THE DRY HYDRANT CONCEPT

Dry Hydrant Advantages

Knowing about a quantity of available water in area streams, ponds and cisterns gives an advantage to a fire department only if the water is readily accessible. Soft or obstructed ground certainly limits access. Or, the needed water may be located so far away from where it is needed that a fire department's ability to do its job of fire control is impaired.

Mobile water supply vehicles can move water from distant sources, but the critical factor is whether or not the fire department can maintain an uninterrupted supply of a predictable rate of water at the fire scene.

Installation of dry hydrants into numerous nearby and developed water supplies eliminates the inefficiency and complexity of long-distance water shuttle operations. This arrangement also allows access to water sources from a roadway instead of having to work on soft ground immediately adjacent to the pond or stream.

Dry Hydrant Construction
Steel and Iron pipe may be used to construct a dry hydrant, but PVC plastic is frequently used because of its low cost, accessibility and low friction loss. Construction details at specific sites an vary in many ways according to local preferences and conditions.

In any area without water mains and domestic fire hydrants, the dray hydrant concept can provide a simple, cost-effective solution to the need for access to water sources without delay. A dry hydrant consists of an arrangement of piping with one end in the water and the other end extending to dry land and available for connection to a pumper. Dry hydrants have the following features:

- A non-pressurized pipe system.
- Use relatively inexpensive piping materials and other supplies.
- Are permanently installed in existing lakes, ponds, streams and cisterns.
- Provide a means of access whenever needed, regardless of weather.
- Allow years of simple operation with a minimum of maintenance.

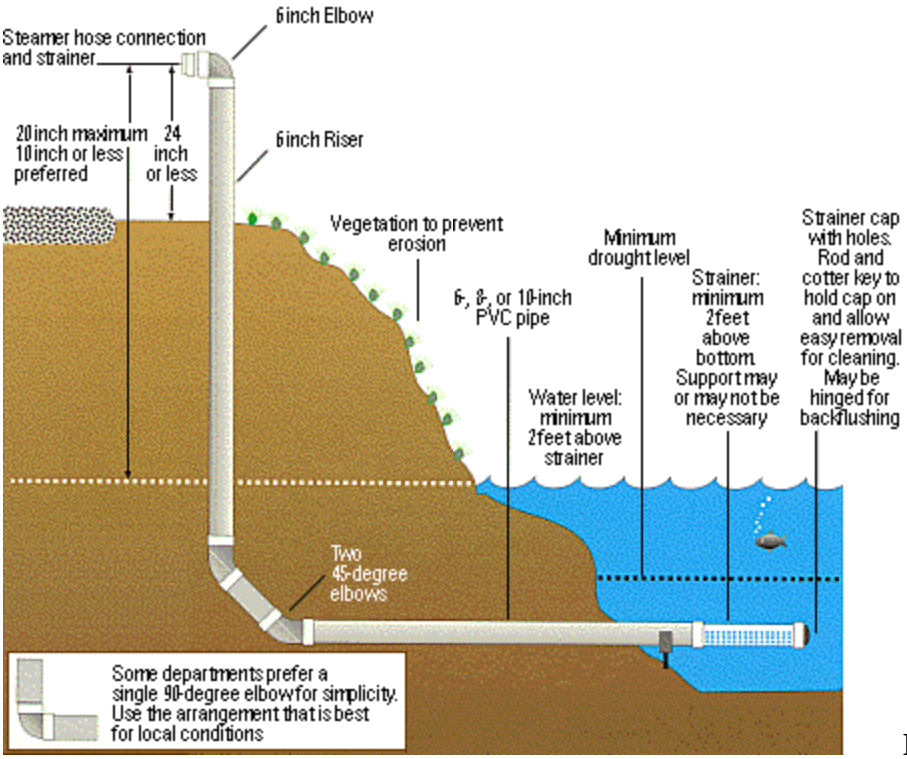
The time savings are many. Multiple lengths of hard suction hose extending to the water are not needed; usually one section to the dry hydrant is enough. The strainer is also permanently attached, saving more time. Fewer people are needed to make a hookup compared to make a conventional direct drafting hookup.

