Appendix C.1

Analysis of Impacts Associated with Stormwater at the Proposed Belleayre Resort

EA Engineering, P.C.
EA Science and Technology

3 Washington Center
Newburgh, NY 12550
Telephone: 845-565-8100
Fax: 845-565-8203
www.eaest.com

PROJECT TECHNICAL MEMORANDUM

TO: NYCDEP – OEPA

FROM: EA Engineering, P.C. and its Affiliate EA Science and Technology

SUBJECT: Crossroads DEIS Review – Subtask C.1, Deliverable Nos. 1 and 2 – Analysis of Impacts Associated with Stormwater at the Proposed Belleayre Resort
EA Project No. 14112.01

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INTRODUCTION

This Technical Memorandum summarizes the results of our review for Subtask C.1 – Analysis of Impacts Associated with Stormwater at the Proposed Belleayre Resort. This review focused primarily on those issues likely to impact water quality and quantity.

WATERSHED TERRAIN AND RESOURCE CONSIDERATIONS

One of the most significant environmental challenges to protecting water quality during the construction and operation of the proposed Belleayre Resort will be the mountainous watershed and rugged terrain on which the project is sited. The 1,960±-acre resort is situated on and around the Big Indian and Belleayre plateaus, within the headwaters of the Ashokan and Pepacton reservoirs that together supply approximately 65 percent of the drinking water to New York City. Of particular concern are activities that have the potential to increase loadings of phosphorus and sediment to these reservoirs. A Total Maximum Daily Load analysis for phosphorus has been conducted to assure protection of water quality for these reservoirs. In addition, the Ashokan Reservoir has been listed by the New York State Department of Environmental Conservation (NYSDEC) as a Section 303 (d) impaired water due to excessive loads of silt and sediment. In this review, several watershed characteristics and terrain features were given particular attention as they relate to water quality protection including: (1) surface water conveyances, (2) soils, (3) shallow subsurface storm flow, (4) steep slopes, and (5) existing landcover within the project boundaries.

Overall, the hydrogeologic setting in relation to the mountainous terrain is not sufficiently identified or described in the Draft Environmental Impact Statement (DEIS). Proper planning considerations for any development prior to designing the layout for the project features and amenities include the comprehensive characterization of surface and groundwater resources both onsite and offsite. Subsequently, it is essential that the relationship of both surface and subsurface hydrologic connections between these onsite and offsite resources be thoroughly documented and evaluated. The DEIS does not provide an analysis of water resources with the necessary level of detail. An incomplete mapping effort is provided that overlooks numerous onsite and offsite drainage channels and gives minimal attention to groundwater resources. These planning steps must be enhanced to provide an adequate basis for design of a stormwater management infrastructure capable of mitigating potential stormwater impacts of the proposed development. The necessary detail must be presented to support a comprehensive discussion of how topographic constraints affect the proposed measures for protection of the resources identified.

The susceptibility of these surface and groundwater resources to adverse impacts of construction and management of the golf course and building development must also be addressed. This critical step is necessary in order to provide a stormwater drainage infrastructure that will: recognize and avoid degradation of existing resources, correctly identify and mitigate post-development changes in hydrology, prevent short-term and long-term construction impacts from erosion and sedimentation, and meet state-of-the-art design standards necessary to mitigate pollutant loads from this complex steep terrain. The hydrogeologic study must provide an analysis of all identified surface and subsurface water resources, including their functions and values. The developed areas are on mountain plateaus and side slopes, not in the flatter valley. The proposed development appears to encompass an area of significant groundwater recharge that contributes to sensitive mountainside watercourses, wetlands, and rocky springs that are tributary headwaters to valley streams. The DEIS does not adequately document the locations of these springs and the flow paths from the developed areas to offsite water resources (both surface and subsurface) that will receive stormwater run-off and shallow subsurface stormflow from the developed area. This critical step in site planning and assessment was included in the DEIS only with regard to a delineation of onsite wetlands, soils, and a post-construction drainage analysis of the development footprint. Adequate detail of groundwater well logs is not provided. As a result of this incomplete offsite analysis, critical hydrologic pathways to sensitive water resources such as Birch Creek and Emory Brook have not been identified, the analysis of channel stability and slopes within the existing and proposed hydrologic pathways is incomplete, and aquifers such as the existing gravel and bedrock aquifer located beneath the northern portion of the Wildacres site (part of which serves Fleischmanns' water supply) are not adequately described and evaluated. These data deficiencies result in a deficient and inaccurate characterization of existing conditions that form the basis for the assessment of the substantive issues that must be addressed in the Stormwater Pollution Prevention Plan (SWPPP).

STORMWATER QUANTITY

Management of stormwater quantity is critical for mitigating potential flooding and environmental damage downstream of the site and affects water quality. The development of the site will increase the impervious area, change cover types, alter drainage pathways in stormwater catchment areas, alter soil characteristics, and shorten the times of concentration in the drainage areas. These factors will interact to increase the quantity of runoff from the site.

Stormwater quantity management for the proposed development is modeled and discussed in the DEIS. The DEIS defines stormwater study areas and drainage areas for the project and provides calculations for runoff flows and stormwater routing. It also contains conceptual details for some of the stormwater management structures. This review of the stormwater quantity management for the project focused on Chapter 3, Appendix 9, Appendix 9A, and the SD and SG drawings prepared by the LA Group. This review primarily addresses the comparison of pre-construction conditions to the operational phase; the construction phase will be addressed more completely as part of the erosion and sediment control review (Appendix C.2).

Stormwater management criteria, which must be met for NYSDEC review of this project, are established in the New York State Stormwater Management Design Manual (2001), related to the NYSDEC State Pollutant Discharge Elimination System (SPDES) General Permit for Stormwater Discharges from Construction Activity (Permit No. GP-02-01) (2002). The stormwater discharges from the site are subject to SPDES permits for both the construction and the operational phases. The SPDES permits require development of an SWPPP. The permit applications and proposed SWPPP are included in the DEIS.

At such time as this project receives approval and is permitted by NYSDEC, the SWPPP will be subject to review, approval, and permitting by the New York City Department of Environmental Protection (NYCDEP) consistent with the *Rules and Regulations for the Protection from Contamination, Degradation, and Pollution of the New York City Water Supply and Its Sources* (Watershed Regulations) (NYCDEP 2002). Under this review, the project will be required to comply with conditions of the Phase I General Permit for Stormwater Discharges from Construction Activity (Permit No. GP-93-06).

The proposed Belleayre Resort has been divided into three distinct large development areas for stormwater management considerations: Highmount Estates, Wildacres Resort, and Big Indian. The developed acreage is split approximately equally between the Ashokan and Pepacton watersheds. Stormwater management ponds, specifically micropool extended detention ponds (P-1), have been proposed to detain the post-development stormwater flows and maintain the quantity of stormwater flows to offsite areas at pre-development levels. Our review of the adequacy of the stormwater quantity management measures focused on 11 general issues. These issues are listed below, along with major findings/comments for each; additional detail is provided in subsequent sections and Attachment A to this Appendix:

1. ***Determination of Study Area*****—**The delineated study areas do not encompass the entire developed area. Critical features relevant to stormwater drainage located offsite between the property boundary and Birch Creek or Emory Brook are not identified.

