



Wildland/Urban Interface Fire Protection Planning

River's Edge Ranch Developing a Water Supply for Fire Protection

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Background

The River's Edge Ranch, herein after referred to as the Ranch, is located at 33433 Hayes Rd in Lucerne Valley, CA 92356. The Ranch is located on approximately 20 acres. The Ranch receives fire protection from the San Bernardino County Fire Department (SBCFD). The Ranch is also located in a Local Responsibility Area (LRA) that is protected by CalFire pursuant to a mutual aid agreement between the County and State. These two agencies work together to provide fire protection. SBCFD Fire Station 8 is the closest station located at 33269 Old Woman Springs Rd in Lucerne Valley, approximately 8.2 miles to the south of the Ranch.

The Ranch is currently being used as an adult Drug and Alcohol Recovery Program. It offers training, healthy eating, restful sleep, exercising as well as animal keeping, manual labor, and faith and mentoring support. The current program has a maximum capacity of 40 men whose ages range from 18-65 years. The current facility consists of a 1,463-sf home, 1,025 sf bunkhouse, 990 sf metal chapel building, and 884 sf metal garage. The primary water source is from onsite wells and water storage tanks. There are several accessory structures including storage buildings, corrals, horse walk and washing facilities. The operational hours are currently Monday - Sunday from 7 am to closing in the evenings at 6 pm.

The Ranch receives approximately 7 inches of annual rainfall a year, a portion of which may fall as snow during the winter months. The ranch is located at an elevation of approximately 2,890 feet. It will be important to protect the water system piping from freezing including that of the fire sprinkler system.

Proposed Expansion

The Ranch owners want to expand the facility that would allow for up to 80 men to be housed while increasing the capacity for administration, kitchen facilities, laundry, and conference room.

Including staff, as many as 100 people could be on the site at any time following the Ranch expansion.

The existing 1,463 sf home is scheduled to be expanded to 6,642 sf that would include additional office space and new kitchen facilities, dining, plus staff quarters with restrooms, shower facilities and a storage room. The largest new building is the bunkhouse which as currently designed will be 11,116 sf. The two buildings will be less than 50 feet apart. Fire sprinklers will be required in all buildings per Title 19 – Public Safety.

Existing Water Supply

There are currently four (4) water storage tanks on the site comprised of 2 tanks of 2,500 gallons and 2 tanks of 5,000 gallons for a total on site water storage of 15,000 gallons. This current storage is available both for domestic use as well as fire protection. Water is pumped into these tanks via a private well. Depth to water in the area ranges from 150 to 200 feet. The depth is generally stable due in part to the reduction in farming and irrigation activity. A significant increase in the amount of water storage will be required to accommodate the planned expansion.

Water System Requirements

The planned expansion will require additional water supplies for both domestic use and fire protection. The primary focus of this report is on the fire protection element. Each water supply should be separate from one another so that the available water for fire fighting is always available regardless of domestic use. While the domestic water supply will need to be potable water, the water for fire fighting may be from other sources that are not potable such as water reservoirs or from rainwater collection that are open to the environment.

A portion of the available water supply will be used to operate the buildings' fire sprinkler systems should a fire occur. The balance will be for firefighting. SBCFD Fire Prevention Standard 5-1 provides guidance for the installation of fire sprinkler systems in non-residential buildings while Standard W-1 Water Supply for Residential Fire Protection guides the remaining structures.

The water that is provided for the fire sprinkler system will need to have a pump, capable of producing the pressures and volume required for its effective operation. Fire pumps play an integral role in sprinklers systems as they provide the needed water pressure to ensure that hydraulic design requirements of the sprinkler system are met. Fire pumps work in tandem with the fire sprinkler system to protect people, buildings, and assets in case of a fire emergency. A licensed contractor with a C16 license (fire protection contractor) will need to design the fire sprinkler system as each system is unique. The system will also require periodic inspection, testing and maintenance per Title 19, Chapter 6 and NFPA 25 - Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.