When a strategically placed dry hydrant with all-weather road access allows more water to be distributed in less time, and the water can be applied effectively on the fire, fire fighter safety is improved.

Savings can be financial, as well. For example, when the volunteer fire department in Forsyth County, Georgia used the dry hydrant water delivery system with proper training and equipment, county homeowners enjoyed a 49 percent drop in insurance rates. Fire departments also save money by reducing fuel and equipment costs through shorter transportation distances and lower operational demands. Communities can preserve more of their treated water supplies, since dry hydrants use untreated water.

Planning for dry hydrants involves several considerations and should involve all affected agencies and private concerns so a coordinated effort can take place.
Some factors to consider are:

- Current and future population and building trends.
- Property values protected.
- Potential for loss.
- Fire history of the area protected.
- Current water supply systems.
- Other potential water sources.
- Cost of project.
- Equipment and personnel of the local fire department .
- Training needs of the fire department.
- Other specific factors of local concern.



Dry Hydrant Location and Design

The location of individual dry hydrants is also influenced by several factors. After conducting a water source survey of the area, use a county road map to mark potentially good sites. Mark them in a priority order, since most fire departments will not have sufficient funding for all the dry hydrants that may be preferred.

- **Maximum distance of travel** between dry hydrants. This can vary for several reasons, but one target distance could be one dry hydrant every 3 square miles. This would produce a travel time of about 6 minutes between the water and the fire, assuming an average safe constant speed for a loaded truck of 35 mph. NFPA 1231 contains numerous design criteria, such as a recommendation for a 6-inch minimum inside diameter of the pipe and limit of 10 to 12 feet for static lift. Use a minimum number of elbows. NFPA 1231 also provides a work sheet for calculating various head loss of the design.
- **Ownership of the land**. The Water Supply Officer or other authority should contact the legal property owner to secure written permission (in conjunction with the town or county attorney) to use the water source (examples are provided in the publications listed on Page 39). if a possible dry hydrant site is along a road right of way, you will need town, county or state approval. In some cases Corps of Engineers approval may also be needed. Obtaining written permission is an important requirement that may take some time.
- **Depth of water at the source**. Careful note should be made about the useful depth of a lake or pond, which is from the minimum foreseeable low-water surface level to the top of the suction strainer (not the bottom of the lake). The low-water mark considers tides, drought, freezing and other effects, such as where the water level is lowered to generate power. The absolute lowest level must be not less than 2 feet, to prevent a vortex or whirlpool, which could allow air to enter the pump and cause loss of pump prime. You may need a minimum of 4 to 5 feet of water over the suction screen and pipe during low water to prevent a freeze-up of the screen.

- **Composition of the bottom material**. For long-term useful hydrant operation, the best composition for the bottom of a lake, stream or pond is sand, gravel or rock or a combination of these. Decaying vegetative matter could clog the suction screen.
- **Ease of digging**. A backhoe will need to get close enough to the water's edge to reach out and dig at least 5 feet below the surface of the water to start the trench.
- **Protection of the connection**. A location that is conveniently accessible to fire apparatus may also be exposed to accidents from other passing vehicles. An impact barrier constructed of partially buried posts may be needed to prevent a vehicle from destroying a dry hydrant in a heavily traveled area. Special markings may be necessary to avoid damage from snow plows.
- **Measurement for the proper amount of materials**. Use a design worksheet (examples are provided in the publications listed on Page 39) to calculate the length of pipe and couplings that will be needed. It is better to have too much pipe than too little. Use a minimum number of joints.
- **Costs**. The expense of a dry hydrant installation depends on local practices and the length of pipe needed. The Wisconsin Department of Natural Resources has estimated the cost there to be between $500 and $750, including the cost for contractor labor and machines.
- **Beware of other utilities** in the digging area. You must carefully check for the presence of buried lines and pipes and notify utility companies before you start digging.
- **Permits and land use agreements**. A Wisconsin publication on dry hydrants (*see References*) cautions that it may take 2 to 4 months to complete the process of permits and agreements for such things as water regulatory approvals. Local requirements vary greatly. Do not attempt to begin actual installation until all regulations are met.

