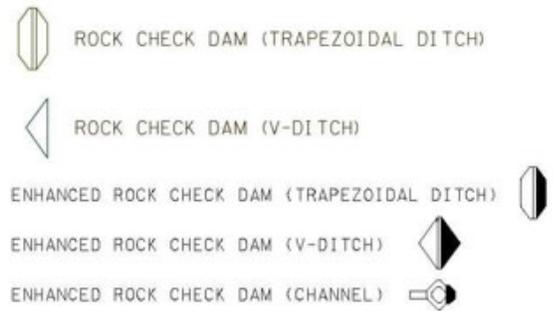




DWR – NPDES-SOP – G – 16 –Erosion Prevention and Sediment Control Handbook – 01092026

Erosion Prevention and Sediment Control Handbook

4.3.3 Check Dams and Enhanced Check Dams



Source: City of Franklin, TN

Definition and Purpose

Check dams, also known as ditch checks, are small, temporary structures placed across swales, drainage ditches, or other concentrated flow areas, excluding streams, on construction sites. Their primary purpose is to reduce the erosion potential of stormwater by intermittently obstructing the flow and not allowing it to reach its full velocity. These structures are typically constructed from materials like rock, sandbags, or wattles and are most effective when used in combination with other erosion and sediment control practices.

An enhanced rock check dam builds on the design of a traditional check dam, where a layer of smaller mineral aggregate (typically size 57) is placed on the upstream side of the dam and is separated from the original check dam by two layers of geotextile fabric. Like standard check dams, the enhanced version slows the velocity of runoff in drainage ditches, channels, or swales. The finer stones in enhanced check dams promote sediment capture and filtration.

Appropriate Applications

Check dams are best suited in open channels, such as swales, roadside ditches, and temporary drainageways. They are a practical solution where erosion and sedimentation problems exist in areas of concentrated flow and permanent stabilization is not feasible due to timing or the nature of the channel. This includes situations where grass or vegetative



DWR – NPDES-SOP – G – 16 –Erosion Prevention and Sediment Control Handbook – 01092026

Erosion Prevention and Sediment Control Handbook

linings are not taking root or where construction or weather delays prevent immediate installation of other stabilization measures.

Limitations and Maintenance

Check dams are to be used in conjunction with other EPSC measures, are not considered a primary sediment control measure, and are not to be used in streams (MPCA, 2023). Check dams become less effective in channels exceeding 10% in slope and when the contributing drainage area exceeds 10 acres (TDOT). Enhanced check dams become less effective when drainage areas exceed 20 or 30 acres, depending on whether the channel drains to an ETW/water with unavailable parameters or a water with available parameters, respectively (TDOT). For larger drainage areas, consider gabion check dams (Section 4.3.3.1), diverting unpolluted runoff away from the main channel (Section 4.2.3), or a greater number of dams.

Because check dams pond water to slow the velocity, they can inadvertently hinder vegetation by smoothing and smothering existing grasses and preventing new vegetation from taking hold. They can also disrupt the natural flow of water, which may reduce channel capacity and cause downstream turbulence. Therefore, inspections of check dams are needed after heavy rainfall and on a regular basis. If downstream turbulence (i.e., supercritical flow; Eqn 16 [Section 4.3.2]) and erosion are noted, additional runoff control and erosion prevention measures are likely necessary downstream (ALSWCC, 2018; NCDEQ, 2013). During runoff-producing events, ensure stormwater passes over the center of each dam and does not excessively penetrate or undercut the dam (i.e., it is impossible to completely eliminate penetration and undercutting) or cut around the sides of the dams. Additionally, ensure the center sag of the dam is at a height such that the dam effectively ponds water and does not immediately pass the runoff. If excessive penetration, undercutting, or passing occurs, the dams likely need to be reshaped. Though not considered a primary sediment control measure, make note of accumulated sediment behind the dams, particularly sediment accumulation behind the mineral aggregate of enhanced check dams. Remove the accumulated sediment before or once it reaches 50% capacity. Check dams should be kept in place until permanent stabilization is established, after which, they must be removed unless they are biodegradable and the area in which they were located is re-stabilized.

Planning and Design Considerations

The channel (Section 4.3.2) and check dam must be designed to adequately convey the design storm for the associated drainage area. Check dams are most commonly constructed with conventional riprap, but other materials such as sandbags, gravel-filled bags, fiber logs, tubes, or wattles (Section 4.4.9), and enhanced silt fence (see appropriate standard drawings, Section 4.4.10 only details enhanced silt fence used in sheet flow applications) can also be



DWR – NPDES-SOP – G – 16 –Erosion Prevention and Sediment Control Handbook – 01092026

Erosion Prevention and Sediment Control Handbook

used (USEPA, 2021). When constructing check dams with materials such as fiber logs, tubes, or wattles, follow the manufacturer’s instructions regarding product applications, limitations, and installation. Many of these products require staking, stapling, or trenching as well as overlapping abutments. Use longer stakes and reduce the spacing where higher velocities are anticipated. Do not stake through the product as this creates a preferential flow path (i.e., an area for water to more easily flow through) and may lead to flotation of the product. Follow specifications in the appropriate standard drawings for enhanced silt fence. For products not requiring anchoring, such as sandbags, it is best to lay the product in a staggering, brick-like pattern. More detailed installation specifications for wattles are also provided in Section 4.4.9. Materials such as straw bales and silt fences are not suitable check dam materials as they are not manufactured to withstand concentrated flows (MPCA, 2019).



