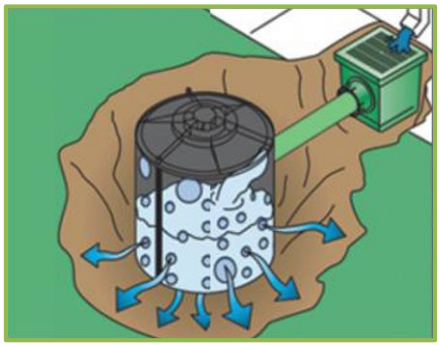
DRY WELLS

Dry wells are either seepage tanks set in the ground and surrounded with stone or 100 percent stone. They are designed to intercept and temporarily store stormwater runoff until it infiltrates into the soil. Alternatively, the pit can be filled with stone where water will flow in via a perforated standpipe in place of the tank.

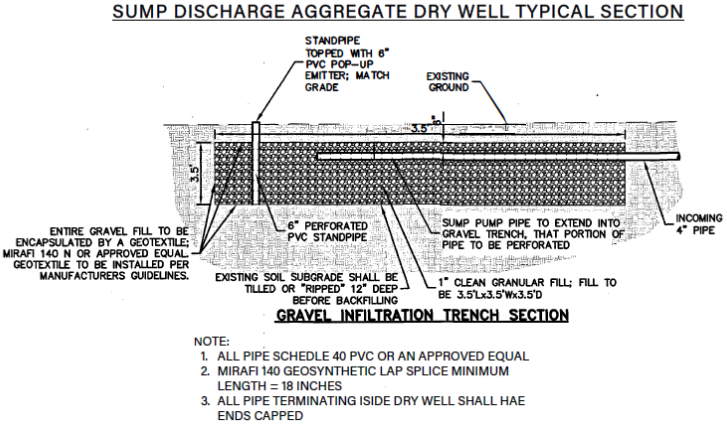


Source: www.earthcontactproducts.com

Dry wells are well-suited to receive rooftop runoff entering the tank via an inlet grate (shown at right) or a direct downspout connection (below right). When properly sized and laid out, dry wells can provide significant reductions in stormwater runoff and pollutant loads. **If an infiltration rate is not measured or when measured in accordance with Appendix A is less than 0.25 inch/hour, a dry well shall be oversized by 10%.**

LOCATION

- **Location.** Dry well excavations must be located: Spacing between drywells shall be a minimum of 30 feet or twice the depth, whichever is greater; 10 feet from building slab foundations / basements / retaining walls / in-ground swimming pools and property lines; on slopes flatter than 5% [20:1 (H:V)]; and to not knowingly cause or contribute to slope instability or that will trigger soil movement.
- **Overflow.** An overflow must be incorporated in the dry well such that excess water will flow into the storm drain system or another pervious area away from nearby foundations or neighboring properties. The point of discharge must be at least 10 feet from any property line.
- **Observation Well.** An observation well shall be installed to monitor the runoff clearance from the system. The observation well shall consist of an anchored, vertical four (4) inch diameter perforated schedule 40 PVC (or approved equal) pipe with lockable above ground cap.
- **Pretreatment.** To reduce the chance of clogging, dry wells should drain only impervious areas, and runoff pretreated with at least one of the leaf removal options to remove debris and larger particles.
- **Height and Diameter Limits.** A dug hole whose depth shall NOT be greater than the largest surface dimension so as NOT to become an Injection Well (https://www.epa.gov/uic/general-information-about-injection-wells). The bottom of the dry well must be below the frost line
    - **Tank.** The height of the tank should not exceed 60 inches unless infiltration testing has been done to ensure a drain time of 72 hours or less. Tank diameter shall not exceed 72 inches.
    - **Aggregate.** The height of the aggregate dry well (H), in inches: $24 \leq H \leq 72$.
- Dry wells should be located in a lawn or other pervious (unpaved) area and should be designed so that the top of the dry well is located as close to the surface as possible. **Avoid siting dry well in low spots to facilitate proper drainage and on or above slopes greater than 15% (1.8:12).**
- Dry wells should not be located:
    (1) Beneath an impervious (paved) surface or shed;
    (2) Above an area with a water table or bedrock less than two feet below the trench bottom;
    (3) Within an area where the slope exceeds 5%;
    (4) Over other utility lines;
    (5) Above a septic field;



(6) Less than 50 feet from slopes at or greater than 15% or that drain into areas prone to landslides; or
(7) In areas where the dry well is in 50% or more of fill.