SBCFD Fire Prevention Standard W-1 Water Supply for Residential Fire Protection shall be the basis for determining the water supply requirements. The emergency water supply system shall be serviceable and available prior to construction. This shall include all water tanks, fire hydrants and

similar features as described in NFPA Standard 24 – Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

Water Storage

Being that the Ranch is located in a rural area without a public water supply, the storage requirements for firefighting will need to be located onsite and calculated based upon the size and use of the intended facilities. NFPA 1142 – Standard on Water Supplies for Suburban and Rural Firefighting and SBCFD Standard W-1 Water Supply for Residential Fire Protection provide guidance in San Bernardino County. For public water systems, the required fire flow would be based on Appendix B of the California Fire Code. Section B103 of the California Fire Code allows the local fire code official to reduce the fire-flow requirements for isolated buildings or a group of buildings in rural areas or small communities where the development of full fire-flow requirements is impractical. Furthermore, Section B103.3 specifies that where adequate and reliable water supply systems do not exist, the fire code official is authorized to utilize NFPA 1142.

Tanks for residential fire protection shall be sized to provide the water supply needed to flow the sprinkler system for a minimum of ten (10) minutes (based on the calculated flow rate of the sprinkler system), or as sized per NFPA 1142. Residential fire sprinkler heads typically have flow rates of 5-7 GPM whereas commercial sprinkler heads can use up to 26 GPM. For larger rooms, such as large bedrooms or lounge areas, more than one head will be required. Assuming a structure is confined to one room, two residential heads would have a combined flow rate of 14 GPM. Over a period of 10 minutes, which would require a tank of a minimum of 140 gallons. This calculation may be fine for sizing the pressure tank that would provide the initial fire flow for a structure fire prior to the arrival of firefighting personnel and equipment.

Firewise2000, LLC believes that it would be best to use NFPA 1142 calculation based on the building volumes as a minimum water supply that would supply water for both the fire sprinkler system plus water for firefighter use.

Firewise2000, LLC determined that the total volume of both the bunkhouse and expanded administrative offices with staff housing, including the attic space is approximately 296,000 cubic feet. Using the NFPA 1142 calculator with an occupancy hazard classification of 7 (apartments, hotels, motels, schools, dwellings, office suites, fire stations) and requiring that an additional 50% of the total fire flow be available for unforeseen situations, total water storage needed for fire protection is a minimum of 70,000 gallons.

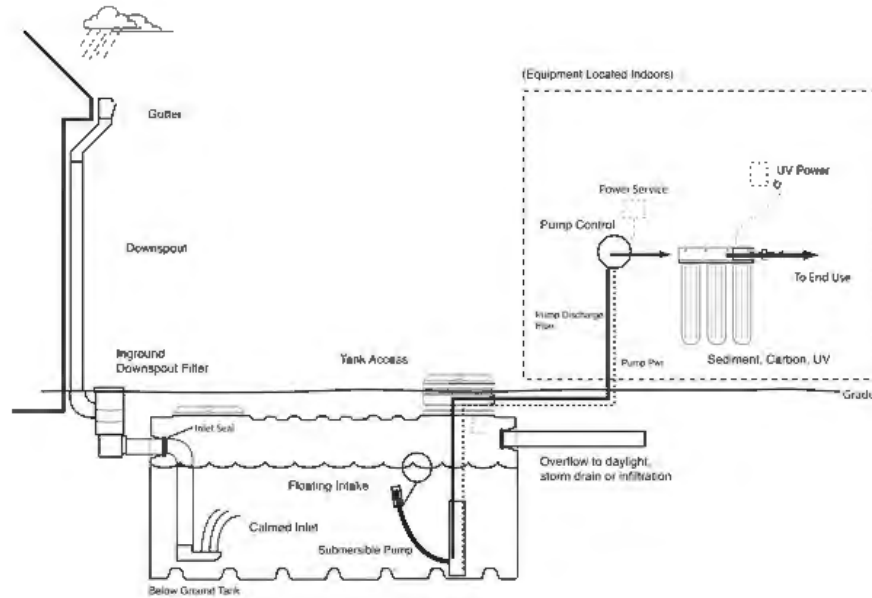
Providing Water for Fire Fighting

Storage of water can utilize several methods including but not limited to:

1. Tanks – either in ground or above ground
2. Cisterns – A water tank whose water is provided by collecting rainwater which if not treated is not potable.
3. Reservoirs – an artificial lake or pond that is open-air thus not potable.
4. Swimming Pools.