It is ideal to use check dams in series. This practice does not allow runoff to regain velocity as it traverses down gradient and further promotes the settling of sediments. However, if sediment is continually observed upgradient of the dam(s), designers are encouraged to incorporate (additional) measures into the overall EPSC plan (USEPA, 2021).

Though a formal design of check dams is not required, there are various design considerations that promote long-term and effective function of check dams. Ultimately, it is the responsibility of the designer to ensure that a check dam system is fully functional. Best practices to ensure check dams are functional include:

- The depth of flow over the center of the structure (weir) should adequately convey the design storm without flow overtopping the channel;
- Six to 12 inches of height from the top of the weir to the top of the channel. (ALSWCC, 2018; NCDEQ, 2013; VDEQ, 2024);
- The horizontal spacing of dams is dependent on channel slope and weir height. Set the spacing such that the elevation at the top of the weir of the downstream dam is the same as the toe elevation of the upstream dam (Figure 4.3.3-A, B);



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Erosion Prevention and Sediment Control Handbook

- Shallow side slopes of the dams. Most sources suggest 2H:1V or flatter (ALSWCC, 2018; MPCA, 2023; NCDEQ, 2013; VDEQ, 2024), while TDOT suggests a more conservative 3H:1V side slope; and
- The use of a geotextile filter fabric under the base of the check dams that extends three feet beyond the toe of the dam (TDOT, VDEQ, 2024). This fabric is particularly helpful for stone dams and will act as a separator between the dam and soil base abutments. The fabric is to be set in the subgrade soils, which will help prevent soil particle migration, scour, and undercutting.

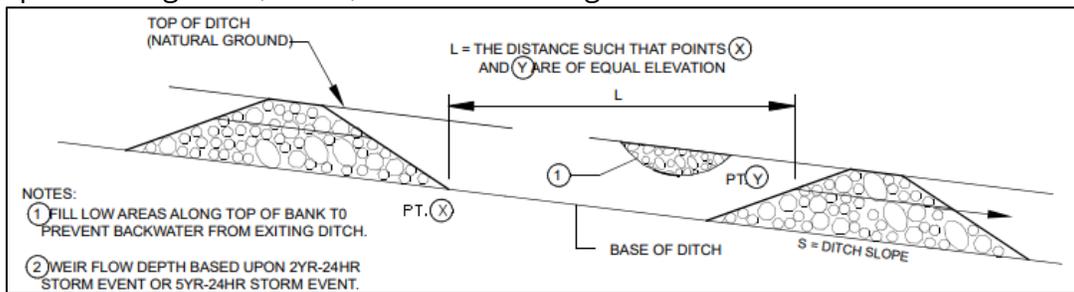


Figure 4.3.3-A: Spacing of check dams.