2. ***Location of Design Points*****—**Design points are locations in the drainage network that serve for comparison runoff flow between pre- and post-development conditions used in modeling stormwater with HydroCAD. The design points selected for analyses in the DEIS are incorrect. Design points must be chosen at locations where runoff control is required before being discharged from the proposed developed area. Existing drainage features above and below the control points and their relationship to the design points must be clearly established and shown on the drawings. The DEIS does not adequately accomplish this. The design characteristics of reaches upstream of the design points are not provided. From the information presented in the DEIS, it is not possible to determine how and where the water flows below the design points between the project boundary

and the receiving waterbodies at the bottom of the slope (i.e., Birch Creek and Emory Brook). Without this information, it cannot be determined whether the existing natural drainage channels are adequate to handle the predicted stormflow discharges. The DEIS has not assessed the potential for increased stormflows to cause an increase in offsite incising and erosion of these stream channels that would exacerbate suspended sediment loadings in the watersheds, particularly for Ashokan Reservoir which is listed as a 303(d) water for silt and suspended sediments.

3. ***Delineation of Subcatchment Areas within Study Area***—The delineation of subcatchments for pre-construction surface hydrologic conditions is incorrect, as the design points were not established at appropriate points of interest. The spatial extent of the watershed catchment areas must be equivalent in order to compare pre- and post-development hydrologic scenarios and assure that the stormwater management program achieves the goal of preventing an increase in the quantity of stormwater during the operational phase of the project. Furthermore, the cumulative flow to the selected design points is not delineated correctly; the flow diagrams and model are not comprehensive in the capture of runoff from all subcatchments to the selected design points. Examples of such omissions include: Wildacres where watershed No. 2 does not flow to either design point 1 or 2 in the pre-developed condition; Big Indian watershed catchments 4, 5 and part of 6 do not flow to either design point 1 or 2; and Big Indian control/design points 3 and 4 do not have their entire watersheds delineated.

4. ***Watershed Routing in the HydroCAD Model***—There are inconsistencies between flow routing shown on the drawings and the routing network in the HydroCAD model. In multiple locations, the subcatchments, reaches, and ponds do not appear to be connected in the model as they are shown on the drawings. This suggests that the model estimated volumes may be less than actual volumes. With these deficiencies, the model results cannot be reviewed for accuracy of the hydraulic and pollutant loadings to the receiving streams.

5. ***Impacts Downstream of Design Points***—The design points are located near the property boundary at tributaries on steep slopes above Birch Creek and Emory Brook. The DEIS must evaluate the potential impacts to these downstream receiving waters. Increases in the flow in these tributaries or changes in the location where the runoff enters these channels can affect the stability of their bed and bank. The result of increased flow on these steep steams could be downcutting of the streambed and slumping of the banks, releasing additional fine sediments into these surface waters. Appropriate analysis of the fluvial geomorphology and modified hydrographs in these stream reaches is necessary to assure that erosional processes will not be increased and to provide a basis for proposing mitigation plans to protect these watercourses.

6. ***Calculation of Times of Concentration***—Flow paths used to establish the times of concentration (T_c) are not shown on the drawings and, therefore, cannot be properly evaluated in the field. These flow paths and associated times of concentration are critical for the estimation of hydraulic loadings and assessment of runoff from the site. The typical initial stage of runoff as sheet flow is not shown in the model calculation, consequently, the times of concentration are incorrect and these results carry through to

the subsequent estimates of hydraulic loading from the site. Failure to incorporate sheet flow into the calculations for pre-development can shorten the time that runoff takes to concentrate in channel flow and artificially accelerates the apparent rate of flow down the slope in the model. This has the potential to bias the comparison of pre- and post-development conditions. Flow paths must be provided for pre- and post-development hydrological conditions so the times utilized in the design calculations and drainage patterns can be verified.

7. ***Selection of Runoff Curve Numbers***—Runoff curve numbers are an index prepared by the U.S. Soil Conservation Service based on empirical data for runoff conditions taking into consideration the hydrologic soil groups, the vegetative cover type, and hydrologic condition. High numbers indicate low infiltration and high runoff; e.g., the runoff curve number for concrete is 98. Generally, the values selected in the hydrologic analysis for the DEIS appear appropriate for pre- and post-development conditions. As expected, curve numbers increase from pre-developed to post-developed condition. The runoff curve numbers are selected from a U.S. Soil Conservation Service table for use in the HydroCAD analysis of stormwater quantity.

8. ***Estimation of Reach Properties***—Reach properties are critical to understanding how the rate of runoff will be controlled in long swales/channels connecting various ponds and control structures in the proposed stormwater management system. There is not enough detail on the drawings to verify the reach properties, particularly channel width and depth. Manning's n values (roughness coefficients) are an engineering index used to characterize the roughness of a channel or pipe; for example, a concrete-lined swale would have a lower Manning's value (0.013-0.017) than a rock lined swale (0.025-0.032). The Manning's values used in the model for open channels seem to be high, although composition of the channel linings is not specified on the drawings to support a definitive evaluation. The swale reaches that parallel the railroad bed at the Wildacres Resort (Reaches 56 and 58) are given a Manning's value of 0.04 in both the pre- and post-development analyses; 0.04 is at the maximum end of the range for an earthen- or grass-lined swale. Concrete-lined swales would be in a range about half this value. Considering the condition of the existing swale and that these reaches will need to be completely reconstructed, it is surprising that the n value does not change. The steep natural stream channel (Reach 199) that drains the western edge of the proposed Wildacres Resort has a Manning's value of 0.05. Considering the coble and boulder bed and debris in the channel, this value seems low, particularly compared to the railroad reaches.

9. ***Calculation of Q_{out} from Ponds***—A major design objective of the micro detention ponds is to slow stormflow and allow settling of suspended particulates. If the ponds are functioning as designed the flow rate (cfs) exiting the pond (Q_{out}) should be lower than the flow rate entering the pond (Q_{in}). For some stormwater management ponds, Q_{out} is larger than Q_{in}. These discrepancies indicate probable errors in the pond configuration or in the input data to the HydroCAD model and potential errors in the estimated hydraulic loadings.

10. ***Consistency of Flows at HydroCAD Model Nodes*****—**There are minor flow losses along the reaches between detention ponds that are documented in the DEIS analysis. The source of these losses is not indicated. Detail should be provided as to how those losses were calculated and accounted for in HydroCAD. These losses will result in an underestimate of the hydraulic loading to downstream components of the system.

11. ***Comparison of Pre-Development Flows to Post-Development Flows*****—**At several design points, post-development flows are higher than pre-development flows for the 10-year and 100-year storms. This does not meet the stormwater management requirements set forth in the New York State Stormwater Management Design Manual (2001) and enforceable by the NYCDEP via the stormwater permitting process under the Watershed Regulations. Increased post-development flows have the potential to increase erosion and loadings of phosphorus and sediments to the watersheds.