Each of these methods of water storage has advantages and disadvantages. Above ground tanks are readily recognizable, easy for firefighters to connect to and cost effective. Cisterns have been used for centuries as a means of collecting and storing water. These can be either be located above or below ground. The roof of a cistern is typically oversized thus allowing it to collect more water, sloped inward toward the center of the tank where a hole in the roof allows runoff to enter the tank. These can be made from metal or concrete.

An example of an in-ground cistern is shown below:



Graphic courtesy of BRAE

An in-ground cistern collects water from a roof which then can be used when needed for firefighting. A fire-rated pump would need to be provided to operate the connected fire sprinkler system. Based on the storage requirements, it could require several tanks that are interconnected to supply the required fire flow.

Firewise2000, LLC evaluated the amount of runoff water that would be available from the facility roofs. The formula to determine how much water can be harvested from the planned expansion of the Ranch facilities is based on the following formula:

- A = Length of the roof area
 - B = Width of the roof area
 - C = The amount of rainfall in inches
- The formula is $A \times B \times C = \text{Water Volume}$
 1 cubic foot of water contains 7.48 gallons.

Calculations:

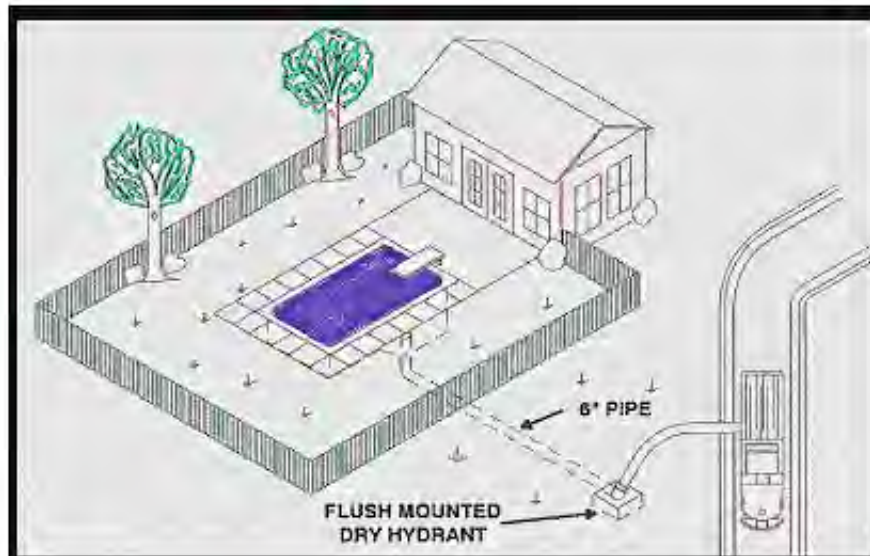
Length of roof – Administrative and Kitchen Building	75
Average width of roof – Administrative Kitchen Building	81

Total Cubic Feet:	6,075
Width of roof – Bunkhouse	26
Length of roof – Bunkhouse	360
Total Cubic Feet:	9,360
Total Roof Volume (cu ft) all buildings:	15,446
Factoring the rainfall in 7.48 gals/cu ft	115,454
Assuming 50 percent of 7-inch annual rainfall available:	
Annual Yield in gallons per year from roof rainwater collection:	<u>32,987</u>

This calculation is based on an average annual rainfall of 7 inches, assuming 50 percent evaporating or not being sufficient to produce runoff into a cistern. Also note, this figure is likely low as it does not incorporate roof overhangs.

Reservoirs can be simply a hole made in the ground where water is stored. The hole, to reduce water loss, is typically lined with an impermeable fabric and sometimes covered to reduce evaporation by a floating membrane.

Another potential source is from a swimming pool, especially a larger one, that can be provided with a dry hydrant that is connected to piping that leads to the lowest point in the pool. No pool is currently planned at the Ranch, but should one be constructed, it may be used for fire protection as well as recreation. An example of a dry hydrant connected to a pool is shown below.



A dry hydrant that is connected to the bottom of the pool by way of a 6-inch pipe. The fire apparatus is able to connect to the dry hydrant and utilize the water stored in the pool for firefighting. Firewise2000, LLC recommends that the flush mounted dry hydrant shown here be replaced by a standard fire hydrant with a least one 4-inch outlet.

Note that fire agencies do not always give credit for pool draft systems as the owners could let the pool go dry in the winter thus reducing the amount of water available. Water from pools is also not available when they are being repaired.

