New Jersey Stormwater Best Management Practices Manual

February 2004

C H A P T E R 9 . 3

Standard for Dry Wells

Definition

A dry well is a subsurface storage facility that receives and temporarily stores stormwater runoff from roofs of structures. Discharge of this stored runoff from a dry well occurs through infiltration into the surrounding soils. A dry well may be either a structural chamber and/or an excavated pit filled with aggregate. Due to the relatively low level of expected pollutants in roof runoff, a dry well cannot be used to directly comply with the suspended solids and nutrient removal requirements contained in the NJDEP Stormwater Management Rules at N.J.A.C. 7:8. However, due to its storage capacity, a dry well may be used to reduce the total stormwater quality design storm runoff volume that a roof would ordinarily discharge to downstream stormwater management facilities.

Purpose

Dry wells can be used to reduce the increased volume of stormwater runoff caused by roofs of buildings. While generally not a significant source of runoff pollution, roofs are one of the most important sources of new or increased runoff volume from land development sites. Dry wells can also be used to indirectly enhance water quality by reducing the amount of stormwater quality design storm runoff volume to be treated by the other, downstream stormwater management facilities.

Dry wells can also be used to meet the groundwater recharge requirements of the NJDEP Stormwater Management Rules. See *Recharge BMP Design Guidelines* in *Chapter 6: Groundwater Recharge* for a complete discussion of these requirements and the use of dry wells and other groundwater recharge facilities to meet them.

Conditions Where Practice Applies

The use of dry wells is applicable only where their subgrade soils have the required permeability rates. Specific soil permeability requirements are presented below in *Design Criteria*.

Like other BMPs that rely on infiltration, dry wells are not appropriate for areas where high pollutant or sediment loading is anticipated due to the potential for groundwater contamination. Specifically, dry wells must not be used in the following locations:

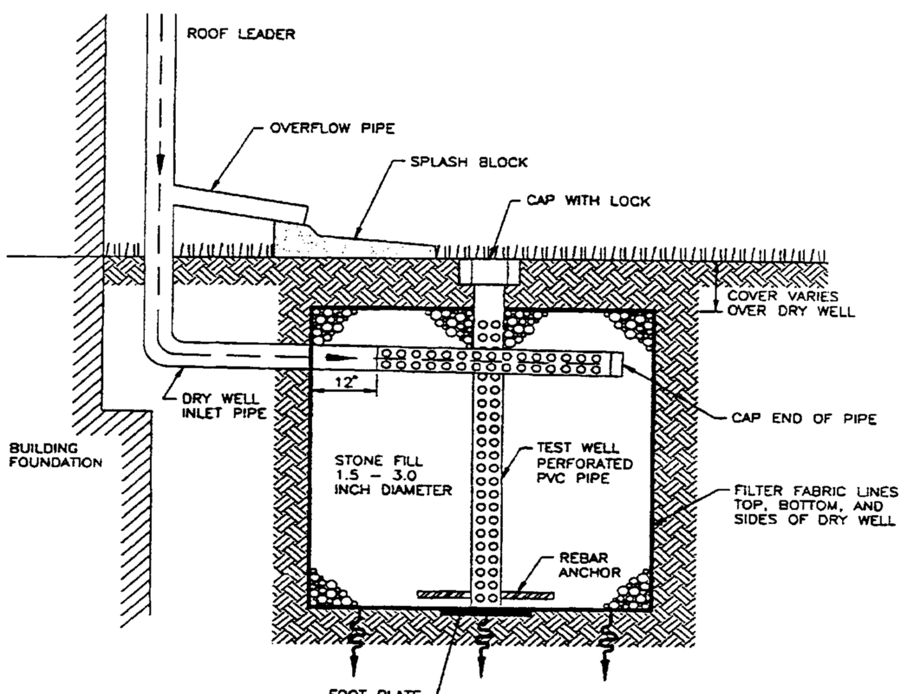
- Industrial and commercial areas where solvents and/or petroleum products are loaded, unloaded, stored, or applied; or pesticides are loaded, unloaded, or stored.

- Areas where hazardous materials are expected to be present in greater than “reportable quantities” as defined by the U.S. Environmental Protection Agency in the Code of Federal Regulations at 40 CFR 302.4.
- Areas where dry well use would be inconsistent with an NJDEP-approved remedial action work plan or landfill closure plan.
- Areas with high risks for spills of toxic materials such as gas stations and vehicle maintenance facilities.
- Areas where industrial stormwater runoff is exposed to “source material.” “Source material” means any material(s) or machinery, located at an industrial facility, that is directly or indirectly related to process, manufacturing or other industrial activities, that could be a source of pollutants in any industrial stormwater discharge to groundwater. Source materials include, but are not limited to raw materials, intermediate products, final products, waste materials, by-products, industrial machinery and fuels, and lubricants, solvents, and detergents that are related to process, manufacturing, or other industrial activities that are exposed to stormwater.