12. ***Validation of Volumetric Runoff Coefficients (Rv)*****—**Rv values are an index of the proportion of rainfall that leaves a particular subcatchment as runoff; the values used for stormwater quality modeling are provided in DEIS Appendix 10A. Compared to site-specific data collected by NYCDEP on Belleayre Mountain (particularly at Giggle Hollow) and provided to the applicant, the literature-based Rv values used in WinSLAMM are too low. Thus, model estimates of loadings may be underestimated.

General comments related to stormwater quantity management at each of the three proposed development areas are listed in the following sections. Comments for Highmount Estates and Wildacres Resort have been combined because the areas are proposed as a single development and fall primarily within the Pepacton watershed. Specific, detailed comments for each development area are tabulated in Attachment A, keyed to the applicable issues above.

A. Comments Applicable to Both Big Indian and Wildacres Development Areas

1. Flow paths for the times of concentration are not shown on the drawings. This information is critical to understanding how runoff drains from the plateau and steep slope under existing pre-construction conditions and how the proposed reconfiguration of the topography during construction will change the runoff pattern. Presentation of the flow path allows an assessment of whether the model characterization of the pre-construction conditions is a realistic representation of site conditions and whether the proposed rerouting of flows in the operational phase is feasible. Flow paths must be provided so that times of concentration can be specifically computed. Flow paths should also indicate where the type of flow changes (i.e., sheet flow to shallow concentrated flow to concentrated channel flow) and where flow surface or channel cross-section properties change. Each flow path segment from the HydroCAD calculations should be easily identifiable on the drawings.

2. Considering the existing topography and apparent hydrology, it is evident that flow paths on the plateaus begin as sheet flow before becoming shallow concentrated flow. A substantial reduction in sheet flow is expected with the amount of grading for buildings and golf course amenities. Existing flow paths, which begin on flatter slopes, particularly near the top of the plateaus, should be re-evaluated based on onsite surveys and more

detailed topography. Sheet flow must be incorporated into each subcatchment model analysis where applicable. The failure to incorporate sheet flow into the pre-construction model calculations artificially accelerates runoff and can diminish infiltration, thus, estimates of pre-construction runoff would be inflated.

3. The DEIS does not present an adequate water budget and hydrology analysis necessary to evaluate impacts to the existing hydrology at the proposed development. This analysis must account for changes between pre- and post-construction hydrology affected by grading, increased impervious surfaces, and realignment of subcatchments. Subcatchment delineations and analysis presented in the DEIS, although applicable for design of stormwater management ponds, do not characterize the impacts to the existing pre-construction hydrology and hydrographs and, thus, may not accurately reflect potential increases in stormwater flows discharged from the site.

4. Due to the steep slopes, the level spreaders proposed to distribute discharges from the detention micro-ponds are not reliable for generation of a stable non-point discharge (i.e., overland sheet flow). The DEIS references that NYSDEC raised concerns with these structures in a meeting in 2003. The *New York State Guidelines for Urban Erosion and Sediment Control* (Blue Book) includes details and specifications on a level spreader on Page 5A.11. The specifications state that, "the area below the level lip must be uniform with a slope of 10 percent or less and the runoff will not re-concentrate after release…" Only one permanent level spreader is shown on the design drawings (Drawing SG-5) and the slope downhill from the spreader is greater than 60 percent. While the other level spreaders are not shown in the design, based on the description of their location, they are assumed to be located on slopes ranging from approximately 30 percent to approximately 50 percent. The DEIS suggests that several temporary level spreaders will also be utilized during the construction phase in these same areas. Reconcentration of flows is probable in these areas given the design and topographic constraints. Flows that reconcentrate below these level spreaders are likely to enter existing channels or erode new unstable channels and be conveyed directly down slope. The level spreaders proposed are inappropriate and inadequate for their design objective, which is to change point discharges to non-point discharges (i.e., channel flow to sheet flow).

5. One objective of the stormwater quantity analysis presented in the DEIS is to compare existing pre-construction and estimated post-construction stormwater flows to demonstrate the proposed stormwater management system is adequate to assure that storm discharges to surface waters do not exceed existing discharges from the site. To accomplish this design points common to both pre- and post construction periods are selected as locations to characterize the stormwater discharge leaving the developed site from within specified drainage areas. The analysis is flawed because the spatial extent of the subcatchment is not consistent between pre- development versus post-development. For the comparison of pre- and post-construction conditions the subcatchments should be delineated using appropriately located design points that remain consistent for both conditions. For example, the Wildacres drainage delineations depict six subcatchments in the pre-development condition; the 46 subcatchments in the post-development analysis

are not consistent with the drainage areas in the existing site. This inconsistency may artificially reduce the estimate of post-construction runoff at design points relative to existing pre-construction conditions.

6. The model output schematics are not consistent with the plan drawings. There are errors in routing of flow in the model when compared to the planned drainage depicted on the LA Group drawings. As one example, post-development drainage calculations for Belleayre Highlands contain portions of development on the Big Indian Plateau. The plans show the flow in this particular area as being directed to pond 14, which is linked to design point 1. The watershed schematic output accompanying the hydrologic computations show this particular area draining to design point 2. Many similar discrepancies were found. All subcatchments must be checked for accuracy and consistency in the hydrologic model. Depending on which flow path characterization is correct the estimated flows to the design points may be inaccurate.

7. Some of the estimated stormwater flow discharge rates (Q_{out}) from the ponds are larger than the inflow rates (Q_{in}) to the ponds. Because the ponds are designed with the objective of reducing flow rates through the ponds to enhance settlement of suspended particulates from the water column, this condition should not exist. The applicant should check the input parameters and calculations in the HydroCAD model to correct this error or modify the pond design to assure operational efficiency and prevent erosion and scouring in these ponds.

8. A range of Manning's n values was used in the various reaches (drainage swales and channels) across the site. It is unclear what the channel linings are in these reaches, thus, it is difficult to check whether the selected n values are appropriate to the channel design and lining. The DEIS should provide a list of channel linings and the associated Manning's n values for verification. The n values listed in the DEIS for open channels appear to be too high, based on the detail provided in the design.

9. The level spreader shown at the Belleayre Highlands site receives flow from 9 subcatchments totaling approximately 50 acres. The structure is modeled in the hydrologic analysis as Pond No. 8 with a peak storage volume of 19,625 acre-ft. The calculated discharge volume during the 100-year, 24-hour storm event is 177.9 cfs with a velocity of 6.2 ft per second. Given the location of this discharge above road cut/fill on steep terrain, this discharge must be redesigned.

10. The DEIS makes reference to Class D streams at the site. NYCDEP Watershed Regulations requires Crossing, Piping, and Diversion Permits for streams that do not require a permit from another agency. Therefore, all Class C and D streams, in addition to any other watercourses designated by NYCDEP, must have the Crossing, Piping, and Diversion Permits. These issues must be included in the SWPPP to be reviewed and approved by NYCDEP.

B. Big Indian

1. The defined study area for Big Indian does not include the entire development. In particular, the new Friendship access road to the west of Winding Mountain Road is not included in the study area. Proposed activity in this area must be addressed in the DEIS as this could be a major source of erosion and pollutant loading to Birch Creek and the Ashokan Reservoir watershed during both the construction and operational phases. Extensive construction will be required to create safe and stable access to the Belleayre Plateau via Winding Mountain Road and the new Friendship Road. Both roads will be on very steep terrain crossing bedrock ledges and highly erodible thin soils on benches. These roads will receive heavy construction vehicle traffic during project construction and service vehicle and visitor traffic during the operational phase. A rigorous stormwater management plan and erosion and sedimentation control plan are required for this work. The necessary analyses for this critical aspect of the project are not presented in the DEIS to approve this project.