CONSTRUCTION

- Consider the drainage area size and the soil infiltration rate when determining the size of the dry well, (see Appendix A). A minimum of 50% of the dry wells storage volume must be located within undisturbed (in-situ) soils.
- The sides of the excavation shall be trimmed of all large roots that will hamper the installation of the permeable drainage fabric used to line the sides and top of the dry well.
- The native soils along the bottom of the dry well shall be scarified or tilled to a depth of 3 to 4 inches.
- **Geosynthetic.** Place and secure filter cloth on the bottom and down sides of the excavation leaving enough to fold over the top below the soil and turf (see graphic). This fabric must be a needle-punched nonwoven polypropylene geotextile Mirafi 140 N or equivalent. Install clean aggregate, installing inflow, observation well, and overflow pipe(s) (solid and filter-sock wrapped perforated) at the desired elevation and location. When the material is cut or is at the end of the roll, overlaps are required. Lap splices must be a minimum of eighteen (18) inches.
- **For a tank installation.**
    - The dry well hole shall be excavated 1 foot deeper and two feet larger in diameter than the tank to allow for a 12-inch stone fill jacket.
    - Install filter non-woven geosynthetic as specified above
    - Fill below and around dry well tank approximately 12 inches of clean, washed ASTM No. 57 stone. No.57 stone averages ½ inch to 1-½ inches.
- **Proprietary Underground Stormwater Storage and Detention Systems.** These systems, when approved, shall be constructed in accordance with the manufacturer's guidelines.
- **Aggregate.** The washed ASTM No. 57 stone. No.57 stone averages ½ inch to 1-½ inches shall be placed and lightly compacted in up to twelve (12) inch lifts with a plate compactor (to reduce post-construction settlement).
- Fill the final 6 inches of the excavation with native soil, pea gravel, or ASTM No. 8 stone.
- **Downspout Connection.** It is acceptable to connect more than one downspout to the dry well as long as the maximum roof drainage area to the dry well of 1,000 square feet is not be exceeded. Pipe shall enter the dry well at 90 degrees to the side wall of the dry well.
- **Pretreatment.** For rooftop runoff, install a leaf screen in the gutter or downspout prior to entering the dry well to prevent leaves and other large debris from clogging the dry well. For non-rooftop runoff, precede the dry well with an in-ground sump grate or inlet leaf trap.
- **Overflow Design Criteria.** In order to prevent backup of water in the downspout, an overflow downspout surcharge pipe must be provided as shown on the Dry Well detail. Discharge from the downspout surcharge pipe must be directed to an above ground splash block and conveyed in a non-erosive manner to a stable outfall. In some cases, it may be desirable to add an additional overflow pipe or pop up emitter directly out of the dry well. This shall be in addition to the required splash block overflow. The flow from the additional overflow pipe or emitter must be directed to a safe location that is unlikely to contribute to nuisance drainage problems such as a wet lawn areas or seepage across sidewalks. An overflow, such as a vegetated filter area or grass channel, should be designed/provided to safely convey the stormwater runoff generated by larger storm events bypassing the dry well.
- **Observation Well.** The design involves placement of a perforated four (4) inch diameter Schedule 40 PVC vertical standpipe connected to the inlet pipe. When using a tank this can be omitted.

Sump Discharge. When incorporating sump discharge into a dry well, the sump discharged is sized to treat a minimum of 175 square feet of contributing area (3.5' X 3.5' X 3.5').

