

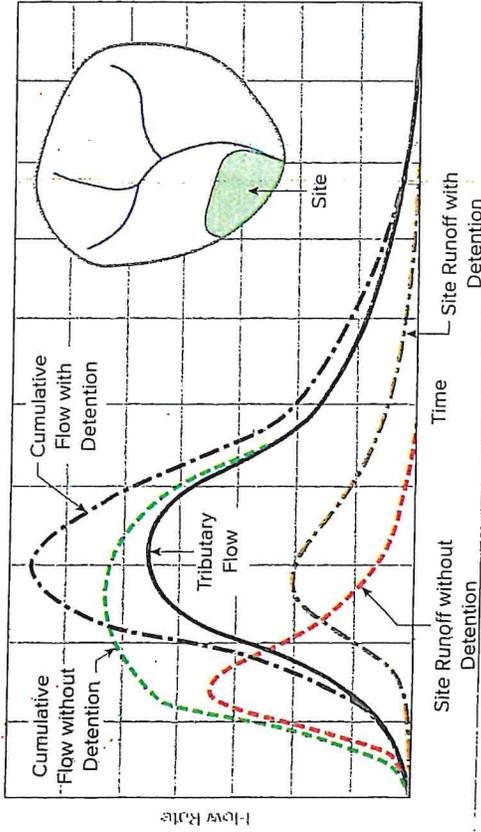
## **Downstream Analysis**

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- **Slide – Possible Coincident Peaks**
- **Pertinent sections of the *RI Stormwater Design Manual and Installation Manual* related to Downstream Analysis**

# Proposed Gooding Avenue Hotel Downstream Analysis Coincident Peaks

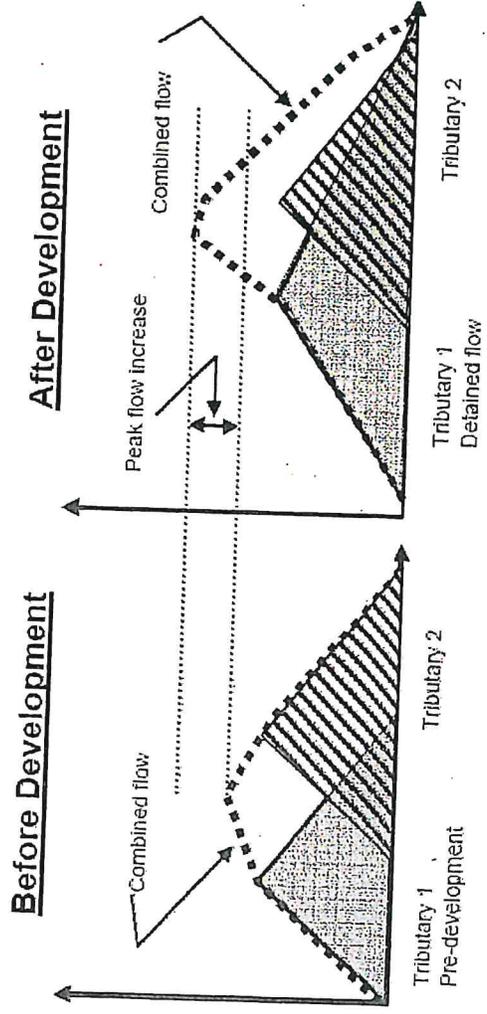
**RAISE  
THE  
RED FLAG**



3.3.6 Downstream Analysis (RISDIM)  
A downstream analysis is required for projects ...when existing conditions are already causing a problem (e.g. known drainage or flooding conditions)

Figure 3-1 Graphical Representation of Coincident Peaks (Ogden, 2000)

## Two Downstream Combining Hydrographs



The figure above shows a case resulting from delaying the recession and extending the recession limb of the hydrograph; the peak flow rate in the main channel increases.



## Downstream Analysis

The Applicant has contended during the RIDEM wetland review process that a Downstream Analysis was not required since they reduced the peak runoff rate. I have attached the pertinent sections of the RI Stormwater Design and Installation Standards Manual, which specifically explains and uses a graph to illustrate why a downstream analysis is required, even though there is a reduction in the pre and post runoff rates.

The Applicant attempted to satisfy the Downstream Analysis by modeling the section of Silver Creek as a 'Reach' using *HydroCAD* Stormwater modeling software. **This assessment is categorically wrong.**

I have attached sections from the HydroCAD Owner's Manual that describes a Reach as a "A uniform stream..." Silver Creek is not a uniform stream. That is why the HEC RAS model requires a series of cross-sections to reflect the non-uniform nature of natural streams. The Beta Silver Creek drainage model uses seven different cross sections in the Applicant's reference section.