2. Similar to Winding Mountain Road and the new Friendship Road, particular attention should be given to water quality protection for the road crossing over Giggle Hollow. Giggle Hollow Road is approximately 4,000 ft long approaching Giggle Hollow from the Big Indian Plateau; a continuous swale parallels the uphill side of the road for this entire length, then discharging to Giggle Hollow. Road cuts and golf course fill for Fairway 16 will create a disturbance approximately 260 ft long on a slope of 60-70 percent along the Giggle Hollow Road. Flow control and velocity dissipation structures, swale dimensions and lining, and discharge structures should be detailed in the DEIS. The DEIS should also provide complete and detailed analysis and design information for temporary and permanent erosion and sedimentation controls in these areas. Special construction sequencing must be developed to account for groundwater seeps that should be expected to be exposed by road cuts. Stormwater management plans for this area must account for potential reconcentrated flows from the stormwater discharges initiating as "overland flow" from level spreaders located located on steep terrain uphill of the Giggle Hollow Road.

3. There is a drainage swale parallel to Giggle Hollow Road that appears to discharge to Giggle Hollow. Flow control and velocity dissipation structures, swale dimensions and lining, and discharge structures for this area should be detailed in the DEIS. Of particular concern, this swale will capture water from seeps and stormwater runoff above Giggle Hollow Road that presently continues down the slope in a number of intermittent drainage channels to eventually reach Birch Creek or enter Giggle Hollow farther downslope. Although inadequate detail is provided in the DEIS, it appears that all this captured water will now be diverted to the head of Giggle Hollow where the Road will cross, significantly augmenting flows in the upper reach of Giggle Hollow. Increased flows in this reach have the potential to destabilize the bed and banks of Giggle Hollow, resulting in downcutting, bank slumping, and erosion that will result in increased sediment load to Birch Creek and the Ashokan watershed. The DEIS must provide a thorough fluvial geomorphologic analysis of this watercourse and propose mitigation to prevent stream degradation.

4. The DEIS states in Appendix 9A, Page 19 that *"The design assumes that any small ephemeral streams, intermittent drainage ditches, or washouts of the railroad ditch that could be intercepted by stormwater discharges will be by-passed in order to maintain separations of stormwater runoff and any of the existing streams. This can be accomplished by repairs made within the existing railroad bed."* The DEIS must provide design details showing the location of these streams/ditches and the structures that are proposed to control flow at these locations to prevent future erosion and washouts. The General Permit requires that unstable existing drainage channels be remediated to a stable condition; the plans in the DEIS do not provide an adequate description of how this stabilization will be accomplished.

5. All stormwater discharges must be evaluated for their impact on channel and slope stability. As discussed relative to Giggle Hollow above, the proposed rerouting of stormwater flows could result in significant changes in the location that stormwater runoff will enter along the length of other watercourse on the project site, altering the steam hydrograph and destabilizing the streambed. For example, if the discharge to steeper upstream reaches of a watercourse increase, erosion and incising in this area would increase, also destabilizing the stream banks. As per Stormwater General Permit GP-02-01, discharge volumes and velocities for the 100-year storm event must be calculated at the pond outfalls and safe conveyance must be provided with design controls to prevent erosion. In particular, the discharges from proposed Ponds 21 and 25 should be evaluated. Runoff from large areas of the site would be captured at these locations in the proposed design. According to data inputs to the hydrologic model, Pond 21 accepts runoff from approximately 74+ acres of the development. This pond discharges (at a rate of 254.7 cfs, @100-year, 24-hour storm event) to Reach 87 and runs 2,100 ft along the new access road to Pond 27, located on a steep slope approximately 400 ft above Birch Creek. Pond 25 accepts flow from approximately 70 acres at another portion of the development and discharges approximately 300 ft upgradient from the wetland/watercourse referred to in the wetland delineation report as No. 35. As mentioned in Appendix A.3, this channel is currently undergoing active erosion originating from previous logging road construction impacts. Increased discharge at this location will certainly exacerbate the condition of this channel.

6. The post-development input parameters for the Big Indian drainage analysis are missing subcatchment 19 (approximately 5.5 acres). In addition, subcatchments 15 and 20 do not appear on the schematic diagram from the hydrologic model and are excluded from the analysis.

7. It is not clear how stormwater flows to the Big Indian Plateau design points or the downstream receiving waters. All existing drainage channels and culverts should be shown on the drawings including those found along skid trails, the railroad track and access roads to private parcels. The DEIS and stormwater control plans must demonstrate that stormwater management controls downstream of the design points are adequate to handle any increased flow, or propose modifications to existing controls to mitigate the changes in flow.

8. Considering the divide between the two areas created by Giggle Hollow, the hydrological analysis should be separated for Belleayre Highlands and Big Indian Plateau. As mentioned before, the locations selected for design points 2 and 3 are not the most appropriate sites relevant to the developed areas.

9. Base flow of Giggle Hollow should be considered in the calculations. It is unclear how stormwater drains to Giggle Hollow (design point No. 2) from the nearby ponds and roads. Reaches should be defined on the drawings. Changes in stormflow routing could significantly change the hydrology of Giggle Hollow and potentially destabilize portions of the stream channel and increase erosion.

C. Highmount Estates and Wildacres Resort

1. Portions of the Highmount Estates area are not included in the study area for the stormwater quantity analysis. Specifically, the lots west of County Route 49A (17, 18, 19, and 20) and the southern portions of Lots 11 and 12 are not included within the study area. All disturbed areas throughout the property affected by or owned by the applicant must be included in the study area in order to account for all stormwater runoff in the management plan and assure that all control structures are adequately sized.

2. Portions of the Wildacres Resort area are not included in the study area for the stormwater quantity analysis. Specifically, the northwest corner of the site appears to be excluded. Again, all disturbed areas must be included in the study area in order to account for all stormwater runoff in the management plan and assure that all control structures are adequately sized.

3. It is not clear how stormwater flows from the Highmount Estates and Wildacres Resort design points to the downstream receiving waters. All existing culverts should be shown on the drawings including at access roads, Gunnison Road, and the railroad track. The DEIS and stormwater control plans must demonstrate that stormwater management controls are in place downstream of the design points and are adequate to handle any increased flow, or propose modifications to existing controls to mitigate the changes in flow.

4. Subcatchment areas 200 and 300 are not consistent between pre-development and post-development conditions. The inconsistencies in the DEIS result in much lower peak flows than EA estimates for the post-development subcatchments. Because these subcatchments are outside of the developed area their flows should not change from pre-development to post-development conditions. Subcatchment areas 200 and 300 are not shown on drawings. These areas must be delineated and shown completely on the drawings. In addition, flow discharging from culverts should never assume maximum discharge as with reach 300 at Wildacres. Likewise, the subcatchment area (subcatchment 300, defined as 42.2 acres) should not be calculated based on this assumed discharge. The actual watershed area contributing to this reach does not support the assumptions relative to discharge.