Use the tables below can be used to size a dry well system. For a given tank height and inside diameter the contributing drainage area captured can be read. For example, if a 10 by 50-foot roof is to be treated, the total roof area is 10 x 50 = 500 square feet (contributing drainage area). Using an infiltration rate of 0.25 inches per hour:

- **Tank Option.** This could be handled by one tank 30-inch high, 42-inch diameter, with a 6-inch gravel bed. It can also be handled by two tanks 30-inch high, 30-inch in diameter, with a 6-inch gravel bed.
- **Aggregate Option.** This could be handled by a 60-inch deep excavation, 60-inches square.

Sizing an aggregate dry well. To size an aggregate dry well:

- Minimum Aggregate Dry Well Excavation Volume=
    - [Contributing Drainage Area (square feet) x 1.14 inches of rainfall x (1 foot/12 inches)] / 0.40

Note: The 0.40 value is the amount of void space the aggregate has (40%) to hold water

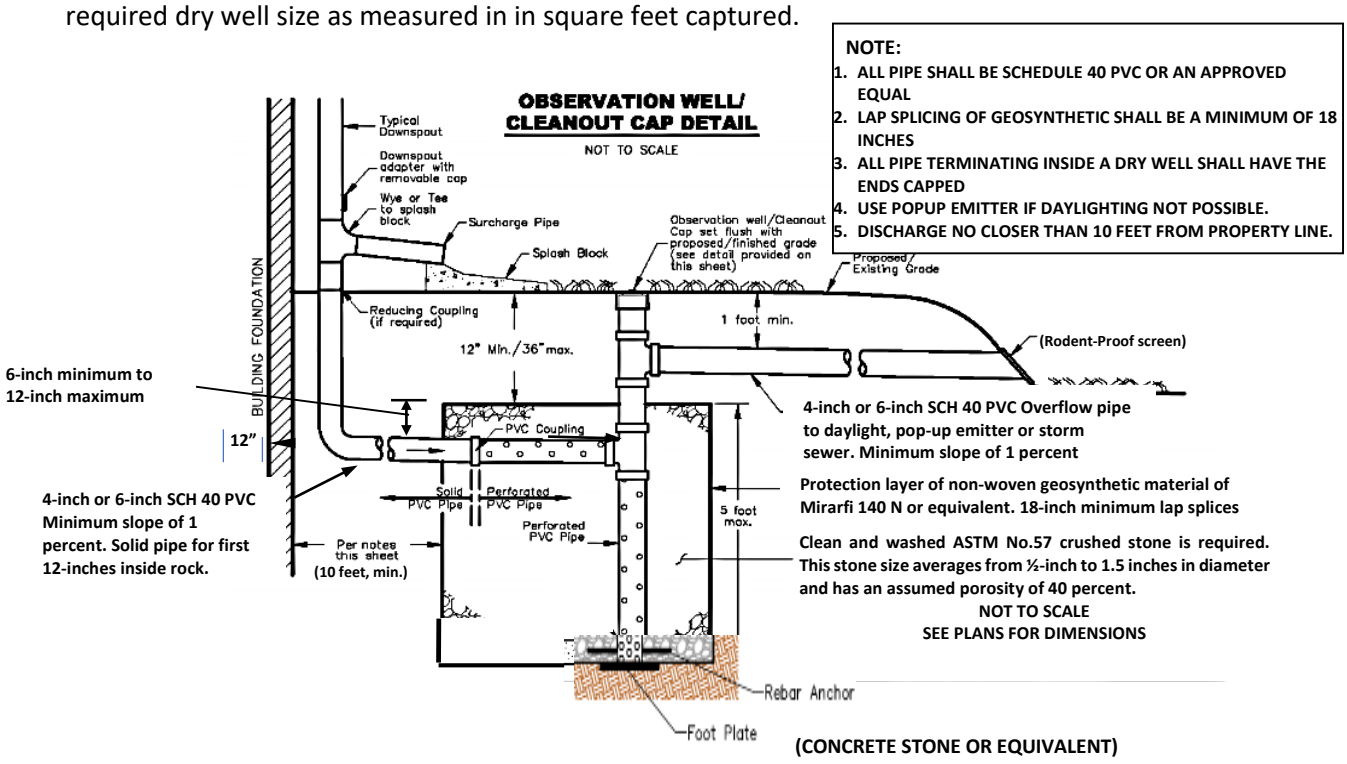
- Divide the volume by the excavated depth desired, in feet, to obtain the excavation area of the dry well. You can use different lengths and widths to achieve the minimum dry well area.

