NFPA No.

25

WATER SYSTEMS FOR RURAL FIRE PROTECTION 1969

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Official NFPA Definitions

Adopted Jan. 23, 1964. Where variances to these definitions are found, efforts to eliminate such conflicts are in process.

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Recommended Practice for

Water Supply Systems for Rural Fire Protection

NFPA No. 25 — 1969

1969 Edition of No. 25

This 1969 edition of No. 25 was officially adopted at the National Fire Protection Association Annual Meeting, held in New York, N.Y., May 12–16.

Origin and Development of No. 25

This text was originally developed by the Subcommittee on Water Supply Systems for Rural Fire Protection of the Committee on Rural Fire Protection and Prevention and processed in accordance with NFPA Regulations Governing Technical Committees. It received tentative adoption in 1968, and was further amended this year.

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Scope: An advisory committee to advise the Association on farm and rural fire problems.

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Water Supply Systems for Rural Fire Protection

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I. Introduction

Fire losses in the rural areas of the United States (open country and communities of less than 2,500 population) continue to increase each year or remain at a high level. Rural losses represent a substantial portion of the total national losses. A significant change in the type of fire losses over past decades has been the great increase in nonfarm occupancies. Included in these are industrial, trade, recreational, organizational and other public occupancy losses as well as residential. The improvement of roads, use of the automobile, and lack of parking facilities in urban areas has been a large factor in the "flight to the fringe" by family, business, and public organizations.

There are several reasons why rural fire losses continue at a high level even though many agencies and individuals are making great strides toward improvement. In comparing the fire protection of rural properties with urban properties, the following stand out:

(1) Lack of building, electrical, and fire prevention codes, or the existence of substandard structures and other hazardous materials or conditions.

(2) The reduced population density often delays the discovery of a fire.

(3) The extended communication facilities — and a telephone connection may not be available — slows up the call for fire protection assistance.

(4) The response of the fire department vehicles is slowed by the fact that most rural areas are protected by a volunteer force of firemen who must be called to the fire department — as opposed to a paid city department force that is immediately available.

(5) Considerable distance, poor roads, hilly topography, and presence of snow and mud slow up, and may prevent, the arrival of the fire apparatus.

(6) When the equipment and men arrive, they are usually confronted with a well-developed fire and a minimum of water with which to combat the blaze. In recent years the fire departments have, however, provided tank trucks that assure at least a basic minimum supply of water.

NOTE: This publication supersedes "Water Systems for Fire Protection on Farms" published by NFPA in 1938.

This publication points out satisfactory methods and facilities to assure rural property owners, fire departments, and insurance companies of adequate supplies of water for rural fire protection.

II. Need for Water Supplies in Rural Areas

(1) Rural Buildings and Fire Load

Any appraisal of the need for water for fire protection requires a knowledge of "fire load."

Fire load refers to the amount of combustible material present in a given situation, expressed in pounds per square foot. Rural fire loads are exceedingly variable and thus the size of hose stream required is equally variable. For instance, from 2½ to 10 gallons per minute may be an adequate first-aid stream for dwellings, whereas a sizable wooden barn filled with hay that had a pre-burn of 25 minutes may require 1,000 gallons per minute.

A statement, "Provide the largest available volume of water discharge that can be afforded, at pressures necessary for the type of hose stream to be used," would appear to be most appropriate at this point.

(a) Farm Buildings

Dwellings offer the potential of several types of fires, with water being the most generally used extinguishing agent. While the possibility exists of electrical fires starting in any room, they usually spread quickly to Class A materials requiring water for extinguishment. Only in the kitchen, cellar and garage, do flammable liquids and gases usually exist for Class B fires. Thus, while a B-C extinguisher is a dwelling requirement, water supplies for extinguishment must be the basic fire fighting materials for dwellings.

Barns and other service buildings provide the greatest potential fire danger as well as the greatest demand for water. Moreover, the frequent absence of personnel often prevents the early discovery of fire. In northern climates, farm buildings are often closely clustered or joined to minimize human exposure to winter weather while individuals are engaging in the farm work. Such clustering or joining increases the fire exposure hazards as well as making the job of fire extinguishment more difficult.

On "residential farms" the existence of obsolete and run-down barns or service buildings, along with more frequent absence of workers, tends to create an even greater fire potential — and thus greater need for water supplies.

(b) Rural Residences

Construction of rural and suburban residences has increased at a pace greater than that in cities. The majority of these residences are beyond the reach of public water systems and hydrant districts.

Because many of the residents in these rural and suburban homes did not grow up in these surroundings, they and their children are often not familiar with rural fire hazards. These hazards include dry grass during portions of the year, careless burning of rubbish, storage of flammable fuels for use with barbecues, power lawn and garden equipment, and assorted chemicals for many uses. For those houses beyond the reach of hydrants, a supply of water for fire protection — both first-aid and community equipment — must be made available.

(c) Public, Commercial, and Industrial Establishments

More and more large enterprises of all types are being established in rural surroundings. Some, such as industries, operate year-round, whereas many camps and commercial establishments are seasonal. Each establishment has particular elements of fire risk that must be individually analyzed. Great variation does exist in the type and severity of fire hazard in these structures. Multistory buildings, large numbers of children in tents and on hikes in the woods, business establishments working with hazardous materials and storing large concentrations of flammable materials are common.

(2) Fields, Woods and Pasture

During dry periods the grasses and woody fuels provide rural fire fighters (in many sections of the country) with their most serious fire problem. The availability of water for first aid fire use by the rural resident will assist the resident to extinguish a blaze before it gets to a serious size. Large supplies of water established at strategic locations can greatly assist firemen who must extinguish a fire which has grown to more serious proportions.