5. Several piped reaches, including reaches 60 and 300, appear as major flow constrictions in the HydroCAD model. Pressure flow should be modeled through these pipes and the potential for flow over the associated roadways should be considered. The existing topography does not show significant areas for water detention behind the culverts, thus flooding of roadways could occur; the DEIS should provide design modifications to alleviate this situation.

6. Drawings SD-3 and SD-4 are marked “not to scale.” The drawings must be provided to scale to allow for an accurate review. A scale for the drawings was estimated so that some comments could be provided. All drawings should be provided to scale to facilitate analysis of potential impacts from stormwater management.

STORMWATER QUALITY

In addition to a detailed stormwater quantity review, a comprehensive review and analysis of the stormwater quality management plan was conducted. Within the project boundary, nine mapped and several unmapped stream courses have been identified, five of which are defined as perennial with the remaining channels listed as intermittent or ephemeral. Several channels originate from wetlands and/or groundwater seeps located on the site. This review focuses on the potential nutrient and pesticide loading that could result from conversion of land use and cover and turf management practices. Water quality impacts from wastewater treatment and from erosion and sedimentation are briefly discussed here, and have been given more detailed review in Appendixes C.2 and C.3.

Overall Effectiveness of Water Quality Mitigation

The size and configuration of a number of the ponds is not adequate or appropriate for management of predicted flows and maintenance of water quality. Many of the ponds are too narrow and channel-like to dissipate predicted post-development flow velocities. Many of these ponds discharge to waters of the State that are managed for trout propagation and survival. The need to limit potential water temperature increases in these state waters has constrained the proposed design for control of other water quality parameters. Water quality issues must be addressed with the same priority as temperature considerations. The design will need to control nutrients, suspended solids, and other contaminants as well as water temperature. If this cannot be accomplished at the design level, it is unlikely that the project as proposed can avoid degrading water quality.

These ponds, as designed, will require routine maintenance to assure proper functioning as a water quality and water quantity mitigation device. Maintenance activities include sediment removal every 5-6 years, or when the pond is 50 percent full; regular removal of any trash/debris collected on the trash rack; clearing any woody vegetation that develops in and around the pond spillway; and inspection and removal of ice buildup during winter months. Maintenance activities and frequency are detailed in the Stormwater Pollution Prevention Plan provided in the proposed SPDES permit. This program must be rigorously implemented to assure that these structures operate effectively.

WinSLAMM Modeling and Nutrient Loading

To estimate potential impacts from post-development stormwater discharge, the DEIS utilized the Windows Source Loading and Management Model (WinSLAMM), developed by R. Pitt and J. Voorhees (2000). WinSLAMM is, in principal, an appropriate model to estimate the nutrient loading potential from a project of this type. The model is capable of modeling a wide range of storms, stormwater control devices, catchment areas, and land cover types (WinSLAMM 2001).

Although WinSLAMM is appropriate for this application, there are a number of deficiencies and omissions in the application as presented in the DEIS that introduce a high level of uncertainty into the results. The input parameters used to set up the model are not presented with the water quality analysis in the DEIS. This information is essential to perform a thorough review of the model application and assumptions and determine if the model results are realistic and applicable for the site. These data were provided on CD after the DEIS was released by the applicant following a request from NYCDEP. All relevant input data and model parameters must be incorporated into the DEIS to provide adequate opportunity for public review and comment. The following issues are raised as concerns with the WinSLAMM modeling and overall nutrient loading potential:

1. At this time, the DEIS does not mitigate nutrient loads to pre-development levels. Pollutant mitigation does not comply with 10 NYCRR§128-3.9 requiring complete mitigation of pollutant loads. Operational phase stormwater modeling results (Appendix 10A) yielded by WinSLAMM show an increase of total phosphorus in both the Ashokan and Pepacton watersheds of 48 kg/year and 22 kg/year, respectively. The DEIS repeatedly references the unallocated total phosphorus loads for each reservoir, suggesting that the reservoirs can assimilate the increased load from the proposed development. However, 10 NYCRR§128-3.9 requires no net increase in loadings over pre-construction conditions as stormwater leaves the site. Moreover, these specific impacts predicted by the applicant's own analysis must be further analyzed for their significance and adequately mitigated. Site-specific monitoring data indicate that the applicants estimate of pre-construction loadings is unrealistically high, indicating that the pollutant increase predicted by the applicant may be underestimated.

2. A number of basins were left out of the WinSLAMM modeling. EA's review of the stormwater quantity design indicates that some basins, due to size and/or configuration, will not adequately handle the runoff from their associated subcatchment, and depend upon the downstream basin for supplemental treatment. These cases should be clearly designated and the associated controls should be specified.

3. There is concern about the lack of connectivity in the WinSLAMM modeling given the complexity of the project areas and the stormwater management plan. WinSLAMM modeling in the DEIS treats each subcatchment individually based on the precipitation that falls within that subcatchment, but does not account for discharge to the modeled subcatchment from control devices in upstream subcatchments. This is a concern given that sequencing of subcatchments is a common feature of the proposed stormwater management plan. Where the stormwater ponds are linked in series, the WinSLAMM modeling approach does not account for the inputs to one subcatchment from another

immediately upstream (Appendix 10A, Page 10). Exclusion of this upstream input may result in an underestimate of the pollutant loading. As the ponds are not 100 percent efficient at pollutant removal, carryover of pollutants to downstream ponds is not accounted for by the water quality modeling. The loading effects from one pond to the next must be addressed to accurately depict the cumulative loadings from the proposed project.

4. Pre-development total phosphorus loads estimated by the model are high compared to site-specific data collected by NYCDEP and values reported in the literature. This overestimate of pre-development total phosphorus load will result in an underestimate of the net change in loadings during the operational phase of the proposed project. Considering that the DEIS already projects an increase in total phosphorus loading from pre- to post-development conditions, then the difference between the pre- and post-development may be even greater than that reported in the DEIS. The DEIS claims that pre-development total phosphorus concentrations may be as high as 0.27 mg/L (Appendix 10A, Page 12) and pre-development export coefficients for the Big Indian parcel may be as high as 0.23 lb/acre or 0.258 kg/ha/year (Appendix 10A, SLAMM output tables). These values are greater than typical total phosphorus exports from relatively undisturbed forested watersheds, such as Giggle Hollow, which encompasses portions of the proposed resort as noted in the table below. Oftentimes modeling applications use literature data to validate models because local data are not available. However, NYCDEP data were provided to the applicant and are presented in the DEIS, but were not used in the modeling effort. Based on literature review and NYCDEP data, it appears that Giggle Hollow yields very little total phosphorus, suggesting that pre-development total phosphorus export in SLAMM is potentially overestimated.