Design factors are affected by:

??? Desired flow from the hydrant in gpm

??? Suitability of pipe materials

??? Size and type of fire apparatus pumper that is available

The following design features are suggested for dry hydrants using PVC pipes:

- Use minimum 6-inch-diameter pipes.
- Schedule 40 pipe should be used as a minimum.
- All exposed pipe should be primed and painted.
- Use a minimum of elbows.
- All connections should be properly jointed and cemented.
- Purchase or construct a suction screen with adequate hole openings.
- Total area of strainer holes must exceed 4 times the area of the diameter of the pipe.
- Installation depth must be below the frost-free depth for the area. (Consult local university extension service or state Department of Natural Resources.)
- Installation depth must be sufficiently below the average 50-year drought. (Consult engineer, soil conservationist or hydrologist)
- Horizontal pipe should be placed level on minus grade of 1 to 2 inches per 100 feet, unless depth of cut is too great.
- For streambed installation (with low flow depth less than 2 feet) the strainer section may be buried below bed of stream and covered with gravel. (Obtain engineering assistance in the design to determine minimum rate of flow during drought with average 50-year frequency.)
- Install dry hydrant as close as practical to the water source.
- A flow of 600 to 1000 gpm from the hydrant is desirable.
- Avoid designs with lifts in excess of 17 feet. (Above this height vapor pressure will begin to exceed atmospheric pressure and cavitation will occur, making pumping virtually impossible.)

- Consider friction loss at high lifts. Losses may be calculated using Manning's formula or Hazen-William equations.
- Place the pump at a higher elevation than the hydrant connection. (This will eliminate air bubble which will limit gpm flow and also prevent the operator from getting wet.)
- When rock is encountered, installation must be adjusted to fit the rock profile. (Additional bends may be necessary.)

Other considerations:

- Each elbow in a dry hydrant installation increases friction loss. Try using 45° elbows and a minimum number of 90-degree elbows. Friction loss in elbows is expressed in terms of equivalent lengths of straight pipe.
- An access road with a sustained maximum grade of 8 percent may not be desirable.
- Does the site have proper drainage?
- Is the access road a minimum 12 feet wide?
- Avoid vertical lifts of more than 10 feet with other than Class A pumps.
- PVC piping that is greater than two full sections will require additional personnel for installation handling.

Excerpts from *Dry Hydrant Manual*, published by the
Georgia Resource Conservation and Development Council.

Installation starts with arranging for a large backhoe and at least three people to handle and place the pipe in the trench. An ideal time to start installation is in the late summer when the water is warm and usually at its lowest level. Another preparation step is to haul clean fill material to the site. Choose material that will not wash out easily.

The actual installation steps are:

- **Dig the trench**. Mark the backhoe arm with a ribbon to indicate the desired vertical depth. (This is helpful only when the ground is level.) Start excavating the ditch in the water and complete the entire horizontal section of the trench. Keep the bottom of the trench level all the way to the hydrant. (It is less complicated to maintain a level trench rather than a sloped one which requires figuring new correct angles of joints.) An important safety rule: No one should ever enter the trench!
- **Cut the pipe to the desired lengths** and assemble. Check dry fit. As a rule of thumb, 6-inch-diameter pipe will not flow 1,000 gpm at horizontal lengths greater than 100 feet.
- **Prepare the joints**. It is better to use two 45-degree elbows for the riser joint instead of a single 90-degree elbow. If your hydrant connection is later broken off accidentally, the wider sweep of the 45-degree elbows would allow you to insert a 2 1/2-inch suction hose into the pipe. (Some may prefer to apply primer at this point, before gluing the joints.)

- **Join the pipe sections with glue**. Make sure you understand the technique, because timing is important. Use PVC cement; never use all-purpose cements to join PVC pipe and fittings. Joints must be held tightly together until both surfaces are firmly cemented. Do not disturb the joint until initial set occurs, which varies according to the temperature. Above 60 degrees F the recommended time is at least 30 minutes. Decrease the chance for an air leak by taping the joints with a rubberized, adhesive-backed wide tape. Attach the strainer with a collar or sleeve so that it can be removed if necessary.
- **Pressure test the joint**. Only after adequate curing according to the instructions for the particular cement. Do not take short cuts!
- **Carry the prepared piping to the trench.**