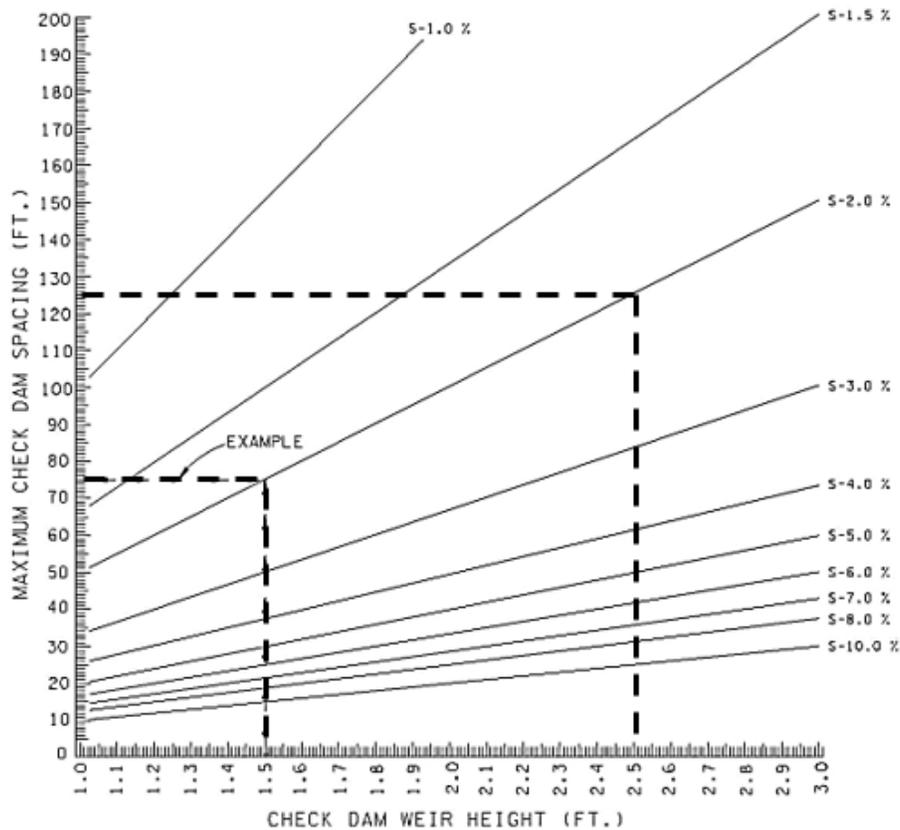


Figure 4.3.3-B: Maximum spacing of check dams governed by channel slope. Source: TDOT



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Erosion Prevention and Sediment Control Handbook

All planning and design considerations of traditional check dams are applicable to enhanced check dams. However, formal design of enhanced check dams is required when draining an area of 20 acres or more (TDOT). Like traditional check dams, the weir of enhanced check dams should not be more than three feet above the channel bottom and should be between half a foot and one foot below the channel banks. Because drainage areas may be larger for enhanced check dams, the weir height below the channel banks should be maximized whenever possible (i.e., as close to one foot below the channel banks). This will maximize the filtration capacity of the structure (TDOT). However, when the drainage area of the channel exceeds 20 acres, it is recommended that the designer compute the depth of runoff over the weir for the design storm to ensure the depth of runoff does not overtop the weir. This can be checked with standard weir equations. Flow over check dam weirs is most commonly governed by rectangular (Eqn 17) or trapezoidal (Eqn 18) weir equations:



$$Q = C \times L \times H^{1.5} \quad (\text{Eqn 17})$$

$$Q = \frac{2}{5} \times C \times z \times H^{2.5} \quad (\text{Eqn 18})$$

where C is a unitless weir coefficient (usually 3.33 for sharp crested or 3.09 for broad crested weirs), L is the length of the weir in feet, H is the height of water above the weir in feet, and z is the side slope in feet per foot (H:V). In general, software such as HydroCAD® may be helpful to accurately compute more complex scenarios. When the flow over the weir exceeds one foot, and the depth of the ditch is less than two feet, the designer is encouraged to consider other EPSC measures, since it will not be possible to provide the minimum weir height of one foot above the channel bottom.

Under certain circumstances, enhanced rock check dams may remain in place as a permanent ditch check at locations where removal would be difficult and might cause significant disturbance. If known during EPSC plan preparation, the designer should indicate on the plans which (if any) should remain in place.



DWR – NPDES-SOP – G – 16 –Erosion Prevention and Sediment Control Handbook – 01092026
Erosion Prevention and Sediment Control Handbook

Example Application

-Example courtesy of TDOT-

Given:

A proposed V-shaped ditch with 6H:1V side slopes has been designed along a roadway. The proposed ditch will be 200 feet long with a grade of 2% and a depth of 3.5 feet.

Determine:

The number of check dams, sizing, and spacing.

Solution:

Step 1 – Determine the height of the weir: Since the ditch is 3.5 feet deep, an ideal height of the weir may be 2.5 feet, such that it is less than 3 feet above the channel bottom and 1 foot below the channel sides.

Step 2 – Determine the spacing of the check dams: The maximum dam spacing can be calculated by dividing the dam height by the channel grade.

$$\text{Spacing (ft)} = \text{dam height (ft)} / \text{channel grade} = 2.5 / 0.02 = 125 \text{ ft}$$

The spacing can also be determined by using Figure 4.3.3-B. This figure also yields an answer of 125 feet.

Step 3 – Determine the number of check dams: The number can be computed by dividing the channel length by the spacing and rounding up to the next whole number.

$$\text{Number of dams} = \text{Length} / \text{spacing} = 200 / 125 = 1.6 = 2 \text{ dams}$$

References

- ALSWCC. (2018). *Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas.*
- MPCA. (2023). *Minnesota Stormwater Manual: Sediment control practices – Check dams.*
- NCDEQ. (2013). *Erosion and Sediment Control Planning and Design Manual.*
- TDOT. *Drainage Manual Ch8.*
- TDOT. *Drainage Manual Ch10.*
- USEPA. (2021). *Stormwater Best Management Practices: Check Dams.*
- VDEQ. (2024). *Virginia Stormwater Management Handbook.*