TOTAL PHOSPHORUS EXPORTS FOR FORESTED WATERSHEDS AS REPORTED IN LITERATURE, MODELED BY SLAMM, AND CALCULATED WITH NYCDEP DATA FROM THE BELLEAYRE MOUNTAIN WATER QUALITY MONITORING PROGRAM

Location	Land Use/Land Cover	Date	TP Conc (mg/L)	Export (kg/ha/yr)	Water Yield (meters)	Source
Big Indian Pre-Development	Predominantly forest	3/15/93 - 11/30/93	**0.23**	**0.258**	**0.114**	**DEIS SLAMM MODELING**
Giggle Hollow	Predominantly forest	4/24/01 - 11/30/01	0.016	0.023	0.155	Calculated with NYCDEP data
Giggle Hollow	Predominantly forest	3/15/02 - 11/30/02	0.017	0.068	0.498	Calculated with NYCDEP data
Giggle Hollow	Predominantly forest	3/15/03 - 8/12/03	0.013	0.066	0.536	Calculated with NYCDEP data
Chesapeake Bay forested areas	Forested sources	1985	---	0.038	---	Shuyler 1993
Town Brook, Catskills	54% Ag; 45% Forest	1/1/99 - 12/31/99	0.64	1.2		McHale and Phillips 1999
Lakes Bennery and Major, Nova Scotia	Forested	---	---	0.054	---	Hart et al. 1978
Multiple	Forested sources	---	---	0.05 - 0.8	---	Uttormark et al. 1974
Multiple	Forested sources	---	---	0.005 - 1	---	U.S. EPA 1976
Copper Mountain	Mixed	---	0.039 - 0.017	---		Lewis and Saunders 2000

5. WinSLAMM does not take into account antecedent moisture conditions, nor does it account for nutrient loads during the winter, thus underestimating annual loads. Since WinSLAMM uses an average runoff coefficient for the entire time period, it may underestimate pollutant loads by underestimating runoff from individual storms when they occur on already wet soils as was the case during the unusually wet 2003 water year. To account for spring snowmelt, the DEIS states that basins have been resized to attenuate spring snowmelt based on the New York State Stormwater Management Design Manual, but does not provide the analysis to support this contention. Calculations and assumptions used to estimate the storage required for spring snowmelt should be provided in the DEIS and validated before the draft SPDES permit that includes stormwater control is approved. Furthermore, the model does not account for runoff during the winter, including rain on snow events, again resulting in an underestimation of runoff and associated pollutant loads.

6. There is no calibration of WinSLAMM, or at least no information detailing if and/or how the model was calibrated. This is a key step in validating the results. The model should be calibrated based on local stream discharge and pollutant loading (these data are readily available from the USGS [www.usgs.gov] and were available to the applicant in regular data submissions from NYCDEP).

7. Several key set-up files and or parameter values are not provided in the WinSLAMM modeling report (Appendix 10A). These files were subsequently provided on request to NYCDEP, but are not part of the record in the DEIS for public review. A complete and thorough validation of the model results cannot be performed without these files. Specifically, no detail is provided about the control devices used (e.g., swales, detention basins, etc.), or the individual subcatchment land use descriptions that drive the modeling results. Because WinSLAMM relies heavily on the land cover classification to calculate associated pollutant loads, even subtle miscalculations or misclassification of this parameter could result in seriously flawed results. In Appendix 10A (Operational Phase Stormwater Quality Plan), the DEIS refers the reader to the HydroCAD analysis in Appendix 9A (Stormwater Quantity Management Plan) to obtain the cover types and controls strategies, however, the information provided is inadequate to reconstruct the analyses performed. For example, HydroCAD classifies the golf course as “Grass,” yet WinSLAMM provides for the area to be broken down into “large turf areas.” Appendix 4A in the WinSLAMM Manual (2000) provides an example printout of the model input file details that should have been included in the DEIS for completeness and to allow verification of model results.

8. The DEIS cites a modest decrease in total solids loading from the pre- to post-development condition. However, there is a large degree of uncertainty around this claim. WinSLAMM does not model ponds in series, yet the proposed stormwater design includes a number of ponds that will receive discharge from upstream ponds. As a result, it is unclear how sediment removal rates in the downstream ponds will be impacted by contributions from upstream ponds. Thus, the WinSLAMM model may generate an overestimate of sediment removal efficiency in these sequential detention ponds.

It should be noted that the particulate and filterable solids summation in WinSLAMM are incorrect (i.e. particulate solids + filterable solids does not equal total solids). This is the case in both pre- and post-development model runs. However, when these summations were performed manually, results still predict a decrease in total solids loading.

Review of Supplemental WinSLAMM Data Submission

EA was provided with a copy of the SLAMM input files on 1 March 2004. A subset of the subcatchments was evaluated relative to some of the areas of concern identified during our initial review of the data deficiencies. Subcatchments were chosen based on the potential that errors would have the greatest impact on model results (e.g., larger subcatchments and those with large impervious areas were examined). This included examining the subcatchment areas, land use characterization, control device characterization (including infiltration rates), and drainage system parameters. Several discrepancies were observed between the HydroCAD output files and the WinSLAMM input files.

This assessment of the WinSLAMM input files has identified a number of discrepancies that create concerns about the robustness of the modeling effort. Differences in the grouping of subcatchments between the HydroCAD and WinSLAMM modeling is suspect. Ponds that assume percolation in the WinSLAMM model, but not in the HydroCAD is also suspect, as are the differences in land use classification for several of the subcatchments examined in this review.

1. The subcatchment areas are not consistent between HydroCAD and WinSLAMM and the discrepancies are likely to result in an underestimate of pollutant loadings. All subcatchment areas for Big Indian were compared to those used in HydroCAD. In most cases, the areas correspond to those used in WinSLAMM, with several notable exceptions. First, Belleayre Highland 21 post-construction was modeled in HydroCAD as 343.01 acres, yet was modeled in SLAMM as only 193.07 acres. Second, a number of subcatchments (19-20-24-25-26-33) were modeled as part of Belleayre Highlands in the HydroCAD modeling, but were then modeled as part of Big Indian Resort in the SLAMM modeling. This inconsistency is suspect and the developer should justify why the subcatchments were grouped differently between the water quantity and water quality analysis. Third, Belleayre Highlands subcatchment 23 appears to have been left out of the WinSLAMM modeling altogether (9.37 acres). All of these discrepancies could potentially result in underestimates of pollutant loadings to the Ashokan watershed.

2. A number of discrepancies in land use characterization were identified for a subset of catchments at Big Indian (1-2, 5-22-32, 21, 22, 23, 24, 26, 30) that are likely to result in an underestimate of pollutant loading to the Ashokan watershed. For example, the employee parking lot for Big Indian 23-24 post-construction was left out of the WinSLAMM modeling. Specifically, parking used for this catchment in WinSLAMM was 0.24 compared to 1.33 acres in HydroCAD. Also, impervious area for Big Indian 5-22-32 post-construction was underestimated in SLAMM by nearly an acre compared to that used in the HydroCAD modeling.

3. Control device setup was examined for percolation rates for a subset of 10 ponds at Big Indian (ponds 3, 4, 6, 9, 10, 11, 25, 27, 28, 100). Several ponds were assumed to have no percolation in the HydroCAD modeling, yet were assigned infiltration rates in the WinSLAMM modeling (e.g., ponds 10 and 11). This may cause an underestimate of pollutant loadings from these subcatchments. The text of the DEIS and the assumptions in the modeling relative to infiltration must be made consistent between the water quantity and water quality analyses.