III. Water Supplies in Rural Areas

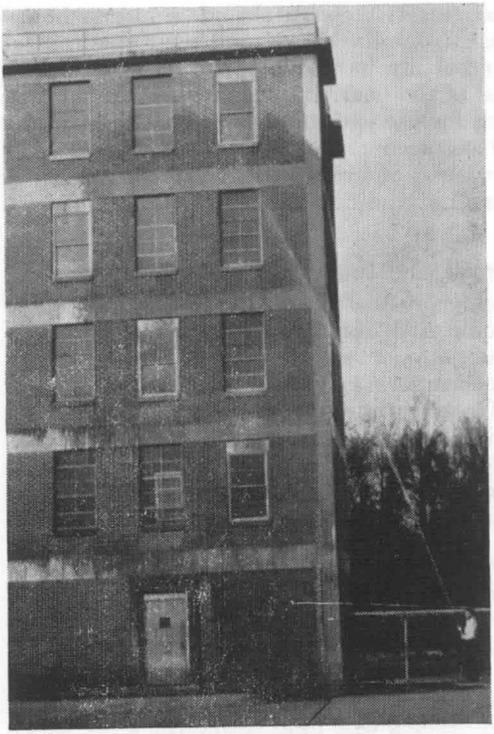
The "domestic" or individual water supply system now provided in virtually all rural homes and business establishments, if properly equipped and maintained, can generally be an effective first-aid fire extinguisher. For large establishments, a large elevated water storage tank or reservoir connected to hydrants and/or standpipes, could provide both substantial fire streams as well as first aid streams.

(1) Water Supply Systems*

To provide for fire protection in depth, three types of water supplies are needed: (1) first aid via the domestic water system, (2) a

*For information concerning the design of individual water supply systems refer to the following:

Manual of Individual Water Supply Systems — U.S. Public Health Service
Water System and Treatment Handbook — Water Systems Council, Chicago, Ill. Planning Water Systems — American Assn. of Agr. Eng. & Vo. Ag., Athens, Ga.



Stream from first-aid fire hose reaching fifth floor of firemen's training tower was provided by demonstration intermediate water system designed by the U.S. Agricultural Research Service, Beltsville, Maryland. This illustrates fire protection benefits of properly designed farm water supply system. *(U S. Agricultural Research Service.)*

bulk water supply at the property, which may be a stream, pond, elevated tank, or cistern (the latter possibly filled by the domestic water system), and (3) an area system of static water supplies with drafting points.

(a) Location of Pump and Well*

The two most important elements are the resistance to fire or mechanical damage of the pump installation, and the protection of the electric supply from being de-energized.

For domestic water systems to have maximum reliability in case of fire, the pump or pumps should be placed in a fire resistive location. The electric power supply should have maximum protection from being de-energized by fire or other cause. From these two standpoints the ideal location is a separate pump house placed at least 60 feet from other buildings with a separate electric service, not exposed to other buildings.

*The American Water Works Association Standard for Deep Wells (AWWA A100–58) is recommended for the reader's information on this subject.

If the pump must be located within the dwelling some protection of the pump can be secured by placing it in a concrete alcove connected to, but to one side of, the main cellar. In the days before plastic pipe this was often done to permit the "pulling" of the well pipe up through a hole in the ceiling of this alcove — and the ceiling might also serve as a back step or terrace.

If the pump is in the main part of the cellar, some protection from mechanical injury can be provided for it by partially enclosing it with a heavy wood or steel frame. This will prevent falling objects from jamming belts or other moving parts. Such a location may permit the pump to operate many minutes even while the house above it might be ablaze.

The electric service to such a pump location should have maximum protection from the entrance throughout all the distance to the pump switch and motor. By placing this wiring along the wall rather than over or through floor joists, some additional time advantage would be expected should a fire engulf the cellar.

(b) Piping System Layout

For first aid fire protection, every portion of the dwelling and outlying buildings should be within the reach of a hose stream. This may require some additional pipelines beyond those needed for other purposes.

To plan such a system assume the use of a 50-foot length of hose. In order to place water upon all portions of the roof of a building, the water system should have a hose connection (sill cock as they are called in New England) every 50 feet around the perimeter of each building. For cold climates these connections should be of the frostproof variety. Pipe size for these runs should be adequate to permit a minimum of 2½ gallons per minute flow from the hose nozzle.

Within the buildings there should also be faucets with outlets threaded for a hose coupling. All too frequently the only place within a modern home to attach a hose is the outlet to the hot water tank. Many home laundry facilities either do not have such a connection or they are not quickly reached in time of emergency.

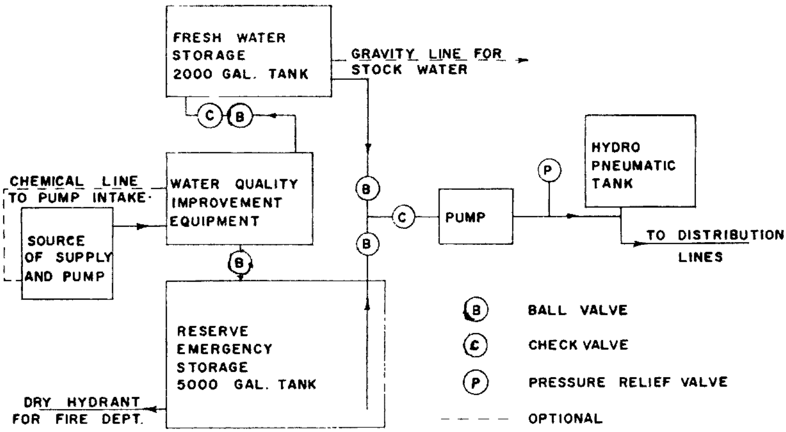


Fig. 1. Block diagram of water system with intermediate storage (see Fig. 3 for elevation sketch).