In addition, as required by the NJDEP Stormwater Management Rules, dry wells must not be used where their installation would create a significant risk for basement seepage or flooding, cause surficial flooding of groundwater, or interfere with the operation of subsurface sewage disposal systems and other subsurface structures. Such adverse impacts must be assessed and avoided by the design engineer.

Dry wells must be located and configured where their construction will not compact the soils below the dry well. Finally, a dry well must have a maintenance plan and, if privately owned, should be protected by easement, deed restriction, ordinance, or other legal measures that prevent its neglect, adverse alteration, and removal.

Figure 9.3-1: Dry Well Components



Source: Adapted from Standards for Soil Erosion and Sediment Control in New Jersey

Design Criteria

The basic design parameters for a dry well are its storage volume and the permeability rate of the subgrade soils. A dry well must have sufficient storage volume to contain the design runoff volume without overflow, while the subgrade soils' permeability rate must be sufficient to drain the stored runoff within 72 hours. Details of these and other design parameters are presented below. The components of a typical dry well are shown above in Figure 9.3-1.

A. Storage Volume, Depth, and Duration

A dry well must be designed to treat the total runoff volume generated by the dry well's maximum design storm. This may either be the groundwater recharge or stormwater quality design storm, depending upon the dry well's proposed use. Techniques to compute these volumes are discussed in *Chapter 6: Groundwater Recharge* and *Chapter 5: Computing Stormwater Runoff Rates and Volumes*. A dry well must also fully drain this runoff volume within 72 hours. Runoff storage for greater times can render the dry well ineffective and may result in anaerobic conditions, odor, and both water quality and mosquito breeding problems. The bottom of the dry well must be at least 2 feet above seasonal high water table or bedrock and be as level as possible to uniformly distribute runoff infiltration over the subgrade soils.

As discussed in *Considerations* below, construction of a dry well must be done without compacting the dry well's subgrade soils. As such, all excavation must be performed by equipment placed outside the dry well whenever possible. This requirement should be considered when designing the dimensions and total storage volume of a dry well.

It is important to note that the use of dry wells is recommended in this manual only for the stormwater quality design storm and smaller storm events. Use of dry wells for larger storm events and the requirements by which such dry wells are to be designed, constructed, and maintained should be reviewed and approved by all applicable reviewing agencies.

B. Permeability Rates

The minimum design permeability rate of the subgrade soils below a dry well will depend upon the dry well's location and maximum design storm. The use of dry wells for stormwater quality or quantity control is feasible only where the soils are sufficiently permeable to allow a reasonable rate of infiltration. Therefore, dry wells designed for storms greater than the groundwater recharge storm can be constructed only in areas with Hydrologic Soil Group A and B soils. Additional permeability requirements are presented below in Table 9.3-1.

Table 9.3-1: Minimum Design Permeability Rates for Dry Wells

Maximum Design Storm	Minimum Design Permeability Rate (Inches/Hour)
Groundwater Recharge*	0.2
Stormwater Quality	0.5
*See text for required diversion of runoff from greater storms.	

It is important to note that, for dry wells that are used only for groundwater recharge (see Table 9.3-1 above), all runoff from storms greater than the dry well's groundwater recharge storm must be directed around the dry well by a diversion structure or device located upstream of the dry well. If the dry well does receive runoff and associated pollutants from greater storm events, a minimum permeability rate of 0.5 inches/hour must be used. Minor basin inflows from greater storms during normal operation of the diversion are permissible provided they represent a small percentage of the total storm runoff volume. For example, the dry well overflow pipe shown in Figure 9.3-1 can serve as such a diversion if it is located vertically as close to the ground surface as practical. Details of a dry well's groundwater recharge storm are presented in Chapter 6.

In addition to the above, the design permeability rate of the subgrade soils must be sufficient to fully drain the dry well's maximum design storm runoff volume within 72 hours. This design permeability rate must be determined by field or laboratory testing. See *A. Soil Characteristics* in *Considerations* below for more information. Since the actual permeability rate may vary from test results and may also decrease over time due to soil bed consolidation or the accumulation of sediments removed from the treated stormwater, a factor of safety of two must be applied to the tested permeability rate to determine the design permeability rate. Therefore, if the tested permeability rate of the subgrade soils is 4 inches/hour, the design rate would be 2 inches/hour (i.e., 4 inches per hour/2). This design rate would then be used to compute the dry well's maximum design storm drain time.

C. Drainage Area

The maximum drainage area to a dry well is 1 acre.