4. Drainage system setup was reviewed for all of the subcatchments in the WinSLAMM modeling; one misclassification resulted in an underestimate of total phosphorus loadings. Most of the existing drainage was classified as containing "undeveloped roadside" or "Curb and Gutters, valleys, or sealed swales" in good condition. Most of the proposed drainage system is classified as containing 100 percent "Curb and Gutters, valleys, or sealed swales" in good condition. One exception is Big Indian subcatchment 30 post-construction where the drainage is erroneously classified as 100 percent undeveloped roadside which is incorrect. When the classification is corrected in the model to 100 percent "Curb and Gutters, valleys, or sealed swales" in good condition and re-calculated, the result is an increase of 13 lb of total phosphorus per year for the post-development condition.

Pesticides

The risk assessment for pesticide use described in the turf management plan used two primary modeling tools: LEACHM to analyze vertical transport of pesticides through the soil and Groundwater Leaching Model to analyze the runoff component of pesticide transport. The assessment used the depth profiles of five soil types mapped on the development site to define the influence of soil characteristics on pesticide fate. This is an invalid approach as the construction plans for the golf courses indicate that much of the area will be cut/filled, crushed rock, and drainage will be installed under fairways, and a 6-in. layer of topsoil and turf will be installed. The existing soil profiles do not adequately reflect the developed conditions under which pesticides will be applied and may underestimate the rate at which pesticides may be transported through the thin topsoil layer to the bedrock fracture zone or to the underdrains and from there to the stormwater detention ponds. Nationwide environmental management golf course signature programs, such as Audubon International, require minimum measures in the design of their certified natural resource management plans. One such measure is that all golf course subsurface drainage be directed to buffer areas or other vegetative filters, and not directly into water. In addition, the entire drainage system for the golf course must be mapped including subsurface drains.

Several concerns should be noted and/or addressed related to the Integrated Turf Management Plan:

1. It should be noted that this plan will not prevent pesticides from reaching surface water resources (Section 3, Page 53) and to assume otherwise is unrealistic. The DEIS indicates that in the event of an extreme precipitation event following a pesticide application levels of pesticides in streams will not exceed levels that are harmful for fish or humans. However, many of the water-soluble pesticides would be mobilized in surface water runoff that will be transported through the detention ponds and to streams.

2. The proposed post-construction subsurface conditions were not modeled to determine pesticide transport. Potential leaching of pesticides to groundwater was modeled assuming a 2.5-m soil horizon layer prior to the water table. In fact, only 6 in. of topsoil on the golf courses is planned, and gravel, bedrock, or native soil may underlie that. The Groundwater Leaching Model should be re-run to reflect a 6-in. soil horizon. Additionally, the crushed gravel base and fairway underdrains have the potential to intercept vertical subsurface flow and route it to the stormwater detention ponds.

3. A rigorous monitoring plan should be implemented to ensure levels of pesticides do not approach harmful levels. The proposed monitoring program described in the draft SPDES permit is inadequate. The wells proposed for groundwater monitoring are all deep bedrock wells and not located appropriately to realistically monitor potential impacts to Waters of the State from pesticide use at the golf courses. The DEIS must propose a rigorous new monitoring program including installation of new shallow overburden monitoring wells in locations approved by NYCDEP and NYSDEC. Only 15 of the 31 pesticides listed in SPDES permits are currently detectable by certified laboratory methods. It seems reasonable that if a pesticide not detectable by currently certified methods is proposed for use, the developer should be required to submit an analytical method validation package, which should be available from the manufacturer of the pesticide. This package should provide sufficient information for a certified laboratory to verify the method and test effluents and ambient receiving waters for the pesticide.

4. It is requested that pesticide application records be filed with NYCDEP for annual review. Records of pesticide application rates must be maintained as required by law. The DEIS states this information will be made available to local towns.

FLUVIAL HYDROGEOMORPHOLOGY (FGM)

The DEIS does not provide a comprehensive description of the watershed FGM (i.e., stream stability, stream lengths, slopes, aspect, and detailed channel morphology) that is necessary to evaluate potential impacts from changes in runoff following development. The NYCDEP 2001 Monitoring Report provides additional information related to 5 of the streams where long-term monitoring locations have been established (3 at Big Indian Plateau and 2 at Wildacres). The information collected by NYCDEP indicates that the streams draining the project site are high gradient streams with slopes ranging from 13 to 27 percent on the Big Indian parcel and from 10 to 20 percent on the Wildacres parcel. In addition, the flow data collected during the monitoring period provide evidence of a widely varying flow regime indicating that the streams are highly responsive to localized precipitation, suggesting potential impacts to flow regimes should be anticipated and addressed. Any active erosion of existing onsite and offsite channels must be identified and evaluated.

Potential Impacts

No details have been provided for stream protection against stormwater runoff from the road at the Giggle Hollow bridge crossing. This information should be provided for all bridge crossings where there is potential to impact the site streams. In addition, construction details of the outfall structures and locations where stormwater is planned to be discharged to site streams (e.g., all regulated stormwater discharge outfalls at Wildacres regulated in the draft SPDES permit) discussed in the DEIS were not presented. Without these design details, the potential impact to bank stability in the streams at or downgradient from the discharge points cannot be evaluated.

The second goal of the stormwater management plan is to maintain or improve water quality prior to discharge to the site streams. The water discharged to the streams should not adversely impact aquatic resources or overall water quality downgradient from the project site. However, without greater detail in the DEIS, it is not clear that this will be accomplished by the proposed design.

Overland flow discharging from level spreaders and swales has been included as part of the stormwater design to disperse flow or convey water from stormwater ponds to site streams. The DEIS lacks detail where swales or overland flow are proposed, particularly in locations where the potential for impacting the watershed is high. The level spreaders proposed in the DEIS are located in areas of steep slopes ranging from 30 to 60 percent that exceed the recommended engineering standard. Engineering details are provided for only one of the proposed level spreaders. An example is the proposed level spreaders draining north of Big Indian Plateau toward Giggle Hollow and swales draining south of Big Indian Plateau toward Lost Clove Brook where no channels appear to exist under pre-construction conditions. If the level spreaders fail to effectively establish sheet flow on the steep slopes, there is a high probability that flow will reconcentrate resulting in uncontrolled stormwater flow and erosion of unprotected drainage channels. The ultimate effect would be an increase in sediment loadings discharged from the project site to both the Pepacton and Ashokan watersheds.

Surficial Geology

The DEIS presents a description of the surficial geology of the project site based primarily on published sources. In addition to these sources, limited site-specific data were collected during geotechnical and hydrological investigations, particularly during the installation of test pits to characterize the locations of stormwater facilities. There appears to be discrepancies between the test pit logs and the site grading plans. In addition, information from a limited number of test pits (i.e., depth to bedrock and percolation rates) was extrapolated, without typical methods of verification, to other areas classified with the same soil type. These assumptions were incorporated into the stormwater model. The results of those modeling analyses must be utilized recognizing this source of uncertainty.