The Ranch currently has a small reservoir where runoff from reverse osmosis is collected. It is unknown how many gallons are stored within this small reservoir. However, it is likely that the Ranch will expand the water treatment which will result in additional water becoming available from this source. Water from reverse osmosis typically has a lower ph than tap water but is suitable for firefighting. The owners may elect to increase the size of the reverse osmosis water treatment system which can provide additional water for firefighting. Each gallon of a typical RO system will generate 5 gallons or more of reject water for every gallon of permeate produced. Some manufacturers claim that they have improved their RO systems and are advertising a 1:1 ratio of permeate to concentrate production.

Should the reverse osmosis system produce sufficient water for firefighting, the reservoir area where the water is stored will need to be fenced to limit access from residents as well as terrestrial wildlife. The sides of the reservoir, especially when lined, may become slippery due to algae growth. Access will need to be restricted.

Fire Department Connections

A dry hydrant, also called a draft hydrant, when connected to a pond, reservoir, pool, or cistern and when provided a 6-inch supply line can provide between 600 and 1,000 gpm. An 8-inch pipe would supply over 1,000 gpm. For a fire apparatus to acquire the water, it first connects a hard suction hose to the dry hydrant and then applies a negative pressure to the hydrant and pipe system which causes the water to flow to the apparatus. This is only effective if the level of the water source is less than 16 feet below the elevation of the fire apparatus. Firewise2000, LLC recommends either a single 8-inch pipe or two 6-inch dry hydrant connections be provided due to the required fire flow of 1,000 gpm for the new facilities.

San Bernardino County requires that when a tank is located above ground and plumbed to a fire hydrant through a 6-inch pipe, the hydrant shall have two - 2 1/2 inch and one - 4-inch outlet. Again, in this planned expansion, an 8-inch or two 6-inch lines would provide the 1,000-gpm requirement.

No fire hydrant shall be located closer than fifty (50) feet from any structure unless approved by the Fire Code Official. When subject to the possibility of vehicle impact, Fire hose connections shall be protected by approved bollards. Bollards shall be installed in accordance with the current edition of NFPA Standard 24. See diagrams in SBCFD Standard W-1.

Fire Pump

To operate the fire sprinkler system, a stationary pump, generally electrically operated but also maybe diesel or propane, will be required. It likely will also be required to have a fuel-based electrical backup. Stationary combustion engines shall be installed per NFPA 37 – Standard for

the Installation and Use of Stationary Combustion Engines and Gas Turbines. The fire sprinkler designer will be able to specify the exact pump requirements. The California Fire Code requires that fire pumps be protected against service interruption in accordance with NFPA 20. These interruptions may be from explosions, fire, flood, earthquake, rodents, inspections, windstorm, freezing, vandalism, and other adverse conditions.

SBCFD requires a self-contained automatic fire sprinkler system that is supplied from a water source that is not dependent on a municipal (public) system. The system will consist of a water storage tank and a reliable method of pressurizing water, such as gravity, booster pump with emergency power, or pressurized cylinder. Firewise2000, LLC believes that the fire pump should be housed within a building that is located a minimum of 50 feet from any protected building per NFPA 20. It also may be located within one of the buildings when the room in which it is housed is accessible from the exterior, provided with fire sprinklers, and the walls within the room housing the pump have a minimum 1-hour fire rating.

Conclusions

It was determined that the minimum water supply exclusively for fire protection will need to be 70,000 gallons. The water supply storage issue will need to be evaluated as to the cost of the various alternatives presented in this report. The fire sprinkler designer will be able to determine how much onsite storage is required to operate the sprinklers, the piping size requirements that will be needed to achieve the required flows and the type, number, and locations of all fire sprinkler heads.

Firewise2000, LLC proposes that the water for firefighting by local fire protection agencies be stored onsite in a tank or reservoir and plumbed to allow the water to be extracted from the tank or reservoir via dry hydrant(s). The existing water storage may be sufficient for domestic use only.

An additional source of water may be from reverse osmosis system expansion. It is unknown what the new system ratios will be and how much water will be available from the reverse osmosis system.

Alternatives to pumping water for fire protection were presented that includes the collection of roof runoff water. No permit is required for rainwater catchment systems if the system is not connected to a public or private potable water supply or alternate water source system (Cal. Code Regs. tit. 24, § 5). Water for firefighting is not required to be potable.