across the floodplain would cause any increased flooding since the Rt. 295 culvert is much smaller and under extreme flow conditions will become the control that will affect elevations back up to the Liberty Lake Dam. The smaller more frequent flooding reported by the Day Camp will not be alleviated by any of the construction in the flood plain since the channel constrictions will remain in place. The placement of the bridge structure upstream of the constriction may or may not have an impact on the more frequent flooding depending on the proposed grading required and the location of the piers in relation to the constriction. These issues could not be evaluated here because those details were not provided.

The more frequent flooding will also be more sensitive to the changes in stormwater flow and timing. The underlying clay layer diverting flow toward the stream depression creates a situation where the stream flow during and right after a storm event is a combination of ground and surface water, unlike a normal site where flooding is predominantly surface flow with the ground water contributing to normal flow well after the surface water has passed. In addition, the Turnpike culvert, the dam on Liberty Lake, the variability of the valley channel, the Rt.295 culvert, and the numerous tributaries all contribute to make this site a more complicated hydraulic condition that really requires a routing to determine the actual flows and flood elevations as opposed to the standard peak flow analysis for a free flowing stream channel.

The submitted design did not model the existing flowpaths or runoff volumes realistically and failed to look at the groundwater contribution, focusing only on the surface water runoff. The proposed stormwater design was done mixing different calculation methods, failed to correctly map the post construction flowpaths, failed to account for the stream flow and affects on the outlets and failed to account for losses in the pipe system and the affects on the flows out of the basins. As such the submitted information does not show compliance with the required reductions as claimed.

Since the obstruction causing the frequent flooding at the day camp will remain untouched, the elevation of the flooding reported by the day camp should not be increased. However the frequency and duration of that flooding could be increased if this project is constructed as proposed.

Steven Jacobus

4-26-10
Date