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Attachment A

Detailed Comments for the Resort Study Areas

ATTACHMENT A

DETAILED COMMENTS ON STORMWATER QUANTITY MODELING LISTED BY CATEGORY IN THE TECHNICAL MEMORANDUM FOR THE RESORT STUDY AREAS

No.	Phase/Area	Category	Comment
			BIG INDIAN
1.	Pre-Development	5	The time of concentration calculation for Subcatchment 6 should consider channel flow instead of shallow concentrated flow for the final flow segment.
2.	Post-Development/Highlands	3	The open channel flow length for the time of concentration calculation seems too long in Subcatchment 33.
3.	Post-Development/Highlands	3	Reaches 46, 45, 52, 53, 27, 31, 30, 22, 13, 6, 32, 33, and 7 are not shown on the drawing.
4.	Post-Development/Highlands	9	Outflow is greater than inflow for Reach 36 in 10- and 25-year storms.
5.	Post-Development/Highlands	9	Outflow is greater than inflow for Reach 45 in 25-year storm.
6.	Post-Development/Highlands	9	Outflow is greater than inflow for Reach 29 in 10- and 25-year storms.
7.	Post-Development/Highlands	9	Outflow is greater than inflow for Pond 8 in 10 and 25, and 100-year storms.
8.	Post-Development/Highlands	9	Outflow is greater than inflow for Reach 22 in 10- and 25-year storms.
9.	Post-Development/Highlands	9	Outflow is greater than inflow for Pond 5 in 25-year storm.
10.	Post-Development/Highlands	9	Outflow is greater than inflow for Reach 5 in 25-year storm.
11.	Post-Development/Highlands	9	Outflow is greater than inflow for Reach 19 in 100-year storm.
12.	Post-Development/Highlands	9	Outflow is greater than inflow for Reach 39 in 100-year storm.
13.	Post-Development/Highlands	10	Outflow is higher in Post-Development for Design Point 2 for the 10-year storm.
14.	Post-Development/Highlands	10	Outflow is higher in Post-Development for Design Point 3 for the 10-year storm.
15.	Post-Development/Resort	3	Subcatchment Areas 13 and 14, Reach 17, and Ponds 13 and 14 are not connected to a Design Point in the HydroCAD Model.
16.	Post-Development/Resort	3	There are two Pond 26s on both the grading plan and the drainage drawing, however, there are not two Pond 26s in the HydroCAD model. The ponds as shown are completely separate but appear as though they could be linked by an unmarked reach.
17.	Post-Development/Resort	3	Reaches 39, 44, 34, 14, 89, and 94 are not shown on the drawing.
18.	Post-Development/Resort	9	Outflow is higher than inflow in Reach 7 for 25-year storm.
19.	Post-Development/Resort	9	Outflow is higher than inflow in Reach 34 for 25-year storm.
20.	Post-Development/Resort	9	Outflow is higher than inflow in Reach 8 for 100-year storm.
21.	Post-Development/Resort	9	Outflow is higher than inflow in Reach 83 for 10-year storm.
22.	Post-Development/Resort	9	Outflow is higher than inflow in Reach 84 for 10- and 25-year storms.
23.	Post-Development/Resort	9	Outflow is higher than inflow in Reach 24 for 100-year storm.
24.	Post-Development/Resort	9	Outflow is higher than inflow in Pond 26 for 100-year storm.
25.	Post-Development/Resort	9	Reach 42 has a outflow of zero with a inflow from Pond 42 of 0.09.
26.	Post-Development/Resort	9	Outflow is higher than inflow in Reach 84 for all storms..
27.	Post-Development/Resort	10	Outflow is higher in Post-Development for Design Point 1 for the 10-year storm.
28.	Post-Development/Resort	10	Outflow is higher in Post-Development for Design Point 4 for the 10 and 100-year storms.

No.	Phase/Area	Category	Comment
HIGHMOUNT ESTATES AND WILDACRES RESORT			
1.	Pre-Development/Highmount Estates		Missing pre-development Subcatchment data for the 10-year storm.
2.	Pre-Development/Highmount Estates	5	Sheet flow should be considered in the time of concentration calculation for Subcatchment 1.
3.	Pre-Development/Highmount Estates	5	Sheet flow should be considered in the time of concentration calculation for Subcatchment 3.
4.	Post-Development/Highmount Estates	3	HydroCAD model shows Subcatchment 6 flowing into Pond 6 and then Reach 6. It appears from the drawings that Subcatchment 6 flows directly into Reach 6.
5.	Post-Development/Highmount Estates	5	Sheet flow should be considered in the time of concentration calculation for Subcatchment 1.
6.	Post-Development/Highmount Estates	5	Sheet flow should be considered in the time of concentration calculation for Subcatchment 3.
7.	Post-Development/Highmount Estates	5	Sheet flow should be considered in the time of concentration calculation for Subcatchment 4.
8.	Post-Development/Highmount Estates	5	Sheet flow should be considered in the time of concentration calculation for Subcatchment 5.
9.	Post-Development/Highmount Estates	8	Outflow is greater than inflow for Pond 1 for 10-year storm.
10.	Post-Development/Highmount Estates	8	Outflow is greater than inflow for Pond 4 for 10-year storm.
11.	Post-Development/Highmount Estates	8	Outflow is greater than inflow for Pond 4 for 25-year storm.
12.	Post-Development/Highmount Estates	10	Post-development outflow is greater than pre-development outflow at Design Point 2 for the 100-year storm.
13.	Post-Development/Wildacres Resort	3	The HydroCAD model shows Pond 60 draining to Reach 57 and Reach 58. No reason or explanation is given for why or how this is accomplished.
14.	Post-Development/Wildacres Resort	3	Routing from Pond 22 to Reach 90 is not shown on the drawing.
15.	Post-Development/Wildacres Resort	3	Routing from Pond 24 to Reach 88 is not shown on the drawing.
16.	Post-Development/Wildacres Resort	3	Routing from Subcatchment 25 to Reach 52 is not shown on the drawing.
17.	Post-Development/Wildacres Resort	3	Routing from Pond 1 to Reach 86 is not shown on the drawing.
18.	Post-Development/Wildacres Resort	3	Routing from Reach 300 to Reach 299 is not shown on the drawing.
19.	Post-Development/Wildacres Resort	3	Routing from Pond 60 to Reach 58 is not shown on the drawing.
20.	Post-Development/Wildacres Resort	3	Routing from Reach 50 to Reach 49 is not shown on the drawing.
21.	Post-Development/Wildacres Resort	3	Routing from Reach 48 to Reach 47 is not shown on the drawing.
22.	Post-Development/Wildacres Resort	7	Reach 32 is labeled on the drawing but is not shown in the HydroCAD model.
23.	Post-Development/Wildacres Resort	8	Outflow is greater than inflow for Pond 110 for the 10-year and 100-year storms.
24.	Post-Development/Wildacres Resort	8	Outflow is greater than inflow for Pond 109 in 10-year and 25-year storms.
25.	Post-Development/Wildacres Resort	8	Outflow is greater than inflow for Pond 11 in 10-year and 25-year storms.
26.	Post-Development/Wildacres Resort	8	Outflow is greater than inflow for Reach 42 in 10-year storm.
27.	Post-Development/Wildacres Resort	8	Outflow is greater than inflow for Reach 44 in 10-year and 100-year storms.
28.	Post-Development/Wildacres Resort	8	Outflow is greater than inflow for Reach 46 in 25-year storm.