There is a section in the HydroCAD Owner's Manual dealing with Reach Routing Limitations. It states that "If a detailed water surface profile is required for a channel, you should use a program specifically designed for that purpose." Footnote 25 states "Water surface profiles are usually calculated under constant flow conditions, rather than with a hydrograph (time-varying flow)"

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# **RHODE ISLAND STORMWATER DESIGN AND INSTALLATION STANDARDS MANUAL**

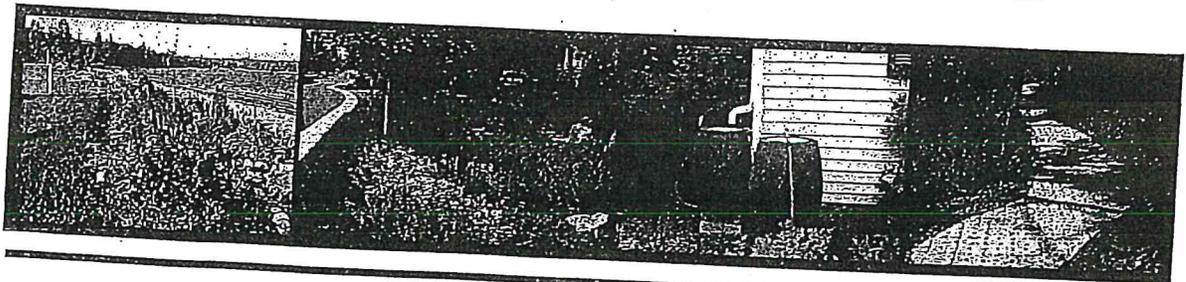
## **AMENDED MARCH 2015**



**RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL  
MANAGEMENT AND**



**COASTAL RESOURCES MANAGEMENT COUNCIL**



For facility sizing criteria, the basis for hydrologic and hydraulic evaluation of development sites are as follows:

- The models TR-55 and TR-20 (or approved equivalent) will be used for determining the required storage and outlet structures for attenuating the peak flows from the 10-year and 100-year, 24-hour Type III design storms.
- The standard for characterizing pre-development land use for on-site areas shall be woods, meadow, or rangeland. For agricultural land, use a CN representing rangeland.
- For purposes of computing runoff, all pervious lands prior to development shall be assumed to be in good condition regardless of conditions existing at the time of computation.
- Off-site areas that drain to a proposed facility should be modeled as "present condition" for peak-flow attenuation requirements.
- If an off-site area drains to a facility, an applicant must also demonstrate safe passage of the 100-year event, based on actual conditions upstream.
- The length of sheet flow used in  $t_c$  calculations is limited to no more than 150 feet for pre-development conditions and 100 feet for post-development conditions.
- An applicant must demonstrate that flows from the 100-year event will be safely conveyed to a practice designed to manage the 100-year event.

The  $Q_p$  criterion can be waived for sites that:

- Direct discharge to a large river (i.e., 4<sup>th</sup>-order stream or larger. See Appendix I for State-wide list and map of stream order), bodies of water > 50.0 acres in surface area (i.e., lakes, ponds, reservoirs), or tidal waters.
- A Downstream Analysis indicates that peak discharge control would not be beneficial or would exacerbate peak flows in a downstream tributary of a particular site (i.e., through coincident peaks).

### 3.3.6 Downstream Analysis

A downstream analysis is required for projects meeting the project size and impervious cover characteristics in the table below, or when deemed appropriate by the approving agency when existing conditions are already causing a problem (e.g., known drainage or flooding conditions or existing channel erosion is evident), to determine whether peak flow impacts are fully attenuated by controlling the 10- and 100-year events. The criterion used for the limit of the downstream analysis is referred to as the "10% rule." Under the 10% rule, a hydrologic and hydraulic analysis is extended downstream to the point where the site represents 10% of the total drainage area. For example, a 10-acre disturbed area within the same subwatershed would be analyzed to the point downstream with a drainage area of 100 acres.