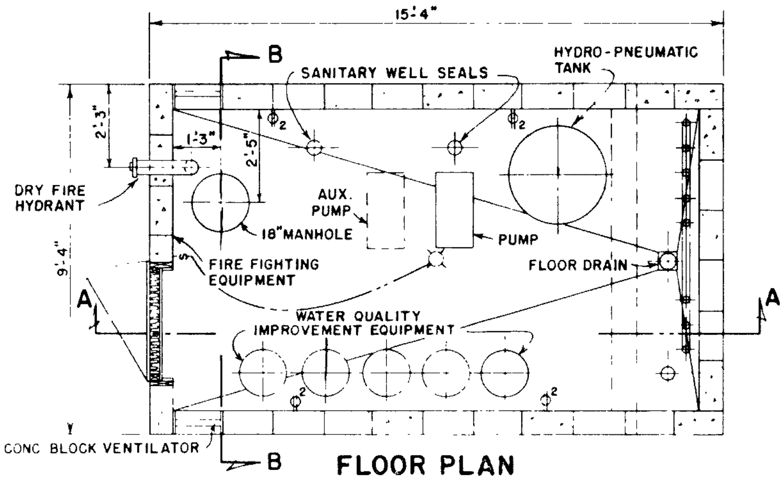
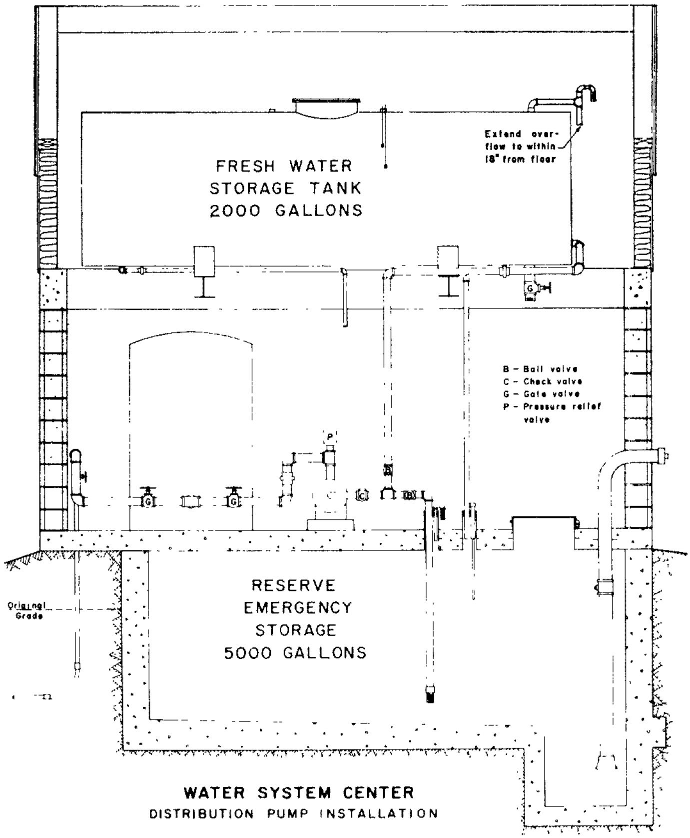


Fig. 2. Water system center.



WATER SYSTEM CENTER
DISTRIBUTION PUMP INSTALLATION

Fig. 3.

NOTE: Consult local fire department for dry fire hydrant thread.

From a first-aid fire protection standpoint, there should be a threaded faucet connection for a hose on each floor. This could be placed back of a small panel door on a wall section wherever a cold water pipeline is available. Of course, it will be of use only if the occupants are aware of its existence, there is a hose with nozzle nearby, and the occupant possesses the presence of mind needed to use it effectively in an emergency.

To provide water to all outlying buildings particular attention must be given to frost resistant underground placement of piping as well as frostproof hydrants. If other uses of this water supply are considered in the installation, such as watering lawns, garden irrigation, washing of agricultural or highway vehicles, or washing of cattle feeding floors, not only will the hose be more likely to be available, but the occupants will acquire the habit of using the water and be ready for an emergency.

Consideration must be given to the mechanical protection of these hose connections. In some instances they can be recessed; however, one suggested practice is to place a block of wood beside the faucet to shield it from damage.

Hose storage must be provided at each faucet connection, or, one 50-foot length of hose should be made available for each building and located in a most accessible place. The hose should be protected from the weather. The hose should also have a minimum inside diameter of ½ inch and be pliable at all usual outside temperatures.

At least one company manufactures a hose reel which is designed for domestic use with models available for both inside and outside placement.

For an adequate stream of water with at least 2½ gpm delivery from the hose nozzle, the pressure setting at the pump may require a change from the factory setting.

(c) Intermediate Water Storage*

Domestic, farm, or industrial use of water is not uniform throughout the 24-hour day. Also, the yield and storage capacity of many wells are not sufficient to meet peak demands of rural use. To meet this condition, a system of intermediate storage of water has been developed.

Intermediate storage is atmospheric storage, with the free water surface at atmospheric pressure, located between the source of supply and the distribution pump, and carefully planned and constructed to preserve water quality. Intermediate storage is in effect the source of supply for the distribution system.

*Elmer Jones, Intermediate Water Supply Systems. U.S.D.A. Mimeo.

Considerable savings may be realized from the use of intermediate storage when one or more of the following conditions exist:

(1) The source of supply is not able to meet the desirable peak demand of the water system, but is able to meet the peak day requirements in 24 hours or less,
(2) low yielding aquifers are encountered requiring a very high lift to meet the desirable peak demand,
(3) the ground water level is substantially below the surface,
(4) effective water quality improvement is desired or required,
(5) arid areas.

(d) Design Recommendations (Intermediate Water Supply Systems)

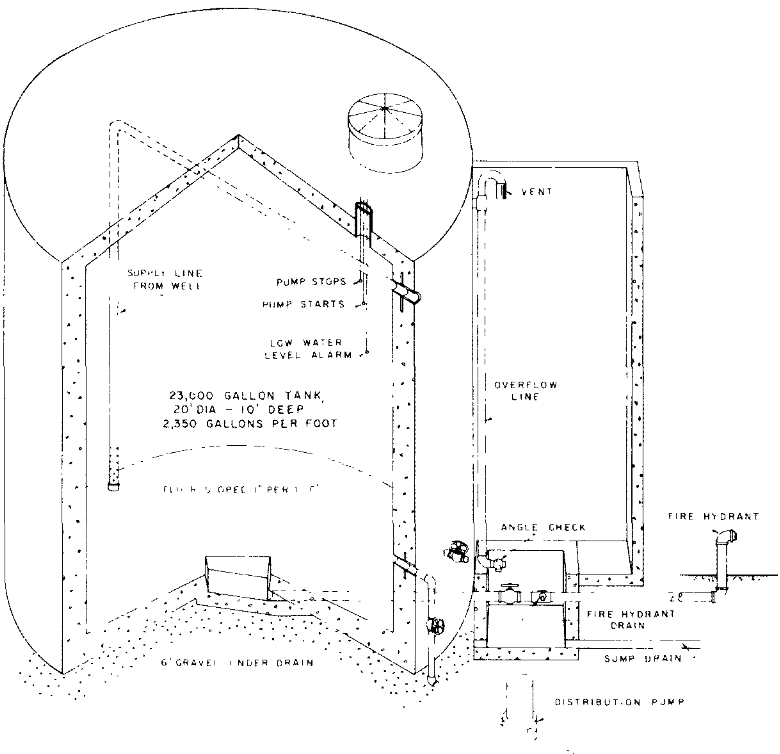
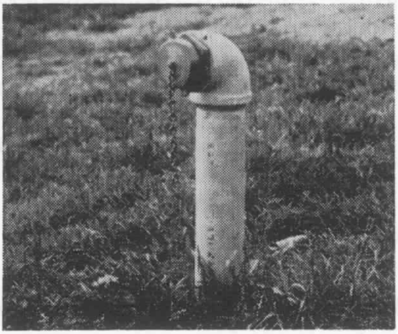