- **Force the strainer under water** until it fills the pipe. Workers with chest waders can help to sink the strainer, but they should be careful to avoid falling into the underwater trench. Anyone in the water should wear a personal flotation device. If more than 8 feet of pipe is out in the pond, a support bracket behind the strainer is a good idea. Support can be as simple as stacked concrete blocks. The strainer must be above the bottom of the pond so that the strainer holes will not be clogged with mud or other debris. Proper placement is necessary for successful operation of the dry hydrant. If available, a diving team should check the screen position when the sediment in the water settles.
- **Backfill around the pipe assembly**, starting with the riser, which should be covered during this operation to prevent rock and fill from falling into the pipe. Tamp the dirt for rigid support. Mound the fill material higher for more freeze protection. If extra insulation is needed, install a styrofoam barrier around the pipe 2 to 3 feet under the surface.
- **Cut off the top of the riser**, after measuring the distance from the bottom of the intake on the pump (positioned as it would be for pumping) to the ground. Cut off the riser so that when you attach the hydrant connection to the riser, the top of the opening of the hydrant connection is lower than the bottom of the pump intake. That is, the pump intake must be above the hydrant connection. Use a handsaw rather than a chainsaw; larger cutting slivers can fall inside the barrel and then stop the impeller of smaller pumps.
- **Smooth over the disturbed areas**, and plant grass seed or other vegetation to retard erosion. Mulching helps the seed or seedlings to get established.

- **Add any needed suction hose support**, (especially if using 45-degree elbows) remembering that connecting a suction hose and drafting through the dry hydrant connection places a lot of stress on the hydrant connection.
- **Place a sign** to identify the dry hydrant and warn against parking and other obstructions. Paint the cap a reflective color for improved visibility during emergencies. If the exposed PVC is not sunscreen protected, exposed pipe must be painted to prevent chemical decomposition from ultraviolet light.

Maintenance and training

New installations should be initially flushed to ensure removal of any debris that could be harmful to pumps.

Dry hydrants require quarterly inspection, testing and maintenance. More frequent cleaning may be needed at streams and ponds to make sure that silt and aquatic growth do not clog the water intake. Aquatic growth can be a special problem in ponds and in slow-moving water sources in some parts of the country. In extreme cases it may be necessary to drain a pond to control the growth. This will require careful timing and good communications to assure that other water sources are available for emergencies and that the pond will refill without undue delay.

Hydrants should be tested with a pumper once a year and backflushed as part of training exercises. Pay particular attention to safety-related features, such as warning signs and bumper guards.

Appearance is another consideration. Grass and vegetation will need to be kept trimmed. Repainting will be needed periodically. Maintaining the grounds around the dry hydrant assures better visibility when the hydrant will be needed in an emergency, and it will help keep good relations with the landowner.

Records should be kept of all inspections and procedures. Keep the records available with the maps showing the location of all installations. NFPA 1231 presents a sample maintenance record that may be adapted and altered for local use.

How many holes in the strainer?

The design checklist states that the total area of strainer holes must exceed 4 times the diameter of the pipe. Here is a simple chart to show how many holes are suggested for different size pipe:

Diameter	**Hole size** (inches)						
inches	1/2	5/8	3/4	7/8	1	1.25	1.5
6	576	369	256	189	144	93	64
8	1024	656	456	335	256	164	114
10	1600	1024	712	523	400	256	178

Strainer holes are drilled into the underside of the pipe, not on the top. Reserve a top 4-inch strip to reduce the possibility of creating a whirlpool during drafting, especially during periods of low water. This also keeps leaves and smaller debris from falling into the water and settling into the holes. Holes are also placed in the end cap, which may be hinged for backflushing. Pre-drilled strainer assemblies are available commercially.

Elbows

Each elbow in a dry hydrant installation increases friction loss. Try using 45-degree elbows as shown in above installation and a minimum number of 90-degree elbows. Friction loss in elbows is expressed in terms of equivalent lengths of straight pipe.

	Equivalent Pipe Length Pipe Diameter (inches)		
	6	8	10
45" elbow	9.2	10.6	13.2
90" standard	18.5	23.8	29.0
90" long turn	11.6	17.2	21.1