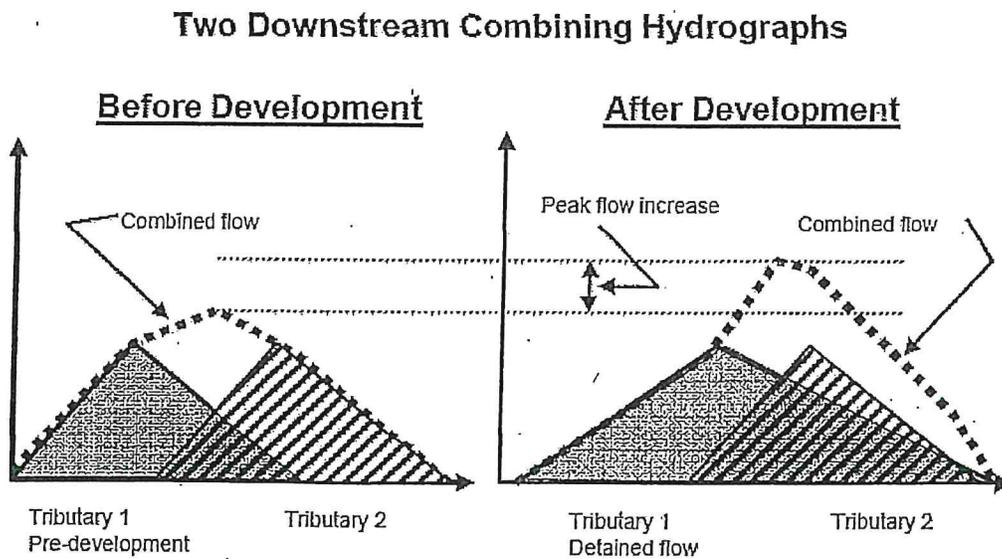
5410 = 50 acres

Table 3-7 Projects for which a Downstream Analysis is required

Area of Disturbance Within the Subwatershed (acres)	Impervious Cover (%) <sup>1</sup>
>5 to 10	>75
>10 to 25	>50
>25 to 50	>25
>50	all projects

A number of hydrologists have noted that overbank and extreme flood control approaches do not always provide full downstream control from the out-of-bank events, due to differences in timing of individual peak discharges in the downstream portion of the watershed. Depending on the shape and land use of a watershed, it is possible that upstream peak discharge may arrive at the same time a downstream structure is releasing its peak discharge, thus increasing the total discharge (see Figure 3-1). As a result of this "coincident peaks" problem, it is often necessary to evaluate conditions downstream from a site to ensure that effective out-of-bank control is being provided.

Figure 3-1 Graphical Representation of Coincident Peaks (Ogden, 2000)



<sup>1</sup> Percent Impervious Cover = I / disturbed area contributing to discharge locations

As a minimum, the analysis should include the hydrologic and hydraulic effects of all culverts and/or obstructions within the downstream channel and assess whether an increase in water surface elevations will impact existing buildings or other structures. The analysis should compute flow rates and velocities (for the overbank flood control storms) downstream to the location of the 10% rule for pre-developed conditions and proposed conditions both with and without detention facility(ies). If flow rates and velocities (for  $Q_p$ ) with the proposed detention facility increase by less than 5% from the pre-developed condition, and no existing structures are impacted, then no additional analysis is necessary. If the flow rates and velocities increase by more than 5%, then the designer must redesign the detention structure, evaluate the effects of no detention structure, or propose corrective actions to the impacted downstream areas. Additional investigations may be required by the approving agency on a case-by-case basis depending on the magnitude of the project, the sensitivity of the receiving water resource, or other issues such as past drainage or flooding complaints.

Special caution should be employed where the analysis shows that no detention structure is required. Stormwater designers must be able to demonstrate that runoff will not cause downstream flooding within the stream reach to the location of the 10% rule. The absence of on-site detention shall not be perceived to waive or eliminate groundwater recharge ( $Re_v$ ), water quality control ( $WQ_v$ ), or stream channel protection requirements ( $CP_v$ ).

A typical downstream analysis will require a hydrologic investigation of the disturbed area draining to a proposed detention facility and of the contributory watershed to the location of the 10% rule for the 10- and 100-year, 24-hour Type III storms. The approving agency may also request analysis of the 1-year, 24-hour Type III storm on a case-by-case basis. A hydraulic analysis of the stream channel below the facility to the location of the 10% rule will also be necessary (e.g., a HECRAS water surface profile analysis). Depending on the magnitude of the impact and the specific conditions of the analysis, additional information and data may be necessary such as collecting field run topography, establishing building elevations and culvert sizes or investigating specific drainage concerns or complaints.

**Table 3-8 Summary of Stormwater Treatment Practice Criteria**

Criteria	Description	Post-Development Storm Magnitude
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