Fig. 4. Intermediate storage installation on a large Maryland dairy. *(U. S. Agricultural Research Service.)*



A 2½-inch gravity hydrant protecting a dairy supplied by 23,000-gallon storage tank. *(U. S. Agricultural Research Service.)*

The following design criteria are recommended for farmstead water systems:

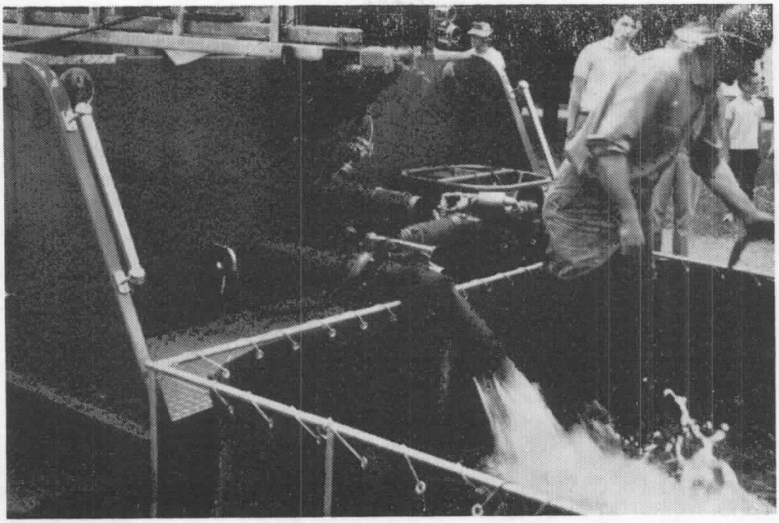
Two storage tanks should be provided for reliability, one may be designated fresh water storage, the other reserve emergency storage. This will permit one tank to be removed from service for maintenance and cleaning without disrupting normal farmstead operations.

The capacity of the fresh water storage tank should permit the distribution pump to operate at maximum capacity for 80 minutes. That is, the storage volume V_s should be greater than the quantity (distribution pump capacity Q_d minus source pump capacity Q_s) times 80. This will permit replacing the distribution pump with a larger pump in the future without having to replace the storage tank which should have a service life of 3 or 4 times that of a pump. Two thousand gallons is recommended as the minimum size tank.

The reserve emergency storage tank should be equipped with a fire hydrant for use by the local fire department. This tank should hold sufficient water for two days' normal needs or 5,000 gallons of water for fire protection, whichever is larger. Many farms should have more than this recommended minimum amount of water for fire protection.

Water quality improvement equipment should be located between the source pump and the storage tanks. A flow regulator may be used to match the source pump discharge to the service flow rate of the water quality improvement equipment.

Electrical grounding, as mentioned before, is usually tied into the water supply system. Where lightning grounds are tied to electrical and telephone grounds, a similar sized cable should be attached to the metal well casing. Wherever plastic pipe is used as a splice in either a metallic waste or water supply line, metallic bonding of both metal pipe ends is needed to prevent differences in electrical potential. Such differences can cause shock hazards as



Fire department tanker discharging into a 1,000-gallon portable pumper suction tank at a farm fire near Wausau, Wisconsin. A two-story storage building for milk cartons at a dairy was saved. (*NFPA photo.*)

Rural pumper at draft supplying 500 gpm spray nozzle through 3½-inch fire hose. A single line of this hose will move 500 gpm over 1,000 feet from a suction source at conventional pump pressures. (*NFPA photo.*)

well as ignition of combustible materials should an electrical discharge take place. Check NFPA Lightning Protection Code, No. 78.

(2) Water Supplies for Community Pumpers

Many rural properties have flowing streams, or could construct farm ponds or cisterns as ready water sources in case of fire.

Fire departments need supplies of this kind to supplement the water which their trucks carry in booster tanks or separate tanker units. On many rural properties water can be piped by gravity flow to either a pressure or a dry-type hydrant located in the center of the farmstead or building group. Such a resource provides a first line of fire defense rather than a supplement. Check with the local insurance rating organization for standards.

(a) Limitations of Farm Ponds

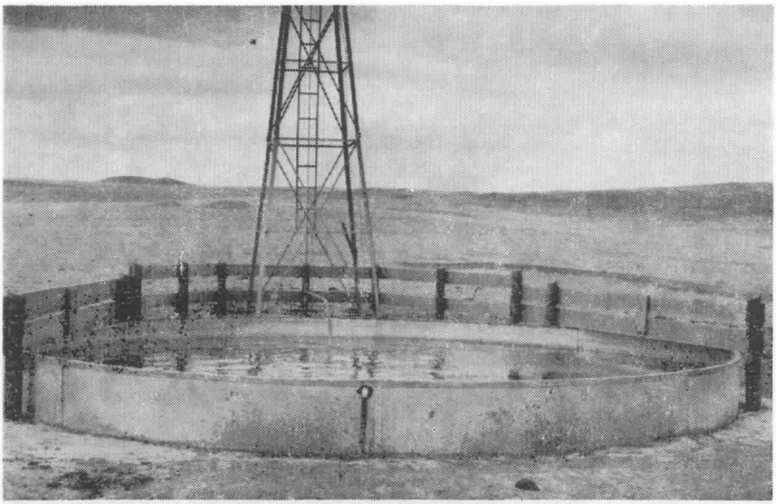
Many farm ponds have the following fire-protection limitations:

(1) The pond is too far from buildings,

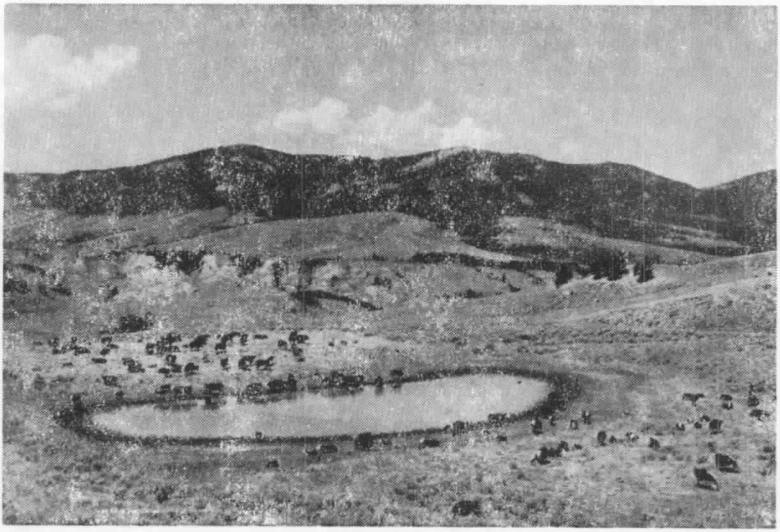
(2) lack of all-weather access roads to the access point,

(3) in Northern latitudes the pond freezes over, prohibiting ready access to water and restricting the volume of water available,

(4) evaporation and periods of drought often severely reduce (or eliminate) the water supply,



24-foot diameter, 8,500 gallon bottomless water tank using bentonite layer to prevent loss of water. Used for watering stock and fire protection in Grand River National Grasslands, South Dakota. *(U. S. Forest Service photo.)*



Stock pond on Montana cattle range provides water which may also be used for fire protection. *(U. S. Forest Service photo.)*

(5) silt and debris, accumulating during high runoff, may displace large volumes of water and create pumping problems,
(6) many ponds are drained at times for fish production and control.

(b) Water Source

Three types of water sources are possible: flowing streams, ponds, and cisterns.

A stream should be considered when it flows at a rate of 250 gallons or over per minute at all times and has a sufficient draft depth for volume desired and strainer used. If its capacity is less, a bypass pond fed from the stream is preferable.

A pond may be stream fed, spring fed, filled from ground water by digging it below the water table, or by surface runoff from a suitable area. Extension Service or Soil Conservation Service plans, information, and assistance are available. Attention must be given to locating the pond in such a way that a hydrant line may be led from it to the buildings at minimum expense. If possible, it should be above the buildings to provide positive pressure on the hydrant.

(c) Cisterns and Swimming Pools

Before the advent of municipal water supplies with hydrants, communities and families often built cisterns to collect water for both domestic use and for fire protection. In rural areas where there are no streams or opportunities for ponds, a measure of fire protection is provided by cisterns, swimming pools, or both. They should have a minimum volume of 3,000 gallons and should be accessible to the fire truck, though a safe distance away from buildings. Cisterns, rain barrels or other storage to catch roof runoff have great potential for emergency water use where larger storages are not practical.

Often, swimming pools are enclosed or so located that they have minimum value in case of fire. Before locating and constructing a pool, ask your fire chief to suggest ways to make this source of water of maximum value to yourself and your neighbors. In many cases the drain pipe for the pond can have a "T" and riser added to provide an excellent attachment point for a portable pump or vehicular pumper. The present practice of leaving swimming pools full during the winter to balance earth (frost) pressures provides a considerable year-round volume of water below the ice cover.

(d) Hydrant and Water-Pipe Supply Line

Although most rural fire departments are equipped to draft water directly from farm ponds or streams, a hydrant beside an all-weather road is preferable.

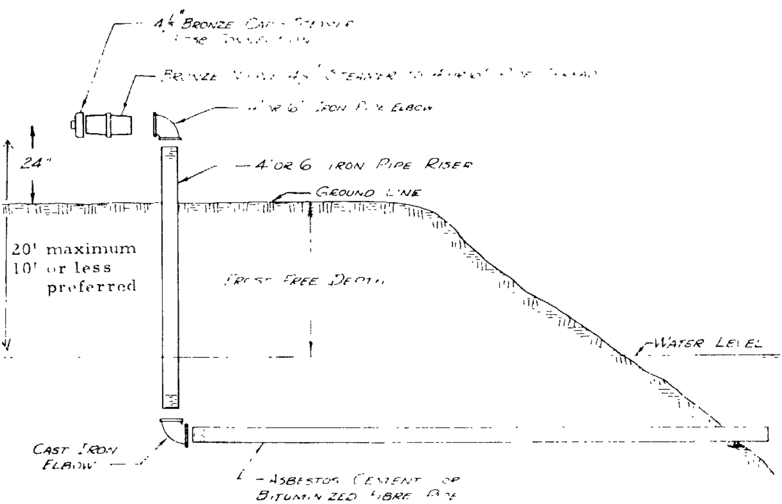
Depending upon the desired flow, the distance to the water, and the difference in elevation between the hydrant and water source, 4-inch, 6-inch, or even larger pipe is necessary. Table 1 will help you determine the pipe size. The pipe should be cast iron, steel, asbestos cement, or bituminized fiber. If there will be pressure on the line, use cast iron, steel, or a pressure-resistant type of asbestos cement. Lay the pipe between hydrant and pond or stream as shown in the drawings on pages 17 and 18. The pipe must be laid at a frost-free depth — down to six feet or more in Northern states.

The following table may be used to determine pipe size of a given hydrant line basing the flow upon 10 psi or 20 feet of head.

Table 1. Gallons Per Minute Flow at 20 Feet of Head*

Length	*Steel Pipe (c = 120)*		*Cast Iron (c = 110)*		*Asbestos Cement (c = 130)*		*Bitum. Fiber (c = 120)*	
	4 in. dia.	*6 in. dia.*	*4 in. dia.*	*6 in. dia.*	*4 in. dia.*	*6 in. dia.*	*4 in. dia.*	*6 in. dia.*
25′	1100	3400	1040	3060	1240	3650	1100	3400
50′	790	2300	720	2100	850	2500	790	2300
100′	540	1600	500	1475	590	1700	540	1600
500′	225	660	200	615	250	720	225	660
1000′	150	460	145	425	170	495	150	460

*Based upon the Hazen-Williams formula with estimated values of C. Courtesy of Dr. Gilbert Levine.