Sizing a tank dry well. To size a tank dry well:

- First, convert stormwater volume in cubic feet to gallons using 1 cubic foot of water being equal to 7.48 gallons; Minimum tanks volume, in gallons, needed =
    - [Contributing Drainage Area (square feet) x 1.14 inches of rainfall x (1 foot/12 inches)] x 7.48 gal/cf
    - Consult tank manufacturer for tank capacity
- Number of Tanks = Minimum Tank Volume (Gallons) / Tank Capacity (gallons)
    - Round up to the nearest whole tank

Infiltration Rate Limits. Measure the site infiltration rate according to Appendix A, if it is less than 0.25 in/hr, a dry well is not suitable for your site (a 10 percent increase in dry well volume may be permitted. This 10% oversizing is not applied to sump dry wells or when adding the 175 sf sump discharge volume to a larger dry well system). If the infiltration rate is higher than 0.50 in/hr, the size of the dry well can be reduced:

- For every 0.5 in/hr increase in measured infiltration rate above 0.50 in/hr subtract ten percent of the required dry well size as measured in in square feet captured.



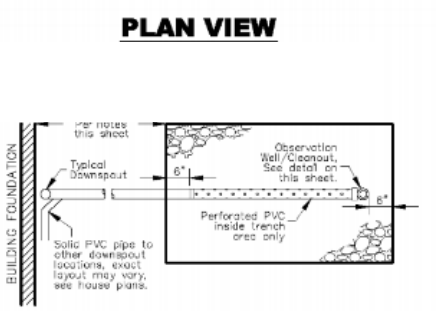
VEGETATION

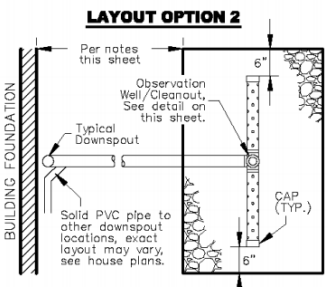
- The landscaped area above the surface of a dry well should be covered with pea gravel if water enters the dry well through surface features rather than a pipe. This pea gravel layer provides sediment removal and additional pretreatment upstream of the dry well and can be easily removed and replaced when it becomes clogged.
- Alternatively, a dry well may be covered with an engineered soil mix, and planted with managed turf or other herbaceous vegetation.

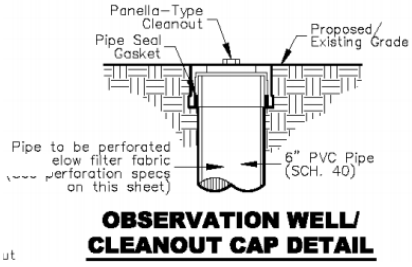
MAINTENANCE

Annual maintenance is important for dry wells to ensure they continue to provide measurable stormwater management benefits over time.

- Inspect gutters and downspouts removing accumulated leaves and debris.
- Inspect dry well following rainfall events.
- If applicable, inspect pretreatment devices for sediment accumulation. Remove accumulated trash and debris.
- Inspect top layer of filter fabric for sediment accumulation. Remove and replace if clogged.





