This guidance is provided to clarify the Channel Protection Standard, and to guide the designer and reviewer through the use of Hydrologic and Hydraulic (H&H) routing software to determine compliance.

3.2.4 Minimum Standard 4: Conveyance and Natural Channel Protection

"Open drainage and pipe conveyance systems must be designed to provide adequate passage for flows leading to, from, and through stormwater management facilities for at least the peak flow from the 10-year, 24-hour Type III design storm event. Protection for natural channels downstream must be supplied by providing 24-hour extended detention of the one-year, 24-hour Type III design storm event runoff volume."

Clarification #1 – What is the Channel Protection (CP) Standard? Is it volume or flow?

The Channel Protection Standard is designed to control both flow and volume. The purpose of Minimum Standard #4 is to protect rivers from increasing erosive flows and volumes generated from increases in impervious cover. It has been found that controlling the erosive flows from the 1-yr storm, protects rivers from widening, cutting, and habitat degradation. Section 3.2.4 of the RISDISM states that protection for natural channels downstream must be supplied by providing 24-hour extended detention of the 1-yr, 24-hr, Type III design storm event runoff volume.

Further study into Harrington's methods developed in 1987, brought to light that the Volume Control method developed by Harrington in 1987, does not account for advancements in hydrologic modeling, storm routing, and infiltration. Because H&H software did not exist, Harrington had to make assumptions to protect stream channels. At the time, the simplest method was to assume that all water was stored and release. And if 65% of the runoff volume was captured and released slowly, Channel Protection was properly addressed. The Department still agrees with Harrington's methods, and this guidance is not written to change the CP standard but to recognize advancements in H&H software that are capable of a more complicated accounting of runoff that can also protect river channels. Practices which will help reduce runoff flow and/or volume include increasing Tc through LID practices, routing runoff through multiple BMP's, and infiltration (which is a type of volume reduction). Therefore, protective flow rates (CP_Q) and volumes (CPv) can be met with methods other than detention.

3.3.4 Channel Protection (CP_v)

"…The CPv criterion can be waived for sites that:

- *Direct discharge to a large river (i.e., 4th-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.*
- *Small facilities with impervious cover less than or equal to 1 acre.*
- *Projects when the post-development peak discharge from the facility **without attenuation** is less than 2 cfs for the 1-year, 24-hour Type III design storm event."*

Clarification #2 – Waivers

Please note that there is an additional reference to waivers in the RISDISM Section 3.2.6:

- Redevelopment

Please note that there is an additional waiver by default, or common sense:

- No discharge of the 1-yr storm. This can occur for sites that have a high degree of LID practices or infiltrate beyond the recharge standards.

Bullet #3 states that the post-development peak discharge from the facility **prior to any attenuation** is less than 2 cfs for the 1-year, 24-hour Type III design storm event. Please note for each receiving waterbody (RIDEM waterbody identification number) the total 1-year 24-hour drainage discharge from all collected stormwater drainage systems (pipes and swales) prior to entrance into any proposed treatment and/or detention practice is limited to less than 2 cfs, otherwise management of CPv is required.

3.3.4 Channel Protection (CP_v)

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

- *The models TR-55 or TR-20 (or approved equivalent) shall be used for determining the CPv.*
- *The Rational Method may be used for sizing the conveyance system.*
- *Off-site areas draining to proposed facility shall be modeled as "present condition" for the one-year storm event.*
- *The length of sheet flow used in time of concentration (tc) calculations is limited to no more than 100 feet for post-development conditions.*
- *The required minimum CPv shall be computed using the methodology developed in 1987 by Harrington (See Appendix H.4) or by calculating 65% of the direct runoff volume from the post-development 1-year, 24- hour Type III storm…."*

Clarification #3 – Facility Sizing Criteria and Hydrologic and Hydraulic Evaluation

H&H modelers must accurately represent the site and some of the sizing criteria in Section 3.3.4 are assumed in principal, but were not clearly listed in the Manual. The following is provided to answer many common questions have been asked with regards to hydrologic basis.

Sheet Flow - It is important to clarify that facility (or storage practices and orifice) sizing criteria does not include sheet flow runoff. Which means that evaluation of sites should only include the stormwater that is captured and conveyed. Sheet flow to streams is **not included** in volume or peak flow calculations.

Point of Study (POS) - Multiple discharges to the same receiving water body have cumulative impacts. Each project must evaluate the applicability of and compliance with CP for each river and therefore, POS must be appropriate. For example, if the site's drainage system has 3 outfalls, 2 of which discharge to Stream A and the third outfall discharges to a roadway drainage system discharging to Stream B, the engineer will need to clearly present the project's drainage system as 2 Points of Study and comply with the conveyance standard and the natural channel protection standard for the POS discharging to Stream A and the POS discharging to Stream B.

- POS #1 (Stream A) - CP is evaluated for reduced discharges from the 2 outfalls, (detention basin #1 and the swale);
- POS #2 (Stream B) - CP is evaluated for reduced discharge from detention basin #2.