Exploded view of dry hydrant construction.

A strainer is needed for the suction end of the pipe line to keep foreign materials out of the pipe. A strainer may be purchased or constructed at home by boring ¼-inch holes through the pipe. Space the holes on ½-inch centers, with at least 12 rows of holes in either 4-inch or 6-inch pipe. Plug the end of the pipe, and place it with the strainer at the deepest portion of the pond, raised up off the bottom about 2 feet so it will always be above any silt that may accumulate. Cover the strainer with crushed rock to exclude marine growth and to prevent mechanical damage. For a dry hydrant, lay the pipe at a minimum slope (2 or 3 inches per 100 feet) up to the hydrant riser. For a pressure hydrant, the pipe should slope downhill to the hydrant riser and be fitted with a gate valve. Where the supply line passes through the dike of the pond, attach anti-seep collars to the pipe to prevent water from seeping and channeling beside the pipe.

The riser on a dry hydrant should be exposed above ground 24 inches or less. Cover the riser with an insulated box to protect it from frost during freezing weather.

For stream bed installations, the strainer must be buried deep enough to prevent the scouring action of the stream, during periods of high runoff, from exposing the strainer and tearing it loose from the supply pipe. An estimate of proper depth should be obtained from a hydraulic, Extension Service, or S.C.S. engineer, who is familiar with such problems.

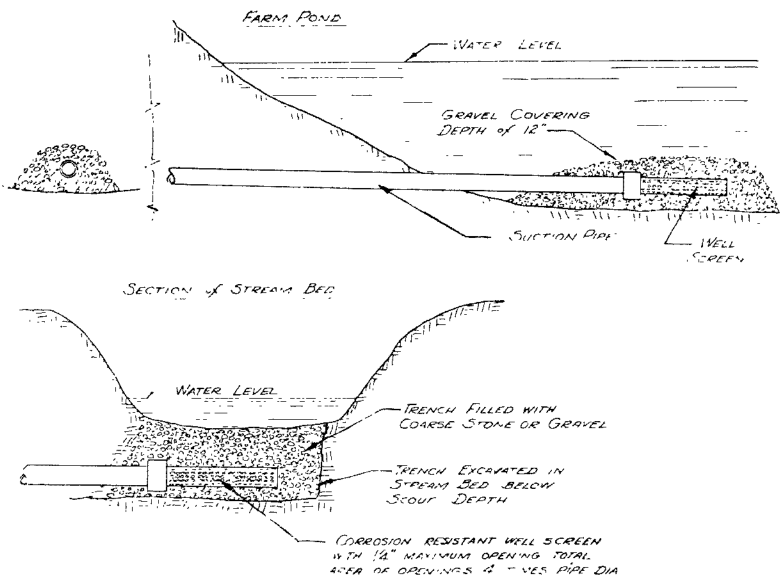
(e) Maintenance

These facilities require periodic checking, testing, and maintenance. When the facility protects more than one property, maintenance should be a line item in the fire department's annual budget. The maintenance work is properly performed by a Public Works unit; however, checking and testing should be a part of fire department training and drills. Inspection of private properties will reveal any deterioration in the water supply situation in these ponds, streams, or cisterns.

Particular attention must be given to streams and by-pass ponds. They need frequent removal of debris, dredging or excavation of silt, and protection from erosion. The hydrant must be tested at least annually with power equipment. This will keep the line and strainer clear of silt and the water supply available for any fire emergency.

Keep pond as free of aquatic growth as possible. USDA Farmers' Bulletin "Waterweed Control on Farms and Ranches," is a source of good information. At times, it may be necessary to drain pond to control this growth.

Inspect watershed frequently for signs of accelerated erosion. Treat critical areas when found.



Details of screen layout — pond and stream sites.

Inspect access road and make repairs as needed. Pay particular attention to culverts, bridges, and to drainage to make sure mud-holes and quagmires do not develop.

Post warning signs at pond to meet local requirements. Provide safety devices such as life preservers, long poles, ropes, etc.

Recommendations for Roads to Farm Ponds

Width:	Roadbed minimum — 12 feet Tread minimum — 8 feet Shoulder minimum — 2 feet
Alignment:	Minimum radius centerline curvature 50 feet.
Gradient:	Maximum sustained grade 8 percent.
Side Slopes:	All cut and fill slopes to be stable for the soil involved.
Drainage:	Bridges, culverts or grade dips at all drainageway crossings. Roadside ditches deep enough to provide drainage. Special drainage facilities (tile, etc.) at all seep areas and high water table areas.
Paving:	Surface treatment as required for year-annual travel.
Erosion Control:	Erosion control measures as needed to protect road ditches, cross drains and cut and fill slopes.