D. Overflows

All dry wells must be able to safely convey system overflows to downstream drainage systems. The capacity of the overflow must be consistent with the remainder of the site's drainage system and sufficient to provide safe, stable discharge of stormwater in the event of an overflow. The downstream drainage system must have sufficient capacity to convey the overflow from the dry well.

Maintenance

Effective dry well performance requires regular and effective maintenance. *Chapter 8: Maintenance and Retrofit of Stormwater Management Measures* provides information and requirements for preparing a maintenance plan for stormwater management facilities, including dry wells. Specific maintenance requirements for dry wells are presented below. These requirements must be included in the dry well's maintenance plan.

A. General Maintenance

A dry well should be inspected at least four times annually as well as after every storm exceeding 1 inch of rainfall. The water level in the test well should be the primary means of measuring infiltration rates and drain times. Pumping stored runoff from an impaired or failed dry well can also be accomplished through the test well. Therefore, adequate inspection and maintenance access to the test well must be provided.

Disposal of debris, trash, sediment, and other waste material removed from a dry well should be done at suitable disposal/recycling sites and in compliance with local, state, and federal waste regulations.

B. Other Maintenance Criteria

The maintenance plan must indicate the approximate time it would normally take to drain the maximum design storm runoff volume from the dry well. This normal drain time should then be used to evaluate the dry well's actual performance. If significant increases in the normal drain time are observed or if it exceeds the 72 hour maximum, appropriate measures must be taken to comply with the drain time requirements and maintain the proper functioning of the dry well.

Considerations

A. Soil Characteristics

Soils are perhaps the most important consideration for site suitability. In general, County Soil Surveys can be used to obtain necessary soil data for the planning and preliminary design of dry wells. However, for final design and construction, soil tests are required at the exact location of a proposed dry well in order to confirm its ability to function properly without failure or interference.

Such tests should include a determination of the textural classification and permeability of the subgrade soil at and below the bottom of the proposed dry well. The recommended minimum depth for subgrade soil analysis is 5 feet below the bottom of the drywell or to the groundwater table. Soil permeability testing can be conducted in accordance with the Standards for Individual Subsurface Sewage Disposal Systems at N.J.A.C. 7:9A. See *Design Criteria* above for further soil requirements.

In addition, the results of a dry well's soil testing should be compared with the County Soil Survey data used in the computation of development site runoff and the design of specific site BMPs, including the proposed dry well, to ensure reasonable data consistency. If significant differences exist between the dry well's soil test results and the County Soil Survey data, additional development site soil tests are recommended to determine and evaluate the extent of the data inconsistency and the need for revised site runoff and BMP design computations. All significant inconsistencies should be discussed with the local Soil Conservation District prior to proceeding with such redesign to help ensure that the final site soil data is accurate.

B. Construction

For dry wells, protection of the subgrade soils from compaction by construction equipment and contamination and clogging by sediment are vital. Prior to its construction, the area to be used for the dry well should be cordoned off to prevent construction equipment and stockpiled materials from compacting the subgrade soils. During dry well construction, precautions should be taken to prevent both subgrade soil compaction and sediment contamination. All excavation should be performed with the lightest practical excavation equipment. All excavation equipment should be placed outside the limits of the dry well.

To help prevent subgrade soil contamination and clogging by sediment, dry well construction should be delayed until all other construction areas that may temporarily or permanently drain to the dry well are stabilized. This delayed construction emphasizes the need, as described above, to cordon off the dry well area to prevent compaction by construction equipment and material storage during other site construction activities. Similarly, use of the dry well as a sediment basin is strongly discouraged. Where unavoidable, excavation for the sediment basin should be a minimum of 2 feet above the final design elevation of the dry well bottom. Accumulated sediment can then be removed without disturbing the subgrade soils at the dry well bottom, which should be established only after all construction within the dry well's drainage area is completed and the drainage area stabilized.

If dry well construction cannot be delayed until its drainage area is stabilized, diversion piping or other suitable measures should be installed during all phases of construction to divert all runoff and sediment away from the dry well. These diversion measures should not be removed until all construction within the dry well's drainage area is completed and the drainage area stabilized.

Stone fill aggregate should be placed in lifts and compacted using plate compactors. A maximum loose lift thickness of 12 inches is recommended.

A preconstruction meeting should be held to review the specific construction requirements and restrictions of dry wells with the contractor.

Recommendations

A. Pretreatment

As with all other best management practices, pretreatment can extend the functional life of a dry well. While generally not a significant source of runoff pollution, roofs can nevertheless be the source of particulates and organic matter and, during site construction, sediment and debris. Therefore, roof gutter guards and/or sumps or traps (equipped with clean-outs) in the conduits to a dry well should be included wherever practical to minimize the amount of sediment and other particulates that can enter the dry well.

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