Clarification #4: Methodology

Given the statements that this guidance has been provided to assist the reviewer and the engineer with evaluating the Channel Protection (CP) Standard for either Method #1 (runoff volume capture as stated in the manual) or Method #2 (routing software which abides by the same principals).

For all methods the following apply:

Vr = runoff volume from the post development 1-year, 24-hour, Type III storm generated by the drainage areas (sub-watersheds) that discharge to piped and/or swale collection systems that will eventually discharge to the point of study (cf or acre-ft).

T = extended detention time of 24 hours.

CP_{QAVG} = Average allowable release rate (cfs) for Channel Protection; or the roughly uniform rate of discharge over a 24-hour duration discharged from the **CP_V**. This is used to design the orifice when method #1 (runoff volume capture) is chosen.

Step 1) Select Method #1 or Method #2 and follow the steps outlined within each method:

Step 2) Calculate the total runoff volume at the POS for the post-development 1-year, 24-hr, Type III storm, **Vr**. Either of the approved models listed above may be utilized to determine **Vr**.

Method #1 (Harrington and runoff volume capture) – CP Standard for compliance is CP_V and CP_{QAVG}:

a) Calculate the volume of runoff to be captured or stored, **CP_V**:

CP_V (cf) **= Vs** (cf) **= 0.65 * Vr** (cf)
or, further utilize the Harrington Method as described in Appendix H for a capture coefficient other than 0.65 (**NOTE**: most adjustments are less than 5% with the Harrington Method)

CP_V = Vs= required minimum channel protection storage volume (cf).

b) Size the basin according to the required storage

c) Calculate the appropriate rate:

CP_{QAVG} (cfs) **= CP_V/ T = CP_V /(24 hrs*3600**sec/hr**)**

d) Size the orifice that releases the volume from the basin at the appropriate rate.
$A= CP_{QAVG} / Cd\ (2gh)^{1/2}$ or **$A = CP_{QAVG}/0.6*(2*32.2*h)^{1/2}$**
where,
A = orifice area (ft^2)
g = gravitational constant (use 32.2 ft/sec^2)
Cd = orifice coefficient (assume Cd = 0.6)

e) Set the orifice elevation and then determine **h**(ft), the average height of water over the orifice, where:

h (ft) = average depth of water above the center of the orifice (ft) = (max basin elevation of **CP_v** – elevation of the center of the orifice) / 2

Method #2 (H&H routing software) – CP Standard for compliance is CP_{QMAX}:
Routing software does not readily provide average release rates, but does provide maximum peak release rates. Reviews of many submittals, as wells as studies from NY and CT have shown that when Method #1 (runoff volume capture) is used, the average release rate over 24-hours is generally one-half of the maximum release rate. Therefore, for ease of determining compliance it is suggested that one-half of or **0.5 x CP_{QMAX}** will be identified as the channel protection standard for each POS. Using H&H software does not change the standard, but allows for a more straightforward interpretation of compliance since much of the calculations for storage, infiltration, routing, and orifice sizes are built into the software.

a) Calculate allowable average release rate **CP_{QAVG}.** Since routing software typically computes volumes in acre-ft. The following equation is used to calculate **CP_{QAVG}**.

CP_{QAVG} (cfs) **= (0.65*Vr)/ T**
= (0.65*Vr acre-ft * 43560 ft^2/acre)/(24 hrs*3600 seconds/hr)

b) Calculate the allowable maximum release rate **CP_{QMAX}**.
CP_{QMAX}(cfs) = **2* CP_{QAVG}**
CP_{QMAX} is the maximum allowable release rate (cfs) for Channel Protection at the POS. This will be used as the Channel Protection standard when method #2 (routing software) is chosen.

c) Size the basin and the orifice with the routing software so that for the 1-yr storm:
$Q_{POST\ 1\text{-}YR}$ is ≤ **CP_{QMAX}.**
(NOTE: LID practices (i.e. reduced runoff) and increased infiltration will result with this approach)

Clarification #5: Coldwater Fishery and CPv

Certain discharges have an increased thermal load that can impact stream temperatures which is harmful to cold-water fisheries. These include:

- discharges from retention ponds (stormwater ponds that hold water for long periods of time) or;
- discharges from detention ponds (as the water warms over the 48 hours into the cold-water fishery)
- any discharge that contains the first inch of runoff (WQv) from impervious cover.

If one of these thermal discharges are proposed within 200 feet of a designated cold-water stream or within 200 feet of a wetland with clear flow-paths to a cold-water stream, the applicant is required to design the release of all flows up to the CPv through an underdrained gravel trench outlet, as described in Chapter 5 of the RISDISM and depicted in figure 5-4.

By reason, Coldwater fishery restrictions as described in the RISDISM do not apply when:

- The WQv is infiltrated, or
- Discharge is not to a coldwater fishery, or is further than 200' from the cold-water stream or wetland that contributes to the cold-water stream.