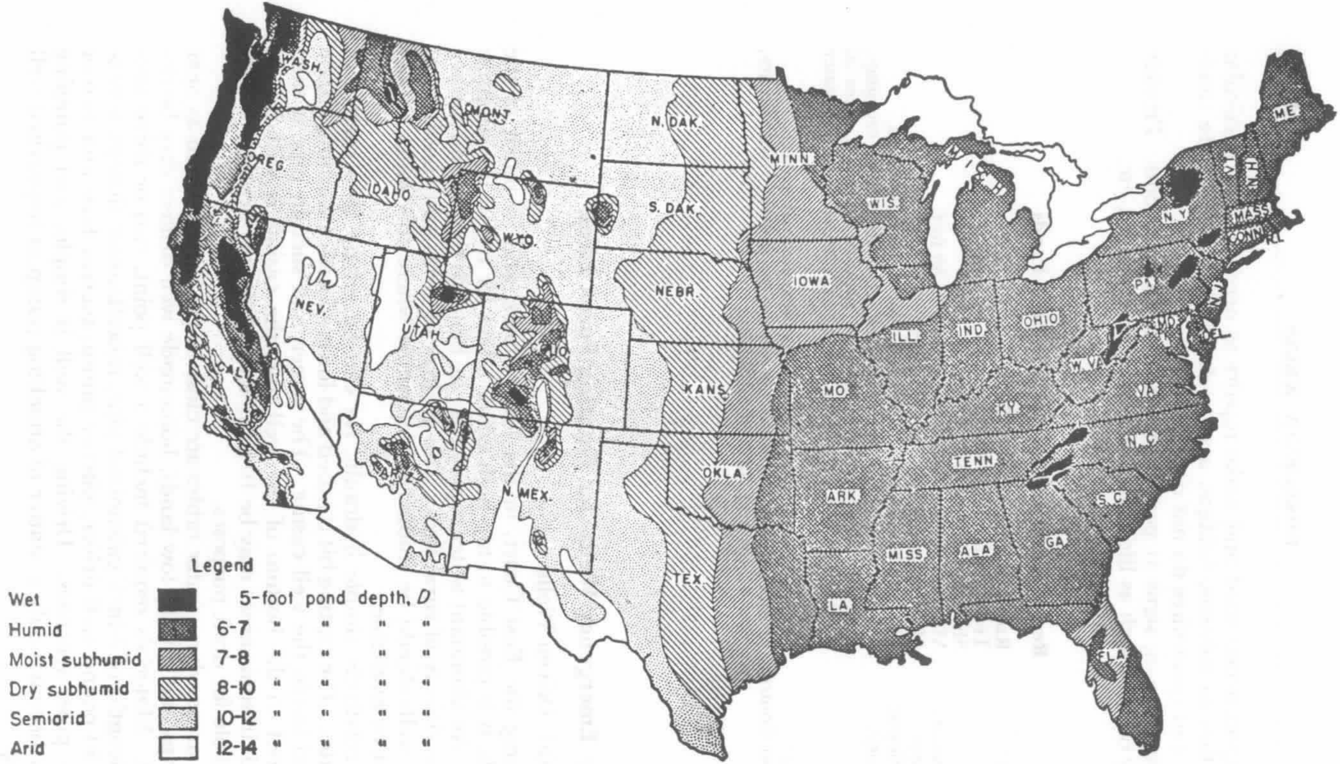
(3) Emergency Wells (for Fighting Forest Fires)

(a) Driven Wells

Along the East Coast, in the Lake States, and in much of the South, it is possible to tap high water tables for use in fire suppression. An abundant water supply may lie beneath the ground surface in the vicinity of rural fires. The geology of areas and condition of local wells should be studied to determine where this water supply might be available.

A relatively simple hydraulic rig can be set up in a matter of minutes. The cutting bit is raised and lowered with a washing nozzle placed inside the well casing. The screen and suction pipe is then lowered to the bottom of the well and the casing is withdrawn. Depth in some areas may be 10 to 30 feet. A supply of water is then available for draft purposes.

In areas where water tables are close to the surface, such as near swamps and similar low lands, homemade well drillers may be devised. Materials required include a well point, two or three five-foot lengths of 2-inch galvanized pipe, miscellaneous fittings, a two-arm 60-pound well driver, pitcher pump, suction hose and two or three pipe wrenches. Driving the well is simple, and pumping water becomes only a matter of attaching pump to improvised well casing.



Recommended minimum depths of reservoirs. An average depth, *D*, should be provided over a pond area sufficient to hold at the designated depth a volume of water that is about twice the amount actually required for the livestock.

Points to remember in driving wells in rural areas are listed here for consideration:

(1) A fair knowledge of the local water table level and wells already driven in the immediate area.

(2) It will help to study geological survey maps, water levels in adjacent ponds, streams, and swampy areas.

(3) Confer with persons using driven wells in the adjacent area at similar levels.

(4) Test wells by stand-by crews in areas likely to be used for underground water supply in case of fire.

(5) Consult engineers who have made surveys of ground water supplies for municipalities.

(6) Ten gallons per minute should be expected from a 2-inch by 4-foot, 60-mesh well point under poor to average conditions and much more under favorable conditions.

(7) A series of two or more points may be driven at intervals of 10 or more feet.

(8) Pumping equipment should be matched with the well.

(9) Avoid if possible heavy vacuum on shallow wells. There is danger of rupture of the button screen which would allow sand or gravel to enter the well and possibly ruin a pump.

(10) After well is driven, use pitcher pump to pump off discolored water into a container. If sand or gravel shows in bottom of container, use caution in operating pump. Discolored water may persist, indicating, for example, swamp water. This will not be harmful so long as there is no evidence of sand or gravel.

(11) Take a sample of water from the pump occasionally to determine if button has been ruptured.

(12) After pumping for an extended period an increase in vacuum may be noted. This may be due to the draw-down. Vacuum should remain fairly constant with a steady rate of demand by the pump. A constant increase in vacuum might indicate unfavorable soil conditions or rupture of a button screen. These points must be given consideration during all trials and careful observations should be made to avoid damage to equipment so that best results may be attained.

(b) Slip-on Tanker

A recommended slip-on tanker for moderate to heavy use from the rural-wildland standpoint should have the following specifications:

36 inches wide and 72 inches long
250- to 300-gallon capacity
Pumper designed to be engine-drive with a minimum capacity

Slip-on tank on a pumper of the United States Forest Service. ***(U. S. Forest Service photo.)***

of 35 gpm at 250 psi, or higher; dry weight of pumper to be under 325 pounds; starter recommended.

Smaller- or medium-sized slip-on tankers may be more practical in rough, steep terrain, and on low-standard roads. These may range from 50 to 200 gallons capacity tank, equipped with two- or four-cycle engines and positive displacement pump. Pump capacity to be 10–15 gpm at 150 psi.

There are many pumpers in the portable class that would be excellent for fighting rural and wildland fires. They range from low output of 10 gpm at 100 psi to 80 gpm at 100 psi. These have air- or water-cooled two- or four-cycle engines with 3 to 18 hp at 3,400 rpm with overall weight from 40 to 300 pounds. These all belong in the "Forest, Brush, Grass"-type of fire equipment which has been used successfully by forest protection agencies throughout the United States.