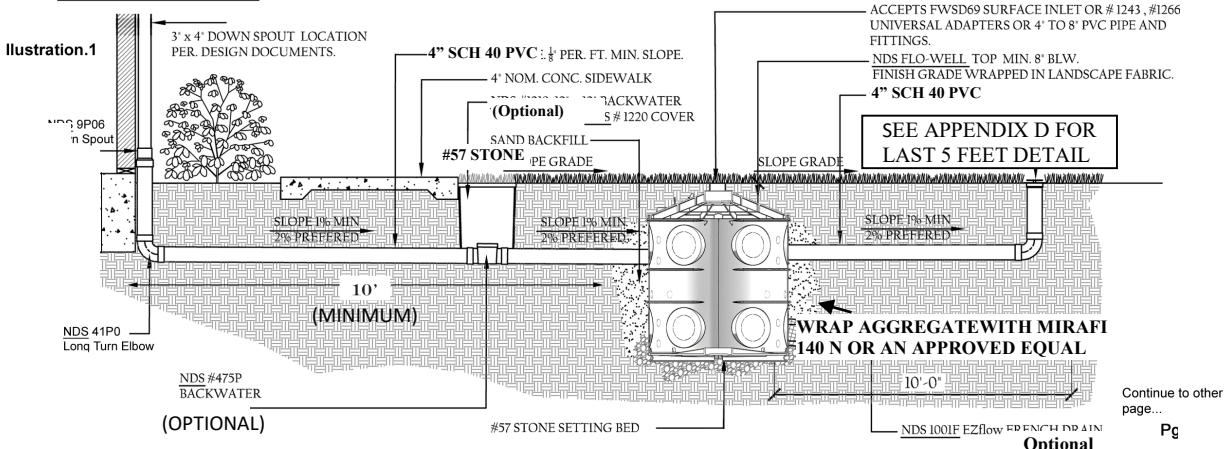


DRY WELLS

Gravel Bed Depth (inches)	Tank Height (inches)	Tank Inside Diameter (inches)					
		30	36	42	48	60	72
		Contributing Area Captured (square feet)					
6	30	340	440	550	680	960	1310
12	30	380	490	610	750	1060	1430
6	60	-	-	-	-	1790	2430
12	60	-	-	-	-	1890	2560

Hole Depth (inches)	6" Perforated Standpipe Square Gravel Hole (inches)						
	24	30	36	42	48	60	72
	Contributing Area Captured (square feet)						
24	40	60	80	100	130	200	290
30	-	70	100	130	160	250	360
36	-	-	110	150	190	300	430
42	-	-	-	180	230	350	500
48	-	-	-	-	260	400	570
60	-	-	-	-	-	500	710

Installation Example: Groundwater Recharge Hardpipe.



(Source: https://www.ndspro.com/PDFs/Installation-Instructions/Flo-Well-Assembly-and-Installation-Instructio

(ATTACH TANK MANUFACTURER'S INSTALLATION & MAINTENANCE SPECIFICATIONS)

CONSTRUCTION STEPS:

1. Review potential dry well areas and layout. Dry wells shall not be located: (1) beneath an impervious (paved) surface or structure; (2) above an area with a water table or bedrock less than two feet below the trench bottom; (3) over other utility lines; (4) above a septic field, (5) closer than ten (10) feet from another dry well, or (6) on slopes greater than 5% (20:1). Ensure outlet daylights or is discharge through a popup emitter (See Appendix D) at least ten (10) feet from property line.
2. Measure the area draining to the dry well and determine required size from the table on the next page.
3. Prior to submittal, perform an infiltration test according to Appendix A. If the rate is less than 0.25 in/hr increase storage volume by 10%. If the rate is more than 0.50 in/hr the storage volume may be decreased 10% for every 0.50 in/hr of infiltration rate increase above 0.50 in/hr.
4. Measure elevations and dig the hole to the required dimensions. Scarify the bottom soil surface 3-4 inches.
5. Place and secure Mirafi 140 N non-woven geosynthetic on bottom and down sides of the excavation leaving enough to have an 18-inch lap fold over the top below the soil and turf.
6. **Installation.**
   a. **Tank Option.** Place and tamp 6-inches to 12-inches of #57 gravel in bottom. Pea gravel can be substituted for leveling purposes in the upper three-inch layer below the tank. Place tank and install piping. Bond top of tank in place. Wrap tank with manufacturer's designated geosynthetic material. Strap and support tank as needed.
   b. **Aggregate Dry Well.** Set inflow, outflow and observation well pipes
   c. All piping must be Schedule 40 PVC, or approved equivalent. Perforated pipe to be wrapped with filter sock.
7. Cut and route downspouts or other rainwater delivery components; install chosen leaf screen option(s) (circle-selected options in Pretreatment Options Detail figure in Appendix E).
8. Create a safe overflow at least 10 feet from your property line and ensure it is protected from erosion.
9. Test connections with water flow.
   INITIAL INSPECTION POINT
10. **Backfill**
    a. **Tank Option.** Fill with gravel jacket around tank and place permeable fabric above between gravel and soil.
    b. **Aggregate Dry Well.** Carefully place #57 gravel and place fabric above and between gravel and soil.
    c. 12-inch thick (minimum) backfill over top of aggregate with soil/sod or pea gravel.
11. Consider aesthetics as appropriate and erosion control for overflow.
    FINAL INSPECTION POINT