(c) Tank Trucks

A majority of rural fire departments now have motorized fire apparatus with substantial tank capacity for water (usually 300 to 500 gallons) and pumping equipment — usually a 500 gpm or larger pump. This combination vehicle is the backbone of the department's fire fighting ability. In addition, more and more departments are also providing a "mother" tanker (truck or semi-trailer) of 1,000 to 3,000 gallon capacity to supply the pumper truck. Caution should be exercised in exceeding a 1,500 gallon capacity for tankers. Many roads, particularly in winter and spring, will offer difficulties for larger units. Where mutual aid arrangements are set up on an area or county basis, two or more of these tankers, working together, can provide a continuous supply of water from a distant source. Fire departments can usually provide a portable ground tank for such use. Specifications for tanker equipment are available in NFPA No. 19, Specifications for Moter Fire Apparatus.

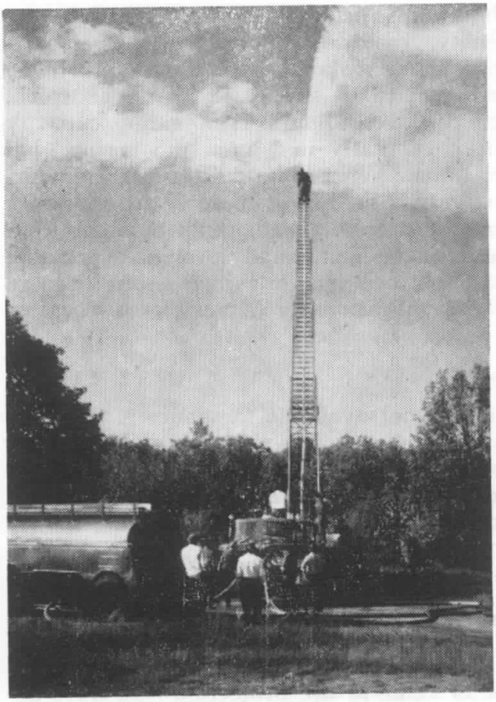
(d) Emergency Tankers

If standard fire tankers are not available for a fire emergency, other types of tank trucks normally used to transport milk or flammable fuels may be pressed into service although these may not meet fire service standards. For short haul service, spraying equipment with wood, metal or plastic tanks may also be used.

IV. Access Roads, Contracts, Agreements, and Mutual Aid Arrangements

All water sources to be of value in fire protection *must* have accessibility that is unlimited and for all-weather use by fire trucks and tankers. Toward this end, hydrants are set at roadside, and all-weather roads are frequently built to the edge of ponds or streams. Arrangements must be made with highway superintendents or public road officials to establish and maintain adequate road surfaces to hydrants and pump sites. For northern locations, hydrants must have suitable frost protection and must be kept free of snow — otherwise the hydrant may literally be lost when needed. Usually, marker poles are fastened to hydrants in the Fall to thereby show above wintertime snows.

Mutual Aid arrangements or agreements are now in effect in many states between fire departments, between county fire organizations, on a state basis, and regional compacts. In sparsley settled areas individual farm or ranch owners often set up formal or informal arrangements with neighbors for assistance should emergencies arise. All arrangements should be formalized in writing to thereby spell out the kind of assistance to be rendered, method of alerting, responsibility in case of accident (liability), and other pertinent matters. Practice in this will make these arrangements more effective.



A 500-gallon-per-minute spray nozzle on an 85-foot aerial ladder being supplied by a large diesel powered tanker. This is part of the equipment of the Dayville, Connecticut, volunteer fire department serving a rural area without hydrants. *(NFPA photo.)*

Telephone and/or short-wave radio are the usual means of communication for rural areas. Often, the radio equipment already in use by the county highway superintendent or sheriff may be utilized for fire emergencies.

Water inventory maps can be developed by firemen, S.C.S. personnel or Forest Service personnel, with the water sources indicated on maps prepared for county highway, S.C.S. or Forest Service use.

V. Civil Defense Needs

A supply of stored water could be your most important survival item in case of National emergency. Emergencies could be from windstorm, flood, drouth, fire, or wartime disaster. With careful rationing, 7 gallons of potable stored water per person for drinking and food preparation can last two weeks. Another 7 gallons per person for hygienic purposes is desirable if space is available. (From U.S. Dept. of H.E.W., "Safe Drinking Water in Emergencies.")

(a) Emergency Water for Drinking

To ensure a safe supply of water for emergency use, store at least two gallons of water for each member of the family. If there are children under three years of age, provide an extra gallon for each child to be sure of a seven-day supply. Enough water should be stored for an additional seven people if you are willing to shelter refugees. (From Ohio State — "The First 14 Days".)

(b) Store Water for Livestock

Water for livestock can be stored in covered barrels, tanks and cisterns. The covers must be tight enough to keep radioactive dust from getting into the water, and after an attack rain water and water from open sources containing radioactive material must not be allowed to contaminate the stored water. The quality of the stored water may be maintained by adding laundry bleach from time to time, as described under purification. (From Federal Extension Service — "You Can Survive".)

(c) Water Supply and Requirements

Supply from covered, spring-fed wells or springs free of surface contamination are excellent. Storage tank supplies should be considered.

Emergency power for pumping is recommended unless artesian or gravity flow is available.

Water Requirements — Gallons Per Animal Day

Animal	*Ample Supply Gal/Day*	*Limited Supply Gal/Day*
Cattle	17	7
Hogs	2.4	1.2
Poultry — layers and broilers	0.06	0.05
turkeys	0.30	0.12
Sheep	1.4	1.0

[From Proposed ASAE Standard Nuclear Radiation Protection Committee (FS-38)]

(d) Emergency Power

Power should be available for water supply, ventilation fans, minimum lighting and other equipment required for survival. Other equipment may include milking machines, refrigeration equipment, and mechanical feeding equipment.

Minimum lighting is ½- to 1-foot candle for a general level. Higher intensities may be required in certain spots.

Emergency power should be located where it can be serviced without unduly exposing the operator. Heat dissipation for the engine and removal of exhaust fumes must be considered.

Electrical connection should be of a nature that serves emergency equipment. Provision for such connection must be made before the time of emergency. See USDA Leaflet 480 "Standby Electric Power Equipment".

VI. Summary

Prevention continues to be the best fire protection measure. Once a fire starts, the most frequently used material for control and extinguishment is water. This publication has discussed how water can be made available for all types of rural fire protection from first-aid use to supplies for fighting fires in large rural establishments or tracts of forest land. The appendix indicates sample ordinances that may be helpful as well as a list of references on this subject. By proper planning and follow-up action of individuals and committees, the number and severity of rural fires can be reduced.