CITY OF KIRKWOOD PROPERTY ADDRESS: DATE:	ATTACH THIS TWO-PAGE SPECIFICATION TO SITE PLAN SUBMITTAL	DRY WELL SPECIFICATIONS PAGE 1 OF 2

DRY WELL – LAYOUT SKETCH

PROVIDE PLAN AND ELEVATION VIEWS OF DRY WELL AND HOUSE SHOWING ROOF AREA DIRECTED TO DRY WELL AND KEY DIMENSIONS, CONNECTIONS AND OVERFLOW RELATIVE TO PROPERTY LINE. Dry Wells shall be setback a minimum of five (5) feet from water and sewer house connections and a minimum of three (3) feet from all other utilities unless a greater setback is required by the utility company. All utilities (for instance water, sewer, gas and electric) must be shown on the plan so setbacks can be verified.

SIZING CALCULATION:

SITE INFILTRATION RATE= _____ IN/HR

- IS BMP SUITABLE FOR SITE? □ YES □ NO
- CAN BMP SIZE BE REDUCED BY 10%? □ YES □ NO
- IS BMP SIZE TO BE INCREASED BY 10%? □ YES □ NO

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		Contributing Area Captured (square feet)					
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Hole Depth (inches)	6" Perforated Standpipe Square Gravel Hole (inches)						
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24	40	60	80	100	130	200	290
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42	-	-	-	180	230	350	500
48	-	-	-	-	260	400	570
60	-	-	-	-	-	500	710

MEASURE CONTRIBUTING DRAINAGE AREA AND READ AREA FOR GIVEN MEDIA DEPTH.

CONTRIBUTING DRAINAGE AREA= _____ SQ FT SLOPE GRADE (%)= ____

□ **TANK DESIGN:**

TANK DIAMETER/WIDTH= _____ INCHES

TANK HEIGHT= _____ INCHES

GRAVEL BED DEPTH (INCHES) = □ 6 □ 12

□ **AGGREGATE DESIGN:**

HOLE WIDTH= _____ INCHES HOLE LENGTH= _____ INCHES

HOLE DEPTH= _____ INCHES

MAINTENANCE:

1. INSPECT GUTTERS AND DOWNSPOUTS REMOVING ACCUMULATED LEAVES AND DEBRIS, CLEANING LEAF REMOVAL SYSTEM(S).
2. IF APPLICABLE, INSPECT PRETREATMENT DEVICES FOR SEDIMENT ACCUMULATION. REMOVE ACCUMULATED TRASH AND DEBRIS.
3. INSPECT DRY WELL FOLLOWING A LARGE RAINFALL EVENT (> 1 INCH) TO ENSURE OVERFLOW IS OPERATING AND FLOW IS NOT CAUSING PROBLEMS.
4. ATTACH THIS TWO-PAGE SPECIFICATION TO SITE PLAN SUBMITTAL

CITY OF KIRKWOOD PROPERTY ADDRESS: DATE:	ATTACH THIS TWO-PAGE SPECIFICATION TO SITE PLAN SUBMITTAL	DRY WELL SPECIFICATIONS PAGE 2 OF 2